

The emergence of a competitive group competence in a research group : a process study

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The emergence of a competitive group competence in a research group

A process study

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**The emergence of a competitive group competence
in a research group**

A process study

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de
Technische Universiteit Eindhoven, op gezag van de
Rector Magnificus, prof.dr.ir. C.J. van Duijn, voor een
commissie aangewezen door het College voor
Promoties in het openbaar te verdedigen
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Frank Bakema

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Rheden, July 2006

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Chapter 1 Introduction

What underlies the emergence of a core competence? Think for example of the core competence of Honda defined as “recycling innovations in motor technology in a broad array of products” (like cars, lawn-mowers, generators, and motor-bikes) and the core competence of Casio defined as “integrating LCD- and semi-conductor technology” (applied in for example keyboards, calculators, small TV-sets and camcorders) (source: Weggeman, 1997). Is the high quality knowledge of motor technology or LCD-technology responsible for the emergence of these core competences? Or underlies the way these firms share and integrate this knowledge in the firm the emergence? Is it their close relationship with and superior understanding of clients? Or is it the combination of all these elements? This question, what underlies the emergence of a core competence, is the starting point for the design of this study. After a number of choices it has developed into the design of a study into the emergence of a competitive group competence in research groups. Such a competence is the specification of the more general concept of a core competence studied at group level. The objective of the study is to gain more insight into the processes responsible for the emergence of this phenomenon, as well as into the characteristics of these processes, how they operate, how they interrelate, how they are affected by the environment, and how they accommodate dynamics and change. We present and discuss the results of this study in this thesis.

Scientifically this study is interesting as organization theory lacks a rigorous integrated, well-developed theory how firms develop the competences they need, how they coordinate and integrate these competences and how they sustain and renew their competitive advantage based on these competences (Grant, 1996a, 1996b, McEvily and Marcus, 2005). This also holds for a core competence, defined as a bundle of underlying competences integrated in an effective and efficient way (i.e. Hamel & Prahalad, 1994). A core competence is unique, non-substitutable, hard to imitate, and underlies leadership in a range of products or services. As competences (often addressed in literature as knowledge) are increasingly recognized as a primary strategic resource for organizations (Grant, 1996a, 1996b, Okhuysen and Eisenhardt, 2002; Kogut and Zander, 1992), integration of competences becomes central to organizational success and competitive advantage. Yet as competences usually reside within individuals, this implies that the integration of competences is a fundamental process by which firms gain the benefits of competences and create competitive advantage (Grant, 1996a). The key, according to Spender and Grant

(1996), is in understanding the relation between abstract knowledge and individual and organizational practices. As this is a fundamental process in organizations and organization science lacks a rigorous integrated theory in this field, a study that focuses on the integration of competences in a competitive group competence is scientifically interesting when it contributes to the development of such a theory, explaining (parts or aspects of) this process. This study aims to do so.

From a societal point of view, and more specifically from the perspective of a firm, the development and application of competences requires both time and money. An increased control of the acquisition, development, sharing, application, and discharge of knowledge could enhance the efficiency and performance of firms (Weggeman, 1997). An increased control of these knowledge processes also suggests that firms are enabled to develop a core competence more easily or more quickly. A core competence is attractive to firms, because it provides a competitive advantage. For both reasons – societal and scientific – we studied the emergence of a core competence at group level, namely a competitive group competence.

This chapter defines the building blocks for this thesis. First, we introduce the subject of the study and provide arguments for its focus. We also position the study against the background of literature (section 1.1). We then discuss previous research (section 1.2) and define the research problem we address in this thesis (section 1.3). We will argue that according to literature, the emergence of a competitive group competence is related to fit between group and environment, expertise development, and development of a practice of integrating expertise in products. We will also argue that our knowledge of the processes responsible for the emergence of a competitive group competence is still limited, as is our knowledge of the context in which these processes operate and how these processes accommodate dynamics and change. Based on this argument, we develop a central research problem. In section 1.4, we sketch the outline of this thesis.

1.1 Introduction to the study

The value of knowledge to organizations is theoretically recognized by calling knowledge a production factor, alongside capital, labor, and materials (Drucker, 1993). According to Berends (2003), this increased interest in knowledge in organizations can be explained by two forces: more and more members of developed countries are performing knowledge-intensive work (for example advocacy, surgery, consultancy, research), and knowledge

becomes outdated increasingly quickly (Castells, 1996; De Solla Price, 1963). This makes knowledge a strategically important source of competitive advantage, not only for individual firms but also for society.

Related to this increased interest in knowledge as a strategically important source of competition, knowledge and knowledge processes in organizations have received more systematic theoretical and empirical attention, developing toward a central concept in the field of organization studies. This interest is reflected in such concepts as core competences (Hamel & Prahalad, 1994), organizational learning (e.g., Levitt & March, 1988; Huber, 1991), dynamic capabilities (Teece et al., 1997), and communities of practice (Wenger, 1998). It is also reflected in the development of a “knowledge-based theory of the firm” (Kogut & Zander, 1992, 1996; Grant, 1996b; Spender, 1996; Nickerson & Zenger, 2004), which aims to explain the structure and performance of organizations. Theorists working on this theory argue that the performance of an organization is based on its capabilities. These capabilities reside not only in the knowledge of individuals, but also – and particularly – in the way they are integrated (Kogut & Zander, 1992, 1996; Grant 1996a, 1996b). Because of the nature of these organizational capabilities (partly tacit and embedded in organizational arrangements), they are hard to replicate or imitate and therefore tend to be sustainable.

Hamel and Prahalad (1994) introduced the concept of a core competence to refer to a specific type of organizational capability. The literature agrees on several dimensions of a core competence. Such a competence provides a disproportionate contribution to the customer’s perceived value; it provides a competitive advantage, it consists of a bundle of underlying competences integrated in an effective and efficient way; it includes the ability to innovate; it is connected with the technology, managerial systems, and values of a firm; it is hard to transfer and to imitate; and it is based on firm’s historic development (Hamel & Prahalad, 1994; Nelson & Winter, 1982; Quinn, 1992; Teece & Pisano, 1998; Leonard Barton, 1995).

Many authors suppose that a core competence resides at the corporate level of a firm (Hamel & Prahalad, 1994; Nelson & Winter, 1982, Quinn, 1992, Teece et al., 1994). They suppose that knowledge is integrated over business functions organized in separate departments (Grant, 1996a). This idea is consistent with the approach to a core competence as consisting of a bundle of underlying competences (e.g., marketing, sales, production, R&D). All business functions contribute to the final performance of the firm, although the contribution of each separate function differs. Therefore, this idea also contributes to explaining why it is hard to transfer and imitate. According to Leonard-Barton (1995), a

core competence can reside at corporate level, but also in a division or department of an organization. Her statement is plausible if a firm is organized in such a way that a division serves a distinguished set of clients, and that in this division all business functions are present that are relevant to deliver to clients products that are perceived as extraordinary and that support innovation.

We chose to focus on a core competence at the level of a department, namely an organizational group. In order not to confuse the reader with regard to our use of the concept of a core competence, we have developed a concept that specifically addresses a core competence at group level: a competitive group competence. The “competitive” refers to the achievement of a competitive advantage. A competitive advantage addresses a preferential position related to the best (worldwide) competitors and which provides the firm with a profitable and (at least temporarily) a sustainable position. Porter (1990) argues that firms create a competitive advantage by perceiving or discovering new and better ways to compete in an industry and bringing them to market. He also argues that the sustainability of a competitive advantage depends on three conditions: the particular sources of advantage, the number of distinct sources and continuous improvement and upgrading. With regard to the particular sources of advantage Porter argues that more sustainable sources depend on more advanced competences, often accompanied by close relationships with leading customers, sustained investments in specialized physical facilities, risky learning and superiority in performing. In explaining a competitive advantage, Porter emphasizes the position of the firm, the core competence literature however also emphasizes the perspective of the client: a competitive advantage refers to the *effect* of providing clients with extraordinary products (i.e. Hamel & Prahalad, 1994). However, both emphasize that a competitive advantage is based on the way the group accumulates competences and integrates these competences in services in a flexible and efficient way. In this respect, the concept of a competitive group competence can be compared to the concept of a competitive capability: “the set of organizing processes and principles a firm uses to deploy its resources to achieve strategic objectives” (McEvily & Marcus, 2005, p. 1034), assuming that a strong competitive position is one of the strategic objectives and that the words “competence” and “capability” can be exchanged. The choice to focus on a group is not only induced by time and budget constraints, but is also supported by literature. Okhuysen and Eisenhardt (2002) state that groups have a crucial role in organizations, as the integration of individual knowledge into collective knowledge is a fundamental activity of groups. These groups can be for example multifunctional product development groups working on a common product (Ancona & Caldwell, 1992), top management teams whose members represent different business functions (Eisenhardt,

1989), teams of factory representatives working on manufacturing process improvements (Tyre and Orlikowski, 1994) and distributed teams working on innovation (Orlikowski, 2002). As knowledge is increasingly recognized as a primary strategic resource for organizations (Grant, 1996a, 1996b; Kogut and Zander, 1992), the work of groups in the knowledge domain becomes central to organizational success and competitive advantage. Besides, the phrase “competitive group competence” is not theory-impregnated, as the concept of a core competence is. It is much clearer to define this concept in relation to our methodological choices, which is what we do in Chapter Two.

We also narrowed our scope with regard to the aspects of a competitive group competence we studied. We focused on the emergence of a competitive group competence, as we have especially little insight in this phenomenon. Orlikowski (2002) suggests that the emergence of a competitive group competence is a joint accomplishment: it is not a static property or stable disposition but an enacted capability, a situated and an ongoing accomplishment that emerges from people’s everyday actions, socially constituted, collective, distributed, and emergent (Orlikowski, 2002, p. 269). This statement stresses that a competitive group competence is the capability of a group, arising from the coordinated actions of the group members, a result which can not be reduced to one group member and which has to be created over and over again. The coordinated actions of group members are not supposed to be incidentally, but to be part of the regular, everyday activities that group members perform, adjusted to the conditions and requirements present at a moment in time. This drew our attention to the practices of a group and to processes underlying the emergence of a competitive group competence. However, the emergence of a competitive group competence also implies development, as a developmental process has to take place before a competitive group competence is able to emerge. Once it emerges, the developmental process does not stop. Because it does not seem useful to speak about the development of a competitive group competence separate from its emergence and as an abbreviation for “development and emergence,” we speak only of emergence, although we do of course also address the development of a competitive group competence.

We focused on the emergence of a competitive group competence with the aim of gaining more insight into the underlying processes. We argue in section 1.3 that we have limited knowledge of these processes, the context in which they operate, and the link with the practices of employees working in a group. But how can we increase our understanding? There are two ways to approach this problem. The first is to gain a deeper understanding of the factors that affect the emergence of a competitive group competence. This approach is directed at gaining more insight in the circumstances that stimulate or hamper the

emergence of a competitive group competence, but it is not directly focused on the process of emergence itself. The second approach is to focus on the processes that are responsible for and underlie the emergence of a competitive group competence. This approach is more fundamental, and also provides sustainable options for control (of the emergence). Therefore, the focus in the study was on processes underlying the emergence of a competitive group competence.

In this thesis, the focus is on the emergence of a competitive group competence in a research group operating in a research organization that is dependent on assignments from the market for its continuation. For several reasons this is an interesting environment in which to research knowledge processes. Doing research is a knowledge-intensive activity. In a research organization that is dependent on assignments from the market, research is focused on providing solutions for problems posed by clients. For this type of work, the organization uses the expertise that has been developed over a number of years. At the same time, the execution of research adds new insights, methods, and techniques, including scientific ones to the organization's expertise. But the organization also innovates, developing expertise the market does not ask for yet, but is expected to ask for in the near future. Because of the nature of the work and the cost structure, there are not many opportunities for competing on costs; competition is possible only on quality. Therefore, the development of extraordinary quality is essential for research groups in order for them to acquire research projects from the market. A competitive group competence provides these groups with a competitive advantage over other research institutions and private firms.

Based on this sketch of the study, we position it as affiliated with research into the resourced-based view of strategy (Barney, 1986, 1991; Rumelt, 1991, Hamel & Prahalad, 1994; Hamel & Heene, 1994), which argues that a firm's internal resources and particularly organizational competences (of which a competitive group competence is part) determine its competitive outcome. The study is also affiliated with the development of a "knowledge based theory of the firm" (Demsetz, 1991; Kogut & Zander, 1992, 1996; Grant 1996b; Spender, 1996; Nickerson & Zenger, 2004), which builds on the insights of the resourced-based view of strategy and in which knowledge and knowledge processes are used to explain the structure and performance of organizations. It is also located within the body of research on "practice," which focuses on how people engage in the doing of real work (Cook & Brown, 1999; Orlikowski, 2002; Wenger, 1998; Brown & Duguid, 2001). As knowledge in organizations is embodied in individuals and is organized by interactions between individuals, studies that focus on practice with regard to knowledge and

knowledge processes in organizations observe how people engage in their work, how they interrelate, and how they apply and integrate knowledge. Finally, this study fits in the trend toward more empirical research on knowledge processes in organizations.

1.2 Previous research

We reviewed previous research with the aim of summarizing what we already know about the emergence of a competitive group competence, either directly from the literature or derived from it. Here, we present three perspectives on literature, namely: (1) Literature that argues that a competitive group competence supposes fit between group and environment. (2) Literature that argues that the emergence of a competitive group competence is based on interaction processes between group members, focusing on the development, exchange, application, and – especially – the integration of expertise. This literature suggests that due to knowledge integration, a research group is able to provide clients with products that are perceived as extraordinary. (3) Literature that suggests that for knowledge integration to take place and to meet the expectations of clients, a group has to learn. The group has to learn with regard to the research area (expertise development) and with regard to their practices (how to integrate expertise and how to maintain fit with the environment).

After this review of previous research, we argue in the following section that our knowledge of the processes responsible for the emergence of a competitive group competence is still limited, as is our knowledge of the context in which these processes operate and how these processes accommodate dynamics and change. Based on this argument, we present our central research problem.

Fit between group and environment

The concept of a “core competence” (or at group level, the concept of a “competitive group competence”) is part of the literature in the field of the resourced-based view of strategy. According to this view, a firm’s internal resources determine its competitive outcome (Penrose, 1959; Rubin, 1973; Lippman & Rumelt, 1982; Wernerfelt, 1984; Barney, 1986, 1991; Rumelt, 1991; Dierikx & Cool, 1989; Conner, 1991; Mahoney & Pandian, 1992; Peteraf, 1993; Mosakowski, 1993, 1998). The resourced-based view of strategy supposes that firms accumulate unique combinations of resources (especially knowledge) that provide them with unique competences that can provide superior performance. Because firms differ with respect to the competences they accumulate, firms differ in terms of

performance. In core competences all competences that are needed to operate successfully in the market are combined. Because firms differ with respect to the competences they accumulate, core competences are unique, non-substitutable, hard to imitate, valuable (organizational) competences that underlie leadership in a range of products or services. Therefore, a core competence is supposed to provide a strong competitive advantage in the market(s) in which a firm operates, compared to its competitors. It also supposes a high fit between organization and environment, because a core competence provides a disproportionate contribution to the customer's perceived value, implying that the organization understands the needs of its environment and how to operate in that environment.

Expertise development and development of a (social) practice of knowledge integration

As we stated, literature argues that a core competence consists of a bundle of underlying competences, integrated in an effective and efficient way (Hamel & Prahalad, 1994; Nelson & Winter, 1982; Quinn, 1992; Teece & Pisano, 1998). Literature also argues that this bundle is composed of a set of differentiated competences, namely competences in a technical domain and competences in a social domain (Teece et al., 1994; McGrath, MacMillan & Venkataraman, 1995; Nerkar & Roberts, 2004). In a research organization – the focus of this study – competences in a technical domain can be translated into expertise in a research area. As for example, expertise of butterflies, reptiles, forest birds, modeling and statistics, which is present in one of the research groups we studied (Chapter Three). In a research organization the competences in a social domain refer to for example how to interrelate with clients and – important for this study – how to integrate all the technical expertise in a project in order to provide answers requested by clients. Especially as the expertise that is needed is not always present in one person: the researcher having expertise of butterflies has for example no modeling expertise and the researcher with modeling expertise has for example no expertise of butterflies. Thus, providing clients with answers, requires the coordinated efforts of individual specialists who possess different types of knowledge (Grant, 1996b). This is what we refer to here as knowledge integration. Literature argues that the emergence of a competitive group competence arises from the interaction processes between individuals, focusing on the development, exchange, application, and – especially – the integration of knowledge (Grant, 1996a, 1996b; Hamel & Prahalad, 1994; McGrath, MacMillan & Venkataraman, 1995; Kogut & Zander, 1992; Haas & Hansen, 2005), including the relevant knowledge and expectations of the client (Danneels, 2002; Ethiraj et al., 2005). Therefore, literature suggests that due to knowledge integration, the group is able to provide clients with products that are perceived as extraordinary.

Knowledge integration is not realized automatically. Literature emphasizes a number of knowledge integrating mechanisms: directives, sequencing, routines, group problem-solving, decision-making (Grant, 1996a), and thinking along (Berends et al., 2005). Literature also emphasizes a number of factors that enhance or hamper knowledge sharing and the integration of knowledge in a group or network. For example, one factor that enhances communication is the presence of common knowledge (Huang & Newell, 2003), including cognitive schemas and frameworks (Weick, 1979), a shared understanding, shared agreement, and shared expectations (Von Krogh et al., 1999; Weick & Roberts, 1993; Fiol, 1994; Dougherty, 1992), common language and stories, communal know-how (Brown & Duguid, 1991, 2001; Cook & Brown, 1999), boundary objects (Carlile, 2002), and transactive memory (Moreland, 1999; Brandon & Hollingshead, 2004; Lewis, Lange & Gillis, 2005). Another factor is the presence of social capital (Leana & van Buren, 1999; Nahapiet & Ghoshal, 1998), which especially addresses relationships between members of a group or network and stimulates knowledge sharing. According to literature, it is based on network features in the group (Burt, 1997; Granovetter, 1973), shared norms (Portes, 1998, Putnam, 1993), shared beliefs (Nahapiet & Ghoshal, 1998, Portes, 1998), rules (Salancik, 1995; Podolny & Baron, 1997), and trust (Adler & Kwon, 2000; Brown & Duguid, 2001). Another factor is how activities in the group or network are interrelated, addressing the style with which they are interrelated (e.g., heedful – heedless) as well as the strength (e.g., loose – tight) with which the activities are tied together (Ash, 1952, Weick & Roberts, 1993; Zárraga & Bonache, 2005), opening the possibility for the emergence of a collective mind (Weick & Roberts, 1993). And finally, without the intention of being exhaustive, shared identities (Orr, 1990; Brown & Duguid, 2001; Orlikowski, 2002) affect the development of social relations and therefore indirectly affect knowledge sharing.

Learning: reproduction and change

As we already stated, literature argues that a competitive group competence should not be understood as a static property or stable disposition, but as an enacted capability, a situated and an ongoing accomplishment that emerges from people's everyday actions, socially constituted, collective, distributed, and emergent (i.e., Orlikowski, 2002, p. 269).

Measurements of the factors that enhance or hamper the sharing of knowledge and knowledge integration (previous paragraphs) will change over time. As groups grow older, the level of transactive memory ("who knows what") for example, the level of common language and stories and communal know how will change. Groups develop, they learn as group members get to know each other better, as they integrate experiences in their

practices and as they integrate new expertise in their products. New technical expertise of the domain in which they perform their core activities (Quinn, 1992; Helfat & Raubitschek, 2000; Danneels, 2002; Henderson & Cockburn, 1994) will lead to new or modified products which – hopefully – will strengthen their competitive position. Integrating experiences in the application of routines, in executing directives, in group decision making (Teece, 1982; Teece & Pisano, 1998; Weick & Roberts, 1993; Nelson & Winter, 1982) and in the development of new ways of working will affect the practice of knowledge integration, improving or worsening this practice (related to the demands of customers). Therefore learning affects the emergence of a competitive group competence.

Because individuals are the primary actors that learn, learning, adaptation, and renewal emphasize the question how individual learning is translated into collective learning and its effect on the performance of the group. Continuous learning also emphasizes the question how groups are able to maintain their practices, how they can ignore or compensate for interruptions (as for example the introduction of new administrative rules), in a strive for the continuation of the emergence of the competitive group competence. Literature addresses both how groups are able to continue their activities over time and how groups are able to learn and change. With regard to the continuation of activities, it addresses the reproduction of identity, decisions, expectations, and the way work is organized, as ways of continuation (Bakema & Weggeman, 2001). With regard to learning (and change) literature addresses for example the renewal of routines (Feldman, 2000; Howard-Grenville, 2005), sensemaking, integration, and institutionalizing as mechanisms for linking individual learning and collective learning (Inkpen & Dinur, 1998; Matusik & Hill, 1998; Crossan, Lane & White, 1999) and the development and operation of a dynamic capability (Teece et al., 1997; Fujimoto, 2001; Zollo & Winter, 2002).

Thus, literature stresses that the emergence of a competitive group competence is related to (a) fit between organization and environment, (b) development of a knowledge integration practice, and (c) expertise development. The actual emergence of the knowledge integration practice and the accomplished depth and breadth of the developed expertise affect the scope, efficiency and flexibility of knowledge integration. These characteristics of the knowledge integration practice are in turn responsible for the performance of the group (the actual emergence of a competitive group competence) (Grant, 1996a). Reproduction and change work on all three domains we identified.

1.3 The research problem addressed in this thesis

Based on the review of previous research, three coherent problems concerning the emergence of a competitive group competence can be identified. Firstly, that our knowledge of basic processes responsible for its emergence is very limited. This includes the nature of the processes, their coherence and interplay, how individuals participate in these processes, and especially how knowledge integration is organized by these processes. Secondly, our knowledge of the context in which these processes operate, and particularly how this context affects the emergence of a competitive group competence, is limited. Thirdly, our knowledge of how dynamics and change (adaptation) are accommodated by these processes is limited. Particularly how accommodation affects the continuation of the emergence of the competitive group competence is still not very well understood. We discuss these issues in the following paragraphs.

Limited knowledge of the processes responsible for the development and emergence

Based on an extensive literature survey, Van de Ven and Poole (1995) identified four basic types of theories on change and development, representing “archetypical” explanations. Each of these theories views change and development as a different cycle of change events, governed by a different “motor” or generating mechanism. The four types are: (1) lifecycle theories, which depict the process of change in an entity as progressing through a necessary sequence of stages, driven by an immanent program, regulation, or compliant adaptation; (2) teleological theories, which view development as goal oriented and occurring through process steps such as implementation and evaluation; (3) dialectical theories, which look at change and development through the confrontation of an opposing thesis and antithesis; (4) evolutionary theories, which depict development and change as a sequence of variation, selection, and retention, driven by scarcity, competition, and environmental selection. Each of the four theories applies under a specific set of conditions, which are distinctive to each theory.

These four types of theories act as a general template for the content of change and development theories on particular problems in organizations. According to Van de Ven and Poole (1995), all specific theories of organizational change and development are built from one or more of the four basic types. The authors define these theories as process theories, aiming to explain development and change by studying a sequence of events that describe how things change over time, how causal factors influenced the case, the order in which events took place, and how long they operated.

The bodies of literature discussed in the previous section do not make it clear which of these four processes are involved in the emergence of a competitive group competence, how individuals are involved in these processes, or how exactly they operate. To some extent, this is due to the study of a core competence at a meso level (that is for example at the level of the organization, the level of a sector, or at the level of product-market combinations), using aggregated concepts (such as “the organization,” “organizational learning processes,” “the knowledge base,” “organizational competences,” and “routines”) that are necessary and sufficient for this level of study, but that are insufficient to understand what happens at a micro level. Aggregated concepts do not make it clear what basic processes underlie these concepts. To understand the emergence of a competitive group competence more fundamentally, we need to develop a deeper understanding. This can be done by a micro level study, one that includes the level of individuals and the interactions between individuals.

Our understanding of processes is also limited, because literature focuses either on factors that are relevant to the emergence of a competitive group competence (theoretical and empirical literature), or on actions to be undertaken to stimulate the efficiency and flexibility of knowledge integration and implicitly to enhance the emergence of a competitive group competence (especially management literature). There is a scarcity of theoretical and empirical literature that focuses on processes in organizations in order to explain its performance (a process approach instead of a variance approach). We reviewed all 160 references to the work of Van de Ven and Poole (1995)¹, a pivotal article in academic management research. Fifteen of them were real process theories (meeting the demands formulated by Van de Ven & Poole, 1995 and by Mohr, 1982), grounded in empirical data, addressing change processes in organizations. For three papers we could not determine whether they addressed a process theory. From the 15 papers that addressed a process theory, 6 addressed change related to organizational performance (in one organization) (Lee & Cole, 2003; Cunha & Da Cunha, 2003; Denis, Lamothe & Langley, 2001; Matthijssens & Pauwels, 2000, Pauwels & Matthijssens, 1999; Marcus & Geffen, 1998). Five of the references referred to papers that did not describe process theories but that contributed to a further development of process theory (Caldwell, 2005; Sturdy, 2004; Langley, 1999; Pentland, 1999; Polley, 1997). We did not find empirical studies that also reflected on process theory. Of course, this literature search did not cover all process

¹ Period: 1995 up to December 2005. Of these 160 references, we managed to find and actually read 127 (the others could not be found or were not available). Of these papers we read the abstract, introduction, research methodology (especially data analysis), conclusions, and discussion.

theories, as research may have been published that does not refer to Van de Ven and Poole (1995).

It is also not clear from literature how the required level of knowledge integration for the competitive group competence to emerge takes place. How do groups manage to integrate knowledge frequently, for a longer period of time, in a work setting in which the researchers are relatively autonomous? What kinds of practices accomplish the emergence of a competitive group competence with respect to knowledge integration? What knowledge integrating mechanisms are used and how do groups realize an effective, efficient, and flexible process of knowledge integration that provides them with a competitive advantage through the emergence of the competitive group competence? How vulnerable is this process to disturbances (e.g., changing administrative rules, new group members, changing demands from the niche) and what is the role of management for the continuation and adaptation of this process?

These questions, which are relevant to understanding the emergence of a competitive group competence studied at a micro level, especially refer to the linkage between characteristics of the practice of a group, the processes that operate in the group, and the consequences for the performance of the group. Our knowledge in this field is not complete. Mintzberg (1983) and Pettigrew and Fanton (2000), for example, relate structure and design parameters to performance (configuration hypothesis), but do not address the particular set of coordination mechanisms used by an organization or group and the balance between these mechanisms to explain performance.

The information-processing approach (Tushman, 1978; Daft & Lengel, 1986) provides suggestions with respect to the characteristics of the practice of a research group, how groups manage to integrate knowledge frequently (for a longer period of time), and the nature of the practice that accomplishes the emergence of a competitive group competence with respect to knowledge integration, but does not provide definitive answers. As Berends (2003) argues, the information-processing approach does not focus on tacit knowledge, but seems to be more focused on adaptation to an existing world (existing questions, problems, and environments) than on an enacted world (development of questions, problems and environments; Daft & Weick, 1984). Conner and Prahalad (1996) provide another reason why our knowledge of this subject is not complete: “a theory of performance differences between firms [but, in my opinion, also between groups; FB] necessarily implies and incorporates a theory of the firm itself” (p. 480). This theory of the firm is still under construction where it concerns the development and application of knowledge resources,

the characteristics of the practice of high-performing research groups, and the knowledge processes that operate in these groups (i.e., Grant, 1996a, 1996b; Spender, 1996; Kogut & Zander, 1992, 1996; Foss, 1996).

In addition, literature hardly addresses how the individual employee relates to group performance, when group performance is equated with the emergence of a competitive group competence. What attitudes, norms, beliefs, motivation, commitment and activities of individuals are necessary for the emergence of a competitive group competence? Of course, there is a large body of literature that addresses group development or the development of social practices (e.g., Stangor, 2004; Hogg & Abrams, 1993; Festinger, 1954; Tajfel, 1957, 1959; Tajfel & Turner, 1979; Wilke, 1980; Turner, 1982, 1991; Bales, 1953; McGrath, 1984; Owen, 1985; Dutton et al., 1994). This literature also provides suggestions why individuals comply with and commit themselves to a practice. But other questions regarding the emergence of a competitive group competence (studied over a longer period of time) are unanswered. How do individuals participate in processes that are responsible for the emergence of a competitive group competence? What role do differences between individuals play in this respect? How can we relate the activities of individuals and the style with which these activities are executed (attitudes) to the performance of individuals and to the contribution of individuals to the joint accomplishment of the group? All these questions are relevant to an understanding and an explanation of the emergence of a competitive group competence studied at a micro level.

Limited knowledge of the context

With regard to the context in which the emergence of a competitive group competence takes place, literature states that its accomplishment is related to a unique constellation of resources: tools, equipment, technology, group members, and culture (i.e., Leonard-Barton, 1995) or the practices (e.g., Orlikowski, 2002). Furthermore, literature argues that the context in which this accomplishment is realized should enhance creativity and innovation, in order to prevent the emergence of a core rigidity (Leonard-Barton, 1995). Clients should also be part of the context in order to include the expectations of clients and to deliver products that provide an extraordinary value (Danneels, 2002; Ethiraj et al., 2005).

However, our knowledge of the context – the constellation of resources – still has many characteristics of a black box, because literature does not make clear what its function is for how employees act and how technology, tools, and equipment affect the interaction between group members and between group members and clients. For an important part this is due to the fact that to explain these functions one needs process descriptions at a

micro level, linking group members, activities, tools, and clients. More in general, the characteristics of an environment that facilitates the emergence of a competitive group competence are not clear. Is every environment supportive, regardless of its dynamics and competitive characteristics? Is every kind of relation with clients supportive, or is a specific kind of relation required? Although many aspects of the context in which a competitive group competence emerges are not fully known at a micro level of study, for this study especially the effects of the context on the accumulation of expertise and on the knowledge integration practice are the most important aspects. For literature argues that due to knowledge integration, groups are able to achieve a competitive advantage and to provide clients with products that are perceived as extraordinary; hence, knowledge integration is responsible for the emergence of the competitive group competence.

Limited knowledge of how processes accommodate dynamics and change

At any point in time, according to Tsoukas (1996), is what is going on in a social system not fixed but inherently indeterminate. Human agents, researchers in this study, select out on the one hand what they understand to be the relevant aspects of both their role and their personal norms and values, and on the other those relevant aspects of the local conditions within which their actions take place, and they try to fit the two together. This process of achieving fit is therefore local. However, these small adaptations to changing circumstances can be shared and institutionalized and can become part of a modified behavioral vocabulary, a new recipe of the group. We interpret this change as that they have learned (Hutchins, 1991; Tsoukas, 1996). But what have the groups learned over time and how have they adapted their practices since they developed comprehension (a shared understanding of the combination of knowledge that is necessary to answer (types of) research questions; McGrath, MacMillan and Venkataraman, 1995) and deftness (a shared practice of interrelating to achieve the answers required by clients; McGrath, MacMillan and Venkataraman, 1995) for the first time? How have they adapted their social knowledge (rules, agreed upon and understood by the group how to solve tasks and how to practice these rules; Von Krogh et al, 1999), how did a pattern of mindful and attentive behavior develop over time (Weick & Roberts, 1993) and how did routines change (Teece, 1982; Teece et al., 1994; Karnoe, 1996)? How do changes affect the application of the mechanisms by which the group integrates knowledge (Grant, 1996a, 1996b; Berends et al. 2005; Willem & Scarbrough, 2002; Van den Bosch, Volberda and de Boer, 1999)? How do group characteristics affect knowledge integration when the group grows older, given that literature argues that interdependency between group members declines (Suitor et al, 1997; Madhavan et al., 1998) and that the balance in the style of how groups execute activities tends to progress in the direction of heedless interrelating (Weick & Roberts, 1993)? How

do groups accomplish sufficient creativity and innovation to prevent the emergence of a core rigidity (Leonard-Barton, 1995)? How do they break through existing routines in order to innovate (Dougherty, 1992)? What do dynamics and change mean for the emergence of a competitive group competence over time? Will it always emerge again after it has emerged once, assuming that the emergence of a core rigidity is prevented? How do the processes responsible for the emergence of a competitive group competence affect adaptation and facilitate or hamper adjustments caused by environmental and organizational dynamics?

These questions all relate individuals, the group, and the characteristics of the group to processes and, as a result of the joint operation of these processes, to the performance of the group. For this study particularly the effects of the accommodation of change of the processes involved in the emergence of a competitive group competence are important, because more insight into the accommodation of change helps to explain why groups are able to accomplish the emergence of a competitive group competence for a longer period of time and the extent to which the emergence of a competitive group competence is threatened. More in particular, a focus on the effects of the accommodation of change on the accumulation of expertise and on the knowledge integration practice seem to be the most important aspects, as literature argues that knowledge integration is responsible for the emergence of the competitive group competence.

Research problem

In section 1.2, we concluded that literature argues that the emergence of a competitive group competence is related to the fit between group and environment, expertise development, and the development of a (social) knowledge integration practice. These elements are assembled when expertise is integrated in products. The actual emergence of the knowledge integration practice and the accomplished depth and breadth of the developed expertise affect the scope, efficiency and flexibility of knowledge integration and thereby whether products provide an extraordinary value for customers. Therefore, knowledge integration is responsible for the performance of the group, the actual emergence of the competitive group competence. It was argued in this section that our knowledge of the basic processes that are responsible for the emergence of a competitive group competence is still limited, as the focus of the study of a core competence has been on a meso level and not on a micro level. For a deeper understanding of the processes involved in the emergence of a competitive group competence, we must include the individual and the interactions between individuals, implying a micro-level study. At this level of study, we not only have limited knowledge of the processes that are involved in the emergence of a competitive group competence, but more in particular we have limited

knowledge of how the required level of knowledge integration takes place for the competitive group competence to emerge (including the individual and interactions between individuals). It was also argued that we have limited knowledge of how the context affects the operation of the processes involved in the emergence of a competitive group competence, and how these processes accommodate dynamics and change. For both the context and the accommodation of change, the effects on the accumulation of expertise and on the knowledge integration practice seem to be very relevant, as literature argues that knowledge integration is responsible for the emergence of the competitive group competence. We therefore defined the following research question for this micro-level study:

Which combination of processes explains the emergence of a competitive group competence and how is the emergence influenced by the context in which the processes operate?

With regard to the processes this research question includes a description of the characteristics of each of these processes, how each process operates, how these processes interrelate and an explanation of why we find this specific combination of processes and of the exclusiveness of this combination. It also includes a description how this combination of processes accommodates dynamics and change and an explanation of why and how this affects the emergence of the competitive group competence (especially with regard to the accumulation of expertise and knowledge integration).

As processes do not operate in isolation, the research question explicitly includes a description of the context in which these processes operate, how the context affects the operation of these processes and an explanation of why and how the context (ual factors) affects the emergence of the competitive group competence (especially with regard to the accumulation of expertise and knowledge integration).

Objectives

The general aim of this study is to contribute to the development of theory on knowledge processes in organizations. Theory-oriented literature tries to understand knowledge processes and their contribution to the added value of organizations related to markets, the boundaries of organizations, and the performance and continuation of organizations. Therefore, this thesis contributes to the theory-oriented literature. More specifically, the objective of this study is to contribute to filling the gap in literature with regard to the processes responsible for the emergence of a competitive group competence.

1.4 Outline of the thesis

Chapter Two describes and discusses the methodological choices we made. These include the approach of the study and the choices made with regard to research methodology. Chapter Three presents the research groups in which the empirical field studies were carried out (i.e., the Ecology Group and the Postharvest Group). It also provides the context in which these groups operate. We provide a description of the core activities of the Ecology and of the Postharvest Group, the organizational position of these groups, and the conditions under which research work in these groups takes place. This description embraces the period from 1983 up to 2001.

Chapters Four to Seven are empirical chapters. Each addresses one of the four processes we found in the field studies. Chapter Four focuses on the process of the design and execution of projects in which knowledge integration takes place (lifecycle process). Chapter Five looks at the tensions researchers experience (in designing and executing projects) and particularly how their solutions to these tensions affect compliance with the social rules that guide knowledge integration (dialectical process). Chapter Six discusses the development of expertise (evolutionary process). Chapter Seven focuses on how the groups envision their future and execute activities to realize this future position (teleological process). In the introduction to Chapter Four, we introduce these processes in more detail, and make some introductory remarks with regard to the coherence between them.

In Chapter Eight, we present a grounded theory of the emergence of a competitive group competence, based on the interplay and coherence between the four processes discussed separately in Chapters Four – Seven.

In Chapter Nine, we summarize our findings, relate them to the research question, and address what our study has contributed to the existing body of literature. Furthermore, we discuss hypotheses that can lead to a more elaborated substantive or formal theory and reflect on our research approach. We also suggest ways in which managers could stimulate the emergence of a competitive group competence. We end with suggestions for future research.

Chapter 2 Methodological considerations

In this chapter the methodological choices that have been made in this study are discussed. These choices translate the research problem posed in Chapter One into a research design to address this problem. By discussing these choices we justify the approach of the study.

This chapter is structured in five sections. In the first section we will explain our choice for an inductive and interpretive research approach to answer the research problem. An important argument is that this approach provides support in answering the research problem posed in Chapter One, given the present knowledge of the emergence of a competitive group competence studied on a micro-level. In addition to the choice for an inductive and interpretive research approach a number of other choices have been made. In section 2.2 we discuss our choice for the development of a process theory, based on our research problem. In this respect process theory acted as a guiding theory and as a research method. In this section we also discuss procedures relating to process theory and how we applied these procedures. In section 2.3 we discuss the use of the Grounded Theory Method (GTM) to collect and analyze data and we discuss how we applied this method. In section 2.4 we discuss the focus in the empirical part of this study and choices we made with regard to data collection. We argue why we have chosen to execute two field studies, the criteria we used to select these field studies and why we executed them with some overlap. Finally, in section 2.5 we discuss the degree to which we meet quality demands: controllability, validity and reliability.

2.1 The research approach: an open, explorative and qualitative design

This study focused on the emergence of a competitive group competence in research groups in a research organization. In Chapter One we argued that this research problem is a problem that addresses a micro level, because it includes the individual and the relations between individuals. We argued that at this level of study we have limited knowledge of the processes involved in the emergence of a competitive group competence with regard to the nature of the processes, how they operate and interact and how they include individuals. We also argued that our knowledge of the context in which these processes operate and how they accommodate dynamics and change is limited. A better understanding of the local

practices, including a better understanding of how group members perform their work and the function of the context (as for instance physical resources as instruments and equipment) are essential for a theory that explains the emergence of a competitive group competence.

Due to the micro level research problem and the present level of knowledge (Chapter One), we have chosen for a research design in which the emergence of a competitive group competence can be studied *intensively*, in a natural situation and in a way in which the relation between the relevant factors stays present, maintaining its complexity (Hutjes & Van Buuren, 1996). This implies a research approach of which empirical research is an important element. Because this study is focused on the development of a *theory* that explains the emergence of a competitive group competence it is not necessary to take a large number of cases into account. For the focus is on the development of the theory through analytical generalizations and not on its testing through statistical generalizations (Yin, 1984). The number of cases that must be involved in the study is therefore small related to the number of factors involved (Hutjes & Van Buuren, 1996, p. 23). This high number of factors is also implied by the word “intensively” in the research design.

The development of theory from empirical research requires an open, explorative design and a qualitative design which enables the researcher to study the phenomenon *intensively*, making in depth observations, in its natural situation and in a way in which the relation between the relevant factors stays present. Following Berends (2003, p. 44) qualitative research should be understood in three ways. Firstly, it refers to the use of textual data that are not reduced to numbers. Secondly, it refers to interpretative research, aiming to understand the subjects in research and their life world. Thirdly, it refers to research that focuses on discovering qualities of phenomena in the life world of subjects. This study was qualitative in all three interpretations. First, we only made qualitative analyses, i.e. textual data were not reduced to data. With regard to the second and third meaning of the word: we tried to understand the practice of research groups in which a competitive group competence emerges and we studied the qualities of the (development and) emergence of a competitive group competence as a phenomenon.

2.2 The development of a process theory

In addition to an open, exploring and qualitative design of this study (previous section), we discuss in this section our choice for the development of a process theory to answer our research problem. Process theory (Mohr, 1982; Van de Ven and Poole, 1995; Poole et al., 2000) acted as an important guiding theory as well as a research method. We will start by introducing process theory, define its core features and provide arguments for our choice to develop a process theory. Then we will proceed by elaborating on its procedures and how we applied these. Our discussion of process theory is based on Mohr (1982) and Poole et al. (2000).

Introduction

Process theory aims to explain development and change (in organizations) by studying a sequence of events that describe how things change over time. In process theory this sequence of events is described in the form of a process or combination of processes. Poole et al. introduce four basic mechanisms that represent “archetypal” explanations of change and development (Chapter One). They provide general templates – and therefore a guiding theory - for the content of change and development theories. The result is a narrative that explains what each step leads to. It particularly addresses the causal factors that influenced the case, the order in which they occurred and the length of time they were in effect. The narrative provides a larger frame, leading to an overall coherency.

The research problem we posed in Chapter One points at identifying, analyzing and describing processes in a research group and understanding their contribution to the emergence of a competitive group competence. As we argued in Chapter One, the emergence of a competitive group competence also implies a development trajectory. Therefore we could also formulate the emergence of a competitive group competence as a change process in a research group: from non-emergence to emergence. When we apply this perspective to the emergence of a competitive group competence, a process theory will answer our research problem in that the processes responsible for the emergence of a competitive group competence can be identified, analyzed and described. Therefore process theory is not just a method, but also a guiding (meta-)theory in this thesis.

Additional arguments why the development of a process theory will answer our research problem can be based on Mohr (1982) who discusses the features of process theory related to variance theory. Process theory depends on *rearrangement* – that is, on the joining or separation of two or more specified elements rather than on a change in the magnitude of a

certain element. Whereas a variance theory explains a behavior or a characteristic of an object, a process theory explains the pairing or other rearrangement of mutually autonomous objects, such as the bets of the players and the number on the roulette wheel, whose individual courses are determined independently of one another by forces external to the core of the theory. One particular combination of the conditions and focal unit is defined, within the theory, *to be* the outcome (Mohr, p. 45/46). Mohr uses the example of malaria contagion as an illustration. But we could also illustrate the characteristics of process theory by a person winning the first prize in a lottery. This person should buy a lottery-ticket. Then the number on this lottery-ticket should be drawn as the first prize. Then this person should still possess the lottery-ticket and step forward to cash the ticket. The occurrence of this sequence is not deterministic, but probabilistic in nature. The sequence of events can lead to more outcomes: a person winning the first prize or not. The development of a process theory on how a person wins a lottery refers to one outcome, this person winning the first prize. This outcome is defined within the theory to be the outcome.

As illustrated by the example of a person winning a lottery, in a process theory the process at issue is a probabilistic conjunction of two or more specified phenomena (Mohr, p. 47). In this example the lottery-ticket and the person, both autonomous objects, are rearranged. Therefore, what is possible in a variance theory, is not possible in a process theory (more or less X means more or less Y: a person wins the first prize, but only to a certain extent). As Mohr argues (p. 55/56): “In general, if one desires an explanation for a different state of Y, or for not-Y, one must produce a second process model (as for instance a person not winning the first prize, FB). It might be quite similar to the first one, but it might be quite different, or it might not exist at all” (p. 55). “Each connection, such as that between X’ and Y’, is a special, distinct case, without any implications for other connections. ...if it is a true process model, one input will be capable of leading to more than one outcome. The true and general way to frame a process theory is to specify the necessary conditions and processes,....., and allow for various outcomes, only one of which is Y” (p. 56). Process theory and variance theory also differ with respect to time. In process theory, time ordering among the contributing events is generally critical for the outcome: “Ingredients alone do not convey a sense of explanation There must also be some instruction for mixing them – a recipe. Recipes generally mandate activities that occur over time and in a prescribed order. They do not necessarily must; a martini, for example, can be arrived at by adding the vermouth first, than the olive, and then the gin, or indeed by adding all three at once. Thus, if a probabilistic process intervenes between two events, it is necessary to allow a place for it in time – generally a place in time over which two objectsbegin within the theory as separated and end as united” (p. 60).

Based on these characteristics we can now provide additional arguments as to why the development of a process theory is needed for our research problem. Firstly, the problem is not to find an explanation for the distribution of a competitive group competence over research groups (why one group has a competitive group competence and another group does not) or to find an explanation for differences in the emergence of a competitive group competence between groups. Therefore, from the point of view of the research problem addressed in this thesis, a process theory is more obvious than the development of a variance theory. Secondly, the development of a process theory not only includes a description of the features of the processes and their interaction, but includes according to Mohr a description of the context within which these processes operate. Mohr refers to this context as “conditions”. Therefore a process theory will also support the answering of this aspect of our research problem: the context in which these processes operate and its effect on the emergence of a competitive group competence.

The application of process theory

Poole et al. argue that a scientific approach to narrative analysis should advance general theories that posit specific generative mechanisms for narratives. They argue that the process approach seeks to develop theories that can be put to a formal test in which they are compared to alternative narrative explanations (p. 49). To this end methods for process research must be developed to accomplish five key tasks. The *first* task they propose is event identification, in which the researcher identifies events. Methods should help to map occurrences into event types, consistently and validly. Events refer to phenomena as the design, the execution and the evaluation of projects (Chapter Four).

The *second* task they propose is characterizing event sequences, in which the type of sequence, event variables and properties and subsequences of events are defined. Characterizing event sequences is followed by the *third* task, specifying temporal dependencies, addressing the question whether events increase the probability of the occurrence of a succeeding event and whether events are of a causal nature. We identified for instance project phases, activities in projects, the duration and size of projects and how projects are designed and executed. We also specified the temporal dependencies in project phases and project activities (Chapter Four). We also identified instances of variation, selection and retention in the research lines in the field studies (Chapter Six) and we analyzed the sequence of strategy development, the content of the strategy, how its execution was monitored and evaluated as well as elements of the strategy with regard to HRM and organizing teams in the groups (Chapter Seven). We analyzed temporal

dependencies when applying the procedure of theoretical coding (section 2.3) of the Grounded Theory Method (GTM).

The *fourth* task described by Poole et al. is evaluating hypotheses of formal and final causality, by comparison of (a) the overall pattern in the event sequence to the pattern implied by the formal or final *cause* and (b) by tests for additional conditions or factors that must occur for a given formal or final cause to operate. This task can only be executed after the development and change process has come to its conclusion and researchers are able to comprehend the whole event sequence in terms of its form or final outcome. Poole et al. propose a number of methods to determine fit between hypothesized and actual patterns of development and change. Before we turn to the way we executed this task we also want to address the fifth and final task Poole et al. propose. This *fifth* task is recognizing patterns that integrate narrative explanations that should be supported by methods that convert a heap of confusing data into a synthetic account in which readers can comprehend all the data in a single act of understanding.

We have executed the fourth and fifth task *for each of the four processes* we distinguished by performing six tests proposed by Poole et al. to determine which of the generative mechanisms operate: a) does the process exhibit a unitary sequence of stages which is the same across cases; b) is there a patterning device; c) is there a goal setting process; d) is (are) the central subject(s) an individual entity or a set of interacting entities; (e) are individual cases to some extent unpredictable; (f) do conflict or contradictions influence the development or change process. The execution of these tests provided us with a pattern of answers that matched with the answers provided by Poole et al. for each of the four basic change models (Appendix one). In addition we tested the number and types of stages in the life cycle model (Chapter Four); we tested if consensus was reached in the teleological model and how monitoring and evaluation took place (Chapter Seven); what entities clash in the dialectical process (Chapter Five) and how variation, selection and retention occur in the evolutionary model (Chapter Six). Next to the identification of each of the four process models we also had to *integrate these processes to present an integrated narrative* on the development and emergence of a competitive group competence (Chapter Eight). Therefore we reflected on the interaction between the models we encountered in the field studies, grounding our reflections in the data we collected in the field studies.

Poole et al. suggest that each task is supported by methods. We followed Langley (1999) in this respect who evaluated seven generic strategies in order to theorize from qualitative process data. Based on Langley we chose a qualitative method that supports the tasks

defined by Poole et al. well: the Grounded Theory Method. We chose this method for a number of reasons. King (1994) puts qualitative methods of analysis on a continuum from structured to unstructured. Strongly structured methods are according to King quasi-statistical approaches that seek to turn the textual data into quantitative data which can be manipulated statistically. The least structured approach according to King is “immersion / crystallization” which thrives on intuitive analyses. The grounded theory approach (Glaser and Strauss, 1967) and the template approach (e.g. Miles and Huberman, 1984) are in between. The template-approach and the quasi-statistical approach require that the researcher has a clear picture of what he aims to study as qualitative data are analyzed through the use of a pre-established number of categories (themes) relevant to the research problem. Therefore the researcher needs to have (at least some of) his concepts in advance. As we did not have concepts in advance, these approaches were not suited for this study – at least not in its primary stages. In order to “work as structured as possible” the grounded theory approach seemed to be a good option. For these reasons, this approach was used in this study.

GTM also fits well with the process theory approach. As we elucidated in the previous paragraphs, a process theory is developed in an open and explorative way, starting with the identification of events and event types (task one), up to the recognition of a coherent pattern that integrates the narrative (task five). Process theory requires that, for the identification of events, the researcher has a clear definition of the central subject of the narrative and a sense of what is relevant to the change process under study, although evolution in concepts is still possible as events are identified through iterative analysis according to Poole et al. (2000, p. 92). As we did not have a clear definition of the central subject when we started, GTM provided an excellent way of developing events and generating ideas about the central subjects in the process theory. From the perspective of GTM there is also a good fit with process theory as a method of research. Both methods emphasize theory development. Theoretical conceptualization in grounded theory research means emphasizing patterns of action and interaction between and among various types of social units and discovering process (Strauss and Corbin, 1994, p. 278). Process theory adds a theoretical sensitivity to this process of conceptualization, especially by providing meta-concepts. GTM requires that the developed theory is developed in interplay with the data and is grounded in and traceable to the data. The proposed tasks in process theory support this orientation. In addition Poole et al. (2000) argue that in event identification systematic coding is used to make the process transparent and to enhance reliability and

validity of classifications (Poole et al., 2000, p. 92). The procedures in GTM (next section) support systematic coding very well.

To summarize, we discussed in this section our decision to develop a process theory and we discussed how we applied the procedures of process theory to develop a theory that explains the emergence of a competitive group competence, the role of the context and how the processes underlying the emergence of a competitive group competence accommodate dynamics and change. In the next section we will turn to characteristics of GTM and the application of the GTM-procedures for data collection and data-analysis.

2.3 The use of the Grounded Theory Method

The most important guiding theory and research method used in this study was process theory, as discussed in the previous section. As a method it was supplemented by the use of the Grounded Theory Method (GTM) developed by Glaser and Strauss (1967). In this section we discuss this method and how we applied it in this study.

Introduction

Data collection and data analysis are combined in GTM. This method supports an open, explorative approach and enables research of an intense nature that studies phenomena in their natural context, leaving the relation between relevant factors intact and supporting the development of theory. Supporting the development of theory from empirical data is what distinguishes the GTM from other approaches. The theory developed by GTM is based on and supported by empirical data. Therefore GTM is an inductive method, a bottom up approach, developing a general theory or hypotheses from empirical data instead of formulating hypotheses from embracing theories.

When researchers use GTM, they do not start with clear concepts in advance, but in an open, explorative way. Of course they will use their background knowledge and knowledge of relevant theories, but only to raise their theoretical sensitivity and to develop sensitizing concepts. The bodies of literature discussed in Chapter One raised our pre-understanding and theoretical sensitivity at the start of this study.

Coding procedures

The data are analyzed according to the methods that GTM offers: open coding, theoretical coding and selective coding (Glaser, 1992; Strauss and Corbin, 1990). The discussion of these methods is based on this literature.

Open coding, the first step in GTM, is concerned with attaching a label to a piece of data. By attaching a label (a code), features of the data are summarized under one concept. That supports a systematic comparison of the data. In choosing a label, existing concepts (literature) can be used as well as new concepts. When the researcher chooses to use existing concepts he should check if the use of that concept fits its use in literature. This stimulates the use of labels (in the first stages of research) that do not exist. The most important issue is that the codes are based on the data and that the researcher does not use an already existing set of codes.

When attaching codes to data the question arises as to how large the episodes should be to which codes are attached. GTM considers it legitimate to attach codes to sentences, larger fragments or complete documents, but Glaser and Strauss prefer a sentence-by-sentence coding. Of course this also depends of the nature of the study. In this study we coded sentence-by-sentence, but also attached codes to larger parts. The process of open coding resulted in about 100 codes. These evolved over time. Firstly, because comparing codes initiated a process of improving names of codes, merging codes and dividing codes. Secondly, because progression in the study made another labeling of the codes more relevant. Because there were no hypotheses and because data can be labeled in many ways, the data were attached with new codes during the study. These were codes that fitted with the analyses that were made and that supported the emergence of a coherent theory. In addition the codes fitted with our learning experiences in which direction the research problem should be answered. A third reason why the codes evolved is that step-by-step it became clear which codes were relevant for the development of the theory (to answer the research problem) and which were not. The codes that seemed less relevant were kept until their irrelevance for the integration of the findings had been established.

As a second step in open coding, categories of codes can be developed in order to bundle a large number of codes by certain features. This categorization is a first step towards an integration of the findings and the development of a theory.

The second analytical procedure of the GTM is theoretical coding. This analysis is directed to the discovery and description of relations between concepts. This step also contributes to the development of a theory, because a theory consists of concepts and relations between those concepts. According to Glaser (1992) theoretical coding should be grounded in data. One should search the data to find indications for the existence of relationships, relevant for the emerging theory. An example, derived from the interview with Laura (Postharvest Group), is for instance a relationship between the project phase “Design of a project proposal” and the activity “specifying the request of the client in interaction with the client”. We defined the relationship between this activity and this phase as “[this activity] is part of”. The relations between the codes can be defined at the level of the separate codes, but become more meaningful when they are applied to more abstract concepts (categories) developed out of the codes. We performed this procedure working inductively, parallel and iteratively with open coding.

Finally, the third analytical procedure, selective coding, is meant to elaborate on concepts and relationships found during open coding and theoretical coding. In this procedure no new concepts are developed, but already defined codes are improved and sharpened. The researcher can execute this step by studying his data again, focusing on pieces of data that have not been analyzed or by returning to the field collecting additional data. We also executed this step. This resulted in a sharper definition for several codes (as for instance with regard to activities and social rules related to the ending and evaluation of projects) and in the collection of additional data (as for instance with regard to the social rule “a success is always a shared success” which we tested by collecting data of publications). As the case studies were executed with some overlap a comparison of the findings also stimulated selective coding. For some codes data were more easily collected (or present) in one case than in the other case, as for instance with respect to the social rule “show respect to a colleague who has acquired an interesting project” which was quite visible in the Postharvest Group but less visible in the Ecology Group. This raised curiosity as to the extent the groups differed in this respect and how this should be reflected in the codes. A comparison of our codes with literature was hardly relevant in our choice for codes for selective coding. We stopped the process of selective coding when the concepts were saturated, i.e. when new collection and analysis of data did not provide additional insights. We used Atlas.ti, a software package that is especially designed for qualitative, grounded theory analysis, as a supporting tool.

The use of GTM has provided a highly satisfactory support for a systematic collection and analysis of the data. The procedures resulted in a large number of codes at a very detailed

level. By integrating the results derived by GTM in process theory we were able to identify four processes and to relate these processes in order to explain the emergence of a competitive group competence.

In this section we discussed our choice for GTM and how we applied the procedures of GTM. Together with process theory (previous section) GTM provides an important part of our methodological framework. In the next section we discuss the focus of the empirical part of this study and the choices we made with regard to data collection. These choices form the final part of the design of this study.

2.4 The design of the empirical studies

In this section we discuss the design of the case studies (section 2.4.1) and choices we made with regard to data collection (section 2.4.2.). Together they form the final part of the design of this study.

2.4.1 The design of the case studies

In this section we discuss the choices we made with regard to the empirical part of this study. We will argue why we chose to execute two field studies and discuss the criteria we used to select these field studies. We also discuss how we handled variation in order to distinguish between the necessary and the sufficient conditions. Then we discuss why we focused on the group as a unit of analysis and not on the design and execution of one or more projects. We end this section by discussing why we first focused on the emergence of the competitive group competence and then on its development.

The empirical part of this study consisted of two field studies in groups in which a competitive group competence emerged. We limited the number of field studies to two for a number of reasons. Firstly, for the development of a process theory it is not necessary to study a large number of cases. Mohr (1982) states, concerning the development of a process theory compared to a variance theory that: “the essence of variance theory, especially in the development stage, lies in the matching up of different pockets of variety, which always means looking at a broad array of instances. The process theory is radically different in this regard. Although a backdrop of variety and some amount of contrast may be helpful or even necessary, the systematic collection of comparative observations is quite distant from

the essence of the approach. What it often takes to develop a process theory is to begin to see the phenomenon just one time in the proper conceptual clothes... since the process is in some sense universal, even testing and refinement often proceed by the carefully instrumented observation of just one unfolding of the events in question, at least just one at a time. Further observations are primarily for corroboration and new ideas, not for establishing parameters” (p. 216). According to Mohr’s reasoning a process theory of the non-emergence of a competitive group competence could be a different theory. Therefore we focused on two cases in which a competitive group competence emerged. Secondly, because the intensity of the empirical part of this study made it possible to only perform a few case studies within limitations of time and money.

Both field studies were executed at Wageningen UR in two research groups both part of the Foundation DLO (Chapter Three). The first field study took place in the Ecology Group and the second in the Postharvest Group. Although both groups are part of Wageningen UR, they work in a different area of research and are part of different institutes. The Ecology Group – working in the field of landscape ecology – is part of the research institute Alterra; the Postharvest Group – working in the field of post harvest physiology – is part of the research institute ATO. The context in which both groups are working is discussed in Chapter Three.

We selected these two groups for three reasons. Firstly, because in these groups a competitive group competence emerged (to be supported later). Secondly, because the emergence of a competitive group competence is very relevant for these groups. They work in an environment in which they must acquire research projects and in which they must compete with other groups and firms. Thirdly, because of the access to these groups by the author.

The selection of two groups working in the Foundation DLO provided a context which is almost the same for both groups (see Chapter Three). They differ with regard to the field in which they operate. Therefore the choice for these groups limited variation on the one hand and on the other hand focused variation on the contents of the field of research. As process theory is a special kind of theory according to Mohr, grounded only in the “necessary conditions”, we were only interested in necessary conditions. But in order to distinguish between “necessary conditions” and “sufficient conditions” variation in cases is necessary. Mohr does not however provide a strategy on how to distinguish between sufficient and necessary conditions. According to Hume (1739) there is no definitive method in this

respect: “no number of repetitions of a particular sequence of events, such as the appearance of light after flipping a switch, can establish a causal connection between the action of the switch and the turning on of the light. No matter how many times the light comes on after the switch has been pressed, the possibility of coincidental occurrence cannot be ruled out” (in Rothman and Greenland, 1998, p. 17). This statement moderates our problem, both with regard to the number of cases to be executed as the variation between the cases. We applied however two strategies to overcome the problem of distinguishing between necessary and sufficient conditions. We evaluated if we achieved saturation by the execution of the second case study. Were there phenomena that were present in the first case study but not in the second? We did not find such phenomena, implying saturation. We also made a causal linkage between the desired outcome of the process theory (the emergence of a competitive group competence) and the processes we found (Chapter Eight). We considered whether they were absolutely necessary to provide the desired outcome, or if they could be left out. In this respect we applied the same strategy as Mohr implicitly uses in discussing the contagion with malaria. In this discussion he searches for all the events that are necessary to infect a non-infected person with malaria.

As stated, we selected two groups in which a competitive group competence emerged. Our study of literature, discussed in Chapter One, provided features of the emergence of a core competence. Literature also provided a definition of competitive capabilities as “the set of organizing processes and principles a firm uses to deploy its resources to achieve strategic objectives” (McEvily and Marcus, 2005). However, we also stated in Chapter One that these features do not provide a sharp definition of the phenomenon; one which enables us to directly recognize its presence, to identify processes responsible for its emergence and to distinguish it from other performance characteristics. But, as we argued, this also provides an opportunity to define the concept of a competitive group competence more clearly.

Literature argues that the emergence of a core competence is especially based on the integration of knowledge (Kogut & Zander, 1992; Grant 1996a, 1996b; Haas & Hansen, 2005; Chapter One). This also meets the definition of competitive capabilities. In case of the emergence of a competitive group competence the integration of knowledge should not be a result incidentally accomplished, but it should be accomplished over and over again, expressed in the (research) products delivered by the group. Therefore this feature should also be part of a “sensitizing definition” of a competitive group competence. Based on the characteristics of the emergence of a core competence directly found in literature and the frequency with which knowledge integration takes place we define the emergence of a

competitive group competence in a sensitizing way as: “a competitive group competence emerges when a group is integrating expertise of individual group members and clients in projects with a high frequency, using supporting resources (models, instruments, equipment). The expertise of the group is expertise of a high quality standard. The research products which are the result of this practice of knowledge integration are experienced by clients as extraordinary and provide the group a competitive advantage. The performance of the group as an effect of this practice is not dependent upon one individual”.

Methodologically the development of a definition of a competitive group competence as a sensitizing concept is supported by process theory (section 2.2). As previously discussed, process theory argues that “one particular combination of the conditions and focal unit is defined, within the theory, *to be* (italics, FB) the outcome” (Mohr, 1982, p. 46). This definition helped in steering data-gathering, in the search for and interpretation of literature and in the selection of groups for the field studies.

Based on our guiding definition of a competitive group competence we looked for groups that met the criteria addressed in this definition. We used several sources: (1) reports of review committees. The groups to be selected had to perform above average with regard to their score on quality parameters; (2) financial reports; (3) interviews with executives of the board of directors of the institutes and with group leaders. In these interviews we focused on testing if the criteria for the emergence of a competitive group competence were met. The Ecology Group and the Postharvest Group were selected because they met all criteria (high quality, products experienced as extraordinary, high frequency of knowledge integration, no dependency upon one individual for group performance, competitive advantage). Our expectation that groups should not experience financial problems appeared not to be true. The Postharvest Group had experienced financial trouble (in 1999) despite their competitive advantage. Changing administrative rules with regard to economic cost calculation had effected their financial position.

As we will describe in Chapter Three the groups in the field studies are characterized by the following features: (1) they work in a beta-field of research; (2) they perform multidisciplinary research; (3) they need interaction with customers as they are dependent on contract research in order to continue their work with a critical mass that assures quality; (4) they combine theory- developing research with more practical problem-solving research.

The first field study was the study of the Ecology Group. The study of the Postharvest Group started when the field study in the Ecology Group had been going on for some time. This approach allowed us to apply learning experiences in the study of the Postharvest Group. This strategy also provided opportunities to compare both groups in order to focus on phenomena present in one or both groups, thus stimulating the exploration of all relevant phenomena and stimulating the completeness of this study.

We had several options with regard to the unit of analysis in the field studies. We could have chosen to study the development and execution of one or of several projects. In a next step we could have broadened the results to the whole group. To study only the actual *emergence* of a competitive group competence this design would have done. However, we chose to study a group as a unit of analysis, because this design makes it possible to study also the *development* of a competitive group competence towards emergence, for this process is not bound to projects but to the group as a whole. Furthermore, interactions not linked to projects could be involved in the study more easily in this way. A final argument is that the focus in the study was on the recognition of behavioral patterns in the group and not on an analysis of the behavior of certain individuals or on behavior in certain projects.

We *first* focused on the actual emergence of the competitive group competence. In the preparation phase of the field studies we raised our theoretical sensitivity with regard to a possible linkage between the emergence of a competitive group competence and the way the expertise of the individual scientists in the groups was applied and integrated. Therefore we focused in the field studies on the interaction patterns between the scientists in both groups and – as a derivative – the interaction pattern with the customers. We studied the interaction pattern with customers only from the perspective of the group members, not from the perspective of one or more customers due to the available time. We also did not focus on the interaction with other research groups within the same institutes or with groups from outside the institutes. Of course we encountered these relations in the projects the groups worked on and in the interviews in which we discussed the search for and integration of expertise additional to the expertise present in the group. We did not give these data a special place in this study, because in the execution of most projects only group members participated.

After the (preliminary) study of the emergence of the competitive competence we focused on the development of the competitive group competence (towards emergence). In this part of the study we also took into account developments and trends in the environments of the Ecology Group and the Postharvest Group. We concentrated on written sources and on

interviews with members of the groups. We did not take the perspective of stakeholders in the environment into account and we did not interview previous group members. We chose to study a period of about 18 years (1983-2001), based on pragmatic reasons and based on the development trajectory of the Ecology Group. The development of the theme of landscape ecology starts in the beginning of the 1980s. After 1990, when this theme is anchored in governmental policy, its development (and the development of the Ecology Group) experiences a flight forward. Due to this reason – and the availability of data – we chose to start the analysis in 1983. Because we wanted to compare, we chose to start the analysis of the Postharvest Group also in 1983 even though the group did not exist in 1983 in the form in which it existed in 2001.

2.4.2 Data collection

Swanborn (1987) and Hutjes & Van Buuren (1996) discuss a large number of options for collecting data. We chose a strategy that provides in-depth observations. This strategy has many similarities with an ethnographic research strategy which is particularly based on interviews, collecting documents and making observations (Hammersley and Atkinson, 1983). The use of several data sources (triangulation) makes it possible to study the phenomenon – the emergence of a competitive group competence - as objectively as possible, as closely as possible and in its natural context.

In order to learn more about the research groups we participated in these groups for some time. By studying a group from within, the researcher is able to take an interpretative stance. The extent to which the researcher participates can range from non-participation to complete participation (Spradley, 1980, p. 59). In this study participation was between these two extremes. Our participation can be defined as passive participation, which means that the researcher is in the place where the group works, but that he does not participate in the work (activities) of the group. Our participation was limited to coffee, lunch and (passive) participation in some meetings.

Since social reality is created by the meaning systems of those involved (Giddens, 1984), we need an interpretative stance to understand these meaning systems when we want to understand social reality. The knowledgeability of the community members can serve as a source of information in order to learn about their actions, artifacts and institutions. However, according to Berends (2003), because “human actors are not completely transparent to themselves... social scientists should also look further than the self-interpretations of the subjects studied. Social research calls for both involvement and

detachment ...” (p. 47). Therefore we used three kinds of techniques to collect data: interviews, observations and documents.

In both field studies we started with a discussion of the goal of the study with the group leader and we made arrangements to get to know the group. This included becoming familiar with projects the group worked on, the number of group members and their names, the position of group members in the group, the physical working place of the group, the distribution of group members over the rooms, when group members had joined the group, introducing ourselves to the group and organizing a workplace, computer and a connection to the e-mail system. Based on several discussions with the group leader we made a list of the group members we wanted to interview. In this list we tried to represent the diversity present in the group: members recently working in the group, members working in the group for a long period of time, men, women, senior researchers, researchers and research assistants, group members with managerial responsibilities and representatives of all sections or subgroups present in the group. Based on this list we interviewed ten group members in the Ecology Group (group size 51 members) and eight group members in the Postharvest Group (group size 31 members). In these numbers the interviews with the group leader and discussions during coffee and lunch are not included.

After receiving permission from the group members for an interview we prepared very thoroughly for these interviews. We studied the projects in which these group members participated, their recent publications and their personal background: education, when they joined the group and their career development (position, type of research).

Each interview was half open and took between one and a half and two and a half hours. They were half open in the sense that a previously defined list of topics was discussed, but there was also sufficient time to get into topics or aspects that were put forward during the interview. Before the interview we sent the interviewees a short introduction of the study. The interviews commenced with a short (personal) introduction and continued with a number of the topics presented in Table 2.1.

Table 2.1 Topics discussed in the interviews

- position in the group, role, background and expertise profile;
- projects that are executed, products and expertise profiles of colleagues;
- phases in the project life cycle;
- the process of acquiring and designing projects;
- the process of executing and ending projects, including communication;
- meetings other than project meetings, their function, meaning and added value
- the function of the section or subgroup to which the group member belongs, goals of this subgroup, the extent to which subgroup members need each other to achieve goals;
- the core expertise of the group or the section, in which field the group or section excels and how group members know of this excellence;
- position of the group related to other groups, competitors and the relevance of the group for customers;
- when the group member is satisfied with his or her contribution (from his or her own perspective and the perspective of the group leader);
- the atmosphere in the group;
- important events and choices made in the past;
- why – according to the group member – the competitive group competence was able to develop and what is expected in the near future (in the group and in the environment);
- instruments and equipment.

The selection of topics was dependent on the data already collected (saturation of the codes, see the GTM-procedures in the previous section) and the background of the group member interviewed. All interviews were recorded on tape and transcribed afterwards. In the interviews we promised the group members anonymity in processing and presenting their statements. This was an important aspect in order to create an atmosphere in the interview in which everything could be said. This aspect required extra attention because the researcher, while carrying out the study for Eindhoven University of Technology, also works at the headquarters of the Foundation DLO and group members could experience feelings of suspicion with regard to “what headquarters could do with this information”. Our promise of anonymity and use of their statements only for the purpose of this study seemed to be sufficient. We did not receive signals – neither from the interviews nor from comparison of the statements in the interviews with other data sources – that issues were not mentioned or were colored due to fear or suspicion. We interviewed with an attitude of an “outsider”, even though in some instances we knew more about some topics discussed in the interviews than the group member that was interviewed. This applied in particular with regard to the relation with the Ministry of Agriculture, Nature and Food Quality, procedures about investments in the development of new disciplines and renewal of expertise in DLO

research and more in general about the development of DLO and the institutes of which the groups are part (the researcher started working for DLO in 1990).

During the field studies we tried to be at the working place of the group for one fixed day, but we were also there at other moments when this was more convenient to interview group members or to make observations. In total we visited the Ecology Group for 17 weeks and the Postharvest Group for 30 weeks (with an interruption of eight weeks). During the field study of the Ecology Group we were connected to the e-mail system which enabled us to follow e-mail traffic between (individual) group members and the other colleagues in the group. We did not succeed in establishing an e-mail connection in the Postharvest Group. Finally we participated in some meetings, to observe how the group members discussed issues. We also walked the hall ways regularly to observe interactions between the group members and we read the announcements made on the notice board of the group.

After transcribing the interviews we asked the interviewees to check the completeness and validity of our interpretations. Swanborn (1996) defines this as a member check, in which the researcher presents data and interpretations to the subjects involved to check if the reconstruction of reality by the researcher is recognized. These member checks initiated some improvements, but no substantial changes.

We also studied a large number of documents, referring to the past of the groups as well as to the present situation and near future of the groups. These documents involved strategic plans – sometimes divided into strategic scientific plans and HRM plans – the year plan 2001, project descriptions, annual reports, descriptions of research programs, descriptions of introduction programs for new group members, documents that were written for reorganizations, career descriptions, documents for meetings of the group and documents describing developments in the environment of the group (especially policy documents).

At the end of each field study we summarized and discussed the (first and provisional) results with the group leader. These “member check” also provided improvements and additional data. We also discussed these results in a presentation for the whole group at the end of the field studies. This presentation was however more practically oriented in which we also made suggestions for future development. These presentations were also suitable for a check on the validity and completeness of the results.

This research approach enabled us to follow the practice of the groups from nearby and to analyze that practice, although we stayed an outsider. But it was very interesting and

sometimes even confrontational and emotional to study the practice of these groups so closely.

In the next section we will turn to the quality criteria which this study has to meet and discuss to what level these were actually met.

2.5 Quality criteria

Traditionally there are three quality criteria to evaluate the quality of research: controllability, reliability and validity (Swanborn, 1996). In this section we will discuss to what degree this study meets these criteria.

With regard to controllability, qualitative research in general is less controllable than quantitative research, although process theory and GTM provide clear analytical procedures that help to raise controllability. A sound process of coding makes the results traceable to the original data. The use of Atlas.ti enhanced this traceability.

The reliability of a study is affected by the instruments that are used, the timing of the study, the subjects chosen and the researcher(s) who execute(s) the study (Swanborn, 1996). Reliability with regard to the research instruments was assured by using different data-sources (data triangulation, Denzin, 1978): interviews, observations and documents. Using these data sources side by side made it possible to cross-check the reliability of the data collected as for instance with regard to the social rule “a success is always a shared success”. We collected data in the interviews with regard to this rule, but we also checked our results by collecting data about publications and in particular to what extent publications were a joint product. Another example is how we checked expertise profiles of researchers by comparing data collected in interviews and data derived from documents.

The influence of timing on the results of the study was anticipated by taking a long period of development into account (about 18 years, see section 2.4.1). It was not possible to observe interaction patterns between the group members for this period of time; this was bound to the period of the field studies. But it was possible to analyze publication behavior (focusing on publications written with colleagues from the group), to study the research programs (and collaboration in projects mentioned in these programs) over these years, to study findings and remarks of review committees and to study the composition of the groups and changes in that composition. This compensated for an important part the

influence of timing on the results of the study. However, because we were not able to observe interaction patterns between the group members for a long period of time, we were also not able to gain a deep understanding of how social rules that guide the integration of expertise (Chapter Four) developed in time and were adjusted. A stronger “micro-oriented approach” for a long period of time could have provided additional insights, as for instance how social rules were actually applied in project activities in various situations and how they became modified, and how modification of social rules is accompanied by debate. But as the field studies took place in one year and the data-sources did not provide historical data in the same level of detail as those with regard to expertise development, on this aspect timing affected the results of the study.

With regard to the choice of research groups involved in the field studies we discussed in section 2.4.1 the methodological considerations, the criteria and data sources that were used to select the groups. We have no indications that our choice for the two groups involved in the field studies affected the outcomes of the study. The choice for the group members to be interviewed was not based on chance, but resulted from a strategy to collect data from a representative portion of the research group. In this representation several dimensions were present such as variation in gender, position, working experience in the group, specialism and membership of a sub-unit. Because of this strategy we do not expect that the choice of the group members that were interviewed affected the results of the study.

With regard to the observations we chose for three strategies: firstly, connection to the e-mail system (Ecology Group) which provided us with all e-mail sent by a group member to all other group members. These mails provided an impression of the interaction between individual group members with the group as a whole. Secondly, the observations in a limited number of group meetings. Observing the group members in these meetings provided data of the issues discussed in these meetings and the kind of interaction between the participants in these meetings. Thirdly, we followed an observation strategy of walking around: are group members sitting alone behind their desks, how often do we see (small) groups of group members discussing a topic, are doors open or closed, how many group members are sharing a room, how are group members distributed along the hall way (by section?, by theme?) and how are group members drinking coffee and having lunch (random?, by section?). Because these observation strategies were passive we do not expect that they affected the results of the study.

Finally, with regard to reliability, the researcher can influence the results in a number of ways. Firstly, he can influence the results by his presence in the field. But as we did not

participate in the research activities of the group, our presence did not affect the interaction pattern between the group members. Providing the group members anonymity in the interviews secured in our opinion an open interview in which nothing was hidden. Secondly, the researcher can also affect the qualitative analyses. Two researchers, beginning with the same data and research problem, will provide different results even when they follow the same process theory and GTM approach. This is however not an insurmountable problem. Process theory and GTM are especially directed at the development of theory and not at testing theory. Nevertheless, aiming for a certain direction of theory development, the results should be more independent of the researcher. The procedures of process theory and GTM probably provide a more researcher-independent result than armchair theorizing and intuitive analysis.

After discussing the aspects of reliability and to what degree they were met, we now will discuss aspects of validity and to what degree these were met. One can distinguish between internal and external validity (Swanborn, 1996). Internal validity points at the justification of the theoretical concepts and relationships defined in this study. External validity points at the generalization of the results to other (research) organizations.

Internal validity presupposes reliability. In the previous section we discussed to what degree we were able to achieve reliability. In this study more attention has been paid to internal validity than external validity. The development of concepts and accurate relationships between those concepts for the groups involved in the study was more important than testing the validity for all research organizations. The argument that supports this decision is that process theory and GTM are particularly focused on theory development and not on theory testing. Hutjes & Van Buuren (1996) state that the researcher has to balance between the added value of a specification of the theory that is being developed, its coverage and the reliability of the results and the time and money that is available. Not only with regard to the codes is the criterion of "saturation" important and relevant, but also with regard to the number of cases. Due to the intensity of the study the number of cases is restricted. These have caused restrictions in the external validity. Only two, comparable research groups, working in the same embracing organization were involved in the study. The two groups operate in a different field of research, are part of different research institutes and operate in a different environment, but have the same focus in their research and must operate within the same conditions (provided by the embedding organization). Between these groups there were no large differences in the results. Concepts and relationships were valid for both cases. This means that the results are most likely also

CHAPTER 2: METHODOLOGICAL CONSIDERATIONS

valid for other research groups operating with a comparable focus and within comparable conditions.

Chapter 3 The context in which the groups in the field studies operate

In this chapter we describe the groups that were involved in the empirical part of this study. They are referred to as the “Ecology Group” and the “Postharvest Group”. This description provides (major elements of) the context for the processes we have found and which we will discuss in the next five chapters.

The chapter is divided into three sections. In section 3.1, we position the Ecology and Postharvest Groups in the embracing organization. From a bird’s eye view, we describe the developments in this organization, the consequences they have for the position of the groups and the conditions they provide. We then focus on the core (research) activities of both groups. In section 3.2 we describe the core research activities of the Ecology Group, while in section 3.3 we describe the core activities of the Postharvest Group. In both sections, we describe four elements: the research field of the group, a description of the competitive group competence, a description of the research field of the institute to which the group belongs (to provide a broader perspective) and a sketch of the history of the group. We also provide an example of the nature of the work performed by the groups in order to familiarize the reader with these fields of research and to provide a “lively image” to be remembered whilst reading the next five chapters.

3.1 Developments in the agricultural research system

In this section, we describe the developments in the agricultural research system from 1983 from a bird’s-eye view. The description of these developments not only positions the Ecology and Postharvest Groups in 2001, but also highlights major developments imposed by the embracing organization that have affected the practices of these groups. This description provides a context for the description of the activities of the groups in the following sections and presents some of the organizational dynamics in the history of these groups.

For the description of the developments in the agricultural research system and to position the groups in this system, we distinguish three periods: a period of reorientation of the agricultural research system (1983-1989), the establishment of the Foundation DLO (1989-

1998) and the development of Wageningen University and Research Centre (1998-2001). These three periods are important because they represent three influential reorientations in the agricultural research system. In three sub-sections these periods are worked out more in detail.

3.1.1 A reorientation of the agricultural research system: the period 1983-1989

The agricultural research system to which DLO and the DLO institutes belong provides specialist and custom-made knowledge for policy making, policy implementation and policy evaluation of the Ministry of Agriculture, Nature and Fisheries (abbreviated as “the Ministry”). Besides the DLO institutes, the Experimental Research Stations, Wageningen University, the faculty of veterinary medicine of Utrecht University and parts of TNO (Dutch technological research institutes) also belong to the agricultural research system. In the Plan for the Development of Agricultural Research (1987), the function of the agricultural research system is addressed. According to this plan, the development and use of scientific knowledge contributes to the continuity of the primary, supplying and processing stakeholders in trade and industry in agriculture by expanding their competitive position. In addition, scientific knowledge contributes to the continuity of food security, the improvement of food quality and the continuity and improvement of nature and the environmental quality. The use of this scientific knowledge is linked with the activities of the policy-making directorates of the Ministry in this plan, as well as to the target groups in society and in trade and industry. The research of the DLO institutes and the experimental research stations is therefore not only directed at specific problems, but also at specific target groups (Plan for the Development of Agricultural Research, p. 4). Research is directed at the primary production (agriculture, horticulture, fruit, animal husbandry, fisheries, forestry), the processing of agricultural products, nature and landscape, rural areas and the environment.

Within the agricultural research system, three types of research are present¹: fundamental strategic research, strategic and application-oriented research, and applied or experimental research. Up to 1997, thus also in this period, research organizations in the agricultural research systems are organized according to these three types of research: Wageningen University conducts fundamental and fundamental strategic research; DLO conducts strategic and application-oriented research, while Experimental Stations conduct applied or experimental research (co-funded by stakeholders in trade and industry).

¹ Report on the detachment of DLO, p. III

The Plan for the Development of Agricultural Research describes the future of the agricultural research system and was sent to parliament in 1987. In this plan, a number of changes that were discussed in politics, in the research organizations and by stakeholders in society were worked out. For four areas (primary production, processing of agricultural products, nature & landscape and rural areas & environment), changes in needs for research were addressed, but, more importantly, organizational changes were proposed. These changes can be summarized in six issues. Firstly, a reduction in the number of (DLO) institutes by merging research areas that were assigned to separate institutes. Secondly, recombining research areas of institutes to raise the critical mass of the research capacity in those areas and to strengthen the coherence between research areas belonging to the mission of an institute. In order to achieve these goals, most institutes needed to reorganize their work. At the end of this trajectory, DLO consisted of 19 institutes instead of the 23 institutes that had existed before. These 19 institutes resulted from the closure of eight institutes and the creation of four new institutes. One of the new institutes is ATO, of which the Postharvest Group is part in 2001. Thirdly, the development of research programs was announced to contribute to the establishment of a coherent package of research. The introduction of research programs also implied a shift in funding towards a system of funding research programs. The plan stated that research programs into nature research, particularly of an ecological nature and directed at the protection and recovery of ecosystems and landscapes (Ecology Group), and research programs into the processing and quality of agricultural products (Postharvest Group) have high priority (p. 10 and 21). Fourthly, the educational level of researchers would be raised and the budget for investments in equipment and buildings would be increased. According to the plan, the size of the DLO institutes would thus decline (the number of employees, FB). The institutes were stimulated to acquire additional research funded by other stakeholders. The plan proposed reducing the number of permanent staff from 2,900 in 1987 to 2,600 in 1990. Fifthly, the introduction of an economic management system was proposed and sixthly, a separation of research policy-making and the implementation of research in the Ministry. This should be a first step to detach the DLO institutes from the Ministry “in order to increase its managerial power, its decisiveness and its flexibility” (Plan for the Development of Agricultural Research, p. 107).

In this period, the Ecology Group was part of the Governmental Institute for Nature Management (in Dutch abbreviated as RIN). This institute was responsible for conducting ecological research into plants, animals and vegetation for the preservation, protection, development and recovery of species and ecosystems, especially in those areas where the

Netherlands has an (international) responsibility; to do research into ecological aspects of rural areas for the design, fitting up and management of those areas; research into terrestrial and aquatic ecosystems; ecotoxicological research in those systems; research into forest ecology, the management of fauna and the development of methodologies for stock taking of nature and environment (Plan for the Development of Agricultural Research, p. 72). The plan stipulated that “special attention” was required for landscape ecology in the short term (*ibid*, p. 73). According to the plan, the capacity for this kind of research would not be reduced during the period 1987-1990.

The Postharvest Group did not exist as one group in this period, but as a number of research groups working in the field in which the Postharvest Group developed its core activities. Two of these groups were positioned in the Sprenger Institute (abbreviated as SI) and one group in the Institute for the Storage of Agricultural Products (abbreviated in Dutch as IBVL). According to the Plan for the development of Agricultural Research, these institutes would be merged to form the Agro Technological Research Institute (in Dutch abbreviated as ATO). The purpose of this new institute would be to develop knowledge and expertise in the field of the processing, transport, storage, presentation and sale of plant-based agricultural products, to make this knowledge applicable, and to conduct research into processing technology, storage and conservation technology and the logistics of agricultural products (*ibid*, p. 78). The research field of the (future) Postharvest Group should receive more attention: “developments in biotechnology, processing technology, post harvest physiology and storage and transport technology will be used in coherence. In particular, the interaction between the biological features of the harvested product and the technologies that can be applied for transport, storage and processing should be studied in more depth” (*ibid*, p. 78).

3.1.2 Establishment of the Foundation DLO: 1989-1998

In 1989, the Ministry separated research policy making and the implementation of research. A directorate of Science and Technology was established to be responsible for developing research policy and a directorate Agricultural Research (in Dutch: DLO) to implement research (programs) as instructed by the directorate of Science and Technology and other directorates of the Ministry.

In January 1991, the Minister proposed in government detaching DLO. Detaching DLO involved establishing a foundation DLO, cutting it loose from the Ministry. The report of the project group that made the recommendations regarding this detachment (the report

EPV²) shows that the Minister wanted to develop an organization to which he could grant contracts for research required by the Ministry and which would be responsible for its own continuity and acquire research contracts from other clients as well (other Ministries, EU contracts and contracts from organized parties in trade and industry as well as individual firms). It also meant that the Ministry could grant research contracts to other research organizations besides DLO based on expertise, price and quality. Therefore, according to the EPV report, DLO should develop as a strong, coherent and flexible organization that could develop and maintain a strong competitive position in the Netherlands and abroad. Elements of competition would have to be quality, client-orientation and business economic performance. At that time, DLO consisted of 17 institutes with a turnover of 300 million guilders (= 136 million Euros), 73% of which was acquired and spent on behalf of the Ministry and 28% on behalf of other clients. In 1991, DLO employed about 3,000 people (source: EPV, p. 1).

In its report, the project group distinguished the following core activities of DLO: development of strategic expertise, the implementation of research programs, the implementation of project contracts, research to support the observance of laws, exploitation of knowledge and services to society (p. VI). According to the project group, these activities should be based on contracts, in which the output of the research, its funding and other conditions were agreed. For the groups involved in this study, strategic expertise development, research programs and project contracts are relevant. These activities will therefore be discussed in more detail.

Strategic expertise development (abbreviated in the groups as SEO) is concerned with research focused on developing the expertise required to serve market needs that will emerge in three to four years' time. The development of this expertise is based on developments in science and developments in market and society. DLO is granted a budget for this kind of research from the Ministry (source: EPV-report).

Research programs are large clusters of research, consisting of a number of projects. An agreement is made with the Ministry regarding the results to be achieved, the conditions under which research is implemented and the budget. In general, these programs extend over a period of four years and the research is application-oriented. In some research programs, the Ministry is user of the results. Policy directorates of the Ministry are

² Report on the detachment of DLO (in Dutch: Eindrapportage Projectgroep Verzelfstandiging), December 1992

involved in the design of these programs. When the results are used by other stakeholders in society, they are also involved in the design of these research programs (source: EPV report).

And finally, project contracts are contracts with a well specified research problem. These contracts can be granted by the Ministry (besides research programs), but can also be granted by other clients. In a contract, the results, research design, conditions and budget are specified (source: EPV-report).

In the period between 1991 and 1998 all research groups (including the research groups involved in this study) were directed to develop a more market and client oriented approach, to work according to business economic rules, to develop marketing skills and to implement a form of research management which distinguishes between project management, program management and line management. This directive was issued by the Board of Directors of DLO in order to strengthen fit with the future conditions under which the institutes would have to operate.

This directive affected the groups involved in the field studies in several ways. Firstly, organizing research work in the form of projects became very strongly embedded in the practice of the groups. Research management and the financial administration of the institutes were also based on organization of the work by projects. Secondly, the introduction of business economic principles in acquiring and implementing research received a lot of attention in 1994-1996 and had a significant effect on research management (see Chapters Four and Five). Being required to take all costs for the execution of a project into account and provide funds from one or more sources to cover all costs changed the way research was acquired and executed in DLO. The researchers (part of the two groups involved in the field studies) still find it hard to meet all demands implied by this approach. As we will see, the business economic principles are also part of the practices of the groups. Its introduction contributed to the development of the social rule “work decently and as a good colleague” that will be described in Chapter Four. Thirdly, the groups had to develop an attitude that took the perspective of markets and clients more into account and to develop competences to market research. The development of this attitude and these competences received much attention in the years 1993-1997³. Fourthly,

³ sources (a): reports and plans expressing actions in the field of marketing in the years 1993-1997 e.g.: The strategic project ‘Marketing’ (Strategic Conference, January 1994), Goal of the task force Marketing & Acquisition (January 1995), Strengthening of the

they had to acquire more work from clients other than the Ministry in order to maintain the size of the group (covering all costs), maintaining critical mass and the ability to deliver high quality results. For the groups involved in the field studies, this necessity created pressure to acquire projects to cover all costs, but also contributed to a consciousness of their own competitive position, the availability and the value of time and money for research and a sense of being dependent on clients in order to survive. This development was also very important in the years 1993-1997⁴. Fifthly, there was the changing role of the Ministry as owner of DLO towards a role as a client of DLO (although the Ministry remains owner of DLO, but more in the background). The projects that are executed on behalf of the Ministry are not granted in free competition – the groups have a preferential position – but the Ministry gives clear indications what knowledge has to be provided and how that knowledge should fit the policy process. Before the start of the proposed research (programs) there is an assessment of this research. After the research programs are completed, they are evaluated⁵. In this evaluation, the Ministry also expresses its satisfaction with the research and the knowledge it provided. The role of the Ministry as a client also appears from the possibility to shift funding from one research area to another. Each year, the necessity of research (in a specific area) is discussed. Research must also support the policy of the Ministry in that area. Finally the Ministry can choose to involve other research organizations to fulfill its needs for knowledge.

Based on these developments, research groups and institutes are reorganized to improve the consistency of the research program of research groups and institutes and to create a sound base for healthy business economic development. This process started in 1991 (source: EPV-report).

marketing function in DLO (June 1995; February 1996), Training in marketing (February 1996), Measurement of the satisfaction of clients (April 1996), Organizing marketing and acquisition in the DLO institutes (September 1996); Definitions in the field of marketing (October 1996), Support of the marketing function of the DLO institutes in 1997 (January 1997), Development of foreign markets (February 1997).

Sources (b): reports expressing actions in the field of development and application of stricter business economic principles include: Management control in DLO (September 1993); Report Management Control in DLO (November 1993); A management report for the Ministry (July 1995); Implementation of the management control system at IBN-DLO (November 1995); Results of the implementation of the management control system in DLO, phase II (July 1996)

⁴ see no. 3

⁵ DLO subsidiary conditions, Appendix three

ATO was founded in 1989 (the Postharvest Group is part of this institute, see section 3.3). In 1991, a new institute for research into nature and forests was established, abbreviated as IBN. The activities and groups in RIN became part of this institute and its establishment changed the organizational environment in which the Ecology Group operated. Besides the research tasks described for RIN in the previous section, this institute also conducts research in the field of management and management systems for the ecological, business economic, technically and socially sound management of nature, forest and nature in cities and urban areas, recreational use of nature and forests, integrated pest control and development of expertise for the selection of new tree varieties.

In 1998, the government decided to establish the DLO foundation and cut it loose from the Ministry. This detachment was implemented according to the lines and conditions as described above. In 1998, DLO consisted of 12 institutes with a turnover of 455 million guilders (206 million Euros), 57% of which was acquired and implemented on behalf of the Ministry and 43% on behalf of other clients (source: CCS-1-6, 1998).

3.1.3 The development of Wageningen University and Research Centre: 1998 - 2001

In 1995/1996, the functioning of the agricultural research system was studied again. Based on the outcomes, the Minister was advised to bundle the work of DLO, Experimental Research Stations and Wageningen University in order to achieve more synergy, but with respect for the mission of each organization. In 1997 this cooperation took effect with the appointment of a new CEO and two other directors who together form the board of directors of DLO and Wageningen University. The new organization operates under the name of Wageningen University and Research Centre, abbreviated to Wageningen UR. In 1998 a strategic vision document was published⁶.

In addition to goals in the field of research, education and the valorization of knowledge, this document addresses intentions to change the organization. Firstly, a reduction in the number of DLO institutes, secondly the development of more integrated research programs and thirdly the organizational integration of the activities of Wageningen University, DLO and the Experimental Research Stations by establishing "Sciences Groups". The Board of Directors plans to establish five Sciences Groups, all consisting of a DLO institute, a part of Wageningen University and – for two of the five – a part of an Experimental Station. ATO

⁶ Strategic Vision Wageningen UR, 1998

would be part of the science group “Agrotechnology and Food” and IBN, after a merger with the SC institute and the establishment of the research institute Alterra, of the “Environmental Sciences Group” (Strategic Vision, Wageningen UR, 1998).

In 2001, at the time of the field studies, DLO consisted of eight institutes with a turnover of 298 million Euros. Of this turnover, 45% was achieved by acquiring and implementing programs and projects funded by the Ministry and 55% was achieved by contract research for other stakeholders. At that time, DLO employed almost 4,000 employees. The plans addressed in the Strategic Vision with regard to the establishment of Sciences Groups were achieved in 2001.

These sections provided an overview of the developments in the agricultural research system, the establishment, merger and closure of DLO institutes and the dynamics of the conditions under which DLO institutes must conduct research. These developments “enclose” the developments experienced by the Ecology Group and Postharvest Group. In the next two sections we will study these groups to provide a background for the practices and developments in these groups.

3.2 A sketch of the Ecology Group and its history

In the previous section we described the developments in the agricultural research system from 1983 from a bird’s-eye view. This description not only positioned the Ecology Group and Postharvest Group in 2001, but also described major developments imposed by the embracing organization that affected the practices of these groups. These developments provide a background for the description of the activities of the Ecology Group (this section) and the Postharvest Group (next section).

In this section, we will start by outlining the research field of the Ecology Group, presenting the field of landscape ecology in which the Ecology Group works. We will also describe the competitive group competence of the Ecology Group. We will then turn to the Alterra institute to which the Ecology Group belongs. This institute and the other research groups in this institute provide the (organizational) environment for the Ecology Group. It positions the work of the Ecology Group in a somewhat wider context. Finally we will sketch the history of the Ecology Group. Together, the description of the research field, the competitive group competence, the institute Alterra and a sketch of the history of the Ecology Group provide a context for the practices of the Ecology Group that we will

discuss in the following chapters. In general we used the annual reports from the period 1983-2001, research programs, strategic plans and the 2001 year plan as sources for the sketch of the group. We do not always refer to these sources in our sketch, because the statements we make are discussed in more detail in the next chapters. We continue with an example of the group's work (box 1).

Box 1: Example of the work of the Ecology Group

Most of the nature areas in the Netherlands are small and positioned in intensively used agricultural and urban areas. Most of the animal and plant species we want to preserve depend on these areas. Due to the small areas involved and the fact that they are not often linked, nature in the Netherlands is dispersed. This is the most important reason for the loss of biodiversity in our landscape. As a result, valuable species become extinct in a region or even in the Netherlands. Species can also be temporarily absent from an area which is suitable as a habitat for reproduction. Sometimes species are not able to operate in the whole area that is suitable as a habitat. This affects the possibilities for species to recover after years of problems in which their numbers have become strongly depleted. For small populations of ten to thirty individuals, a few severe winters, hot summers or a disease can wipe out the population. The extinction of small populations thus affects the continuity of the population as a whole.

The size of the habitat and its spatial positioning are responsible for a balance in an area between the risk of local extinction and the opportunity for neighbouring populations to migrate to this suitable, but empty habitat. When man can manage to restore this balance, populations can be sustainable (Figure A). Figure A also shows that large natural areas can promote migration to small patches in the landscape.

In a landscape as depicted in Figure A, small landscape elements can be present: hedgerows, woodland, ditches, road verges, etc. Studies of field voles have shown that small bushes in which these animals live are regularly empty. Their re-population not only depends on the quality of these bushes, but also on the resistance of the landscape in the land space in between bushes. For field voles, maize is much easier to cross than meadows.

Continuation of box 1

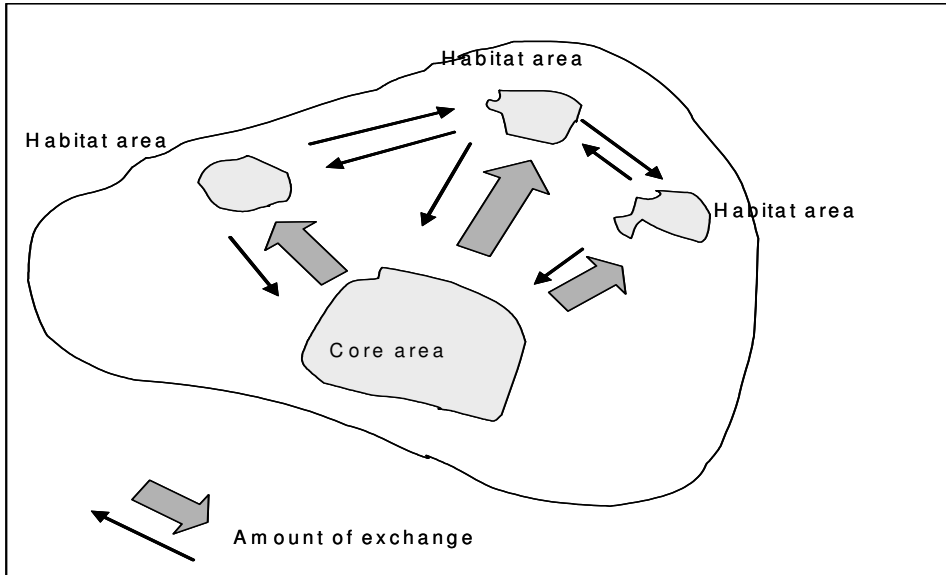


Figure A: Habitat areas and the exchange of species

In re-allotment processes whereby meadows for agriculture are enlarged by removing hedgerows, ditches and bushes, man affects the possibilities for animals for spread. For example, we know that several species of birds forage between 10 to 300 metres from their nest site. The absence of these species from a landscape can be explained by too long distances between nest site and foraging place.

Another example is how the presence of small elements in the landscape affects the number of birds (Figure B).

Continuation of box 1

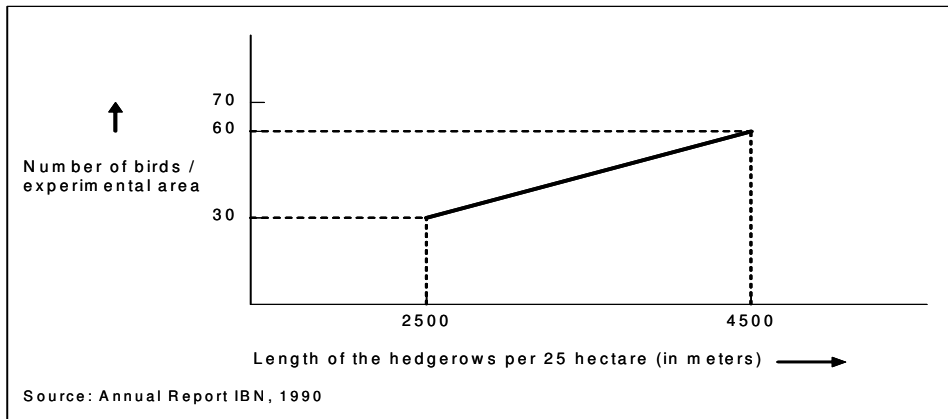


Figure B: Effect of length of hedgerows on the number of birds in an (experimental) area

For different species, the required size of areas and the distances they can cross from one habitat to another have quite different dimensions. They depend on their body size, their capacity to move and their ability to cover large or small distances.

In order to effectively strengthen the spatial quality of an area, connecting zones can be developed. The Ecology Group has created a method to decide where these connecting zones can best be developed. By connecting areas of heath and by making arrangements to cross roads (an ecoduct or a tunnel), for example, the area in which the viper is present can be enlarged.

The field of research of the Ecology Group

The Ecology Group described the reason for its existence in the following mission statement: “The Ecology Group develops knowledge about spatial and environmental conditions of species and ecosystems and the competence to integrate this knowledge into spatial images for sustainable nature in the context of multifunctional use of space. The images are developed at each spatial scale to highlight problems, solve problems, predict effects, evaluate policies and explore future developments” (Ecology Group, Strategic Plan, 1999, p. 3). As its name suggests, the Ecology Group works in the field of landscape ecology. This field focuses on research into the survival, sustainable development and extinction of valuable species (animals and plants), taking into account the qualities of the landscape and habitat in which these species live. The focus is not on individual animals or

plants, but on populations. Key words that characterize the research are cutting up (of areas in which valuable species live) and the connection of ecological niches in order to create transfers between those niches to make it possible for the species to survive. The expertise the group develops and transfers not only concentrates on the ecology of species (amphibians, insects, birds, plants and mammals) but also on processes of cutting up and connectivity taking place in the landscape. Besides the expertise of species, the expertise of spatial aspects and processes is part of the “core” expertise of the group.

Compared with competitors, the group focuses more strongly on projects related to the process of prioritizing the political agenda, projects that support policy processes or are concerned with questions involving political consequences (e.g. planning new roads or railways). These projects all need a broad ecological knowledge base and models that support the results. Furthermore the group is called in to address problems that need innovative research at a high professional level. In many projects, knowledge must be integrated, focusing on isolated ecological niches and developing “robust connections”. Clients ask for contributions that require scientific knowledge as well as knowledge of the practice of the client.

In the Ecology Group, the share of projects in the project portfolio funded by the Ministry is 62%. The other 38% are projects funded by other clients. Although the group has a preferred position in acquiring projects from the Ministry, there is no guarantee that the Ministry will grant all projects within this field to the Ecology Group. The same applies for the projects acquired from other clients such as the EU, other Ministries, provinces and municipalities. There is therefore a dependency on this network of clients to continue the research activities.

The competitive group competence of the Ecology Group

The researchers of the Ecology Group define the competitive group competence that emerges as “the capability to develop spatial images of sustainable nature, made to measure”. They have also formulated a longer definition of their competitive group competence: “the capability to develop and integrate knowledge of spatial and environmental conditions of species and ecosystems towards spatial images of sustainable nature within the context of the multifunctional use of space. The images are developed at any scale to highlight problems, for problem solving, the prediction of effects, policy evaluation and prediction of the future [situation]” (p. 3, Strategic Plan Ecology Group, 2000-2003). Although the group members do not literally produce this statement in interviews, they can paraphrase the competitive group competence (Table 3.1).

However, in order to become more familiar with this competitive group competence, we also asked the group members how they know that this is their competitive group competence, and what kind of signals they receive from the environment in which they operate (Table 3.2). As a competitive group competence ought to provide a competitive advantage, we also asked them about the competitors the group meets in the market and how they differ from their competitors (Table 3.3). Finally we gathered data with regard to the products that are based on this competitive group competence (Table B, Appendix two). The answers to the questions we posed with regard to the competitive group competence, how group members know, competitors and products (Tables 3.1 to 3.3 and Appendix two) confirm and strengthen each other. Furthermore the answers position the group with regard to their client groups, competitors and other research groups working in the field of landscape ecology.

Table 3.1 Statements about the competitive group competence of the Ecology Group from interviews	
<ul style="list-style-type: none"> • “We are very good at research into spatial arrangement for nature, including nature quality [...]. Beneath lies ecological knowledge of animals at population level (so the spatial aspects of ecology). We do research into landscapes with ecological knowledge of animals at population level as a basic competence” (Sarah, Ecology Group, 278-280); • “The functioning of plants and animals in a scattered landscape (caused by the crossing of nature areas by infrastructure like roads). How do populations function in a landscape in which the habitat is no longer connected but is only available in small patches [...] We stand for and are good at landscape ecology” (Kimberly, Ecology Group, 27-29, 245); • “We are good at making scientific knowledge in the field of landscape ecology applicable for solving practical problems” (Brian, Ecology Group, 94); • “The combination of ecology and spatial knowledge. The group works on several themes in the field of landscape ecology, it is multidisciplinary. We apply experiences derived in one theme to other themes. Other landscape ecology groups restrict themselves to one topic, which does not enable them to exchange expertise” (Ken, Ecology Group, 96-99); • “We are good in the spatial aspects of nature preservation. How large a nature area has to be, where it has to be positioned, how nature areas should be connected, what infrastructure crosses these areas and what its effect is. [...] For us the dispersion capacity of species is very important. Dispersion is the move from the place of birth towards the place of settlement. We have measured this phenomenon for several species” (Andrew, Ecology Group, 156-161); • “The group is good at the development of spatial planning concepts related to biodiversity. In other words, how you must improve the spatial configuration of nature areas in order to create sustainable populations” (Joe, Ecology Group, 151-153); • “The group is good at spatial population dynamics, how do species behave in a heterogeneous landscape, i.e. in a landscape that is scattered. We know a lot about these problems and we have tools to simulate and calculate its effects. We are unique with regard to these elements in the Netherlands. We can help provide more insight into the problems as well as contribute to solutions. I think for instance of connecting zones, ecoducts and evaluation of effects” (Simon, Ecology Group, 319-323). 	

Table 3.2 How group members know that a competitive group competence emerges

- “I know by signals we get from our scientific colleagues who are also working on landscape ecology. In addition [X] has toured the United States. We also know because the research program ‘Spatial arrangement’ was granted to this group. Furthermore, the assignment of a project at European level in which we cooperate with Norwegian scientists and scientists from Sweden, Denmark, Great Britain and Belgium. Finally we know, because a number of our ideas have been taken over” (Andrew, Ecology Group, 185-189);
- “Clients (almost automatically) approach this group about research problems regarding the establishment of connecting zones, their location and questions with regard to their effect” (Joe, Ecology Group, 155-157).

Table 3.3 The Ecology Group: competitors and competition

- “There are many groups in the world working on landscape ecology. But these groups are either concentrating on processes and not looking at the application of their insights, or they are concentrating on practical problems and do not have much knowledge of the processes involved in landscape ecology. We combine knowledge of processes and the application of our insights. In this, we are unique” (Kimberly, Ecology Group, 245-248);
- “Companies lack fundamental expertise. And other groups that have fundamental expertise lack the application of this expertise. They are simply not approached for those questions. Therefore our position is created from the combination of both” (Sarah, Ecology Group 304-305);
- “Whether we suffer from competitors depends on why we are approached. Is the reliability important, does it involve political conflict, is the way the problem has to be answered unclear? We are often approached in these situations. If clients have a more general problem, competitors can also provide the answer” (Andrew, Ecology Group, 203-206);
- “Compared with us, engineering firms have insufficient critical mass to work for a longer period of time on these kinds of issues [...]. To achieve critical mass you must make big investments” (Andrew, Ecology Group, 193-195);
- “We can develop an innovative approach or solution in a short period of time. When clients want a certain level of quality in a field in which there is not much knowledge, they tend to turn to this department. They also come to us when they attach more importance to the results” (Ken, Ecology Group, 104-107).

Position of the Ecology Group in the research institute Alterra

Alterra, the research institute of which the Ecology Group is part, was established in 2000. In this research institute two previous DLO institutes (with the abbreviations SC and IBN) are merged. The institute focuses on strategic and applied research for policy making, the design, the management and the use of our life environment on a local, national and international scale (Yearbook Alterra, 2000). In 2001, at the time the Ecology Group was studied, the institute consisted of eight research groups, facilitated by supporting departments and staff. Besides the Ecology Group that focuses on ecological problems in a

spatial context, there are two other research groups with a strong ecological orientation. The first group has detached two researchers to the Ecology Group who act as a linking pin. This group focuses on the relationship between ecology and society and conducts research in the field of leisure, nature and society, ecology and economics, urban ecology and the link between urban areas and rural areas. The other group with a strong ecological orientation is focused on the relationship between ecology and environment. In this group, research is conducted in the field of freshwater ecology, exotoxicology, functional and genetic biodiversity, vegetation ecology & wildlife conservation and forest ecology. The other five groups work on topics that are not very close to the work of the Ecology Group. Nevertheless the Ecology Group maintains relationships with these groups by cooperating in projects on specific topics. The first group works in the field of landscape and spatial planning research; the second on water and environmental research; the third on soil and land use; the fourth concentrates on research into geographical information systems and finally the fifth group concentrates on research into and the development of software to be used in science. In 2001 Alterra employed over 500 people, had a turnover of 49 million Euros of which 35 million was achieved implementing programs and projects on behalf of the Ministry. In this year, Alterra researchers wrote 684 publications: 116 in scientific journals, 122 in other journals, 364 reports and contributions in books and 82 contributions to scientific congresses.

A brief description of the history of the Ecology Group

In 1983, the first year this study takes into account, the Ecology Group was already one of the groups in the RIN institute. The group started to explore the theme of landscape ecology. This was done by descriptive research, concentrating especially on birds. The group consisted of six to seven members. Some of these members were working on topics related to landscape ecology, but these topics were not the focus of this field of research. This changed in 1986, after the appointment of a new group leader in 1985. In 1986 two projects were launched focusing on the development of the discipline of landscape ecology. Contrary to the other projects executed by the Ecology Group in these years, many members of the Ecology Group collaborated in these projects. These projects continued up until 1991. In 1987 the group also decided to start work on models, in order to avert the drawbacks from empirical studies. In 1989 the Ecology Group decided to develop expertise on several spatial scales and in several environmental conditions (ecosystems). These were focused on national, regional and local level. The group balanced between activities focused on the development of theoretical expertise in the field of landscape ecology and research focused on practical problems experienced by stakeholders in their environment.

They also balanced between developing expertise in the ecosystem in which the Ecology Group started and developing expertise of other ecosystems.

In the years 1987 – 1990, the group established a link with the political agenda by contributing to the development of the “National Nature Policy Plan”. Almost all available research capacity in the Ecology Group was involved in landscape ecology research with key words like cutting up, isolation, connectivity and ecological infrastructure. The group was able to persuade policy makers to apply their concepts and allocate money to resolve landscape ecological problems that contribute to the preservation of biodiversity and nature. In these years the group also developed a scientific position and chose a guiding theory. In this period, the Ecology Group had six to seven permanent staff and five to ten temporary staff.

In the years 1990 to 1996, the group continued to develop expertise in the field of landscape ecology, including the development of methodology. This development of expertise was based on the choices made in the period 1987-1990. In 1991 a reorganization was announced due to the launch of a new institute in the field of nature research. The group became part of this new institute, IBN. In 1993 the Ecology Group organized the researchers into three teams focusing on empirical research in the field of landscape ecology and one team focusing on the development of models. In 1994/1995 the Ecology Group consisted of four teams, three of which were species-based: birds & plants, mammals & amphibians and insects. In 1991, the Ecology Group had eight members with a permanent contract. The group gradually grew to 23 members (1996). The group worked in its “own” research program (funded by the Ministry), but also participated in research programs that were mainly executed by other research groups. Other research groups also participated in the research program of the Ecology Group. This reflects the linking of research into landscape ecology with other themes in research.

In 1996 a reorganization was announced and several plans were developed related to this reorganization. One of the choices in the reorganization was to organize researchers in teams oriented towards themes (this choice was made effective in 1997). This should strengthen fit with the stakeholders in the environment. The new teams were not meant to divide the group; the researchers should continue to cooperate using all the expertise available, as was done before. In 1997 the Ecology Group consisted of three thematic teams. To preserve the expertise of species, this kind of expertise was assigned to researchers in the group to keep that knowledge up to date.

In 1999 there was another reorganization. The IBN became part of the new research institute Alterra. The Ecology Group was given a new name, increased the number of themes it worked on to seven and grew – with regard to the number of researchers - to 50 members.

In recent years the group no longer “owns” its own research program (funded by the Ministry). The Ecology Group participates in several research programs directed by other research groups: the work of the Ecology Group is fully integrated in a larger context.

3.3 A sketch of the Postharvest Group and its history

Firstly, we will sketch the research field of the Postharvest Group in this section. This will make clear in what part of the field of post harvest physiology the group works. We also describe the competitive group competence of the Postharvest Group. We then turn to the ATO institute to which the Postharvest Group belongs. This institute and the other research groups that are part of this institute provide an environment for the Postharvest Group. It positions the work of the Postharvest Group in a somewhat wider context. Finally we will sketch the history of the Postharvest Group. The description of the research field, the description of the competitive group competence, the description of the institute ATO and a sketch of the history of the Postharvest Group together provide a context for the practices of the Postharvest Group that we will discuss in following chapters. In general we used the annual reports in the period 1983-2001, research programs and the 2001 year-plan as sources for the sketch of the group. Often we do not refer to these sources in our sketch, because the statements made are discussed in more detail in the next chapters. We continue with an example of the work of the group (box 2).

Box 2: examples of the work of the Postharvest Group

In this box we provide three examples of the work of the Postharvest Group

The storage and quality of potatoes

Most of the potatoes grown in the Netherlands are supplied to the potato processing industry for the production of French fries, potato chips, etcetera. Besides the weight of the batch, the price of a batch of potatoes also depends on its frying colour index. This index is an indication of the colour of the potato product after frying. Because the consumer wants bright French fries, this index is a quality parameter.

Continuation of box 2

As we all know, when a fresh potato is frozen (often by accident) it is no longer consumable. One of the processes that take place inside the potato is that it sweetens. This process also takes place when a potato is stored at low temperatures for a long period of time. When this process takes place, its quality changes and its value on the frying colour index reduces. Experiments on the effect of different temperature regimes during storage on the processing quality of potatoes have shown that temperature management during storage has a strong effect on the frying colour of potatoes.

For the potato grower it is therefore essential to sell as many potatoes as possible with the best possible frying colour index. Until now, potatoes have always been stored under a fixed temperature regime, but better results can be attained if the storage regime is made dependent on the quality of the batch and processes (like the sweetening process) in the batch. A storage system developed by the Postharvest Group focuses on achieving the best possible frying colour index and the highest possible weight. For this purpose the batch is sampled and tested while it is being placed in the storage facility. The results of this test are entered into an advanced computer model based on extensive expertise in potato storage, thermodynamics and climate control. The model then calculates the best storage regime and

adjusts the conditions in the storage facility accordingly. During storage, measurements are carried out to make sure that the conditions are correct and that the ideal storage regime is adjusted according to new tests made on the potatoes. This assures a maximum yield of the batch of potatoes.

Source: based on Annual Report ATO-DLO, 1993 and 1999

Bending of tulips

The tulip is a cut flower which grows very quickly in the vase. Consequently, the flowers tend to bend over. Although some people appreciate bent tulips, most consumers prefer tulips that stand up straight. The Postharvest Group has succeeded in finding an agent which, in laboratory tests, slows the growth of tulips in the vase and therefore prevents them from bending so quickly. The same agent also extends their flowering period.

Source: Annual Report ATO-DLO, 1998

Continuation of box 2



Bending of Gerbera

As with the tulip, the gerbera bends over in the vase. Unlike the tulip however, the problem with gerberas is not so much their rapid growth, but the weak structure of their stem. Due to this weakness, gerberas are frequently sold in bouquets that are held up with wire. Most consumers do not appreciate this. Moreover, wrapping the stems with wire is labour-intensive and therefore expensive. The Postharvest Group is now in the last stages of developing a treatment to keep gerbera stems upright. The agent works well in the laboratory, but it must still be tested for the desired results when used by growers. Source: Annual Report ATO-DLO, 1998

Continuation of box 2



The field of research of the Postharvest Group

The Postharvest Group has described the reason for its existence in the following mission statement: “The Postharvest Group works on the development of knowledge of fresh agricultural products. The group applies this knowledge in cooperation with other groups and clients in the development of technological applications that raise the added value of fresh agricultural products” (Year Plan 2001 Postharvest Group, p 2). The Postharvest Group, as its name and mission statement suggests, works in the field of post harvest physiology. This field focuses on research into the preservation of the quality of fresh harvested products after they have been harvested. It not only takes into account the physiological qualities and physiological processes in the product, but also their interaction with the environment and the opportunities to affect environmental conditions (which in turn can affect physiological processes in the product). The group concentrates on fruits, vegetables, ornamentals, potted plants and potatoes. Key words that describe their work are storage techniques, physiological processes, development of molecular markers and new packaging concepts.

Compared to competitors, the group has a stronger focus on assignments directed at the interaction between features of fresh harvested products and technical equipment used to accompany these products from the producer to the consumer. These assignments are also related to the scientific support of practical solutions and the application of the knowledge of physiological processes in fresh products. This is partially expressed in assignments directed at developing new concepts. In this group the integration of knowledge is also important. The clients of the Postharvest Group ask for contributions that require scientific knowledge as well as knowledge of the practice of the client.

In the Postharvest Group the share of assignments from the Ministry in the project portfolio is 29% and the share of projects from other clients is 71% (of which 21% is subsidized by several subsidies from government). Although the group has a preferred position in acquiring projects from Ministry, there is no guarantee that the Ministry will grant all projects within this field to the Postharvest Group. The same applies for the projects acquired from other clients such as auctions and transport companies. Therefore, there is a dependency on this network of clients to continue the research activities.

The competitive group competence of the Postharvest Group

The researchers of the Postharvest Group define the core competence that emerges as “the capability to provide practical solutions in the field of post harvest physiology, based on scientific knowledge of (the linkage between) physiological processes in fresh products (produced by plants), environmental factors and the decline of quality in the post harvest phase of the chain.” The group has not literally formulated this competitive group competence, but we have derived this definition from the statements made by the members of the group in interviews (Table 3.4) and checked this definition in a meeting of the group.

In order to become more familiar with the competitive group competence of this group we also asked the group members how they know that this is their competitive group competence, and what kind of signals they receive from the environment in which they operate (Table 3.5). Because a competitive group competence should provide a competitive advantage, we also asked them about the competitors the group meets in the market and how they differ from their competitors (Table 3.6). Finally we gathered data with regard to the products that are based on this competitive group competence (Table B, Appendix two). The answers to the questions we posed with regard to the competitive group competence, how group members know, competitors and products (Tables 3.4 to 3.6 and Appendix two) confirm and strengthen each other. Furthermore the answers position the group with regard

to their client groups, competitors and other research groups working in the field of post harvest physiology.

<p>Table 3.4 Statements about the competitive group competence of the Postharvest Group from interviews</p> <ul style="list-style-type: none"> • “This group particularly excels in linking scientific information and practical solutions. The group has very practical expertise at its disposal. Different managers and growers may turn to the group and never have the sense that we do not know what we are talking about. We also have a lot to offer with regard to the breadth of our expertise. We are a real post harvest physiology group” (Edward, Postharvest Group, 190-194) • “Well, simple, knowledge of all processes with regard to quality and the application of this expertise in the chain of agricultural and horticultural products including the measurement of the quality of these products. What I mean is that we are excellent in a wide field: what processes are responsible for quality decline. But also the application of our expertise for our clients. Thinking along with clients, integrating new insights. We not only provide results with regard to the temperature to be set up, or the composition [for example, of the air in a storage cell, FB], but also how they can organize things better. In a wide area, including logistic conditions, logistic options, etcetera” (Kevin, Postharvest Group, 103-110); • “The combination of practical and scientific knowledge of products. We are excellent in using our expertise for solving clients' problems. Knowledge you have, knowledge you derive from books and articles. A solution to a problem often emerges from this knowledge” (Larry, Postharvest Group, 198-201); • “I think we are excellent in translating scientific knowledge in the field of physiology to practical solutions [...]. This translation is made in the minds of my colleagues. They are very good at making this translation” (Laura, Postharvest Group, 302-304).

<p>Table 3.5 How group members know that a competitive group competence emerges</p> <ul style="list-style-type: none"> • “Well, I notice. I notice that we are quite good in design and execute projects that must provide results that can be applied in the practice of our clients compared to groups abroad. These groups are often theoretically much better, or more experimental, but they often miss a link to what's going on in the business of growers and other actors in the chain. We have more knowledge of the problems these actors experience. But we are not as good in the theory of post harvest physiology. In the U.S. and Israel there are post harvest groups which produce many more publications than we do. But these groups cannot get funding from actors in the chain to the extent that we do. Although these groups are part of institutes that are positioned close to the actors in the chain, apparently they are not as good in translating their expertise” (Michael, Postharvest Group, 300-306) • “The knowledge we have, our equipment, the expertise we have built up in the past; together provide a unique position” (Larry, Postharvest Group, 228-230) • “You can see by the results, the questions posed to the group by the sector, returning clients. This side of our work is excellent. The scientific aspects of our work are also good, although not excellent. But a number of colleagues write papers on a regular base. Papers that are accepted by reputable scientific journals. And we also get a response from scientific congresses” (Laura, Postharvest Group, 317-320).

Table 3.6 The Ecology Group: competitors and competition

- “We experience competition from advisory firms. But looking more closely, we notice that we have a link with the scientific world and that we develop new knowledge ourselves. In the Netherlands we are unique for that link. We also have the experimental stations in plant production as a competitor. But they cannot work seriously on many projects. Therefore I do not see them as a competitor” (Edward, Postharvest Group, 196-201);
- “Competitors? Yes some of the other DLO institutes and the experimental stations in plant production. But I think we approach the field more cleverly than the experimental stations. They think of short term solutions while we think more of concepts to solve problems in the longer term. And Plant Research International is a competitor, because they serve a group of clients to whom they can also sell post harvest solutions [by selling breeding solutions, FB]. And this is an important competitor, because the group of clients they serve is quite large. But they do not really have post harvest expertise” (Michael, Postharvest Group, 308-312);
- “We experience some competition from the other DLO institutes and the experimental stations in plant production. For instance climate control in storage cells, the IMAG institute can also answer these kinds of questions. We are often focused on what’s in the storage cell, IMAG is more focused on the technical equipment of the storage cell” (Larry, Postharvest Group, 204-207);
- “Plant Research International is a competitor and [YY] and of course the research departments of the companies when they have a research department. These are the most important competitors. Large companies can often conduct the same research as we can. Perhaps not everything, but we cannot solve all problems either, even though we have many storage cells and a molecular laboratory. We are not unique, but I think it’s the combination of scientific expertise in the group, knowledge of the practice of clients, facilities and being part of ATO that allows us to perform high-quality and highly appreciated research. We are close to the department that focuses on packaging. And this is important as this field of research is close to our field. For many companies this is useful, because we can also develop new packaging. This combination gives us a stronger competitive advantage related to Plant Research International” (Laura, Postharvest Group, 321-329).

Position of the Postharvest Group in the research institute ATO

The institute of which the Postharvest Group is part in 2001 is the Agro Technological Research Institute, abbreviated in Dutch as ATO. The Postharvest Group is part of a larger division in this institute: “Agricultural and Industrial Production Chains” abbreviated in Dutch as AIPK. Besides the Postharvest Group this division consists of two other groups, one working on packaging, transport and logistics and the other working on production and control systems. The Postharvest Group has relationships with these groups (in projects), as their research is related to the research of these groups. But there is also a link between the Postharvest Group and the other groups regarding research management. At the level of the AIPK division, the acquisition of new projects is coordinated and information regarding the financial development of the research groups shared among other research management issues. Besides this division, there are two other divisions in ATO in addition to supporting departments and staff. These divisions work on food and food processing (food structure, functional ingredients, preservation technology, and sensory science) and renewable

resources (polymer coatings, adhesives, composites, additives, bioconversion, industrial and specialty biochemicals, pulp and paper). In 2001 ATO employed over 500 people, had a turnover of 23.5 million Euros, seven million of which was achieved by acquiring and implementing programs and projects on behalf of the Ministry. In this year, the researchers of ATO wrote 190 publications: publications in scientific journals, in other journals, reports and contributions in books and contributions to scientific congresses.

It is important to mention here that ATO did not experience a long period of stability after its establishment in 1989. From 1990 to 1998, the institute experienced an enormous growth, during which the number of employees more than doubled. This also applied to the Postharvest Group. Due to this strong growth, but also related to the strengthening of the recognition of labels of research groups in the market, the groups were frequently reorganized and renamed, sometimes every year. After 1998, the institute was confronted with a strong decline in the market and the consequences of a stricter application of business economic rules. In 2001, about 20% of the volume of work could not be acquired from the market again. This decline also had consequences for the size of the Postharvest Group.

A short description of the history of the Postharvest Group

Contrary to the Ecology Group, there was no Postharvest Group for a long period of time, but there were two (and in the beginning even three) groups, sometimes divided into smaller teams. There has only been one Postharvest Group since 1999. Due to restrictions in the availability of data and the fact that there were two (three) groups working in the field of post harvest physiology in the period between 1983 and 1999, it is only possible to outline the choices made by the groups. We have found no indications that the two (three) groups made very different choices. However, it is only since 1999 that all choices regarding the Postharvest Group were made by one management team. Not one of the groups in the period 1989 – 1999 can be defined as the precursor of the Postharvest Group. In general we will address the two (three) groups that worked on the field of Postharvest physiology as “the Postharvest Group”.

In the first period we take into consideration (1983-1989), there were three groups working in the field of post harvest physiological research. The first group worked on ornamentals, the second on vegetables and fruit and the third on potatoes. The first two groups are part of the same institute (with the abbreviation SI). During this period, cooperation developed with the third group which was positioned in another institute (with the abbreviation IBVL). Regrettably, there are no data available about the choices and goals of the group

working on potatoes (IBVL). However there was data about the other two groups (SI) that merged during this period in one research group.

With regard to their positioning, their scientific development, the development of their staff and their organization, the two groups seemed to continue the lines defined in the period before 1983. The annual reports express an atmosphere of relatively stable lines. With regard to market orientation and management this phase is characterized by a slightly decreasing number of group members (and a growth of the budget for equipment and materials). The groups receive an assignment to acquire projects with additional funds in the second part of this phase. The annual report of 1985 mentioned in a precarious way that in 1987 15% of the budget should consist of incomes acquired from stakeholders in the environment not being the Ministry. The groups worked on a large number of themes, such as the effect of carbohydrates on the flowering of ornamentals, pre-treatment of cut flowers, the quality of circumstances during transport, the role of micro organisms in disturbance of the water management of cut flowers, the effect of temperature during transport, packaging, the effect of light during storage, controlled atmosphere-storage and the post harvest quality of new breeds (fruit). The groups worked on products like roses, potted plants, vegetables (tomato, pepper, cabbage, onions) and fruit (apple, pear, strawberry). Their work was strongly focused on solving practical problems. But, particularly in the study of the effects of plant hormones on processes of aging of products and the study of the effects of water management of plants, more curiosity-driven scientific research was executed. The two groups working on post harvest physiology positioned at SI comprised between 15 to 17 members.

In April 1989 a new institute in the field of agro technological research had been established of which the Postharvest Group was still part in 2001. In this institute (ATO), the work of SI and IBVL was merged. By concentrating research capacity, the research groups should gain more critical mass and be able to develop a stronger scientific profile. In the establishment of this institute many young academics were recruited, up to 33 to 40% of the staff of the groups working in the field of post harvest physiology.

The post harvest groups were divided into two divisions, one more focused on storage and transport problems and the other more focused on problems related to biological processes in the product. In the first two years, both divisions were still working on a broad array of themes. In 1992 this changed. The first division concentrated on three themes: abiotic stress, texture & ripening and storage physiology & modeling. The other division concentrated on development and differentiation (molecular orientation) and hormonal

regulation and senescence (in total the groups were working on five different themes). The teams in both divisions worked on one of the themes. Due to this choice, the teams improved their profile and developed critical mass. They became more oriented towards fundamental research in the field of post harvest physiology. In 1993 the number of thematic teams was reduced to four. In 1994 these teams were given new names and in 1995 both divisions merged, but they were still visible as sub-divisions.

Although collaboration between both divisions seemed obvious due to the themes they were working on, publications do not show any collaboration. They seemed to develop separately. We know from this period, that the institute encouraged a climate of strong competition between research groups.

In the first years of ATO (1989-1995), the groups working in the field of post harvest physiology grew rapidly from 28 group members in 1989 to 64 in 1995. A large percentage of these new group members were temporary staff. For the institute as a whole, up to 50% of its employees were working on a temporary contract. From this group of employees, about 50% had a contract shorter than one year. A study of the composition of the Postharvest Group shows large fluctuations in the turnover of group members (Appendix thirteen). Not all new group members who started work for the Postharvest Group were recruited from outside the institute. Some group members worked for another research group in the institute. Some group members who left the group joined another research group in the institute. In this period the ratio of the funding of the Ministry and the funding by other stakeholders changed radically for the institute as a whole. In 1989 the funding of the Ministry was still two thirds of the turnover, in 1995 it was only one third of the turnover (and in this period the turnover doubled).

Between 1989 and 1995, the Postharvest Group persuaded stakeholders in its environment (especially representatives of businesses) to assign projects based on its expertise in new technological developments. Furthermore the group used several subsidiary funds of other ministries and public organizations. Although the group experienced strong growth in assignments from clients other than the Ministry, the group also experienced a loss in the strength of the link with its stakeholders due to its scientific orientation. In the subsequent period (1996-1999) the group was able to create a new balance between a scientific and a practical orientation which supported the continuation of its research work.

In the period 1996 – 1999, some major changes were made. The first has already been addressed and was concerned with creating a new balance between a scientific and practical

orientation. Secondly, all research funded by the Ministry was concentrated in one program. An analysis of publication behavior shows that collaboration between the thematic teams started in this period. It seems as if the teams no longer developed in isolation. In this phase, the management of the institute worked on raising the synergy in the institute and reducing the competitive climate between the research groups. The third change was, as in the Ecology Group, that management implemented a research practice of working according to business economic rules and, related to (the effects of) those rules, a broad availability of researchers and allocating researchers to projects in a cost effective way. The costs related to the facilities and equipment of the group also had to be passed to projects. The fourth change was that the stabilization of the composition of staff of the Postharvest Group. The number of group members declined slightly. In 1997 the sub-divisions working in the field of post harvest physiology were renamed, but their composition hardly changed. In 1998 this happened again and in 1999 the thematic teams were merged into the Postharvest Group as we met it in 2001. In 1999 big cuts were made in the number of staff due to financial problems resulting from changing administrative rules with regard to economic cost calculation. About 50% of the members of the Postharvest Group left the group in 1999. The fifth change was that the group chose to deepen its expertise in the field of genomics, especially to make expertise in this field applicable for the field of post harvest physiology. In addition the group continued its strategy to interest stakeholders in its environment in research based on new technological developments and scientific breakthroughs.

By merging the thematic teams into one group in 1999 and maintaining the acquired expertise, the last phase of the group's development was characterized by concentration and consolidation. The new research program funded by the Ministry which was launched in 2001, placed the work of the Postharvest Group in a broader context, referring to the perspective of the supply chain, safety, health and transparency. The orientation of the teams in the Postharvest Group was constantly aligned to new opportunities in the market.

In 2001 the Postharvest Group was divided into three (virtual) teams working on three research lines: (1) vegetables, fruit and bulbs: how to control changes in the product by climate control in the post harvest phase. Topics belonging to this line of research were dynamic control storage, storage conditions, energy saving in climate control and micro-atmosphere packaging; (2) flowers, physiology and ripening: in this research line expertise in the field of aging and expertise into the effects of environmental factors for flowers and plants were combined. Topics included: study of processes involved in the aging and disturbed opening of flowers, green chemicals, new packaging concepts and the

development of molecular markers; (3) storage of potatoes and potato quality. Topics were control of pathogens during storage, prediction of quality, biological processes in the potato related to environmental factors. In 2001, the group consisted of about 31 members.

What have we learned?

This section and the previous one provided an overview of the position and activities of the groups involved in the field studies. Together with the developments described in section 3.1 in the organization and the environment that enclose these groups, a background is provided for the chapters to come. To make this background easily accessible, we have summarized our findings in Table 3.7. This table also expresses what we have learned about the context in which the groups in the field studies must operate.

Table 3.7 Summary of the features of the groups in the field studies	
a)	both groups employ professionals (Weggeman, 1997)
b)	the conditions under which they acquire, execute and manage research: <ul style="list-style-type: none"> • organization of research work by projects; • research work guided by business economic principles; • market and client orientation; • a dependency on clients to provide research projects (and money) in order to continue research work and – in the longer term – to survive; • a preferential position towards the Ministry, but no guarantee that research programs of projects are granted.
c)	the research performed by the groups can be characterized as application-oriented, with some projects aimed at expertise development to meet needs of clients in the near future;
d)	working on an interdisciplinary field of research, where clients have needs for knowledge requiring the integration of disciplinary knowledge;
e)	working in an environment requiring scientific knowledge as well as knowledge from the circumstances and practitioners' (clients) experience;
f)	both groups experienced dynamics in their positioning in the DLO organization in the period of 1983 – 2001;
g)	a huge change in what is expected from the researchers in both groups, changing from science-driven research (although fitting in the mission of an application-oriented research institute) towards a market and client oriented research approach.

Chapter 4 Knowledge integration in a repeated project life cycle process

In this chapter we will discuss the first process underlying the emergence of a competitive group competence. We have defined this process as “the process of a repeated project life cycle”, executed with the process quality of “heedful interrelating”.

Besides this process we found three other processes, necessary for the emergence of a competitive group competence. In the Chapters Four - Seven we will discuss each of these processes separately. In Chapter Eight we will integrate our findings with regard to these processes and present a grounded theory. In order to provide a structure for the reader, we will shortly address each of the processes in the next paragraphs.

As we explained in Chapter Two, we decided to build a process theory in order to address our research problem (Chapter One). More in particular we built upon process theory as worked out by Poole and Van de Ven (Van de Ven and Poole, 1995; Poole et al. 2000). Based on empirical research and after a critical reflection on our findings we decided to conform ourselves to the classification and definitions of processes developed by Poole and Van de Ven and define our processes in their terms.

As we discussed in Chapter One, they found four basic types of process theories on change and development, representing “archetypical” explanations. Each of these theories views change and development as a different cycle of change events, governed by a different “motor” or generating mechanism: (1) life cycle theories depict the process of change in an entity as progressing through a necessary sequence of stages, driven by an immanent program, regulation or compliant adaptation; (2) teleological theories view development as goal oriented and occurring through process steps such as implementation and evaluation; (3) dialectical theories view change and development through the confrontation of an opposing thesis and antithesis and (4) evolutionary theories depict development and change as a sequence of variation, selection and retention, driven by scarcity, competition and environmental selection.

The analysis of the data collected in the case studies resulted in the recognition of four processes, together explaining the emergence of a competitive group competence. When we interpreted these four processes in terms of Van de Ven and Poole’s (1995) typology, it

appeared that each of the four processes could be interpreted as a token of one of the four types of their processes. One process appeared to be a life cycle process; one process appeared to be a teleological process; one process appeared to be a dialectical process and one process appeared to be an evolutionary process. As we will argue in Chapter Eight, the grounded theory we developed is an example of a quad motor theory in the taxonomy of Poole et al. (2000), addressing change *in* an organization. The example Poole et al. provide of a quad motor theory addresses human development progressions (Riegel, 1976); this is not bound to change in organizations.

The *first* process we found and which will be discussed in this chapter is a repeated cycle of design, execution and ending of projects (a life cycle process), executed with a quality of heedful interrelating. In this process knowledge integration takes place. As we argued in Chapter One, the kind and amount of knowledge integration is responsible for how the products of the group are experienced and the achievement of a competitive advantage. The *second* process is a process of balancing tensions experienced by group members. In Chapter Five we will discuss this process and define it as a dialectical process. In this chapter we also identify a second quality with which the project life cycle is executed: content over management. The *third* process we found (Chapter Six) is a (co-) evolutionary process responsible for the development of expertise. This process is fueled with “variation” by the project life cycle process and fuels the project life cycle process with new or adapted (technical) expertise. The *fourth* process is a process in which a group envisions its future and defines activities to realize this future. We identified this process as a teleological process. This process to some extent aligns the group with the needs and demands of its environment. As we will argue (Chapter Seven) it is fueled by experiences and ideas from the other three processes and it (especially) fuels the other three processes with objectives: needs for expertise, products to be delivered, clients to be served, positions to be developed and selection criteria for projects. We address this function by stating that it provides a frame of reference. In Figure 4.1 these processes and their relations are visualized.

A further specification of the relations and how the processes operate together will be discussed in Chapter Eight. We would like to emphasize again that the model in Figure 4.1 is a product of the empirical research. It is not a pre-specified conceptual model, but the result of grounded theory analyses and the application of process theory.

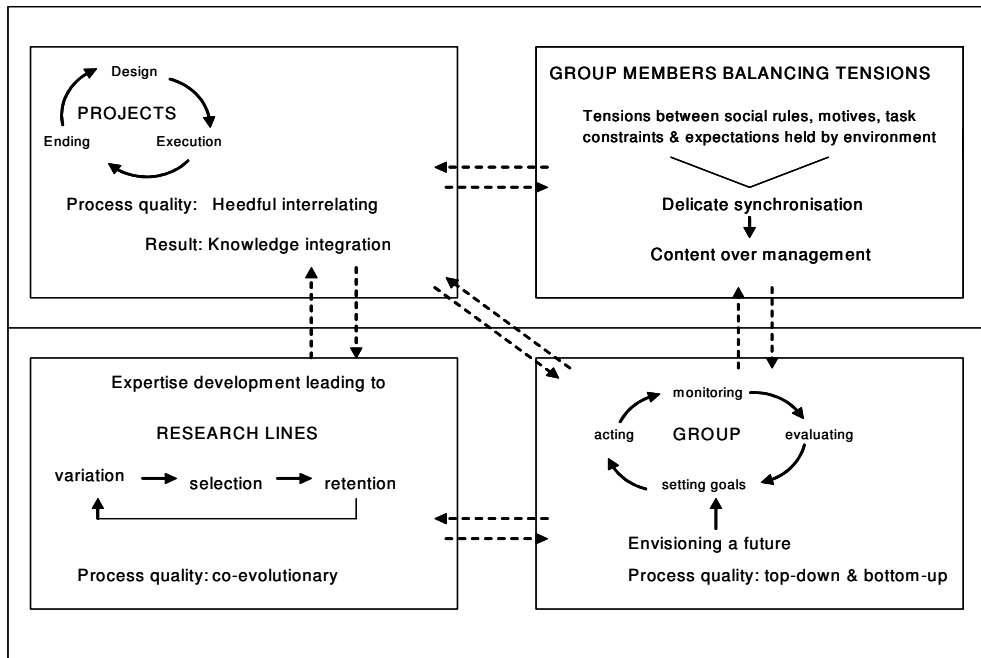


Figure 4.1: The four processes responsible for the emergence of a competitive group competence and their relations

In the remainder of this chapter we will discuss the repeated project life cycle process. A life cycle process is defined by Poole et al. (2000) as a “motor” responsible for a process of change. This process supposes according to Poole et al. that “the developing entity has within it an underlying form, logic, program, or code that regulates the process of change and moves the entity from a given point of departure toward a subsequent end which is already prefigured in the present state. What lies latent, rudimentary, or homogeneous in the embryo or primitive state becomes progressively more realized, mature and differentiated. External environmental events and processes can influence how the immanent form expresses itself, but they are always mediated by the immanent logic, rules, or programs that govern development” (p. 60). These processes are also characterized by a unitary sequence with regard to the progression of change events (it follows a single sequence of stages or phases), it is cumulative (characteristics acquired in earlier stages are retained in later stages) and it is conjunctive (the stages are related such that they derive from a common underlying process) (Poole, et al., 2000). In the design, execution, ending and evaluation of projects and the activities that belong to these phases, these features can be recognized very well as we will argue in this chapter.

How to position this chapter with regard to the body of literature addressed in Chapter One and our research problem? This chapter focuses on knowledge integration – on how groups accomplish the integration of knowledge over a longer period of time with a high frequency. It is the first process we will discuss underlying the emergence of a competitive group competence. Perhaps we should even state, “the most relevant process” as in this process the actual emergence is accomplished as the needs of clients, all the expertise that is needed to solve the problem and heedful interrelating (and content over management, Chapter Five) as the way the groups integrate knowledge in projects, come together. In this process we can recognize all three elements that are related to the emergence of a competitive group competence according to literature (Chapter One): (a) expertise (development); (b) (development of) a practice of knowledge integration and (c) fit between organization and environment. This process is not particularly directed at development, but is based on the developed expertise, the developed practice of knowledge integration and the accomplished fit with the environment.

We have organized the discussion of the repeated project life cycle process in five sections. In section 4.1 we will discuss the project phases distinguished by the researchers in the field studies. We will argue that they distinguish three phases: the design of a project proposal, executing the project and ending and evaluating a project. These results are similar, in general terms, to those found in literature. Furthermore we will discuss seven kinds of activities that take place in projects. These activities focus on the interaction between researchers and interaction between researchers and clients. We will argue that our findings are not completely identical to those found in literature, due to the specific angle of analysis.

In section 4.2 we discuss the social rules we found in the field studies. We found 12 rules that define how the activities in the three phases of the project lifecycle are executed. The identification of rules contributes to the existing literature in which micro-level analysis of social rules is scarce.

In section 4.3 we discuss the pattern in the practice of the groups, distracted from the social rules discussed in section 4.2. We argue that the practice of the groups is dominated by a pattern of “heedful interrelating”. Because we link the social rules to the concept of heedful interrelating we deepen this concept.

In section 4.4 we reflect on the meaning of the project life cycle process and the process quality of heedful interrelating for the emergence of a competitive group competence. We

will argue that due to this pattern in the practice of the groups they are able to integrate expertise in an effective, efficient and flexible way. This, in turn, is responsible for the emergence of a competitive advantage.

Finally in section 4.5 we reflect on our findings with regard to heedful interrelating. We will argue that our findings with regard to heedful interrelating not only deepen the concept but also expand the theory of distributed cognition to loose work settings in which strong integration of knowledge is present.

4.1 The project life cycle: a framework for knowledge integration

In this section we discuss the project life cycle of the projects executed in the groups involved in the field studies. We will not only address the project phases distinguished by the researchers in these groups, but also project activities. Together they provide a framework to identify the process quality with which projects are executed (section 4.3).

Projects are a vehicle, a way in which work is organized (Luhmann, 1984; Bakema & Weggeman, 2001) and thus a vehicle for the emergence of a competitive group competence. The content of research work is focused on answering a question of a client, satisfying one's scientific curiosity into a specific aspect in a field of research, developing a theory, developing a scientific based explanation of phenomena or solving problems of stakeholders in the niche. Discussing the project life cycle will give insights into the life cycle of one, average (hypothetical) project. Groups do not work on one project at a certain moment in time, but on a large number of projects. During the field studies the Ecology Group worked on 64 projects and the Postharvest Group on 61 projects. Some of these projects were small and took only a number of months; other projects were large and took a number of years. Therefore the groups work on projects in different phases at one moment in time and because projects succeed one another, the project life cycle is repeated in time.

As we will argue in this section, three project phases describe the project life cycle: designing a project proposal, executing the project and ending & evaluating the project. These results are supported, in general terms, by those found in literature (Steyn et al., 2003; Maylor, 2003; Cleland, 1990). The life cycle is experienced by the researchers in the field studies as "fading in" and "fading out"; their attention is focused on the content and not on the organization of work and related procedures to control work and manage risks. These results correspond with literature (Weggeman, 1997; Miller, 1988). Seven kind of

activities emerged from the data, focused on the interaction between researchers and the interaction between researchers and clients. Although these can be related to literature, we identified also some differences due to the specific angle of analysis. Section 4.1.1 will be focused on the phases in the project life cycle and section 4.1.2 will be focused on the project-activities we found. In section 4.1.2 we link the activities to the project phases.

4.1.1 Phases in the project life cycle

From the data three phases in the project life cycle emerged: a phase directed at the design of a project proposal; a phase directed at the execution of a project and a phase in which the project is ended and evaluated (Table 4.1). Table 4.1 also provides some transition points in the life cycle of a project: its absolute starting point, its absolute end point and the points that mark a transition from one phase to another.

Table 4.1 Project phases and their definition	
Project phases	Definition
Design of a project proposal	Design of a project proposal starting with a question from a client or an acquisition trajectory in the environment. In the second situation, this phase includes the development of an idea and (sometimes) a "business case". This phase ends by approving the project: its goal and approach, the duration and funding.
Executing the project	Execution of the project in order to realize the project goals. This phase starts with an approved project plan and ends with the passing of (the final) results to the client.
Ending & evaluating the project	Ending and evaluating the project, including post-project work due to requests of clients, writing publications and administrative activities to end the project. This phase ends with the administrative project status changed to "finished".

As Table 4.1 shows, the groups do not distinguish between the development of an idea (a concept), formulating a project and planning a project in the first phase as is often done in literature (Steyn et al., 2003; Maylor, 2003; Cleland, 1990). These activities take place however, but the researchers in the groups consider these as part of one and the same phase. Of course some considerations are made, but not structured by formal transition points. Literature suggests that there could be post-project activities, for instance with regard to

maintenance (Cleland, 1990). Although these activities are also present in the groups in the field studies (for instance the maintenance of models and data-sets), we did not come across them explicitly as the follow-up of a project or as a separate project phase.

Project management literature especially describes in a normative way how project management can be institutionalized and describes the effect of several factors on the success of a project. Empirical knowledge of how project management is executed in organizations is sparse (an exception is for instance White & Fortune, 2002). Differences between the way project management is institutionalized and actually executed affect the ability to learn (Schein, 1996). Differences between formal rules and procedures that prescribe project management (Table 4.2) and how they are interpreted and executed informally in the field studies are highlighted in Tables 4.3 and 4.4. Table 4.2 presents a number of eye-catching formal rules for all phases of the project life cycle. Table 4.3 expresses how these rules are experienced and applied for the design phase of projects and Table 4.4 for the phase of ending and evaluating a project.

As we emphasized in Chapter Three, the research groups must end each year with a positive financial result, based on financial accounting rules. In the calculation of this financial result all costs are taken into account. The tariffs for which clients can be charged are based on an integral cost price and are equal for all the research groups. To realize a positive financial result, research has been made manageable and the project cycle provides a structure which enables this goal. In order to manage projects and the financial risks involved in projects a set of administrative rules and procedures has been developed (Table 4.2).

The scientists in the groups are less focused on the financial administrative side of work and on conscientiously executing the related procedures, as Tables 4.3 and 4.4 show. Formal rules are not always applied, or are applied in a much less formalized way. Although the formal rules suggest otherwise, procedures are not always well known. These findings are confirmed by Weggeman (1995, 1997) who states that in a professional organization the professionals are especially interested in the content and methodological aspects of research work. For them the organization is a peripheral issue. In these organizations there is a loose, informal structure with an accent on individual autonomy. The findings also reflect the tension in professionals between a focus on the professional standards and the conditions provided by the organizations for the execution of research, as Miller (1988) argues. This tension especially emerges where it concerns business economic rules and managerial rules to control risks. In addition Weggeman (1997) states that the set

of procedures and rules that guide or facilitate the daily cooperation and the planning and control of the work of professionals should be limited, as professionals can hardly be managed by imposing rules and procedures.

The scientists in the field studies experience the life cycle of projects as “fading in” and “fading out”. They contribute to several projects in one period of time. When their contribution is delivered, they move to the next project. Delivering this contribution implies sometimes only a gradual involvement in the project during a limited period, sometimes it takes intense involvement from the beginning to the end of a project. The content of a project is what inspires the researchers. The formal context of working in projects makes researchers complain, e.g. “sometimes I have the idea that financial issues are the only important thing in the organization; profits seem to be more important than the results of the project” and some moments later “Furthermore I like to write scientific articles, but I have not much time to do so. I like a dynamic work environment, but all this talking about money; I am fed up with it” (Kimberly, Ecology Group, 138-142).

Table 4.2 Project phases	
Project phases	Formal rules based on a study of documents
Design	<p>For each project a project plan has to be made. As well as a description of the problem and the research approach this plan contains a description of the duration, financial costs and financial coverage</p> <p>Projects are formally approved. Project plans are approved by the leader of the research group and – dependent on the size and type of project – by a program leader or the executive board of the institute. Approval is focused on the quality of the proposal and an assessment of financial risks and financial coverage.</p> <p>After approval, the project is taken up in the project administration. Only after approval research time spent on the project can be registered. All researchers are supposed to account for 65% of their working time on projects. The remaining time is available for acquisition, meetings (not related to projects), education, leave due to sickness and regular leave.</p>
Execution	<p>Only the researchers mentioned in the project plan are supposed to work on the project and are able to account for the research time spent on the project. Execute the project within budget and correct execution if necessary.</p>
Ending & evaluating	<p>When a project is ended and evaluated it is no longer possible to register research time spent on that project nor to account for costs made for the project.</p>

Table 4.3	How the design phase and its rules are experienced (interviews)
	<p>“for DWK-programs the trajectory is not clear to me. For projects that follow another route there is often a process of interaction. There comes a request from a client or you take the initiative and try to sell” (Simon, Ecology Group, 218)</p> <p>[does the approval procedure also apply for SEO-projects and projects funded by program funds]: “I don’t know, for I have never done that. It would be desirable if this procedure also applied for those projects” (Kim, Ecology Group, 312-315)</p> <p>[do you have a sound image of the procedures]: “No, I don’t think so. Some things are still not clear to me, for example funding projects from the DWK program budget” (Simon, Ecology Group, 100-104)</p> <p>“yes, there is a very official routing of projects, but I do not live up to those rules. But you should. TFM should know about your project. But I feel that is only necessary when the phase of the business case is over, that it is clear that a new project is coming, then I acknowledge them ...I know there is a protocol how to handle these things, but that I do not know how this really works is illustrative. In my opinion I do not need to know. As long as the right department knows what is going on” (Laura, Postharvest Group, 155-162)</p> <p>“when it is a project that is funded from the program funds you are able to direct the content and course of the project yourself, by inserting your ideas. In projects assigned by an external client it is primarily about your reputation, your image” (Kimberly, Ecology Group, 150-152)</p> <p>“when you receive an assignment a project number is opened in the project administration and you can register the research time you spend on the project. The project plan and the project offer contain a form that is read – and approved – by the group leader or the executive director. Then a scrawl is added from FBEZ and from someone else ...” (Kim, Ecology Group, 185-189)</p>

Table 4.4	How the phase of ending & evaluating the project and its rules are experienced (interviews)
	<p>“ending a project is often messy. The client has additional questions, leaving you wondering whether these are part of the assignment or not. Ending a project is often a speedy process and is often handled bilaterally. For other colleagues the project is already finished in this phase, they have delivered their contribution. It would be better to organize one final meeting” (Kim, Ecology Group, 197-199)</p> <p>[evaluating projects ?]“that happens, but less structured than you would like to see, because of the daily delusion” (Andrew, Ecology Group, 141-142).</p> <p>“I have not evaluated all projects. It is obligatory, because it is an institutional policy’ (Kim, Ecology Group, 203)</p> <p>“The internal evaluation of projects does not proceed in many cases due to the available time. The evaluation has no deadline” (Kimberly, Ecology Group, 176-179)</p> <p>[are projects evaluated ?] “No, bad, the evaluation process is poor. At least in the projects in which I am involved. A report to the client is often the end of the project. In many cases, when the project is finished the available research time has been spent, the colleagues are busy and the evaluation is skipped” (Larry, Postharvest Group, 187-192)</p>

Continuation of Table 4.4
<p>"It doesn't proceed in many projects, although everyone feels it's important and management promotes evaluation strongly" (Joe, Ecology Group, 143-147)</p> <p>"Official evaluation...., in fact you evaluate during the execution of the project" (Michael, Postharvest Group, 227)</p>

4.1.2 Activities in projects

In order to develop a more precise representation of interaction patterns in the life cycle of a project we also collected data about activities in projects that organize the interaction between the researchers in the groups and between researchers and clients. These are activities that take place within the three phases of a project life cycle. These activities define *what* takes place in a project life cycle and provide an anchor for *how* activities are executed (section 4.2). Based on the data collected in the field studies we identified seven kinds of activities in the project life cycle (Table 4.5) that organize interaction. Of course these activities are only a small part of all activities that take place to design, to execute and to end and evaluate projects (Steyn et al., 2003; Maylor, 2003; Cleland, 1990). In our analysis we sometimes unified several activities in the definition of one type of activity. All kinds of meetings are for instance unified in the activity "integration of knowledge". They are constructed "events" (Poole et al., 2000), although still grounded in the data, because they were confirmed by the researchers in the field studies. The seven kinds of activities we identified are: (1) specifying the request of the client, (2) translating the request of the client into the expertise that is needed, (3) searching for and committing colleagues with the expertise needed, (4) integrating individual knowledge, (5) project management, (6) transferring the results to the client and (7) post project work for the client.

Table 4.5 Activities in projects		
Activities in projects	Description	Support from interviews (characteristic example)
Specifying the request of the client in interaction with the client	Specifying, elaborating the need for knowledge of the client by interacting with the client	"You often start with a business case in which [the institute] describes what you have been discussing with the firm and what research can be done. When it becomes interesting a project proposal is made, a description of the desired results. Next that is discussed with the firm" (Larry, PostharvestGroup, 119-121)

Continuation of Table 4.5		
Activities in projects	Description	Support from interviews (characteristic example)
Translating the request of the client into the expertise needed	Translating the request of the client into a research problem and research process. This includes the development of an image of the expertise needed to solve that research problem.	"I organize some meetings with colleagues; who knows something about this topic, who can contribute ..." (Kim, Ecology Group, 169)
Searching for and committing colleagues with the expertise needed	Searching for colleagues that have the desired expertise, checking availability, committing these colleagues and making arrangements about the contribution of those colleagues (content, amount of time).	"You evaluate with whom you can cooperate well, you think about the expertise you need and you check the time people have available" (Andrew, Ecology Group, 128-131) "In many situations there are not many people available, so you must shop around and look for the people that know something about the topic involved" (Sarah, Ecology Group, 109-111)
Integrating individual knowledge, planned and ad-hoc	All kind of activities in which individual knowledge of the researchers (in- and outside the project) is integrated to realize the desired project results. This can be planned, but can also be spontaneous and <i>ad hoc</i> .	"For project [P] we had a discussion before the start who was coordinating the various aspects of that project and we also had a discussion with the client to tune things. For project [M] I think we also had a good discussion before the start and we also had a discussion with [P] and [Q] and we still have a meeting with them every week. Project [C] is quite different because of the involvement of foreign partners. We have a schedule for this project. A lot of e-mail contact and twice a year a management meeting and once a year a meeting in which everyone is involved. In this project there is much structure" (Laura, Postharvest Group, 163-170)
Project management	Directing the execution of a project, with the assignment to realize the desired project results in the project duration time that was agreed upon, and with the financial funds available.	FB: Do you check figures with regard to the amount of time spent on the projects for which you act as a project leader? "Quite strictly, and always when you think things are getting out of hand. Then you reorganize your project" (Sarah, Ecology Group, 241)
Transferring the results to the client	Transferring the results to the client. The form of transfer is quite diverse.	"At the end of a project, when the final product is almost there, we interact with the client" (Brian, Ecology Group, 48)

Continuation of Table 4.5		
Activities in projects	Description	Support from interviews (characteristic example)
Post project work for the client	Executing additional work for a client, in addition to the project results already transferred. This additional work is supposed to raise the added value of the research and is also done to learn the knowledge needs of the client for future assignments	"Ending a project is often messy. The client has additional questions, leaving you wondering whether these are part of the assignment or not. Ending a project is often a speedy process and is often handled bilaterally" (Kim, Ecology Group, 197-199).

However, this taxonomy is somewhat arbitrary. The division into the activities “transferring the results to the client” and “post project work” is merely a matter of definition. Another option would have been to integrate “post project work” in “transferring the results to the client”. The activity “integrating individual knowledge in the project” has some overlap with the activities “specifying the request of the client” and “translating the request of the client” that also will embrace some knowledge integration. In these activities knowledge that emerges in the interaction of the client and the researcher and knowledge that emerges in the interaction between researchers is integrated. An example is the next statement: “Yes, but the request [of the client] is discussed in the team meeting. This discussion is about the type of problem and the proposed solution. The members of the team can bring related ideas into discussion: have you thought of [A] or [B]. I feel you should also talk with the people that worked with the crop and ask for their ideas. You can ask them in a team meeting, but it also happens at the coffee table” (Larry, Postharvest Group, 124-128). However, we decided to distinguish between these activities because their aim is different. We do not claim that our way of distinguishing activities is the only option or the best choice. Other taxonomies would have been possible. Our goal was not to impose a category scheme from the literature, but to make different kind of activities as clear as possible for the next analysis in this study, an analysis of *how* activities are executed. This taxonomy meets this goal.

Literature argues that it is important to involve the stakeholders and to determine objectives and expectations of key stakeholders for a project to be successful (Steyn et al., 2003; Maylor, 2003; Cleland, 1990; Ethiraj et al., 2005), referring to results of research that argue that responsiveness and flexibility to customer requirements and changes is an important factor for team performance (Cleland, 1990). This acknowledges the relevance of the activities “specifying the request of the client”, “translating the request of the client”, “transferring the results to the client” and “post project work”. According to Maylor

reacting on the request of a client creates opportunities for creativity, as the emerging project team can take several options into account. This element seems to be present in the activity “specifying the request of the client” as well as in “translating the request of the client into the expertise needed”.

The pattern of activities we found also matches the main results that we found in the studies of Ancona & Caldwell (1992) for successful groups, as far as the perspective of our studies overlap. Results of studies of Ancona & Caldwell (1992) indicate that the type of external communication teams engage in, not just the amount, determines performance. They have found that teams executing a strategy performing high on “task coordination” (coordinating technical or design issues, obtaining feedback, coordinating and negotiating with outsiders), high on “ambassadorial activities” (persuasion for a project, lobby for resources) and low on “scouting” (general scanning for ideas and information about the market or technology) are very successful, not only in the short term, but also over time. They define this strategy that stresses close alignment with customers as a “*comprehensive strategy*”. The client oriented activities we identified especially focus on task coordination and ambassadorial activities, although they also contain some elements belonging to scout-, guard- and sentry-activities (Appendix four). The activities “searching for and committing colleagues with the expertise needed” and “integrating individual knowledge, planned and ad-hoc” are particularly directed towards other group members. Although we have not measured how the group members spend their time with regard to the categories of activities, our findings suggest – examining the distribution of activities over the categories, Appendix four - that the groups in the field studies also execute a comprehensive strategy. Furthermore we will argue in Chapter Six that expertise development in the groups is of a co-evolutionary nature. It is closely linked with stakeholders in the niche and based on a pattern of “persuading” clients and meeting the expectations that are raised. This finding suggests that the groups perform high on ambassadorial and task coordination activities. Because the co-evolutionary strategy is supported by a strategy of “enacting” (Daft & Weick, 1984, Chapter Six) the findings suggest that the groups perform low on scout activities, implying a comprehensive strategy.

The activity “translating the request of the client into the expertise needed” also reflects (the development and presence of) comprehension (McGrath, MacMillan and Venkataraman, 1995), an understanding of the knowledge combination necessary to solve a research problem. The client oriented activities support the development of a practice with clients. Clients become part of a “network of practice” (Brown & Duguid, 2001). The word network indicates that although clients and the research group share a number of elements

of a practice, the relations among them are significantly looser than those within a community of practice (the group). But this network provides a common substrate, enhancing communication and coordination (Orlikowski, 2002; Ethiraj et al., 2005) and therefore this network of practice makes knowledge flow. This enhances competitiveness.

The activity “project management” should be understood as an activity that also organizes interaction; it should be understood in a broad sense (Steyn et al., 2003; Maylor, 2003; Cleland, 1990). In the interviews and conversations with the researchers however, project management was especially focused on the concern to deliver the desired project results within time and budget. Other aspects of project management, such as quality of the results (closely linked to the content of a project and professional norms), have been underexposed.

In Figure 4.2 the activities are linked to the phases in the life cycle of a project. The positioning of these activities in the life cycle of a project is to some extent grounded in the data of the empirical part of the study directly. To some extent they are “logically” and roughly positioned in the life cycle of a project, based on the definitions of the activities and supported by literature (Steyn et al., 2003; Cleland, 1990; Maylor 2003). Figure 4.2 also suggests a match with the findings of Ancona & Caldwell (1990): in the design phase of a project more ambassador (persuasion for a project, lobby for resources) and task coordinator (design issues, negotiating, obtaining feedback) activities are found. In the execution phase of the project less ambassador and task activities are found. In the phase of ending and evaluating the project we found more external interaction, especially with regard to task coordination.

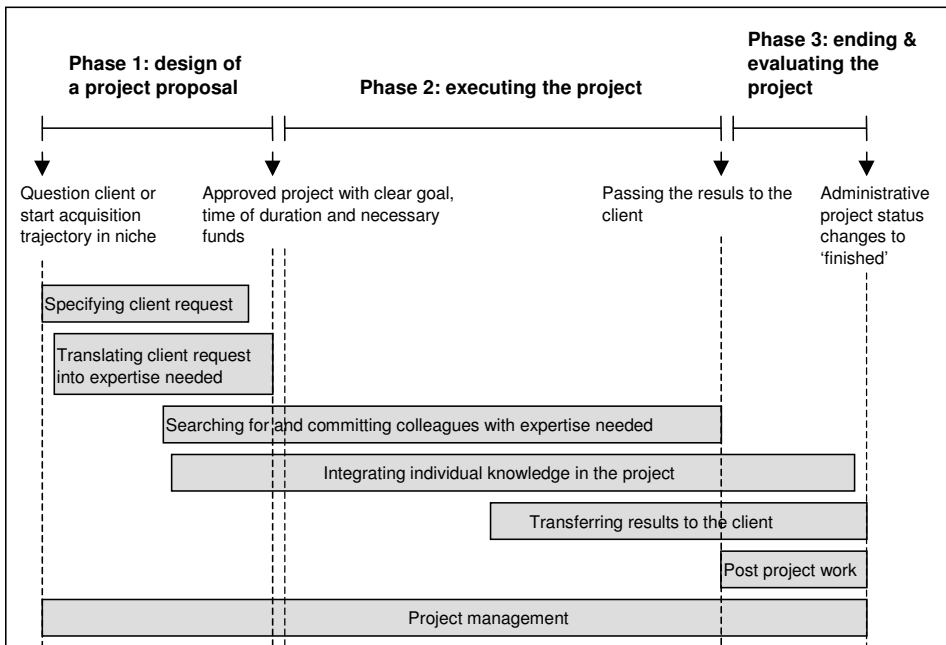


Figure 4.2: Positioning activities in the phases of the life cycle of a project

Figure 4.2 is an outline in which the activities in the life cycle of the project are positioned. Activities are positioned more strictly and consistently than the practice of the research groups shows. An example is specifying the request of the client (phase one). Research in the groups is not organized in a way in which the research request of the client is specified in the first phase and in which the results are transferred to the client at the end of the second phase. There is – more or less – a continuous interaction with the client, in phase one but also during the execution of the research in phase two. The presentation of preliminary results can initiate a process of redefinition of the research question and the research approach. An example is the next statement: “Yes, we have a of contact with the client in the execution phase of the project. In general, a lot more than I like...When a client is paying for research, he wants to know everything and therefore he calls often...” (Michael, Postharvest Group, 221-224). The activity “specifying the request of the client” is therefore not strictly linked to phase one in the practice of the groups, but will continue during the lifecycle of the project. As this example shows, there will also be interaction of this activity with the activity “transferring results to the client”.

4.2 Social rules in the practice of the group

In the previous section we discussed the life cycle of a project by describing phases and activities in projects. In this section we discuss the social rules that guide the execution of activities in projects. These social rules are the third building block, necessary to identify and discuss a pattern of behavior of group members in section 4.3.

In Table 4.6 the social rules that emerged from the data are defined. They are referred to as social rules, because they prescribe behavior in interactions. The literature also provides other concepts, often used as interchangeable but which will not be used here: recipes (Weick, 1979), imperatives, code of conduct, social conditions, social values (Pascale, 1985), rules (Lawrence, 1995), social norms (Bettenhausen and Murnighan, 1991), a repertoire (Wenger, 1998). We do not claim that this is a complete set of all the (social) rules that are relevant in the research groups involved in the field studies. It is a subset, because we focused on rules that guide interaction. We have tried to be exhaustive within this focus.

In the remaining part of this section we will focus on the social rules that are linked to the execution of one or more activities in the project lifecycle. Table 4.6 presents a description of each of the rules and one or two characteristic examples from the interviews that support the presence of this rule. Besides the social rules we define in Table 4.6 we found six other social rules that are not included. Two of these rules were driving and regulating interaction and work practices with partners: “expertise of partners has to be complementary” and “cooperation with partners needs financial coverage”. These rules are however not especially linked to the execution of one or more activities in the project life cycle. Therefore they have not been included. The other four social rules do not guide the execution of one or more activities in the project life cycle: “Take your responsibility”, “acquire strategically, unless the financial position makes it impossible”, “Don’t bring your group or the institute in problems” and “Show respect to a colleague who has acquired an interesting project”. Therefore they were also not included. We made this decision by a personal judgment, but only after a careful consideration of the relations of all social rules with one or more activities in the project life cycle (section 4.3).

Besides the social rules defined in Table 4.6 and the six we left out, we found two issues that played an important role in the interaction between researchers and between researchers and management. After close examination we defined these issues however as

task constraints and not as social rules. In Chapter Five we will define task constraints more in detail, but in summarizing we define task constraints as norms imposed by the organization on the activities and behaviors of researchers. They are experienced by the researchers as constraining them in their primary interest which is “working on what they like”. These norms act as criteria and as researchers are evaluated on these criteria they also affect interaction. But our findings suggest that they are experienced more in terms of criteria than in terms of social rules on how to interact with colleagues. The first issue, “provide a positive financial result at the end of a project”, prescribes a project leader to achieve project results within budget, leading to a positive financial result. Joe (Ecology Group) states with regard to this issue: “in the eyes of group management an employee performs well when ... a positive financial result is achieved” (Joe, Ecology Group, 120). In addition Edward (Postharvest Group) states: “when a project is not profitable, you’re spoken to. You also have to come up with an explanation when you don’t realize your accountable project time” (Edward, Postharvest Group, 254-255). These statements refer to this issue as a criterion. The second issue we found is “take care of your financial coverage” which prescribes all researchers to cover 65% of working time by contributing to projects. It stimulates researchers to acquire projects and to participate in projects managed by colleagues. Peter (Ecology Group) states in this respect: “You’re doing well when the amount of research time spent on projects is sufficient” (Peter, Ecology Group, 98-103). Furthermore Michael (Postharvest Group) states: “You better take care yourself that your working time is covered because then no-one can force you and you have more freedom. Because when you’re not covered by projects on paper you could be assigned to a project that you don’t like.” (Michael, Postharvest Group, 275-280). These statements refer to this issue as a criterion and what it means to researchers. As both issues refer to criteria we have defined them as task constraints. The twelve remaining rules (together) define how the activities in the three phases of the project lifecycle are executed.

Table 4.6 Social rules guiding interaction		
Social rule	Description	Support from interviews (characteristic example)
Provide a satisfied client	Prescribes the researcher to provide a satisfied client in interacting with that client. Can also be considered as the assignment to inspire the confidence of the client that is he has been understood and gets what he wants.	<p>“That was a very exacting client, whose wishes we tried to fulfill every time” (Simon, Ecology Group, 205-206)</p> <p>“You do want to satisfy the client, that aspect of the work receives a lot of attention” (Andrew, Ecology Group, 200)</p> <p>“I feel that it is very important that people are able to provide a satisfied client within the arrangements that were made” (Joe, Ecology Group, 129-130)</p>
Respect the client	Prescribes researchers to respect the client, to act carefully. This rule coheres with the previous rule.	<p>“Clients are cherished, they are considered as very important. You listen very well to a client when you are executing a project, and also when you’re transferring the results to the client” (Simon, Ecology Group, 200-201)</p> <p>“I have never heard colleagues talking about clients in a negative or a contemptuous way” (Simon, Ecology Group, 211-212)</p>
Involve the client in making a project proposal	Prescribes researchers to involve the client in making a project proposal, to insure a sufficient elucidation of the client’s request, to focus on what the client wants and to insure a superior translation in the project proposal.	<p>“One project leader pays more attention to this aspect than the other. But the notion that this is an important aspect of the work, is between everyone’s ears. People think along with the client very well, people are encouraged to do this. In the contact with the client we also pay attention to how the request of the client is translated into a work process” (Kimberly, Ecology Group, 165-170)</p>
You don’t have to involve the client in an evaluation	Suggests the project leader that it is not obligatory to involve the client in an evaluation.	<p>“Account management is handling that ... [hesitation]. It is not standardized” Kimberly, Ecology Group, 172)</p> <p>“External evaluation is not the regular policy” (Kim, Ecology Group, 207)</p>

Continuation of Table 4.6		
Social rule	Description	Support from interviews (characteristic example)
Involve the colleagues you need in your research project	Invites the project leader to involve the researchers necessary to solve the research question with the desired quality and within the arranged time span.	<p>“You can invite yourself the people you want to involve. Often the research question is quite clear and it is obvious who you need” (Kim, Ecology Group, 177).</p> <p>“In many cases you don’t have the expertise that is needed and so you need your colleagues. Doing research is an interactive process: you develop something and you need each other in doing so” (Sarah, Ecology Group, 193-197)</p>
Be open and behave like a good colleague	Prescribes the researcher to take up an open position and behave like a good colleague. Refers to providing advice, thinking along, discussing project design, project execution and results.	<p>“Colleagues are always willing to reserve a part of their time to think along in problems you experience” (Simon, Ecology Group, 156-158)</p> <p>“Whether or not you’re doing your job the right way appears from the reactions of your colleagues. Are you involved in problem solving, do colleagues consult you, do they involve you in their project? If this happens, then you’re doing your job properly...” (Kim, Ecology Group, 231)</p>
If you don’t want to participate in a project, you don’t have to	Suggests (requested) project members to refuse an invitation for participation due to a lack of time, in order to anticipate tensions in the team or when there is a lack of confidence in the qualities of the project leader.	<p>“A project leader has to respect whether people have time available or have a ack of research time” (Simon, Ecology Group, 239)</p> <p>“Yes, that is possible [to say no, fb]. That can be sincere, but it could also be that you don’t want to cooperate with one or more colleagues in a project” (Peter, Ecology Group, 121-127)</p>
A success is always a shared success	Prescribes researchers to acknowledge contributions of all participating colleagues in a project.	<p>“For me it’s not my personal goal to score. When a project team is working quite well, I’m also satisfied; when my colleagues are happy and something beautiful emerges. It’s OK with me when colleagues that have developed a concept are mentioned as first author” (Sarah, Ecology Group, 177-183)</p>

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Continuation of Table 4.6		
Social rule	Description	Support from interviews (characteristic example)
The project leader involves his project team	Prescribes project leaders to involve their team during execution of a project.	“Principally, a project starts with a project startup, but this is not done for all projects. For this startup all participants in the project are invited. In this meeting the context of the project is highlighted, what has to be done is discussed as well as the research process [...]. People expect from a project leader that there are moments at regular intervals when concepts and results are discussed, that there is a meeting of the project team” (Kim, Ecology Group, 195-197)
Ending a project is primarily the task of the project leader	Suggests that members of a project team don't have to contribute to the ending of a project unless the project leader asks them to do so.	“No, when they have made their contribution, they don't. When they are busy, they ask if more is expected of them in the project” (Larry, Postharvest Group, 176-177). “For other colleagues the project is already finished in this phase, they have delivered their contribution. It would be better to organize one final meeting” (Kim, Ecology Group, 199)
The evaluation of a project is obligatory, but you don't have to follow that rule	Suggests to project leaders that they don't have to evaluate projects, although the procedure is obligatory. The rule affects the attitude towards project evaluations as well as doing project evaluations	“It doesn't happen in many projects, although everyone feels it's important and management promotes evaluation strongly” (Joe, Ecology Group, 143-147). “No, poor. Evaluation is poor. At least, for the projects in which I am involved. The report to the client is often the end of the project. In many cases when [...] the available time has been spent, people are busy, and the evaluation is skipped” (Larry, Postharvest Group, 187-192)

Continuation of Table 4.6		
Social rule	Description	Support from interviews (characteristic example)
Work decently and as a good colleague	Prescribes the project leader to manage in a way that keeps the gap between the project budget and the project spending small. The rule is not adhered to strictly. The rule is prescribed by colleagues.	“You speak to colleagues about the research time spent on the project and you encourage colleagues to register their time spent. But this department is not very strict about this” (Ken, Ecology Group, 86-87)

We searched literature for empirical studies reporting on the appearance of social rules, rule systems and routines (the use of these concepts in the document title or abstract) in order to compare our results. For literature into routines we limited ourselves to the period between 2000 and 2005. Literature that actually describes sets of rules or routines was found to be scarce. Braithwaite (2004) reports about a study into clinician-managers' behavioural routines, focusing on the activities of the managers and how they perform these activities. But with respect to how they execute activities his study is still quite abstract, referring to “adopting an achievement orientation, through the structure and hierarchy, and by managing change, in taking decisions and solving problems, and educating and developing self and others” (p. 245) and “mobilising work through meetings” (p. 251). Bettenhausen and Murnighan (1991), Cohen and Bailey (1997), Ancona & Caldwell (1988) and Bresnen, Goussevskaia and Swan (2005) support our finding that literature is scarce. Ancona & Caldwell (1988) mention three reasons why literature on behavior of groups and changes in behavior is scarce, including literature on the appearance of social rules. Firstly, because models of group processes have often failed according to Ancona & Caldwell to address the complete range of group behaviors, particularly those that describe how members of the group interact with others outside the group. Secondly, researchers do not take differences into account in the tasks that groups must complete. Thirdly, researchers often use very general global frameworks to predict performance instead of producing fine grained models. One exception is a paper on social rules guiding humor in the interaction between participants involved in the formation of a (temporary) group (Terrion and Ashforth, 2002). More recently the appearance of social rules and routines has gained more attention as part of studies into continuous change in organizations (Tsoukas & Chia, 2002; Orlikowski, 1996; Weick & Quinn, 1999; Howard-Grenville, 2005). An example is a study of Feldman (2000) into continuous change of routines in some processes at a high school.

In discussing our findings with regard to (project) activities we argued that our findings suggest that the groups execute a “comprehensive strategy” (Ancona & Caldwell, 1992) with regard to their boundary activities. The social rules that emerged from the data support this strategy. “Provide a satisfied client”, “respect the client”, “involve the client in making a project proposal” support the ambassador and task coordinating activities defined by Ancona and Caldwell (1988; Appendix four). Molding (part of ambassadorial activities) can also be supported by the rule “involve the client in making a project proposal”. For “guard” and “sentry” activities (Appendix four) no specific social rules were found in the field studies.

Some rules reflect reciprocity (Gouldner, 1960) as for instance the rule “be open and behave like a good colleague”, which stimulates making time to provide a colleague with advice and which creates an obligation for the other colleagues to do the same in return. Gouldner theorized that the stability of social systems depends in part on a norm of reciprocity among the members of the system, especially in situations where there is no clear authority structure and therefore no formal definition of obligations. He noted that reciprocity is a universal characteristic of human civilization. Reciprocity is also a form of social exchange (Blau, 1964), which is characterized by unspecified obligations in response to a favorable treatment, and a long-term orientation that reciprocity will occur. Deckop, Cirka & Andersson (2003) argue that employees who receive help from fellow workers are more likely to be helpful to others, creating a virtuous cycle. Finally, Feldman & Rafaeli (2002) argue that routines make connections between people, contribute to shared understandings and therefore attribute to stability. This is also reflected in the social rules we found, as for instance “The project leader involves his project team”. But routines also link the group with other departments, as reflected in for instance in the statement of Laura in Table 4.3.

In summarizing, based on a comparison with the boundary activities found by Ancona & Caldwell (Appendix four) we argued that the social rules support particularly ambassador and task coordinating activities. In discussing our findings with regard to (project) activities we argued that our findings suggest that the groups execute a “comprehensive strategy” (Ancona & Caldwell, 1992) with regard to their boundary activities. Therefore the social rules and the relevance of activities seem to be coherent. Due to the reciprocity that some rules reflect, they contribute to the stability of the system.

4.3 The dominant pattern: heedful interrelating

In the previous section we discussed the social rules that direct the interaction with colleagues and clients. In this section we will identify the dominant pattern in the practice of the groups based on these rules: a pattern of “heedful interrelating”. For the identification of this pattern we first argue that researchers interact with respect. Next we argue that they not only interact respectfully in one activity, but that they interact respectfully in all activities, due to the linkage between social rules and activities. The social rules fit and they form a coherent package and in general they do not require contradictory behaviors (but see Chapter Five). As a third step we ask ourselves if respectful behavior is only based on compliance with the social rules or if this behavior is also stimulated by personal motives. We argue that the social rules are not a solitary phenomenon, and that they are grounded in motives of the researchers. Based on these analyses we argue that there is a process quality in the project life cycle of heedful interrelating.

Interacting respectfully

Interpreting the meaning of the social rules we found, we argue that the researchers in the field studies take their work very seriously and interact respectfully, with clients, as well as with partners and colleagues. We found that the researcher thinks along (rules “involve the client in making a project proposal”, “involve the colleagues you need”, and “be open and behave like a good colleague”), is open for advice (rules “involve the colleagues you need”, “be open and behave like a good colleague”), applies the expertise of others (rules “involve the client in making a project proposal”, “involve the colleagues you need”, and “be open and behave like a good colleague”), involves colleagues and clients (rules “involve the client in making a project proposal” and “the project leader involves his project team”), does not make promises he can’t keep, respects the contributions of others in a project (rules “the project leader involves his project team”, “a success is always a shared success”) and embodies recommendations learned from previous projects (rule “the evaluation of a project is obligatory, but you don’t have to follow that rule”), although not through a formal evaluation.

But our conclusion that the researchers take their work seriously and interact respectfully must also take into consideration the following nuances. Why do they not evaluate projects even though it is obligatory; why do they not include the client in a project evaluation and why does the project leader have to end a project? In the empirical data the following explanations can be found. The pressure group members experience to obey the task constraint “provide a positive financial result” is so high, that they have given up a mutual

ending of projects and project evaluations. Although evaluations with clients are not formal policy, researchers recognize the possibility to learn from these evaluations and to apply the results to future assignments. The same is true for the internal evaluations, but researchers are glad when they are able to show a positive financial result at the end of a project which they find hard to realize. Margins are small and an evaluation takes time and reduces the financial results. Furthermore researchers are of the opinion that the scientific results and the research process are discussed enough during the execution of the project in all kind of meetings and that the recommendations – if any – are embodied or will be embodied in the group. The pressure to realize a positive financial project result is also responsible for the fact that the project team more or less has split up at the end of the project in many projects, at least informally. Most of the researchers involved have provided their contribution and are already involved in or act as a project leader in a new project. They have “faded out” section 4.1.1 and that’s why the project leader has to finish the project more or less on his own (but receiving help when he asks for support).

The relation between social rules and activities and the operation of the set of social rules

A next question to be addressed is whether the researchers interact respectfully in all activities and project phases. Furthermore, how do the social rules interact with each other and particularly, do they fit (work in the same direction) or are they contradictory?

Based on the definition of each of the social rules and each of the activities we have linked the rules with the seven kinds of activities. In addition to the definition, we made a judgement for each rule if it directs the execution of one or more activities and which activities. We found support for a majority of our judgements in the data we collected in the field studies. In Table 4.7 we present the results of the linkage between social rules and activities. In this table it is apparent that the execution of each activity is directed by more than one rule, except for the activity “project management”.

Table 4.7 Rules regulating practices and driving and regulating interactions with colleagues and clients linked with the activities in the project life cycle	
Activities	Social rules
Specifying the request of the client	<ul style="list-style-type: none"> • Provide a satisfied client • Respect the client • Involve the client in making a project proposal
Translating the request of the client towards the expertise needed	<ul style="list-style-type: none"> • Provide a satisfied client • Respect the client • Involve the client in making a project proposal • Involve the colleagues you need in your research project • Be open and behave like a good colleague
Finding and committing colleagues for the project	<ul style="list-style-type: none"> • Involve the colleagues you need in your research project • Be open and behave like a good colleague • When you don't want to participate in a project, you don't have to
Integrating individual knowledge in the project	<ul style="list-style-type: none"> • Be open and behave like a good colleague • Involve the colleagues you need in your research project • When you don't want to participate in a project, you don't have to • The project leader involves his project team • An success is always a shared success
Transferring results to the client	<ul style="list-style-type: none"> • Provide a satisfied client • Respect the client
Project management	<ul style="list-style-type: none"> • Work decently and as a good colleague
Post project work	<ul style="list-style-type: none"> • Provide a satisfied client • Respect the client • Ending a project is primarily the task of the project leader • The evaluation of a project is obligatory, but you don't have to follow that rule • You don't have to involve the client in an evaluation

We found a number of examples that the social rules fit with each other in the execution of activities and do not operate in a contradictory way. A first example, especially referring to the activities of “finding and committing colleagues for the project” and “integrating individual knowledge in the project” is the interaction between the rules “when you don't want to participate in a project, you don't have to”, “involve the colleagues you need in your research project” and “be open and behave like a good colleague”. The first of those three rules does not provide a lot of trouble in daily working practice. Reasons other than that a colleague has no time available are not frequently encountered. The reason that a colleague has no time available and can't contribute seems to be accepted quite easily (respectful interrelating). The colleague seems to be willing and meets the rule “be open”. The researcher searching for expertise of some kind approaches another colleague that has time available (“involve the colleagues you need”). A second example is the interaction between the rules “ending a project is primarily the task of the project leader”, “an evaluation of a project is obligatory, but you don't have to follow that rule”, “you don't

have to involve the client in an evaluation” and the task constraint “provide a positive financial result” (particularly in the activity “post project work”). We discussed this interaction in one of the previous paragraphs. Although these examples do not cover all relations between the social rules and although we have not found examples of interactions between social rules for all activities, the examples we found suggest that *in general* the rules fit and are not contradictory. We also found however some tensions between the social rules implying dialectical situations in which the researcher has to decide how to behave (Chapter Five).

Based on our findings and analyses so far, we conclude that the researchers in the groups interrelate respectfully, stimulated by the social rules that define the interaction between colleagues and with clients. Not in one particular activity or project phase, but in all project phases of the project life cycle.

Next we wondered whether respectful interrelating was only addressed by the social rules or that the researchers also were stimulated to behave this way by their personal motivation, expressing beliefs, goals and emotions whereby initial wishes and desires are selected, prioritized, operationalized and acted out (based on Dörnyei and Ottó, 1998: 65). We found that the social rules are not an isolated phenomenon, but that they are embedded in the motives of the researchers. They do not only interrelate respectfully because of the social rules, but also because of a well grasped self-interest. We found that for the researchers in the Ecology and Postharvest Groups the most important thing was to work on what they like (motive). Working on what you like has to do with the content of the work, the research topics you like to work on. They put their heart into research work, specializing in a specific subject or aspect of the field of research: “Researchers just want to do the kind of research they like. They want to develop a scientific profile, therefore you must develop a professional status in a field of research” (Andrew, Ecology Group, 211-213). For a researcher to work on what he likes, he has to take care of his financial coverage (task constraint), because if he doesn’t, he could get an assignment in a project that he doesn’t like (because of the research topic) and when he is not able to find financial coverage for a longer time he even could get transferred to another department or get fired. From this necessity for financial coverage the researcher is willing to provide a satisfied client (rule), involve the client in making a project proposal (rule) and respect the client (rule).

We also found that researchers not only want to work on what they like, but also want to become an expert in that field and achieve a high level of professionalism. Therefore they must specialize, develop a profile. Specialization also means collaboration – given the type

of projects the groups in the field studies work on – to answer the requests of clients. Working on what you like, developing a profile and reaching a high professional standard lead to or affect the motive “I like to collaborate with my colleagues as they provide support”. Kevin states in this respect: “[you need the participation of other researchers] because of the physical requirements, you can’t do it all on your own, but also because you need colleagues with a special kind of expertise or educational background, colleagues who can conduct experiments, colleagues who can focus on the fundamental aspects of certain processes” (Kevin, Postharvest Group, 41-45). This attitude contributes to an open position and behavior as a good colleague (rule), involving colleagues in a project team (rule), and experiencing a success as a shared success (rule). Expression of this behavior leads towards appreciation and the opportunity to develop a profile and a high professional standard and in doing so the chance to be involved in a next project. As Simon states: “The most important criterion is that my colleagues are satisfied with my work. That they tell me “well you’re doing some very interesting work”. Besides, output is important, I mean papers to be published in scientific journals. And that colleagues approach you with scientific problems. That they recognize and acknowledge that you have a high professional standard in a field of research and that they are eager to use your knowledge” (Simon, Ecology Group, 227-230).

These examples illustrate that respectful interrelating is not based on the social rules solely, but that it is also stimulated by the motivation of the researchers; they have put their heart into research work, they have the intention to become an expert and in order to continue their research work they are willing to collaborate, they are willing to take care of the needs of clients and they are willing to involve colleagues.

Respectful behavior based on motivation is addressed in literature with the concept of “heedful interrelating” (Weick & Roberts, 1993). They define this concept as having qualities as “noticing, taking care, attending, applying one’s mind, concentrating, putting one’s heart into something, thinking what one is doing, alertness, interest, intentness, studying and trying” (p. 335). These qualities are also present in the practice of the researchers in the groups involved in the field studies, as we just illustrated by a number of examples. But even more, their behavior is also directed by the social rules that guide interaction between researchers and between researchers and clients, as in the rule “involve the colleagues you need in your research project” and “be open and behave like a good colleague” (Table 4.6).

Because the qualities of heedful interrelating are present in almost all the identified social rules relevant for the project life cycle and because the execution of all activities in the project life cycle is guided by a number of those rules (Table 4.7) as we discussed earlier in this section, the (first) dominant *pattern* in the practice of the groups with regard to the project life cycle is a pattern of heedful interrelating.

According to literature heedful interrelating is locally embedded, situated (in time) and linked with activities in which it is expressed (Boland, Tenkasi & Te'eni, 1994; Hutchins, 1991; Tsoukas, 1996; Weick & Roberts, 1993; Busby, 2001; Cicourel, 1990; Faraj and Sproull, 2000). The findings from the field studies acknowledge these features.

The identification of 12 social rules adds a new dimension to the definition and emergence of the concept of heedful interrelating: the concept no longer only depends on a certain individual attitude reflecting qualities as “noticing, taking care, attending, applying one’s mind, concentrating, putting one’s heart into something, thinking what one is doing, alertness, interest, intentness” (Weick & Roberts, p. 335), but as a phenomenon that is part of a practice, describing how people engage in the doing of real work (i.e. Orlikowski, 2002; Cook & Brown, 1999; Wenger, 1998; Brown & Duguid, 2001). Our study also broadens the concept of being grounded in and directed by social rules. The linkage with the social rules contributes to an explanation why the emergence of a pattern of heedful interrelating is not a mere coincidence and explains why a group is able to perform during a long period of time with a process quality of heedful interrelating. It also expands the theory of distributed cognition because it contributes to an explanation why heedful interrelating is able to emerge in a “loose” work setting (section 4.5).

Because the social rules address *how* activities in the project life cycle are executed, the pattern of heedful interrelating in the practice of the groups can be defined as the *process quality* with which the project life cycle – and the activities in each phase - is executed. The pattern of heedful interrelating is also examples of a communal practice, a shared know how which enables the groups (as communities) to share and integrate “know that” effectively as we will discuss in the next section.

4.4 The significance of the repeated project life cycle process

In this section we will reflect on the significance of the repeated project life cycle process and the process quality of “heedful interrelating” for the emergence of a competitive group

competence. We will argue that due to this process quality the groups are able to accomplish the emergence of a competitive group competence and more particularly, that without this process quality there will be no emergence of a competitive group competence.

In this chapter we report our findings of the characteristics of the project life cycle of “an average” project in the field studies. We found that the groups in the field studies distinguish three phases in a project: design, execution, ending & evaluation. We also found seven kinds of activities in projects, describing interaction between the researchers and between researchers and clients. We found 12 social rules that direct how activities are executed; for each activity (with the exception of project management) more than one social rule appeared to be involved. Therefore the social rules direct the interaction between researchers and between researchers and clients in the design, the execution and the ending & evaluation of projects.

Groups do not work on one project at a certain moment in time, but on a large number of projects. Some of these projects are small and take only a number of months; other projects are large and take a number of years. Therefore the groups work on projects in different phases at one moment in time and because projects succeed one another the project life cycle is repeated in time.

We concluded that the project life cycle is executed with the process quality of heedful interrelating, based on the findings that the social rules direct interaction during the whole project life cycle, that groups work on different projects which are in different phases at any particular moment in time, and on an indication of the relevance of the social rules.

What do these findings mean for the emergence of a competitive group competence? To start with, projects are a vehicle, a way in which work is organized. Projects provide products, for instance an answer to the question of a client, a theory, a science based explanation. From the social rules we know that in the design, the execution and the ending & evaluation of a project researchers (and clients) share knowledge, they develop knowledge, they apply knowledge and – especially – they integrate knowledge in order to establish the desired product. Therefore the project life cycle is responsible for knowledge integration. The literature discussed in Chapter One argues that the actual emergence of the practice of knowledge integration and the accomplished depth and breadth of the developed expertise affect knowledge integration. Knowledge integration is according to this literature responsible for the emergence of a competitive group competence as it integrates the underlying competences (Chapter One).

But knowledge integration in itself is insufficient for a competitive group competence to emerge according to Grant (1996a). He distinguishes three qualities of knowledge integration that have to be met: the scope, efficiency and flexibility of knowledge integration. He defines the scope of integration as the breadth of specialized knowledge the organizational capability draws upon, efficiency as the extent to which the capability accesses and utilizes the specialist knowledge held by individual organization members and the flexibility as the extent to which a capability can access additional knowledge and reconfigure existing knowledge (p. 380). Does the process quality of heedful interrelating that we found meet these criteria?

With regard to the scope of knowledge integration the researchers in the field studies define the projects they were able to acquire as projects that need a broad knowledge base (Chapter Three). Projects in the Ecology Group all need a broad ecological knowledge base and models that support the results. Researchers in the Postharvest Group defined the projects they were able to acquire as projects that focus on the interaction between features of fresh harvested products and technical equipment used to accompany these products from the producer to the consumer. In these projects scientific knowledge as well as knowledge of the practice of the clients is needed. As is apparent in Appendices eight and nine, both groups have a broad knowledge base at their disposal. Different types of specialized knowledge are complementary rather than substitutes. With regard to the flexibility of knowledge integration the practices of “involve the client in making a project proposal”, “involve the colleagues you need in your research project” and “be open and behave like a good colleague” stimulate and direct interaction and discussion with regard to choices in the design, the execution and the ending & evaluation of projects. These social rules also stimulate the inclusion of the most valuable expertise in the group needed to solve the problem of the client and provide a result experienced as extraordinary. Because these rules do so for each project, it provides a way of making very flexible combinations of expertise. As can be derived from the Appendices six and seven, we did not find particular patterns of collaboration between researchers (as for instance researcher A *always* collaborates with researcher B), implying that there is flexibility and scope in the knowledge integration practice of the groups.

Efficiency is affected by three factors according to Grant (1996a): (a) the presence of common knowledge, (b) the frequency with which specialized knowledge is integrated in projects and (c) the structure of knowledge integration (by which he means the combination of mechanisms used to integrate knowledge). Our findings suggest that the social rules are

part of the common knowledge of the group and that they often integrate specialized knowledge in projects (Chapter Three and Appendices six and seven). Due to the nature of the work (research-work) and based on literature (i.e. Berends, 2003) and the context in which the groups operate (Chapter Three and previous paragraphs) we suggest that face-to-face interaction is an important knowledge integrating mechanism applied in the groups. The likelihood that the same results are established by the use of a less intensive combination of mechanism of knowledge integration (for instances a combination of directives and sequencing; Grant 1996a) is very small, due to kind and level of knowledge integration that is required, the presence of specialist researchers in the group and the characteristics of less intensive knowledge integration mechanisms. But face-to-face interaction is also very expensive because it is the most intensive way of integrating knowledge. The emergence of heedful interrelating helps to make face-to-face interactions as efficient as possible. When clients grant a project that requires intensive knowledge integration by face-to-face interaction and this is not established by heedful interrelating, a group in which this pattern does not emerge has a relative disadvantage compared to a group in which this pattern emerges. As this type of group is less flexible and less capable of making combinations of the desired expertise and as knowledge integration will be more expensive and probably will take more time. Because the groups in the field studies must provide results within (restricted) budget and within a restricted time-span a practice of heedful interrelating is responsible for an efficient and flexible way of knowledge integration. Due to the context in which the groups work, a large scope of knowledge is integrated in projects. All features of knowledge integration, needed for a competitive group competence to emerge, are met.

Poole et al. (2000) argue that the project life cycle process is a prescribed process. This means that this process evokes a sequence of change events in accordance with a pre-established program or action routine. It tends to create first-order change, change within an existing framework that produces variations on a theme. Over a longer period, small changes may cumulate to produce a larger change. In other words, the execution of projects becomes smoother during the development of the pattern of heedful interrelating. This makes it hard to imitate and contributes to the development of a competitive advantage. It also enables the execution of the project life cycle with this process quality with a high frequency (Chapter Two), as an ongoing accomplishment.

Therefore we conclude that the emergence of a competitive group competence can not take place without the process quality of heedful interrelating, in a context in which groups work in competition, in which clients ask for products that require the integration of knowledge

and in which the required products must be provided within a restricted budget and time-span. Heedful interrelating seems to be the most efficient and flexible way to provide knowledge integration based on (a large amount of) face-to-face interactions (to be tested in other situations however, Chapter Nine). Our findings with regard to the significance of heedful interrelating are congruent with and extend the findings of Hoegl, Weinkauff & Gemuenden (2004) and Zárraga & Bonache (2005). Hoegl, Weinkauff & Gemuenden found that teamwork quality is responsible for performance; Zárraga & Bonache (2005) found that a high-care atmosphere favours knowledge creation and transfer.

Finally, related to the *accommodation of change* addressed in Chapter One, we argue that this process enables the groups to accommodate rapid changes in the environment (with regard to the desired knowledge included in projects) very efficiently, as far as this expertise is present in the groups. Earlier in this section we explained that due to the social rules the repeated project life cycle process is very flexible in making (new) combinations of expertise. Therefore this process enables the groups in making rapid changes in combinations of expertise needed to answer problems posed by clients. This feature of this process contributes to the fit with the environment, in addition to the comprehensive strategy (sections 4.1.2 and 4.2).

4.5 Reflection on the findings with regard to heedful interrelating

In the previous sections we discussed the project life cycle and the pattern of heedful interrelating we encountered in the field studies. In this section we reflect on the contributions of these findings with regard to literature, focusing on the theory of distributed cognition. We will argue that our findings suggest that the theory that describes the emergence of heedful interrelating should be broadened to loose work settings.

The body of knowledge of the situations in which collective mind is developed and in which it emerges is defined by a strict work setting, with strict roles for all the actors involved, high task interdependency, low autonomy, a system that is concrete and has clear boundaries and in which the members have experienced a (long) period of training (for example Hutchins, 1991; Weick & Roberts, 1993; Hutchins & Klausen, 1996; Faraj and Sproull, 2000).

The researchers in the groups in the field studies have a role, a formal description of tasks, which defines their attitude and actions in the daily practice. But how the group members

act is not prescribed by the description of their tasks. Group members have a high autonomy with regard to the tasks they perform and how they perform their tasks. According to Tsoukas (1996) a firm has more or less control over normative expectations (descriptions of tasks, FB), but has no control over its members' dispositions which are derived from past socializations in contexts outside the firm. Concerning the interactive situations, where the expectations and dispositions come together, Tsoukas states that the features of those situations cannot be fully known *ex ante*, but that they are actively shaped by practitioners as they confront local circumstances (which also implies a large autonomy of group members, FB).

The groups in the field studies operate in a context in which the "system" that has to be understood is less obvious and in which feedback has shifted in time and is less obvious to interpret. In the situation in which pilots fly an airplane, the system to be understood is the airplane itself (flying characteristics) and how actions of the pilots affect flying the airplane. In the study of Hutchins (1991) the system which has to be understood is even narrower: measuring the position of the ship, the meaning of these measurements for the actions of the pilot of the ship and understanding the implications of the actions of the pilot for the position of the ship. In the field studies, the group members must understand the goals of a project and how their actions contribute to the project goals, but they also should understand how their actions contribute to the continuation of the group, in the short term and in the long term. Colleagues and clients will provide feedback as a direct result of an action, but feedback can also be shifted in time when we think of clients assigning additional projects or taking their business elsewhere. This situation differs considerably from flying an airplane or measuring the position of a ship. It is more abstract and the consequences of actions are often not directly visible in feedback.

Berends (2003) relates (the degree of) task interdependency to the (degree of) integration of cognitive work. The degree of integration of cognitive work refers to the degree in which cognitive work is oriented toward the same tasks according to Berends (p. 174). He dichotomizes both the dimension of task interdependence and the dimension of integrated cognition into a strong and a weak pole (p. 178). He positions Weick & Roberts (1993) as an example of strong integration of cognitive work and strong task interdependence. According to Berends the studies of Hutchins (1991), Hutchins and Klausen (1996) and Faraj and Sproull (2000) focus on groups executing tightly coupled tasks. Berends shows that in an industrial R&D environment there are situations in which there is a strong task interdependence, but there are also situations in which there is weak task interdependence while there still is a strong integration of cognitive work. This means according to Berends

that the integration of cognitive work is not only a response to task interdependence. In this study, as in the study of Berends, a number of research tasks were found that are quite independent. The analysis of the project portfolio (Appendix five) shows that in 5% of the projects of the Ecology Group and in 18% of the projects of the Postharvest Group (during the first quarter of 2001) only one researcher was directly involved (other researchers can be involved on an *ad hoc* basis, providing advice and thinking along). In 27% respectively 43% two researchers were directly involved. The remaining projects involved between three and fourteen group members. This analysis suggests that the task interdependence in the projects in the group does not depend upon the involvement of the whole or almost the whole group providing specialist results to be integrated in the project. Therefore, the absolute level of task interdependence seems to be weaker than in the study of Hutchins (1991), Hutchins & Klausen (1996) and Weick & Roberts (1993), where the whole crew is necessary to perform the task at hand; they work on tightly coupled tasks (Berends, 2003). In this study we found projects in which there is strong task interdependence, but there are also a number of projects in which the task interdependence is weak.

Finally with regard to training, the groups involved in this study show a situation where group members differ in their educational backgrounds but also had a mutual training during the period they worked together as a group. The group head of the Postharvest Group explained that there was no educational program (at university level or other educational levels) which directly fit with the field of research of the Postharvest Group. Therefore the group members had different backgrounds. There were a lot of group members with an educational background related to plant physiology, but these backgrounds differed quite a lot. Group members had not all followed a course of study at Wageningen University, but there were also group members that had studied at other universities. A number of research assistants were trained in analytical techniques to be used in laboratories. Linked to the introduction of genomics, there were also group members with an educational background in biochemistry and cell biology. In their education, group members will not only have developed competences with regard to the content of the profession, but the study will also have affected their attitudes and beliefs. A similar situation was present in the Ecology Group. Most group members had finished a study related to landscape ecology (and a number had studied landscape ecology), but there were also group members with a different educational background (i.e. mathematics, GIS). So, with regard to the educational background, the group members of the Ecology and Postharvest Group did not have an identical or mutual background. However, in work practice they had trained together. They trained by designing and executing projects, by acquiring projects and – more importantly – by sharing their experiences. Compared to the

situations described by Hutchins (1991), Hutchins & Klausen (1996) and Weick & Roberts (1993) executing tasks was not preceded by a (long) period of (mutual) and formal training in which roles and attitudes are explained and relatively sharply defined.

To summarize the context in which the groups in the field studies operate, this context is characterized by relatively weakly described tasks and roles (a low degree of formalization), high autonomy, an abstract representation of the system, a combination of strong and weak task interdependency and a mutual training by participating in the practice. This is quite contrary to the situation defined by Hutchins (1991), Hutchins and Klausen (1996) and Weick & Roberts (1993). As our study shows, in a context characterized by a low degree of formalization, high autonomy, an abstract representation of the system, a combination of strong and weak task interdependency and a mutual training by participating in the practice, a strong integration of cognitive work is also present. The fact that a strong integration of cognitive work is also present in this situation adds a new dimension to the theory of distributed cognition. Findings of Berends (2003), who studied technical communication between researchers in an industrial R&D environment, also point towards this new dimension. He found many instances of technical communication that show a relatively high degree of integration of cognitive work. In our study this result is linked to the emergence of a competitive group competence. In particular the social rules explain how heedful interrelating emerges in a context characterized by the features mentioned above.

Chapter 5 Balancing tensions in a dialectical process

In this chapter we discuss the second process underlying the emergence of a competitive group competence. Central in this process is how individuals balance tensions they experience in mutual interaction and in interaction with clients. We discuss these tensions against an established background of heedful interrelating and have characterized this process as a dialectical process (Poole et al., 2000; Riegel, 1975). We depicted it in the introduction of Chapter Four as the process in the right upper corner (Figure 5.1).

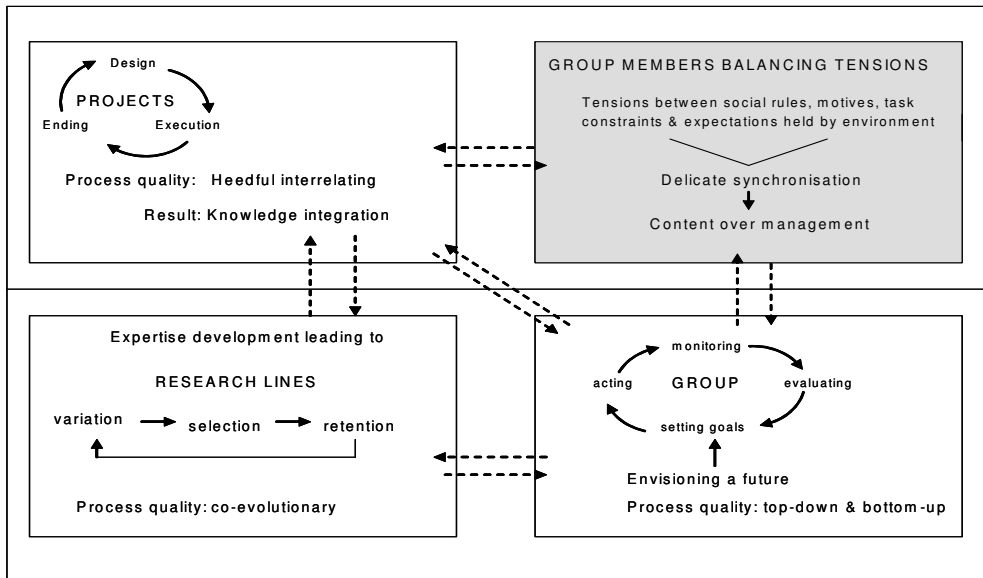


Figure 5.1: The four processes responsible for the emergence of a competitive group competence and the focus of this chapter

Our findings in the field studies suggest researchers in general comply with the social rules and therefore with the practice of heedful interrelating (Chapter Four). However we also found a number of instances in which researchers did not. What we found in the field studies is that researchers experience tensions in the design, execution and completion & evaluation of projects between four dimensions: *social rules* (Chapter Four), *motives* (beliefs and goals that initiate and direct behaviour), *task constraints* (norms imposed by the organization on the activities and behaviour of researchers that are experienced as constraining them in their primary interest: working on what they like) and *expectations*

held by the environment (expectations held by clients, other stakeholders or the general public that are associated with carrying out a particular role). These tensions emerge in a number of dilemmas, related to specific situations. What we found is that the majority of these tensions are situated on the border between content and (financial) management, expressing a second practice in the project life cycle: “*content over management*”.

The tensions address struggles on how to execute project activities (discussed in Chapter Four) in a specific situation. These struggles are addressed by Poole et al. (2000) and Riegel (1975, 1976) as a dialectical process. Poole et al (2000) define a dialectical process as a “motor” responsible for a process of change, explaining “stability and change by reference to the relative balance of power between opposing entities. Stability is produced through struggles and accommodations that maintain the status quo between oppositions. Change occurs when these opposing values, forces or events gain sufficient power to confront and engage the status quo” (p. 63). Riegel (1975, 1976) describes a dialectical process more in terms of balance and imbalance (between dimensions defining biological and psychological development of an individual) and delicate synchronization between these dimensions in order to restore balance. In this chapter we will discuss the kind of tensions researchers meet and how these tensions are solved. We will argue that our findings are closer to those of Riegel than of Poole et al. (2000).

How to position this chapter with regard to the body of literature addressed in Chapter One and our research problem? This chapter focuses on how individuals balance tensions against a background of heedful interrelating. Therefore it is also related to the practice of knowledge integration, how groups manage to integrate knowledge for a longer period of time with a high frequency. We argue in this chapter that this process is also related to changes in the practice of knowledge integration and maintaining fit with the environment, especially as this process accommodates rapid changes in behaviour in the short term related to changing environmental circumstances.

We have organized the discussion of how researchers balance tensions in three sections. In section 5.1 we introduce the dimensions involved in balancing tensions and provide 16 examples of dilemmas we found in the field studies. We will argue that our findings are congruent with literature. In section 5.2 we reflect on our findings with regard to their meaning for the emergence of the patterns of heedful interrelating and content over management and thereby on the meaning of the dialectical process for the emergence of the competitive group competence. In section 5.3 we develop some hypotheses about the adjustment or development of social rules. Our findings in the field studies were

insufficient to describe the process by which social rules are adjusted or developed. Our argument in section 5.2 that the dialectical process of balancing tensions provides signals and new experiences with regard to interacting behaviours will be extended in this section into hypotheses with regard to the process of adjustment and development of social rules.

5.1 Tensions and their balancing in a dialectical process

As we stated in the introduction to this chapter, our findings in the field studies suggest researchers generally comply with the social rules and therefore with the practice of heedful interrelating (Chapter Four). However we also found a number of instances in which researchers did not. An example is the behaviour of Michael (Postharvest Group), especially with respect to the rules “involve the colleagues you need” and “the project leader involves his team”. He states that he does not always consult his colleagues. To my question “do you consult colleagues about the expertise required to answer a request from a client” Michael answers: “No, not in my situation. I don’t know if other colleagues do. I think they ultimately do, because the project must be implemented in the end and then you have to check if the required expertise is there. For the proposals I write and offer, I do not have to consult much. I know what I can do. And whether there are people who are complementary. No, there is not much consulting [about the expertise required to answer a question from a client]” (Michael, Postharvest Group, 121-126). His score in Appendix seven with regard to his involvement in projects confirms this statement. Another example is Andrew's statement (Ecology Group) stating “Researchers just want to do the kind of research they like” (211) and “Most researchers do not dislike working on questions posed by clients, but they still prefer to work on problems based on their own curiosity. They feel nostalgic about the period in which this was common practice” (215-217). Kim (Ecology Group) also expresses a tension stating: “Yes we try to meet the needs of the client and not what you would prefer yourself. We realize that we need this attitude to continue a fruitful relationship with a client and thus serve this client in the best way” (60). What we learn from these examples is that they describe tensions between motives and social rules, in particular in Michael's example. The examples of Andrew and Kim particularly address tensions between motives and task constraints and between motives and expectations held by the environment. The groups must acquire projects from clients in order to continue their research activities in the near future (task constraint) and therefore researchers cannot work (only) on problems based on their own curiosity. Clients that grant projects expect to be served in the best way (expectation held by the environment) and this is also in the interest of the group as they are dependent upon clients (Chapter Three). These examples show

(possible) tensions between four dimensions: motives, social rules, task constraints and expectations held by the environment in which researchers must operate. In Chapter Seven we will argue that due to the process in which the future of the group is envisioned (the teleological process of envisioning a future), motives, personal goals and those of the group are matched, suggesting a higher congruence between these goals and diminishing tensions related to motives.

The tensions we found emerge in a number of dilemmas, related to specific situations. We found that these tensions are situated on the border between content and finance in particular. In Table 5.1 we present 16 dilemmas we found in the field studies, positioned on the interaction between the four dimensions we have just introduced. Posing the question how individuals solve tensions with regard to expected behaviour has provided a focus to search our data for these dilemmas. Inspired by Riegel (1975, 1976) we distinguished between dilemmas in which researchers produce a “reactive” solution and dilemmas in which researchers resolve the tension by a “generative” solution. By a reactive solution we mean that a loss is experienced on one of the (at least) two dimensions involved in tension. This is the case in the example of Michael (previous paragraph), in which he follows his motives and personal preferences but in which a “loss” is experienced with regard to the social rules: he does not comply with some of the social rules (in particular situations). By a generative solution we mean that a tension is balanced by providing a solution in which there is no loss experienced on both (or all) dimensions involved in the tension. Our discussion in Chapter Four on researchers who want to work on what they like (motive) but must also be financially covered (task constraint) provides an example. Instead of waiting for assignments (with the risk of being assigned to a project you don’t like) they actively acquire projects combining the motive to work on what they like and providing financial coverage. For some of the cells in Table 5.1 we found a number of examples and we chose one. For other cells there was only one example available, as these dilemmas do not represent an exhaustive analysis of all dilemmas present in the field studies. They serve as illustrations of the kind of dilemmas researchers meet.

In order to address tensions, we also had to develop an understanding of each of the dimensions in Table 5.1. In Chapter Four we discussed the social rules, but what are the motives of researchers, what are the task constraints they have to meet and what expectations are held by the environment? We found a number of motives, task constraints and expectations held by the environment that raised our understanding and supported the identification of tensions. However we will not argue that we identified all motives, task constraints and expectations held by the environment.

Motives

Dörnyei and Ottó (1998: 65) define the concept of a motive from an individualistic and psychological-behavioural perspective: “a motive is the dynamically changing cumulative arousal in a person that initiates, directs, coordinates, amplifies, terminates and evaluates the cognitive [...] processes whereby initial wishes and desires are selected, prioritized, operationalized and [...] acted out”. In this definition, beliefs, goals and emotions (cumulative arousal) in the individual are linked to behaviour. This is also the perspective from which we defined motives in the field studies. We found three widely shared motives: “I like to work on what I like (and satisfy my curiosity)”, “I like to collaborate with my colleagues as they provide support” and “I like to be recognized as a professional (by my colleagues and management)”. In Chapter Four, section 4.3, we argued that the social rules are not an isolated phenomenon, but that they are embedded in the motives of the researchers. Researchers not only interrelate respectfully because of the social rules, but also because of a well grasped self-interest. In Chapter Four we discussed the first two motives (“I like to work on what I like” and “I like to collaborate with my colleagues as they provide support”) related to compliance with the social rules. With regard to the third motive, in Chapter Four we explained that researchers substitute the task constraint “provide a financial result” with the rule “work decently and as a good colleague” in the execution phase of projects. Applying this rule (in general) leads to appreciation (from colleagues and management) and acceptance as a project leader. This appreciation makes it more likely that the researcher will be asked to lead a project again. It also contributes to the maintenance of the status of researchers in the group and promotes their chance of working on what they like and achieving a high professional level. These motives are in line with literature (Weggeman, 1997; Eckval, 1988; Shapero, 1985), as literature argues that becoming an expert in a field of research and achieving a high level of professionalism are important drivers for researchers.

Task constraints

In addition to the social rules (Chapter Four), we found task constraints that regulate behavior. The social rules we found particularly refer to arrangements made by and supervised by the researchers themselves, whereas the task constraints refer to arrangements imposed by management (of the group or the institute). Both categories of arrangements are also perceived differently. The social rules are taken for granted, as “this is our practice”, whereas the task constraints are perceived as norms that are imposed, as annoying, norms that you must obey although you would rather not. In the examples we provide in the next paragraphs, these characteristics emerge very clearly. We therefore

define task constraints here as norms imposed by the organization that have a guiding role on the behaviour of researchers and by which behaviour is assessed. Norms are perceived as constraints by researchers as they feel that they limit their primary interest: working on what they like.

In Chapters Three and Four, we identified a number of these task constraints. In Chapter Three we argued that the groups (and thereby the individual researcher) were forced to develop a market and client-oriented way of working in time, meeting opportunities in the market and meeting requirements posed by clients. When we evaluate this way of working from the perspective of the conditions experienced by the groups in the past and the motives of researchers, this new way of working is a (new) task constraint, as seen in the statements of Andrew and Kim provided in the introduction of this section. We also argued that the groups had to develop a practice in which they work according to business economic rules, taking all costs for the execution of a project into account, providing a net positive financial project result and a yearly positive net financial result for the group as a whole. Some business economic rules have been translated into social rules in time, as for example into “work decently and as a good colleague”. Working according to business economic rules also provided more fine grained constraints. One example is that every researcher has to cover 65% of his working time by contributing to projects. Another example is that research time spent on projects has to be accounted for, implemented by operational rules prescribing that only researchers mentioned in the project plan are supposed to work on the project and can account for their research time spent on the project (Table 4.2). Why this works as a constraint is illustrated by Laura: “People cannot account for their time on a project on which they are not registered when they help each other. They then must fill out another form, which doesn't work at all. Although it should be possible” (Laura, Postharvest Group, 223-225). Another example is Brian's statement: “The administrative bureaucracy drives you crazy. There are too many forms to fill out and rules to obey if you just want to buy a photo for a research report, for example. This constitutes a severe constraint and reduces your enthusiasm to work here” (Brian, Ecology Group, 121-122). Two other examples are the evaluation of projects within budget and the acquisition of projects with a budget that includes sufficient room for set-backs and that even then provides a financial result. Another example of a fine grained constraint is that project leaders are expected to manage projects at a relatively high professional level. They have to make project plans that are formally approved, they have to operate within budget and they have to evaluate projects (Tables 4.2 and 4.4). Finally we found a task constraint that prescribes that valuable knowledge that provides a competitive advantage should be protected. This includes models (as in the Ecology Group) but it also refers to knowledge which can be patented. This knowledge

cannot be freely shared with clients, directly or in publications. A discussion we found in the Ecology Group with regard to making models “free for all” on the internet refers to this constraint to some extent (Table 5.2 and Chapter Six).

To summarize, we found nine task constraints: (a) a market and client-oriented way of working; (b) protecting valuable knowledge that provides a competitive advantage and (c) working according to business economic rules, for which we found four more fine grained constraints: (d) covering 65% of working time by contributing to projects (“take care of your financial coverage”, Chapter Four); (e) only researchers mentioned in a project plan can account for their research time spent on a project; (f) filling in forms for the purchase of materials, (g) evaluating projects within budget, (h) acquiring projects with a budget that has sufficient room to provide a financial result even when set-backs are met (in coherence with “provide a positive financial result at the end of a project”, Chapter Four) and (i) executing project management activities at a relatively high professional level.

Expectations held by the environment

In addition to normative constraints (see previous paragraphs on task constraints), Tsoukas (1996) uses the phrase normative expectations to refer to expectations that are associated with the carrying out of a particular role. Where these expectations refer to those held by the environment (clients, government and the general public) we define these as “expectations held by the environment”. They differ from norms as they still have an element of desirability and ambiguity and are not translated into a quantitative or qualitative standard or measure. In addition they do not necessarily have to be experienced as a constraint in the implementation of the role as a researcher as they can still be an element of what researchers “really like to work on”. However, these expectations are not completely without engagement as meeting these expectations raises the social justification of research and of being a researcher (Krijnen, 1986, based on Pearson, 1979).

We found a number of expectations held by the environment. Firstly, clients want to be served as well as possible, just as in all other fields of the economy in which clients buy products. This refers to the term in which an offer should be made, the term in which they can expect results from research and fit between what they intended to receive as a product and what they actually receive. They want to be served as well as possible and therefore they sometimes even require the best researcher to work on their project. As we will illustrate in Table 5.1, these demands can be experienced as severe constraints as carefully formulating an offer often requires involvement of a number of researchers and the expert may not always be available to work on a specific project. Secondly, in Chapter One we

discussed that fit between environment and the group is an important requisite for the emergence of a competitive group competence. The consequence of this requisite is that the environment (implicitly) expects the research group to provide solutions for problems of present interest but also to work on expertise development that will lead to new ideas and new concepts. The group has to balance these demands, keeping their customers satisfied now and in the future. Thirdly, we found that what is expected of researchers changes in time. Researchers in the field studies are supposed to make stronger contributions to solving social problems, comparing the terms of reference for an external evaluation committee in 2002 with those of 1995¹. The terms of reference in 2002 refer to demonstrable influence on government policies, generating public opinion, contributing to the solving of social problems and business development. Researchers are also supposed to focus more on knowledge transfer, through consultancies but also through educational programs. In the research programs executed on behalf of the Ministry for example, five percent of the budget is reserved for knowledge transfer. All these expectations held by the environment can also create tensions related to the present social rules, motives and task constraints as we will illustrate in Table 5.1.

¹ Terms of reference for the evaluation committee of Alterra, May 2002 and the Terms of Reference for the evaluation committee of IBN, 1995

Table 5.1: Dilemmas found in the field studies related to tensions between social rules – motives – task constraints and the expectations held by the environment				
	Social rules	Motives	Task-constraints	Expectations held by the environment
Social rules	Involve the colleague you need and if you don't want to participate, you don't have to (RE) a	Working on what you like and respect the client / provide a satisfied client (RE) b	Respect the client and provide a financial result (RE) c	Meet expectations of a client with regard to the speed of making an offer and involve the colleagues you need (RE) d
Motives	An individualistic orientation and involving colleagues in your project (GE) e	Being acknowledged as a professional and an attitude of collaboration (GE/RE) f	Providing room to work on what your colleague like and providing a financial result (RE) g	Opinion about the contribution of a researcher and the motive of being a researcher (RE) h
Task constraints	Involving a colleague in your project and meeting administrative rules (GE) i	Working on what you like and being financially covered (GE) j	Evaluating projects and ending a project within budget constraints (RE) k	Accepting projects that are not scientifically challenging and ensuring satisfied clients (RE) l
Expectations held by the environment	Meeting the requirement to include top quality researchers and involving the colleagues you need (GE) m	Meeting expectations held by clients and working on what you like (GE) n	Sharing knowledge and strengthening your scientific position (GE) o	Focus on providing solutions for customers versus expertise development for the future (RE) p

Notes: The cells contain examples of dilemmas researchers meet; cells are coded from a up to p
 GE means that we found a generative solution in the field studies
 RE means that we found a reactive solution in the field studies

In Table 5.2 we have worked out each of the dilemmas we presented in Table 5.1. For each dilemma we define the dilemma, describe the situation in which it emerges, the solution we found and we indicate the frequency with which we met this dilemma in the field studies.

Table 5.2 Dilemmas experienced by the researchers in the field studies and how these are solved

Cell	Dilemma
a.	<p><u>Situation</u>: the social rules prescribe a project leader to “involve the colleagues you need in your research project”. This enables the project leader to include all the expertise that is needed in the project to answer the research problem at hand. It also enables the group to make flexible combinations of distinctive competences. However, when researchers are asked to participate in a project, they can also refuse this request, applying the social rule “if you don’t want to participate in a project, you don’t have to”. However this can have serious consequences if the specialist expertise of this researcher is not available elsewhere in the group and it is imperative in order to answer the research problem, to provide a result experienced as extraordinary and to provide a satisfied client.</p> <p><u>Dilemma</u>: how to involve a colleague you need in your project (<i>social rule</i>) when this colleague refuses the request to participate (<i>social rule</i>: if you don’t want to participate in a project, you don’t have to)?</p> <p><u>Solution ‘reactive’</u>: There do not seem to be many other reasons in the groups in the field studies to refuse to participate in a project other than that a colleague really has no time available (his/her time is covered completely by projects, projects have high priority and cannot be postponed). Reasons not to participate seem to be accepted quite easily (respectful interrelating). As Kim states: “Then others have to do the job, but if it is not done properly you ultimately have to fix it and that costs money” (Kim, Ecology Group, 181)</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: several times</p>
b.	<p><u>Situation</u>: Researchers prefer to work on what they like, what really inspires them. But they also must provide the results expected by clients, even if this means that you have to work on issues that you find less inspiring. As Andrew states:” Most researchers do not dislike working on questions posed by clients, but they still prefer to work on problems based on their own curiosity. They feel nostalgic about the period in which this was common practice” (Andrew, Ecology Group, 215-217)</p> <p><u>Dilemma</u>: how to combine working on what you like (<i>motive</i>) and act according to the <i>social rules</i> “respect the client” and “provide a satisfied client”.</p> <p><u>Solution ‘reactive’</u>: Kim states in this respect: “Yes, we try to meet the needs of the client and not what you would prefer yourself. We realize that we need this attitude to continue a fruitful relationship with a client and thus serve this client in the best way” (Kim, Ecology Group, 60).</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: several times</p>
c.	<p><u>Situation</u>: One of the <i>social rules</i> stipulates that researchers should “provide a satisfied client”. However, there is also a <i>task constraint</i> that stipulates that researchers should “provide a financial result”. Sometimes researchers encounter situations in which they have to do extra work in order to satisfy the client and in which it is often unclear whether these activities should be performed within budget. Kim states: “Ending a project is often messy. The client has additional questions, leaving you wondering whether these are part of the assignment or not. Ending a project is often a speedy process and is often handled bilaterally” (Kim, Ecology Group, 197-199). Ken (Ecology Group) also addresses this situation. He states that “It is hard to distinguish extras you deliver over and above the project result. And it is even harder to make a client pay for these extras. We still have the image of a research institute that delivers all that is asked for without additional budget. We have to educate our clients that we will charge them for extras” (Ken, Ecology Group, 68-70).</p> <p><u>Dilemma</u>: meeting the requirements formulated by the client (in order to provide a satisfied client) without additional budget means that a financial result is not achieved. Ensuring a satisfied client (without additional budget) often means that there will be no financial result (so a <i>social rule</i> and a <i>task constraint</i> conflict in this dilemma).</p>

Continuation of Table 5.2

Cell **Dilemma**

Solution 'reactive': breaking the task constraint "provide a financial result" but providing a satisfied client. As for example in: "that was a very exacting client, whose wishes we tried to fulfil every time" (Simon, Ecology Group, 205-260)

Frequency with which we met this dilemma combined with this solution: frequently

- d. Situation: The researchers sometimes encounter situations in which expectations held by the environment conflict with the social rules. One example is when a client requires an offer very quickly, which makes it hard to involve the client and to involve colleagues in translating the request from the client into a research proposal. As Kim states: "Sometimes an offer is sent to the client very quickly; each situation is different in that respect. It depends on the client, how fast your offer has to be there. There is not always sufficient time [to consult colleagues and the client, fbj]" (Kim, Ecology Group, 173)

Dilemma: How to meet the client's requirement for delivering an offer very quickly (*expectation held by the environment*) and including colleagues and the client (*social rules*)? We have not found a social rule that requires colleagues to be involved in making an offer, but from the project activity "translating the request of the client into the expertise needed" a general practice emerges to do so as for example Kim's statement: "I organize meetings with colleagues who know something about this topic, who can contribute..." (Kim, Ecology Group, 169). The involvement of the client is addressed in the social rule "involve the client in making a project proposal".

Solution 'reactive': as we see from Kim's statement, offers are sent without consulting colleagues and the client.

Frequency with which we met this dilemma combined with this solution: several times

- e. Situation: researchers differ in the way they feel others can contribute to their work. Some have a stronger natural tendency to work on their own; others are stronger team players who interact with colleagues a lot. However, a stronger orientation to work on your own conflicts with the social rules, see for example the rule "involve the colleagues you need". One example is Michael's behavior. In answer to my question whether he consults colleagues about what expertise is needed to respond to a request from a client, Michael says: "No, not in my situation. I don't know if other colleagues do.... For the proposals I write and offer, I do not have to consult much. I know what I can do. And whether there are people who are complementary. No, there is not much consulting..." (Michael, Postharvest Group, 121-126).

Dilemma: how to stay an accepted and appreciated member of the group when you have a strong preference to work on your own (*motive*) and will break some of the *social rules*.

Solution 'generative': a solution to this problem is provided by Joe who states that as a group leader he also takes into account strong and weak points of his group members, for example, when he assigns tasks to people. He is thus able to provide researchers with a strong preference to work on their own with a job that suits them and to make them valuable for the group. "Based on a mutual image of strong and weak points, assignments have been made with regard to who performs what task. I am satisfied when group members take their responsibility and are able to accomplish what we have agreed. In addition when social relations are businesslike at the same time, people respect each other and do not frustrate each other by acting too strictly" (Joe, Ecology Group, 115-119).

Frequency with which we met this dilemma combined with this solution: once

Continuation of Table 5.2

Cell Dilemma

- f. Situation: one of the motives of researchers is to be acknowledged as a professional researcher with a scientific standing. For example, in Andrew's statement: "therefore you must develop a professional status in a field of research" (Andrew, Ecology Group, 213). In order to achieve this status, you have to be recognized by colleagues outside the group and by clients. They will evaluate you by the projects you work on or have worked on and particularly by your publications. This need for recognition implies a natural tendency to work on your own or to highlight your personal contribution to projects. But the researchers in the field studies also act by the motive "I like to collaborate". Kevin states "[you need the participation of other researchers] because of the physical requirements, you can't do it all on your own, but also because you need colleagues with a special kind of expertise or educational background, colleagues who can conduct experiments, colleagues who can focus on the fundamental aspects of certain processes" (Kevin, Postharvest Group, 41-45).
Dilemma: how to acknowledge recognition as a professional (*motive*) and to behave in line with the *motive* "I like to collaborate with my colleagues as they provide support".
Solution 'generative': development of a specialist profile which, in combination with clients that grant projects requiring the integration of a number of disciplines, also stimulates collaboration. As Simon states: "The most important criterion is that my colleagues are satisfied with my work. That they tell me "you're doing some very interesting work". Besides, output is important, I mean papers to be published in scientific journals. And that colleagues approach you with scientific problems. That they recognize and acknowledge that you have a high professional standard in a field of research and that they are eager to use your knowledge" (Simon, Ecology Group, 227-230).
Solution 'reactive': application of the rule "a success is always a shared success". For example Ken who states: "When your contribution is substantial, it will be recognized. It is not recognised if your contribution was only small. But that's OK." (Ken, Ecology Group, 49-51). And Edward who states: "Colleagues often know what you contribute in projects, what your role is....." (Postharvest Group, 236).
Frequency with which we met this dilemma combined with these solutions: frequently
- g. Situation: every researcher in the group likes to work on projects that include his or her expertise (*motive*). They expect to be included if their expertise is needed and they want to make a contribution of high quality. This emerges from statements like "researchers just want to do the kind of research they like" (Andrew, Ecology Group) and "are you involved in problem solving, do colleagues consult you, do they involve you in their project? If this happens, then you're doing your job properly..." (Kim, Ecology Group). In order to provide this contribution, they need sufficient time. The project leader however also has to ensure that he ends the project within budget and provides a financial result, meeting the *task constraint* "provide a positive financial result at the end of a project".
Dilemma: how to include your colleagues with the expertise you need, provide them with sufficient time to make a valuable contribution (*motive*) and provide a positive financial result (*task constraint*)?
Solution 'reactive': breaking the task constraint "provide a financial result" by applying the rule "work decently and as a good colleague" (Chapter Four) as in Ken's statement: "You speak to colleagues about the research time spent on the project and you encourage colleagues to register their time spent. But this department is not very strict about this" (Ken, Ecology Group, 86-87), by which he implies that a high quality contribution is more important than strictly meeting agreements about the time that can be spent on a project.
Frequency with which we met this dilemma combined with this solution: frequently

Continuation of Table 5.2

Cell	Dilemma
h.	<p><u>Situation</u>: researchers in the field studies want to do research to satisfy their curiosity. As Ken states: "What is important for me in my work here is my enthusiasm for this field, working on nature and ecology. And in addition, working with people who have the same interests" (Ken, Ecology Group, 13-16). But the context in which the groups work also requires them to write articles in non-scientific journals, to discuss their findings with the public and to transfer their findings to educational programs. They are thus supposed to contribute to a public debate and the solution of social problems. These expectations have developed in time (this chapter).</p> <p><u>Dilemma</u>: how to satisfy your own curiosity (<i>motive</i>) and transfer and discuss your findings with students, politicians and the general public (<i>expectation held by the environment</i>) although you want to move on to the next project?</p> <p><u>Solution 'reactive'</u>: accept that transferring and discussing your findings with students, politicians and the general public has a higher priority than your own curiosity. This is reflected in the terms of reference of external evaluation committees and in the ex-post evaluations of research programs funded by the Ministry. It is also reflected in social rules like "take your responsibility" and "don't bring your group or the institute in problems"</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: once</p>
i.	<p><u>Situation</u>: The social rules address that researchers should "involve the colleagues they need in their project" (Chapter Four). However, they sometimes meet situations in which it is not clear beforehand that a specific colleague is needed. In this situation they approach this researcher for his participation but they also need to make administrative arrangements because the administrative rule states: "only the researchers mentioned in the project plan are supposed to work on the project and can account their research time spent on the project" (Table 4.2; task constraint).</p> <p><u>Dilemma</u>: how to include a colleague in a project at the moment he or she is needed (<i>social rule</i>) and to meet the administrative <i>task constraints</i>? As Laura states: "people are not able to account for their time on a project on which they are not registered when they help each other. Then they must fill out another form, which doesn't work at all, although it should be possible" (Laura, Postharvest Group, 223-225).</p> <p><u>Solution 'generative'</u>: project leaders allow project members who instantly must help a colleague with another project on which they are not allowed to account their time, to account the time on their own project. This is corrected afterwards in discussing the budgets of projects. As Larry states: "we have a meeting of project leaders once a month in which we discuss the figures about budget and progress of each project and in which the project leader summarizes the state of affairs" (Larry, Postharvest Group, 156-157).</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: several times</p>
j.	<p><u>Situation</u>: management requires that researchers work on projects that are financially covered with a (approved) budget (<i>task constraint</i>). Researchers want to work on what they like (<i>motive</i>) and for them their financial coverage is not their first priority. But in order to work on what you like, you must be financially covered.</p> <p><u>Dilemma</u>: how to work on what you like (<i>motive</i>) when you're not financially covered (<i>task constraint</i>)?</p> <p><u>Solution 'generative'</u>: because researchers can be assigned to projects that they do not like when they are not financially covered they start to acquire research projects: "you better take care yourself that you're working time is covered because than no-one can force you and you have more freedom. Because when you're not covered by projects on paper you could be assigned to a project that you don't like" (Michael, Postharvest Group, 275-280).</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: several times</p>

Continuation of Table 5.2

Cell	Dilemma
k.	<p><u>Situation</u>: it is important to evaluate projects because it enables the organization to learn from these projects and apply lessons learned in new projects or projects that are currently being executed. This is why the management of the Ecology Group has made project evaluation compulsory.</p> <p>However, evaluations are also time consuming. As budgets are often tight and an evaluation is the final step in the execution of a project, there may be little or no room left for an evaluation.</p> <p><u>Dilemma</u>: how to evaluate a project (<i>task constraint</i>) and stay within project budget (<i>task constraint</i>)?</p> <p><u>Solution 'reactive'</u>: neglect the obligation to evaluate projects. This practice is addressed in one of the social rules: "the evaluation of a project is obligatory, but you don't have to follow that rule" (Chapter Four).</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: frequently</p>
l.	<p><u>Situation</u>: in order to stay attractive for clients, the groups in the field studies must ensure that their projects are scientifically challenging. Otherwise they lag behind their competitors and become too expensive. The Ecology Group, for example, has developed a number of models. Because of these models, clients also ask them to execute projects in which these models are (only) applied. These projects are not very challenging.</p> <p><u>Dilemma</u>: each researcher experiences the tension to accept such a project in order to satisfy a client (particularly relevant for important clients) (<i>expectation held by the environment</i>) and raise financial coverage or refuse such a project and acquire a scientific more challenging project (<i>task constraint</i>). Besides, the acquisition of a project which is not very challenging is not appreciated by colleagues, as in Simon's statement (dilemma f).</p> <p><u>Solution 'reactive'</u>: accept the project to satisfy a client and raise financial coverage. As Peter states: "In acquisition trajectories, you try to live up to this principle [of acquiring scientifically challenging projects]. You keep this in mind. However, it depends on the financial situation" (Peter, Ecology Group, 49-50).</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: several times</p>
m.	<p><u>Situation</u>: clients sometimes want to involve the best researcher or expert in a field of research in their project. But these researchers often have no time available to participate. Although a social rule states that "you should involve the colleagues you need" this is not always possible. When researchers do not have time available, they can say "no" to a request for participation (Chapter Four).</p> <p><u>Dilemma</u>: how to include the colleague you want to involve (requested by the client; <i>expectation held by the environment</i>) when he or she has no time available to participate in your project and can say "no" (<i>social rule</i>)?</p> <p><u>Solution 'generative'</u>: if a colleague has no time available and a project leader is set on involving this colleague, group members come up with constructions that allow participation in a form which is restricted with regard to the required research time. An example is involvement as a reviewer. As Kim states: "As an alternative, I try to arrange thing so that others do the job and that this colleague is invited as a reviewer, or as a trouble shooter, or I invite him to brainstorm" (Kim, Ecology Group, 181).</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: once</p>

Continuation of Table 5.2

Cell	Dilemma
n.	<p>Situation: as we explained in the situation described in cell h, researchers want to work on what they like. They want to work on problems that satisfy their curiosity. Researchers can experience clients as very demanding and as a constraint in developing new expertise as they (have to) interact with the client frequently: consult the client, keep the client informed, provide results, don't break the promises you made, etc. Remember Michael's statement in this respect: "We have a lot of contact with the client in the execution phase of a project. In general more than I like. Maybe because our expectations and those of the clients differ. When a client is paying for research, he wants to know everything and so he calls often. Maybe more than you would like him to call" (Michael, Postharvest Group, 221-224)</p> <p>Dilemma: how to satisfy your own curiosity (<i>motive</i>) and meet the expectations held by clients (<i>expectation held by the environment</i>)?</p> <p>Solution 'generative': acquire projects funded from budgets that provide more freedom. This is reflected in Michael and Kevin's statements. Michael refers to a budget for strategic expertise development and states: "Well, for this fund there is not a very strict obligation to provide results, so there is more freedom and that is what everybody likes" (Michael, Postharvest Group, 149-150). And Kevin refers to this budget stating: "These are the most important projects. In these projects we want to learn and strengthen our scientific position. These projects also provide opportunities for people to work on a thesis" (Kevin, Postharvest Group, 139-141).</p> <p>Frequency with which we met this dilemma combined with this solution: several times</p>
o.	<p>Situation: in order to stay attractive for clients, the groups in the field studies must ensure that their projects are scientifically challenging. Otherwise they lag behind their competitors and become too expensive. The Ecology Group, for example, has developed a number of models. Because of these models clients also ask them to implement projects in which these models are (only) applied. These projects are not very challenging.</p> <p>Dilemma: each researcher experiences the tension to accept such a project in order to satisfy a client (particularly relevant for important clients) (<i>expectation held by the environment</i>) and raise financial coverage or refuse a project and acquire a scientific more challenging project (<i>task constraint</i>). Besides, the acquisition of a project which is not very challenging is not appreciated by colleagues, as in Simon's statement (dilemma f).</p> <p>Solution 'generative': in the Ecology Group a discussion took place about making the developed models accessible on the internet, stimulating their use ('free for all') and tempting clients to grant projects to improve these models. As Andrew states: "I feel we have to make our models accessible on the internet. Questions to improve and expand these models will come automatically. Until now we were the only users of these models. We must be careful, otherwise our work will become repetitive. We should develop a situation in which others apply our models and in which we focus on renewal" (Andrew, Ecology Group, 235-238).</p> <p>Frequency with which we met this dilemma combined with this solution: several times</p>
p.	<p>Situation: The research groups need to provide solutions to clients often based on their present expertise. But they also have to work on expertise development which will provide them with new concepts and ideas. These new concepts and ideas are important to strengthen their scientific reputation, raise commitment for new research lines with clients and finally to increase the chance of grants for future projects. Although assignments between researchers differ, a (large) number of researchers is involved in projects providing solutions and in projects directed at expertise development. To some extent, these projects are funded by a budget for strategic expertise development or by research programs funded by the Ministry. Because the projects directed at strategic expertise development have no direct client waiting for solutions, these projects often have a lower priority.</p>

Continuation of Table 5.2	
Cell	Dilemma
	<p><u>Dilemma</u>: how to manage the balance between projects directed at expertise development and projects providing clients with solutions (here <i>expectations held by the environment</i> conflict)</p> <p><u>Solution 'reactive'</u>: postpone projects focused on expertise development. An example is Edward's statement: "I worry about the scientific part of our work. We operate in a commercial environment and if we do insufficient scientific research, generating new concepts and ideas, we will be sold out in a period of 10 years. We therefore must look at this aspect of research work" (Edward, Postharvest Group, 90-92). However, he also states: "The pressure of ending projects for clients makes it difficult to execute projects directed at expertise development. We have had a year in which we had a reasonable amount of money for expertise development, but we were not able to develop these projects because there was no time" (Edward, Postharvest Group, 111-114).</p> <p><u>Frequency with which we met this dilemma combined with this solution</u>: several times</p>

Interpreting the dilemmas and linking them to literature

What we learn from the examples provided in Tables 5.1 and 5.2 is that tensions can emerge in and between all four dimensions. We also learn from these tables that most of the examples express tensions related to the content of research work and the management aspects, especially financial aspects (examples c, g, i, j, k, n and p). Another important group of tensions are those related to the content of research work and clients (examples b, l, m and o). To some extent this relation is implicitly related to the financial aspects of research work. The other examples address tensions between social rules and motives (example e), between motives (example f), between rules (example a) or between expectations in the environment and motives (example h). With regard to the solutions, the tables show that content is more important than management (examples c, g, i, j and n) and that the solutions often (also) favour the interests of the client (examples b, d, h, l, m and o).

Therefore, the way these tensions are solved indicate a second quality, an established practice, in the design, the execution and the ending & evaluation of projects (Chapter Four): a practice of '*content over management*'. As we stated in Chapter Four, the most important thing for the researchers in the Ecology and Postharvest Group is to work on what they like. Working on what you like is related to the content of the work, the research topics you enjoy working on. Research work is not about superior project management. Achieving a financial result is not considered the most important aspect of research work: success is evaluated by professionals on other criteria than financial criteria (Sadler & Milmer, 1993). Of course researchers must comply with the task constraint "provide a financial result", but we found that this constraint was often translated into the rule "work

decently and as a good colleague” (Table 4.6). In this rule, a better balance was found between working decently within all (business economic) rules and doing justice to the scientific contributions necessary to complete a project result even if this means that the project budget is somewhat violated. This also emerges in dilemma g presented in Table 5.1., as every researcher in the group likes to work on projects that includes his or expertise (motive), expects to be included in a project if this expertise is needed and wants to make a contribution of high quality (professional norm). We find these issues for example in Kim's statement, concerning whether she is doing her job properly: “are you involved in problem solving, do colleagues consult you, do they involve you in their project? If this happens, then you're doing your job properly...” (Kim, Ecology Group, 231). In order to provide this contribution, a researcher needs sufficient time. The project leader however also has to ensure that he completes the project within budget and that he provides a financial result, thus meeting the task constraint “provide a positive financial result at the end of a project”. So the dilemma experienced here is how to include colleagues with the required expertise, provide them with sufficient time to make a valuable contribution and stay within budget. What we frequently found is that this dilemma is solved by applying the rule “work decently and as a good colleague”, breaking the task constraint “provide a financial result”. An example is Ken's statement: “You speak to colleagues about the research time spent on the project and you encourage colleagues to register their time spent. But this department is not very strict about this” (Ken, Ecology Group, 86-87).

The pattern “content over management” is in line with literature, following the arguments presented by Shapero (1985), Miller (1988) and Weggeman (1997) who argue that professionals focus on the content of their work and not on the managerial and organizational aspects.

As solutions often favour the interests of clients, Table 5.1 also confirms the practice of heedful interrelating with clients (Chapter Four). Based on Fosstenlocken et al. (2003) we can interpret the groups in the field studies as groups operating in a “professional service company” as they deliver knowledge-intensive services with a high degree of customization, a high degree of discretionary effort and personal judgment, substantial interaction with the client and as these services are delivered within the constraints of professional norms of conduct. For these kinds of organizations, decisions in favour of the client are not rare or strange as these companies depend on clients. Finally, Table 5.2 also shows that the solution for dilemmas f and k is the application of a social rule. This suggests that these tensions have existed for some time and that in this time a social rule has been developed to solve this tension.

In our findings the dilemmas represent a thesis and antithesis and the solutions reflect the synthesis. This process is addressed by Poole et al. (2000) and Riegel (1975, 1976) as a dialectical process. Poole et al (2000) define a dialectical process as a “motor” responsible for a process of change, explaining “stability and change by reference to the relative balance of power between opposing entities. Stability is produced through struggles and accommodations that maintain the status quo between oppositions. Change occurs when these opposing values, forces or events gain sufficient power to confront and engage the status quo” (p. 63). Their definition of the (ideal type of) dialectical process seems to address the terms posed by Marx as one of the pioneers of this theory of social change in particular (p. 59): opposition, conflict, confrontation, contradictory forces of interests, thesis, antithesis and synthesis. Riegel (1975, 1976) however, describes a dialectical process more in terms of balance and imbalance and delicate synchronization between these dimensions in order to restore balance. The words used and the atmosphere created by Riegel are more friendly, not specifically drawing attention to conflict but to tensions and how these are solved. Our findings are closer to those of Riegel than of Poole et al (2000). We did not find conflict in the field studies, practices heavily debated and researchers with very different ideas on how to proceed. In interpreting our findings, we suggest that the solutions we found in the field studies are not concerned with “struggles”, but with maintaining the status quo between “opposing entities”. We have not encountered completely new, radical solutions to solve these tensions, or one of the dimensions gaining so much power that the other dimension is put out of order. Therefore this process takes places against a background of established practices of heedful interrelating and content over management. However researchers do meet tensions (imbalances) in specific situations. What we found is that these tensions require delicate synchronization in order to re-establish balance.

To summarize, we found that researchers experience tensions in the design, the implementation and the ending & evaluation of projects. We argued that these tensions are solved in a dialectical process against a background of established practices of heedful interrelating and content over management. These tensions do not express conflict or heavy debate, but express imbalances in specific situations that require delicate synchronization in order to re-establish balance. Finally we argued that our findings are supported by literature. Our finding of the practice “content over management” also expands literature, providing task constraints and social rules in which this practice is embedded. In the next section we will discuss the significance of this dialectical process of balancing tensions for the emergence of the competitive group competence.

5.2 The significance of the dialectical process

In this chapter we discuss our findings of how researchers balance tensions they meet in their work, especially with regard to compliance with the social rules. Compliance is important, as the social rules support the emergence of the social practice of heedful interrelating that underlies the emergence of the competitive group competence. But what is the contribution of this dialectical process of balancing tensions with regard to the emergence of a competitive group competence? Based on our findings, we address five contributions.

Firstly, the kind of dialectical process we found addresses delicate synchronisation of the dimensions social rules, motives, task constraints and environmental expectations to solve tensions researchers experience in their mutual interaction and in interaction with clients. This kind of dialectical process, its style, suggests that it takes place against a background of established social practices of heedful interrelating and content over management. The word established meaning that in most situations most researchers comply with these practices, as this style is quite different from a situation as addressed by Poole et al. in which there is conflict, opposing behaviours, struggle and contradiction. Therefore implicitly the dialectical process of balancing tensions shows that in most situations researchers comply with the social rules and thereby with the practice of heedful interrelating that underlies the emergence of the competitive group competence. But this process also stresses that the emergence of a competitive group competence is not a static property of stable disposition, but an ongoing accomplishment (Orlikowski, 2002). As the practice of “content over management” implies that the content has priority over (financial) management, this practice strengthens the delivery of highly appreciated products and therefore also contributes to the emergence of a competitive group competence. On the other hand, this practice increases the risk of financial problems in the group.

The second contribution of this process is that although researchers decide to comply with the social rules in most situations, in situations in which they experience (stronger) tensions, they may also decide to act otherwise. The finding in this process that researchers can also decide not to comply with the social rules is a valuable contribution of this process as these decisions explain how individuals in the group can adapt very quickly to changing circumstances in the short term. This is important as it prevents rigidity and can strengthen fit with environmental demands. As we have discussed, fit with the environment is an important requisite for the emergence of the competitive group competence.

A third contribution of this process is that decisions of non-compliance with the social rules provide an incentive to adapt these rules (or more general social practices) to changed circumstances. This is important to maintain fit between the social practices in the group and expectations in the environment in the longer term. As long as the practice of heedful interrelating remains the dominant social practice and adjustments strengthen this practice, it contributes to the emergence of the competitive group competence. For the sake of clarity, we should mention however that adjustments can also take place in the direction of heedless interrelating. This will weaken the dominant pattern of heedless interrelating and thereby weaken the emergence of the competitive group competence. In section 5.3 we will discuss our findings with regard to the process of adjustment of social rules and develop some hypotheses about this process.

The fourth contribution of this process is that it explains how differences and preferences between individuals in the group (dilemma e) should be evaluated against the collective establishment of the emergence of a competitive group competence. The discussion of the dialectical process illustrates that the emergence of a competitive group competence is not based on a situation in which all group members behave heedfully in all situations during one time span, but that the dominant pattern is a pattern of heedful interrelating. Considering it as a dominant pattern disregards the fact that some group members will not comply with the social rules or even exhibit heedless interrelating in a number of occasions during one time span. This also illustrates that it is unlikely that groups will behave completely heedfully as Weick & Roberts (1993) suggest over a longer period of time. There will be a mix of heedful and heedless interrelating.

The fifth contribution is that it suggests that there is an optimum in the amount of heedful interrelating, as group members do not comply in all situations. Literature (i.e. Weick & Roberts, 1993) suggests that the emergence of a higher level of heedful interrelating and a more stable emergence of a pattern of heedful interrelating are desirable. In the field studies, heedful interrelating is linked with supplying services to clients. From this perspective, it is not obvious that more heedful interrelating is always better. The groups also work on a number of projects that only involve one or two researchers (Appendix five). As we discussed, not all group members always interrelate heedfully. Is this bad for the emergence of a competitive group competence? The dialectical process shows that these exceptions are acceptable as long as the majority of group members, in the majority of projects, in the majority of situations comply with the social rules and interrelate heedfully. The quality of the product seems to be sufficient and a higher level of heedful interrelating will make the product more expensive than the product of competitors and it is not clear

whether or not clients are willing to pay for these additional costs. The group members worry about their competitive image related to the price of their services, as for example in Joe's statement: "In contacts with clients we sometimes see ourselves as very expensive; so we make the margins in the project budget too small. This creates problems even before the start of a project. We will have to make more realistic project budget" (Joe, Ecology Group, 135-137). This concern suggests that there is an optimum in the amount of heedful interrelating that should be present from the perspective of costs and revenues. Therefore this dialectical process is also related to the effectiveness and efficiency of the performance of the group, reflected in the emergence of a competitive group competence.

Finally, with regard to the body of literature discussed in Chapter One and our research problem, this process illustrates how individuals are involved in the emergence of the patterns of heedful interrelating and content over management, especially when they meet tensions. In these situations they can still comply with the social rules, but may also act otherwise. Contrary to Poole et al. (2000) we did not find that the atmosphere in this process is one of conflict, practices heavily debated and researchers with very different ideas on how to proceed. The tensions we found express imbalances in specific situations that require delicate synchronization in order to re-establish balance. With regard to the *context*, the character of this process shows that it takes place against a background of established social practices of heedful interrelating and content over management. In reflecting on one of the characteristics of the process of balancing tensions, the process suggests that it facilitates rapid changes to changed circumstances in the short term. This is how it *accommodates dynamics and change*. This characteristic of the process also partially explains how the groups *maintain fit* with the environment. However, we suggest, that due to the style of this process and because of the anchoring of the social rules in motives (Chapter Four) it provides a buffer against large fluctuations in the emergence of heedful interrelating and content over management. Disturbances in the social practice, but also experiments, improvisations, expansion of social rules and opportunistic behaviour become effective when these are anchored in the shared norms and beliefs of the group members (Wenger, 1998; Orlikowski, 2002). Although behaviours different from the social rules affect the practices of the group, they are "micro changes" (Chapter Nine) or incidents. The field studies showed, for example, that the business economic rules under which research has to take place are translated in a form which matches the professional norms and the beliefs of what it is to be a researcher (Bresnen, Goussevskaia & Swan, 2004; but also Chapter Four and this chapter). Therefore changes are gradual in time. This characteristic more or less "protects" the groups against large fluctuations. However, when the group has to adapt to rapid changes this is insufficient, as we will argue in Chapter Nine.

5.3 The adjustment and development of social rules

In this section we will develop some hypotheses about the adjustment or development of social rules. Our findings in the field studies were insufficient to address the process by which social rules are adjusted or developed. In the previous section, with regard to the meaning of the dialectical process for the emergence of the competitive group competence, we argued that the dialectical process provides signals and new experiences with regard to interacting behaviours. Although the group members do not comply with the social rules in all these situations (Table 5.1), they are still executed against a background of established social practices. They are “short term” solutions to reduce tensions. We hypothesize however, that these behaviours are also one of the inputs in a process to adjust the social rules. This process provides new social rules aimed at solving tensions in a more structural way. This links the dialectical process of solving tensions and this process of adjustment and development of social rules.

However, adjustment or development of new social rules will not solve all tensions. It can also create new tensions. As individual researchers want to maintain their integrity, expressing the personal characteristics they think they have and that they value (Dutton et al., 1994), development or adaptation of social rules can cause conflict between the individual and the group or conflict between groups of group members when there is no consensus on how to act or how to handle interactions between colleagues or with clients.

In addition to the outcomes of the dialectical process of balancing tensions, the repeated project life cycle process (Chapter Four) also provides (individual and collective) experiences that reflect the application of the established social rules. We hypothesize that these are also an input for the process of adjusting social rules. We also hypothesize that the outcome of the teleological process of envisioning a future (Chapter Seven) acts as a frame of reference for the development, adjustment and continuation of social rules, for example with regard to research-related competences, such as the ability to perform participative research (Ecology Group). This goal, addressed in the Strategic Plan of the Ecology Group (2000-2003) requires the development of social capabilities and a strong attitude to involve stakeholders outside science as an equal partner and therefore will act as a frame of reference for new or adapted behavior. We hypothesize that the teleological process also will act as a frame of reference for the continuation of social rules, for example for the rule “be open and behave like a good colleague” (Chapter Four). Not that these rules are explicitly written down in plans, but because management highlights these practices in

meetings and evaluations as important for the future. We refer for example to the statements made by Joe (Ecology Group) in Chapter Four in Tables 4.4. and 4.6.

We continue this section by discussing an example of adaptation to changing circumstances we found in the field studies. It is an example that shows how the social practice gradually changes and (in this example) contributes to the development of a pattern of heedful interrelating. It is an example of behavior apparently evaluated as positive, becoming a new norm in time. This example has to do with publication behaviour. In Chapter Four we argued that one of the social rules is that “a success is always a shared success”. Besides the interviews we analyzed publication behaviour in both groups to gain supporting evidence for this social rule (Appendices 10 and 11). In Figures 5.2 to 5.7 we present the results.

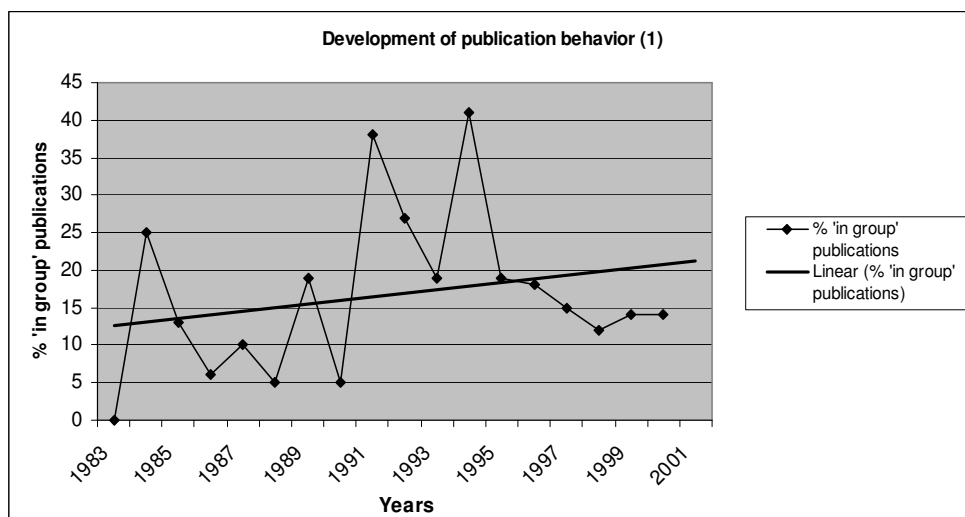


Figure 5.2: Percentage of “in group publications” of all publications in the years 1983 – 2001. Sources: Annual Reports Ecology Group 1983 up to 2001.²

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- We distinguished between publications written by researchers who all belonged to the (Ecology or Postharvest) group ('in group publications'), publications written with colleagues from other research groups in the institute, in other institutes or working at other organizations ('publications written with others') and publications written by only one of the researchers of the Ecology or Postharvest group ('solo publications').
- In counting the number and type of publications on which Figures 5.2 to 5.7 are based, we experienced some difficulties:
- In some years researchers joined the group who had previously worked in another research group in the same institute. They also wrote publications, on their own or with colleagues. However we

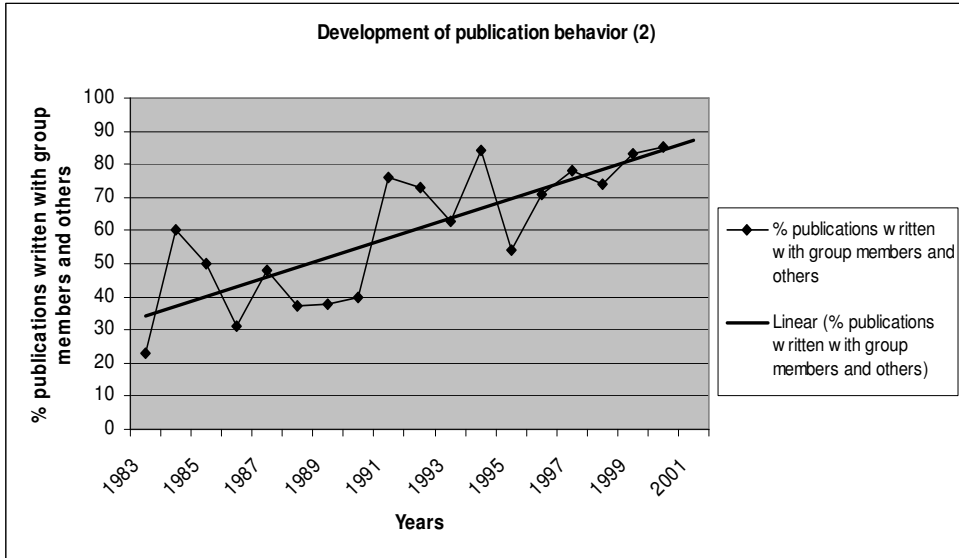


Figure 5.3: Percentage of “in group publications” and “publications written with others” of all publications in the years 1983 – 2001. Sources: Annual Reports Ecology Group 1983 up to 2001

were not able to identify whether or not they wrote those publications once they had already joined the Ecology or Postharvest Group. Therefore it is not clear whether these publications should be counted or left out. We have decided to count all those publications, although they may have affected the visualization of the behavioral pattern.

- Some publications were written in collaboration with students. Because students are not mentioned as members of the Ecology or Postharvest Group, we could not decide whether or not these co-authors were students or researchers working in another group inside or outside the institute. However these publications have been counted as ‘publications written with others’. They will also have affected the visualization of the development of the behavioral pattern.

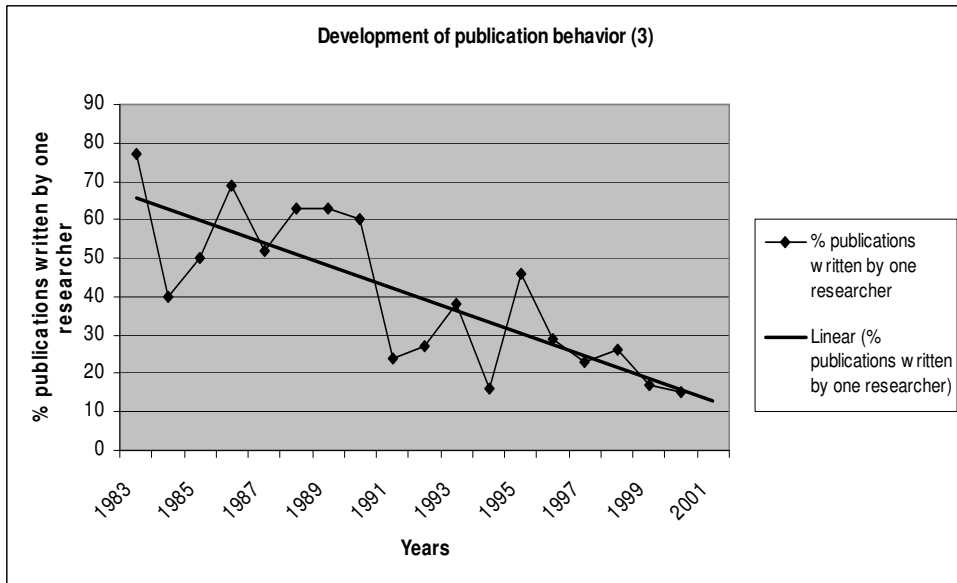


Figure 5.4: Percentage of “solo publications” of all publications in the years 1983 – 2001. Sources: Annual Reports Ecology Group 1983 up to 2001

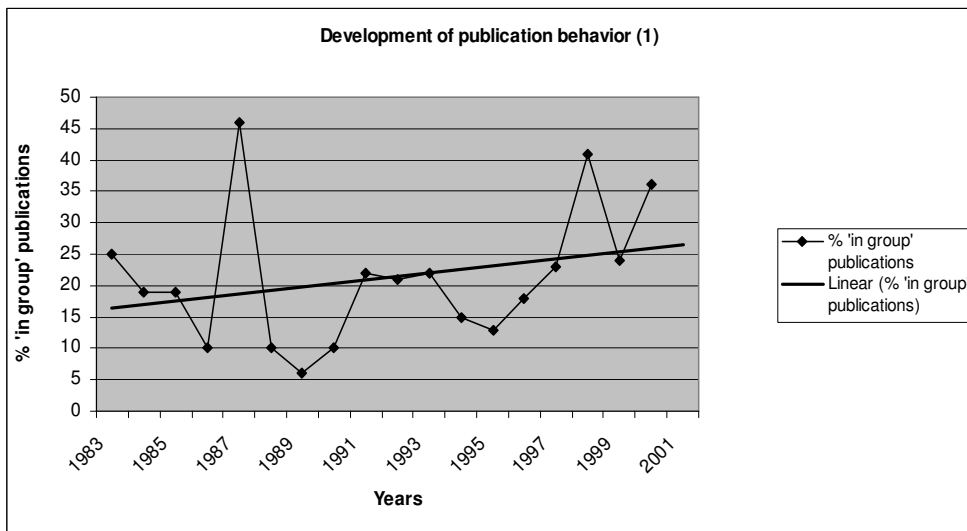


Figure 5.5: Percentage of “in group publications” of all publications in the years 1983 – 2000. Sources: Annual Reports Postharvest Group 1983 – 2001

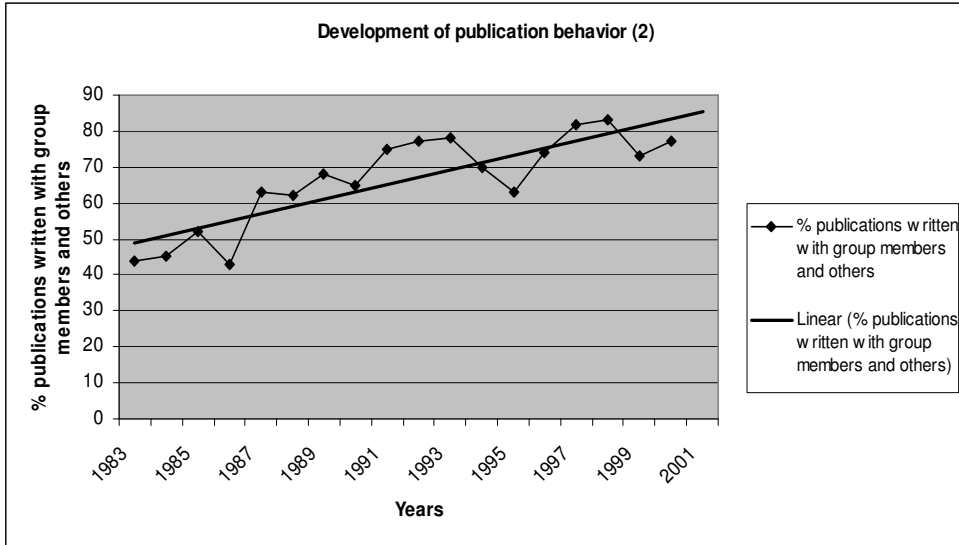


Figure 5.6: Percentage of “in group publications” and “publications written with others” of all publications in the years 1983 – 2000. Sources: Annual Reports Postharvest Group 1983 – 2001

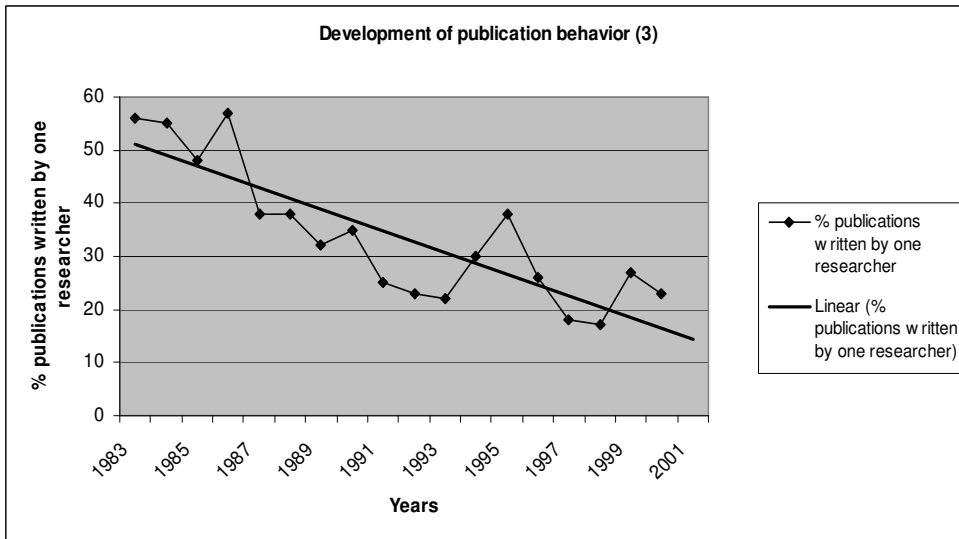


Figure 5.7: Percentage of “solo publications” of all publications in the years 1983 – 2001. Sources: Annual Reports Postharvest Group 1983 – 2001

Gradually, we see in both groups a growth in the number of publications written with group members and with colleagues outside the group. The percentage of publications written by one researcher declines. For both groups this behaviour can be considered to be a change in their practice, learning and applying new behaviour and developing the rule “a success is always a shared success”. This change contributes to the practice of heedful interrelating. Other examples we found (but which could not be visualized) are changes in the practice related to a strengthening in client orientation and the development of marketing and acquisition competences during the period 1993-1996 and a more strict application of business economic rules in the period 1995-2001 (Chapter Three).

Hutchins (1991) defines experimentation with new behaviours due to changed circumstances as organizational change produced by an *evolutionary process* (adaptive search without representation of the search space) and by a process lying between evolution and (supervisory) design. Our findings are insufficient to argue for the presence of an evolutionary process for the adaptation of social rules. But despite the kind of process, in the long term successful behaviours based on experimentation will lead to the development of new or to modified social rules (Owen, 1985; Zajonc, 1966). This implies a change in the patterns of heedful interrelating and content over management, leading to a strengthening (as in the example we provided above with regard to publication behaviour) or a weakening in one or both patterns.

We also hypothesize that this process of adjustment and development of social rules is related to the process of development of expertise which we will discuss in Chapter Six. We hypothesize that the process of expertise development *stimulates* the development of a pattern of heedful interrelating and content over management in the groups involved in the field studies. In a direct way, this is the result of positively evaluating the experiences of collaboration and involving each other's expertise; in an indirect way, it is the result of the research questions granted by clients, the need to combine the expertise of the members of the group in order to solve those research questions. This occurs in the Ecology Group, for example, where they combine the expertise of members of the group with knowledge of a specific group of species or combining modelling expertise with other fields of expertise. We also hypothesize that the other way around, the development of a pattern of heedful interrelating and content over management will *stimulate* expertise development. The presence of transactive memory (“knowledge possessed by individual group members with a shared awareness of who knows what”, Moreland 1999, p. 5; Brandon & Hollingshead, 2004; Lewis, Lange, Gillis, 2005; see also Appendices eight and nine), being able to speak a mutual language, understanding the relevance of specialized fields of expertise and

willing to involve each other's expertise will affect the process of expertise development with regard to speed, ambition and the prevention of redundancy because a number of social barriers have already been pulled down. We also hypothesize that the development of a pattern of heedful interrelating and content over management will have *supported and strengthened* position creation in the market, because this practice implies carefully listening to clients, understanding what they need, carefully handling feedback and providing meaningful contributions.

Our hypothesis that the development of a pattern of heedful interrelating and content over management will have stimulated and will stimulate the development of expertise is supported by the findings of McGrath, MacMillan and Venkataraman (1995). They relate competence development with meeting goals, the development of deftness and comprehension. In order to become competent, they hypothesize that a project group must develop deftness and comprehension. They define deftness as a form of "collective mind" in which activities performed by a group are interrelated so that desirable outcomes may be achieved and undesirable outcomes avoided (p. 254) and they define comprehension as those pursuing an initiative (come to) understand precisely what combination of resources will allow them to achieve objectives (p. 254). McGrath et al. (1995) find support for their hypothesis "that it is very difficult to become competent as a group when group processes are clumsy or awkward. Deftness thus appears to be a fundamentally important construct for the study of emerging competence" (p. 262). Their results, that deftness and probably comprehension are necessary antecedents for emerging competence, support our hypothesis that the development of a pattern of heedful interrelating and content over management will have stimulated and will stimulate the development of expertise with regard to its direction and its efficiency. Where we formulate our hypothesis by using the word "stimulated", McGrath et al. (1995) are more precise: they found that the development of a behavioral pattern preceded emerging competence. For the sake of clarity, they presented the process of competence development as more-or-less linear. But they argue that as competence emerges, groups may retrospectively rationalize the causes of its emergence. This also implies that expertise development may stimulate the (further) development of a pattern of heedful interrelating and content over management. Our hypothesis is also supported by Zárraga & Bonache (2005), who found that a high-care atmosphere favours the transfer and creation of knowledge. This also implies that the development of a practice of heedful interrelating stimulates expertise development. Finally our hypothesis that the development of a pattern of heedful interrelating and content over management will have *supported and strengthened* the creation of a position in the market is supported by Ancona & Caldwell (1992). As we discussed in Chapter Four, results of studies by Ancona & Caldwell (1992)

indicate the type of external communication teams engage in, not just the amount, determines performance. They found that teams that implement a strategy that performs high on “task coordination” (coordinating technical or design issues, obtaining feedback, coordinating and negotiating with outsiders), high on “ambassadorial activities” (persuasion for a project, lobby for resources) and low on “scouting” (general scanning for ideas and information about the market or technology) were very successful (Chapter Four).

Finally, as our findings with regard to publication behaviour suggest, the adjustment or development of social rules takes time. In order to maintain fit with the environment with regard to behavioral practices, this supposes that the requirements of the environment should not change too fast, creating a situation in which the level of dynamics in the environment is higher than the level of dynamics the group can accommodate in its process of adaptation of social rules. As the social rules support the practice of heedful interrelating, rapid changes can endanger the level of knowledge integration based on heedful interrelating and thereby affect the emergence of the competitive group competence. In Chapter Nine we will reflect on this issue.

As this discussion of the adjustment and development of social rules is related to the dialectical process of balancing tensions but is not part of this process, we will now summarize the main findings with regard to the dialectical process again as we will refer to this process repeatedly in the chapters to come. We found that in the dialectical process of balancing tensions, researchers find solutions to solve dilemmas they meet in the design, the execution and the ending & evaluation of projects. The dilemmas concentrate on the boundary between content and (financial) management in particular and are often solved according to a pattern we defined as “content over management”. We interpreted this balancing of tensions as delicate synchronization, because the status quo between “opposing entities” remains and because tensions are balanced against the background of the established practice of “heedful interrelating” and as none of the dimensions involved in the dilemmas is gaining so much power that the other dimension is put out of order.

Chapter 6 Co-evolutionary development of expertise

This chapter discusses the third process underlying the emergence of a competitive group competence: the development of expertise. Based on our findings, we define this process as the “co-evolutionary development of expertise”. We have depicted this process in the introduction of Chapter Four as the process in the left lower corner (Figure 6.1).

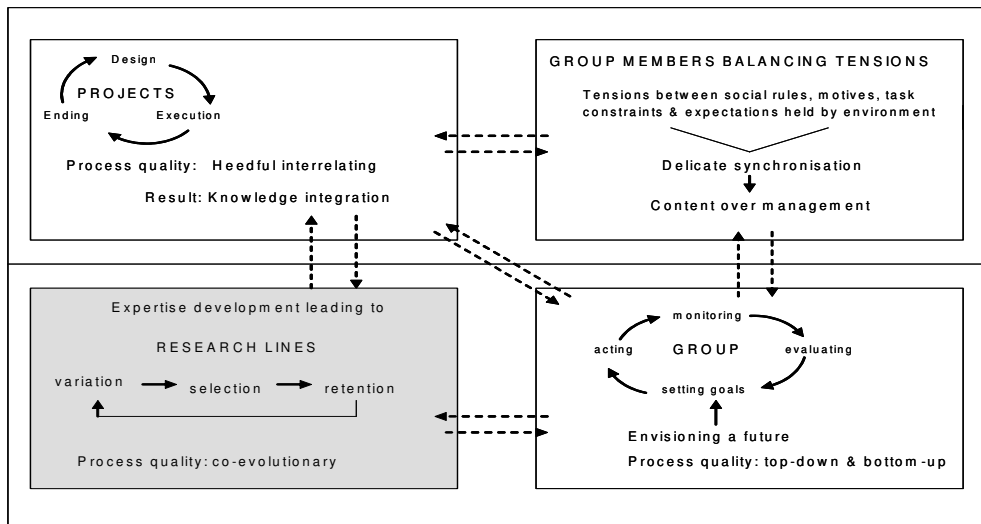


Figure 6.1: The four processes responsible for the emergence of a competitive group competence and the focus of this chapter

The word “evolutionary” in co-evolutionary addresses the nature of the process. We will argue that this evolutionary nature matches the definition of Poole et al. (2000) of an evolutionary process. According to Poole et al., an evolutionary process explains change as “a recurrent, cumulative, and probabilistic progression of variation, selection, and retention of organizational entities. ...while one cannot predict which individual entity survives or fails, the aggregate population persists and evolves through time according to the specified population dynamics” (p. 64). This process is characterized by a (possible) progression in stages; there is a pathening device (driving enactment, selection and retention), there are interacting entities and there is a conflict for the available resources.

Related to the aspects of the research problem addressed in Chapter One, we focus on the characteristics of the process, the context in which this process operates and how it

accommodates dynamics and change. With regard to the context, our findings not only address the situation *in* the group, but also how the group *interacts* with stakeholders in the niche and some characteristics of this niche. It therefore also addresses some aspects of how the group achieves to maintain fit with the environment (addressed as one of the elements related to the emergence of a competitive group competence in Chapter One). We will argue that our findings regarding the separate elements that describe the process of expertise development and the context in which this takes place are supported by and provide evidence for findings reported in literature. In particular the *combination* of these elements related to the emergence of a competitive group competence deepens literature.

Our findings suggest that the groups have committed themselves to a particular set of problems and methods. This has enabled the groups to provide their clients with new or better solutions in a relatively short time frame. We also explain that the groups work on “normal science”, which means that there is consensus within the scientific community on foundational issues. Furthermore we found that the process of expertise development is of a co-evolutionary nature, reflecting a mutual development of needs in the environment in which the research group works and expertise development in the group. We found that the groups experiment and discuss new concepts and solutions and finally “persuade” their stakeholders to adopt new ideas and concepts. This in turn provides the groups with new assignments and the possibility of developing expertise in these ideas and concepts. We will argue that this co-evolutionary character should be understood as a continuous cycle of position creation and meeting expectations raised by this position. We also found that the groups have a close relationship with the stakeholders in the environment; that they have adopted a strategy of “enacting” (Daft & Weick, 1984) their environment. This allows the group to pick up signals of changing demands very quickly and to “probe” what works and what does not. As expertise development takes several years, we will argue that both (co-evolutionary expertise development and enacting the environment) are essential for the development and emergence of a competitive group competence and to prevent the development towards a core rigidity.

We have organized the discussion of the co-evolutionary expertise development in four sections. We first present a general outline of (expertise) development in the groups in the years 1983 – 2001 relating to developments in the environment and we provide arguments for the evolutionary character of expertise development (section 6.1). In the next section we argue that the groups have adopted a combined strategy of position creation and enacting the environment and we discuss the co-evolutionary nature of expertise development (section 6.2). In section 6.3 we argue that the groups have focused (with regard to content

and methods), work on “normal science” and that they experience path-dependency. In section 6.4 we reflect on our findings with regard to their significance for the emergence of the competitive group competence. We will argue that this co-evolutionary process of expertise development is responsible for gaining a deep understanding of the field of research and for achieving extraordinary performance as well as for adaptation and renewal, gaining fit with the environment and preventing a trend towards non-emergence or the development of a core rigidity.

6.1 The evolutionary character of expertise development

In this section we will discuss our first main finding with regard to expertise development, namely that expertise development has an evolutionary character. We discuss instances of variation, selection and retention and link our findings to literature. Based on a comparison with literature, we argue that our findings suggest the presence of an evolutionary process. First, however, we present a general outline of (expertise) development in the groups in the years 1983 – 2001 relating to the developments in the niche.

Outline of the development of a body of knowledge

In Tables 6.1 and 6.2, we present key-instances that define the development trajectory of the bodies of knowledge of both groups. We present this trajectory against a background of trends and developments in the respective niches. We do so because we will argue that we are dealing with an evolutionary process. In an evolutionary process the environment selects those forms that optimize the resource base of an environmental niche (Hannan & Freeman, 1977). Our choice for the niche as the environment is based on the context in which the groups operate (Chapter Three). This means that only the research lines (and expertise) for which the niches grant projects can be maintained and developed (an important selection criterion which we will discuss in this section).

In Table 6.1 we present key-instances of the development trajectory of the body of knowledge of the Ecology Group. In the first period (1983-1987), we see the discovery and exploration of the theme of landscape ecology. In the next period (1987 to 1990) the link with the political agenda is strengthened. The group chooses a guiding theory, starts to develop (ecological) models and, based on the theory and models, develops a scientific position. In the third period (1990-1996), the group develops methodology in the field of landscape ecology. Expertise development shifts from landscape ecological problems in rural areas (outside the National Ecological Main Infrastructure) to problems in the

National Ecological Main Infrastructure. In the fourth period (1996-1999) the most important characteristic is an organizational turnaround from species to themes. And finally in the fifth period (1999-2001), the themes in which the group operates are broadened and deepened. The selected key-instances in Table 6.1 show that the choices made between 1984 and 1987 were the foundation for later developments: a broadening the body of knowledge towards more spatial scales and more species, linking the field of research to other sectors and developing knowledge into other types of landscapes.

Related to the developments in the niche, the key-instances in Table 6.1 show a niche in which needs for knowledge gradually change. The cutting up of ecological habitats and the protection of species become important political and social issues in the period 1983-1990. The ambition and goals of government are laid down in a national policy plan, published in 1990. The second period (1990-1997) is characterized by working out these goals. They address the development of a National Ecological Main Infrastructure, the development of zones in agricultural areas linking areas with nature and implementing the policy regarding (the protection of) species. In the third period (1998 to 2001), the monitoring of goals and targets in the field of nature protection and development is institutionalized. Attention for biodiversity covering all dimensions becomes the dominant theme. In this period nature policy is embedded in a larger and broader context.

Table 6.1 Key instances in expertise development in the Ecology Group related to trends and developments in their niche	
Niche	Expertise development of group
<p>1983 – 1990: Discovery of the theme of landscape ecology</p> <p>E1: raised political awareness E2: more attention for the possibilities to connect isolated populations of one species E3: (1990) development of the National Nature Policy Plan E3-1: development of the NEMI E3-2: formulation of policy of protection of species E3-3: announcement of intensifying research E3-4: announcement of start of research Program into nature research, focusing on the NEMI</p>	<p>1983-1987: Discovery of the theme of landscape ecology</p> <p>C1: explorative research (bird communities). Provides indications about effects of structural features of the landscape on variation in the composition of bird communities C2: literature study into meaning of small landscape elements C4: development of methodology for research into landscape ecology (1985) C5: attention towards processes in landscapes (from descriptive and comparative studies towards analytical studies) C8: start model simulations (1987) and introduction of concept of meta-populations (C9: 1987)</p>

Continuation of Table 6.1 Key instances in expertise development in the Ecology Group related to trends and developments in their niche	
Niche	Expertise development of group
<p>1990 – 1997 Execution of the National Nature Policy Plan (= NNPP)</p> <p>E4: elucidation of goals and targets in NNPP E4-1: [1990-1993]: focus on realization of the NEMI and focus on spatial scales E4-2: need for guidelines and norms, development of methods and instruments for the making of spatial plans. E-4-3: focus on three kind of ecosystems: (1) forests, (2) heath & moors, (3) swamps E-5: (from 1995) need for expertise to evaluate policies in the preservation of biodiversity; need for development of guidelines for policy making into biodiversity preservation and a need for models that support the evaluation of policy options in the field of biodiversity preservation. <i>Underlying requirements:</i> measures of the quality of water and environment and knowledge of their effects, measures of the spatial quality, embedding of spatial quality in processes of spatial planning, measures of terrain management, expertise to evaluate goals in the preservation of biodiversity <i>Concepts:</i> connecting zones, extrapolation to Urban areas, landscapes characterized as mosaic landscapes, the scale of Europe <i>Expertise in field of NEMI:</i> indicator systems, norms and scenario studies, development of an ecosystem vision E6: (1997): publication of report 'The state of nature and trends to be expected' (1997)</p>	<p>1987 – 1990: Developing a scientific position</p> <p>C11: influential contributions made to National Nature Policy Plan. Key-words: cutting up, isolation, connectivity, ecological infrastructure C12: start programming study, stimulating coherence C13: presentation first simulation models C14: continuation of research into the survival of species and processes in landscapes</p> <p>1991-1996: First period of growth</p> <p>C16: research not only focused on ecological infrastructure, but also at the NEMI C17: focus on species that can be studied very well C18: scales include regional and national scale C19: focus on three kind of ecosystems: (1) forests, (2) heath & moors and (3) swamps C20: linkage of models with GIS C21: development of guidelines and norms for spatial structure of landscapes and development of initial methods and instruments to link the results of the research to the planning process of landscape design C23: trend in modelling work to include regional knowledge</p>

THE EMERGENCE OF A COMPETITIVE GROUP COMPETENCE IN A RESEARCH GROUP

Continuation of Table 6.1 Key instances in expertise development in the Ecology Group related to trends and developments in their niche	
Niche	Expertise development of group
<p>E7: (1997) establishment of the 'Nature Planning Bureau' by law</p> <p>1997 – 2004 Linking and broadening nature policy</p> <p>E8: (1998) Nature Planning Bureau publishes first 'Nature Balance'</p> <p>E9: Aim to achieve combinations of functions in spatial areas. Provinces and municipalities have to take stronger responsibility to enhance ecological richness and to diminish the number of ecological niches.</p> <p>E10: policy document 'Nature for the people, people for nature' is published (1997). Is successor of National Nature Policy Plan. <i>Focus:</i> (1) preservation, restoration and development of sustainable use of nature and landscape. Government wants to focus on the realization of NEMI, improvement of the linking of spatial areas and general environmental quality, strengthening the identity of landscapes, policy making with regard to green elements in urban areas and a sustainable use of biodiversity. (2) integration of nature in other areas of policy making: water, living, industrial areas and infrastructure (3) increase of number of stakeholders that contribute to this policy <i>Concepts:</i> NEMI, green connections between nature areas, robust linkages, environmental conditions, species, quality of landscapes, production of blue-green veins to improve landscape quality, development of forests near urban areas and nature in wet areas. <i>Change in needs of expertise:</i> integration of Existing knowledge, economy in rural areas, qualities of rural areas, possibilities to strengthen cooperation between rural areas, management of nature areas, interdisciplinary solutions, changes in climate, integration of ICT.</p> <p>E11: research programs in field of nature should Integrate research problems in the field of nature, water, spatial design and environment (1998)</p>	<p>1996-1999 Second phase of Growth</p> <p>C25: development towards 3 research lines: C25-1: grounding instruments (models, developing quantitative measures) C25-2: making knowledge applicable by directives and guidance of its application C25-3: broadening the field of expertise</p> <p>C26: stronger focus on research supporting the development of NEMI</p> <p>C27: research into connecting zones (outside NEMI) and into general environmental quality</p> <p>C28: attention for quality of models</p> <p>C29: role field research changes from explorative to evaluating</p> <p>C30: establishment Nature Planning Bureau</p> <p>C31: still 'own' research program; participation of other groups and in program of other groups</p> <p>C32: expertise with regard to species attributed to group members, with the assignment to keep this up to date implicitly</p> <p>C33: size from 23 (1996) to 50 (1998). Organization from species-based to thematic groups</p> <p>1999-2001 Exploitation and deepening of subthemes</p> <p>C34: no longer 'own' research program funded by the Ministry. Participation in programs directed by other groups</p> <p>C35: 7 themes in research of group, to be clustered into 3 lines: C35-1: grounding instruments C35-2: making knowledge applicable C35-3: deepening the expertise of species, ecosystems, urban areas, Europe</p> <p>C36: integration region specific expertise; development of participative, interactive research approaches</p>

Continuation of Table 6.1 Key instances in expertise development in the Ecology Group related to trends and developments in their niche	
Niche	Expertise development of group
E12: stakeholders request for expertise made specific for a region and to support its implementation. Need for competences to execute participative and interactive research	C37: key words: NEMI, green-blue veins, buffer zones, connecting zones, urban networks, integrated models, integrated indicators and eco-profiles, area specific spatial concepts mosaic landscapes, scenario studies, quality of models, recreation, specie complexes C38: size about 50 group members, organized in 7 thematic groups.
<p><i>Sources:</i> Research program 383 'Natural biodiversity and management of species, 2001-2004; report of the strategic conference April 1999; Strategic Plan Ecology Group 1996-1999; Strategic Plan Ecology Group 2000-2003; Year Plan Ecology Group 2001, Scientific Strategic Plan 1997-2000, Vision on the research of the department of Landscape Ecology after 1995; Proposal for reorganizing the sections of Landscape Ecology, 1996; Research lines Landscape Ecology 1989-1993; Description of the department of Landscape Ecology 1992; Research program 24 'Ecological processes in a cut up landscape', 1986-1995; Research program 325 'Nature planning bureau' (1998-2001), Research programs 382 (2001-2004) and 383 (2001-2004), Report 'Nature Balance' 1998; Policy document 'Nature for the people, people for nature', 1997; Policy document 'National nature policy plan', 1990, report 'The state of nature and trends to be expected'; 1997.</p> <p>Distinguishing <i>phases</i> is based on the appearance of policy documents and research programs (E-instances), formal reorganizations of the group and major changes in the research program (C-instances)</p>	

Table 6.2 Key instances in expertise development in the Postharvest Group related to trends and developments in their niche	
Niche	Expertise development of group
<p>1983 – 1990: A growing need for knowledge regarding quality control</p> <p>E30: raised awareness for the quality of fresh agricultural products. Stakeholders need more fundamental knowledge of post harvest physiology of fresh products.</p> <p>E31: More specific with regard to quality control</p> <p>E31-1: in agriculture: a need to raise general quality</p> <p>E31-2: in horticulture in the open: a need to strengthen agro technological research</p> <p>E31-3: in bulb flowers: a need to improve durability and quality preservation</p> <p>E31-4: in fruit: research into quality control and optimizing storage circumstances</p>	<p>1983-1989: Expertise development in a large number of themes to solve practical problems</p> <p>C50: Three groups working on post harvest physiology</p> <p>C51: Groups work on a large number of themes and two of the three groups work on a large number of crops</p> <p>C52: Curiosity driven research into the role of hormones on aging and the effects of water management of plants on keepability of products</p> <p>C53: group working on ornamentals and group working on vegetables and fruit merge (1988)</p> <p>C54: size of groups (C53) together: 15-17 members</p>

THE EMERGENCE OF A COMPETITIVE GROUP COMPETENCE IN A RESEARCH GROUP

Continuation of Table 6.2 Key instances in expertise development in the Postharvest Group related to trends and developments in their niche	
Niche	Expertise development of group
<p>E31-5: in horticulture (in glasshouses): research into new breeds and ornamental quality. For vegetables focus on quality control in the chain</p> <p>E32: for government focus on creating conditions and developing stimulating measures.</p> <p>E33: 'Research priorities relate to handling quality in the chain, from primary producer to consumer...' (p. 210). The improvement of 'the storage, durability and processing of agricultural products [...] has induced government to renew the field of agro technological research regarding content and structure' (p. 154).</p> <p>1989-1998 Incremental innovation in quality control</p> <p>E34: Need for innovative storage and transport systems in order to guarantee maximum preservation of quality. Making quality measurable is an important issue, linked with the need to predict and control quality in the chain. Innovations should also contribute to the storage of fresh products (cut flowers, potted plants, vegetables, potatoes). Especially with regard to the technology used to store products and to control temperature, gas composition, light, hygiene and availability of water. In addition these storage systems have to be environmental friendly and economize on energy</p> <p>E35: Technological developments in the field of biotechnology, molecular biology, sensor technology and ICT provide options for new innovations to improve measurability and the and the control of the quality of fresh products in the chain. New methods must measure quality 'objective' and predict quality based on genetic coded features. Technological developments should also contribute to the development of new (interactive) storage and transport systems.</p>	<p>1989-1995: Fundamental expertise development in the field of postharvest physiology</p> <p>C55: groups become part of new institute. Groups divided into two divisions. First two years still working on broad array of themes</p> <p>C56: focus in expertise development (1992): (1) abiotic stress (2) texture and ripening, (3) storage physiology & modeling, (4) development and differentiation, (5) hormonal regulation and senescence. Groups improve their profile and develop critical mass</p> <p>C57: number of themes reduced to 4 (1983) and renamed (1994): biophysical measurement of quality, interactive storage techniques, molecular regulation and quality of flowers</p> <p>C58: size of group from 28 (1989) to 64 (1995). Many group members working on a temporary base</p> <p>1995-1999: Consolidation and exploration of a new research line</p> <p>C59: renaming of sections (1997, 1998), merger into the Postharvest Group (1999). Postharvest group is divided into 3 sections: (1) flowers & plants, (2) vegetables & fruit, (3) potatoes</p> <p>C60: key-words in research program: development of tests, intelligent and interactive storage systems, CA-storage, storage problems, molecular markers for quality and prevention of vein blockage</p>

Continuation of Table 6.2 Key instances in expertise development in the Post harvest Group related to trends and developments in their niche	
Niche	Expertise development of group
<p>1998-2001 The move towards sustainability</p> <p>E36: At some points (agri-) sectors still do not meet social demands. In order to meet those demands the sector must make large investments. To improve the quality of food, policy making is directed at strengthening the development of chains and private guarantee systems, food safety and strengthening the debate regarding the opportunities for biotechnology for the preservation of safety, diversity and the freedom of choice of the consumer.</p> <p>E37: three lines with regard to the development and application of new technologies. One of these lines is to stimulate the development of expertise about 'networks of chains, logistics and information and ICT'</p> <p>E38: growth in attention in the sector for health and related presence of positive substances in agricultural products. Other interests are a need for a steady quality, the need for quality guarantees and information about the origin and production method. The need for expertise about measuring the quality of the product continues to be important, still with the need to predict and control quality in the chain. These needs also concern the storage of fresh products (cut flowers, potted plants, vegetables, potatoes), especially regarding the technology that can be used. Better application of ICT, integrated process control, intelligent data processing and sensor technology can provide new perspectives for storage and transportation systems and can contribute to a better prediction and quality control in the chain.</p>	<p>C61: decision to start expertise development in the field of genomics</p> <p>1999-2001: concentration and consolidation of expertise present</p> <p>C62: research program of group put in a broader perspective: the chain, health, safety, transparency. Program focuses on internal quality and health promoting substances. Other topics: measuring methods, decision support, monitoring and direct quality measuring methods</p> <p>C63: orientation of section constantly tuned to new opportunities in the market, but focused on flowers, plants, fruits, vegetables and potatoes</p>
<p><i>Sources:</i> Year Plan Postharvest Group 2001, Research program 391 'Safe and healthy food from a transparent production process, 2001-2004; Research Program 289 'Post harvest physiology and product quality, 1996-2000; Research program 58 'Storage methods and systems', 1990-1995; Research program 60 (1990-1995), policy document 'Food & Green', 2000; policy document 'Strength and Quality', 1999; policy document 'The structure of agriculture in the Netherlands', 1990</p> <p>Distinguishing phases is based on the appearance of policy documents and research programs (E-instances) and formal reorganizations of the group (C-instances)</p>	

In Table 6.2 we present key-instances of the development trajectory of the body of knowledge of the Postharvest Group. We see that in the first period (1983-1989), expertise is developed in a wide range of themes. This expertise is focused on solving practical problems. From 1989 to 1995, the focus of the groups shifts towards fundamental expertise development in the field of post harvest physiology and thereby the groups strengthen their scientific position. More fundamental and strategic (pre-competitive) expertise is developed and made available for the stakeholders. Businesses in the niche transfer this expertise into innovations. New technological developments make it possible to measure more accurately and to predict product quality. From 1995 on (period 1995 – 1999) the groups working in the field of post harvest physiology start to collaborate and to exploit their synergy. A new research line is started, focusing on expertise development into the genes coding for quality features of products and applying this expertise in the field of post harvest physiology. In 1999 the groups working in the field of post harvest physiology merge. From 1999 on the group focuses on consolidating the present research lines. As in the field of landscape ecology, the development trajectory of the body of knowledge in this field also shows that choices made in the first or second period of the time span studied here still affect the body of knowledge of the group in 2001. Expertise in the field of plant hormones and choices relating to crops are examples of this phenomenon.

We also find gradual shifts in this niche with regard to knowledge needs. The first period (1983-1989) is characterized by growing attention for (the physiological aspects of) the quality of agricultural products, due to changes in the agricultural sector from supply-driven to demand-driven production. Based on these changes, the stakeholders in the sector need more fundamental knowledge of post harvest physiology. The second period (1989-1998) is characterized by working out the developments started in the period 1983 – 1989. The third period (1998 to 2001) is characterized by a continuation of the needs for expertise we already saw in previous periods. In evaluating the trends, the stakeholders in the niche express a gradual broadening of their needs for expertise, linking these needs to the availability of new technologies (like ICT, genomics, sensor technology, and packaging materials). Developments in these fields are made available for application in the field of post harvest physiology. However, the basic needs for expertise are still the same.

When we compare Tables 6.1 and 6.2, we notice that in the first period of the time span taken into consideration, the scientific fields in which the groups operate receive extra attention from their respective niches. In the niche of the Ecology Group, political awareness is increased for the protection of species (Table 6.1, instances E1-E3); in the

niche of the Postharvest Group there is increased awareness for the quality of fresh agricultural products (Table 6.2, E30-E32). This increased attention is based on changes in society (public concern for biodiversity respectively a change in agriculture from supply-driven to demand-driven markets). To meet these social demands, the scientific knowledge base must be strengthened (Table 6.1, C11-C14; Table 6.2, C55-C58). In time, this created a position for both groups that was anchored in the practice of their respective niches on one hand and in the scientific community on the other hand. In addition, Table 6.2 shows that the Postharvest Group increased (the number of researchers, C58), just as the Ecology Group increased from seven researchers in 1983 to 50 in 2001, resulting in more critical mass. The maturity of their expertise also deepens and new applications of their expertise are found (Appendix two). Finally, in the last period taken into consideration, we see that both groups consolidate their position (and research lines) and that their field of expertise is linked to other social issues (Table 6.1, E11 and C34; Table 6.2, C62). Their field of expertise is placed in a broader context.

What we also found in the field studies is that projects differ in duration. Some projects take only three months, other projects take a number of years (up to four or five years)¹. In the field studies, we found that the average duration of projects in the Ecology Group was about two and a half years and that the average duration of projects in the Postharvest Group was about one and a half years². Related to the duration of an average project, the time horizon of the development of a distinctive competence is at least three to five years; in order to develop a distinctive competence, a number of projects have to be executed.

Expertise development as an evolutionary process

Following this general outline of expertise development in the groups, we will now address the evolutionary character of this process. In the field studies we found examples of variation, selection and retention when we studied the development of expertise at the level of research themes. These research themes interact and are in conflict for the available resources. It is not only clients (the Ministry, for example) who can spend their money only once; researchers too can only spend their time once and wish to develop a distinctive profile. Some research themes will therefore emerge and grow, others can only be interpreted as an experiment and a number of themes will fade away. It is hard to predict which themes will survive in the long term.

¹ Source: analysis of project portfolio in 2001 and statements made in interviews

² Source: analysis of project portfolio; personal interpretation of the researcher

The concept of *variation* is defined by Burgelman (1991) in two ways. Firstly, he defines variation as initiatives that are based on the strategy already present and corresponding with this strategy. These initiatives are based on the factors that explain past success and are defined as “induced”. Secondly, he defines variation as initiatives that do not correspond with the present strategic context, but that are promising for the near future. These initiatives are defined as “autonomous”. With regard to variation, we found for instance an initiative in the Ecology Group to develop expertise into the genetic aspects of the dispersal of forest plants. Genetic expertise was addressed in the Strategic Plan 2000-2003 as an important distinctive competence for the future direction of the group's field of research. Until then, the group had no genetic expertise. Another example is the development of expertise in the ecology of river landscapes (Ecology Group). The group hired a researcher with knowledge in this field. This researcher provides a link to a new group of clients, while broadening the expertise in the Ecology Group. This helps the group collaborate with other researchers working in the field of “water” inside and outside the institute and strengthens the position of the group in the field of water management in the Netherlands (interview with Sarah, Ecology Group, 5-16 and 108). Expertise development in internal quality features like the effects of storage on health promoting substances (i.e. vitamins) can also be considered as a new initiative, providing variation in the Postharvest Group (source: Year plan Postharvest Group, 2001). These initiatives were still quite new and at the end of our field studies it was difficult to assess whether these initiatives would develop into a new line of research. Looking back, the start of the development of models (Ecology Group, Table 6.1, C8) and the start of expertise development into genomics (Postharvest Group, Table 6.2, C61) can also be evaluated as examples of variation. At the time they did not correspond with the existing strategic context yet these initiatives have developed into a full line of research - a distinctive competence.

We also found a number of *selection* criteria in the field studies. The concept of selection is defined by Burgelman (1991) as “administrative and cultural mechanisms regulating the allocation of attention and resources” (p. 240). We found selection criteria for the selection of projects as well as criteria for the selection of themes in research (Table 6.3). For projects we found that the strategy of the group is a selection criterion, besides the financial coverage of all costs of a project, a scientific challenge in the content of a project, the present level of maturity of expertise in the group and the complexity and size of a project. But even when one of the groups has acquired a number of projects in a specific topic, for example river landscapes, not all the topics become new themes in research (a distinctive competence). We found that new research themes must also meet a number of criteria: they have to correspond with the mission of the group; there must be long-term opportunities in

the market and there must be mature expertise on the topic in the group. Due to a lack of market opportunities, research into mushrooms (Postharvest Group) for example has never become a theme in research. Other distinct competences have faded, such as the expertise of butterflies and forest birds (Ecology Group) and expertise into small fruits (Postharvest Group), related to a lack of opportunities in the market.

The selection criteria for projects are applied by the researchers in the acquisition trajectory of projects. As the acquisition of a project also needs management approval (Tables 4.1 and 4.2), these criteria are also applied by management. The selection criteria for themes are applied by the groups as a whole, most explicitly in the teleological process of envisioning a future (Chapter Seven). This also applies to the use of the criterion for the loss of expertise from the group.

Table 6.3 Selection criteria	
I.	For research themes
a.	fit with the mission of the group (Kevin, 190; Laura 340-348; Postharvest Group)
b.	opportunities in the market (Kimberly, Ecology Group, 291; Joe, Ecology Group, 177-182)
c.	present level of maturity of expertise on the topic in the group (analysis of strategic plans of the Ecology Group 1996-1999; 2000-2003 and Year Plan 2001 of the Postharvest Group)
II.	For projects
a.	The strategy / goals of the group (analysis of the strategic plans of the Ecology Group 1996-1999; 2000-2003 and the Year Plan 2001 of the Postharvest Group; Tables 6.1 and 6.2; interview Joe, Ecology Group, 138-142);
b.	Financial coverage of all costs of a project (interview Joe, Ecology Group, 120-121 and 135-137; Edward, 254-255 and Larry 131-132 and 261-262 Postharvest Group);
c.	Scientific challenge in the content of a project (interview Ken, 56 and Peter 100 / 107-109 Ecology Group; Larry 233 and 263 and Laura, 370, Postharvest Group and Year Plan 2001 of both Ecology Group and Postharvest Group with regard to publication targets);
d.	The present level of maturity of expertise in the group (interview Brian, Ecology Group, 35-38)
e.	Complexity and size of a project (analysis of Strategic Plan Ecology Group 1996-1999 and Year Plan 2001)
III.	For the loss of expertise from the group
a.	No continuation – in the long term – of a market for this expertise (Andrew, 31-32, Ecology Group; Edward, 142 and Michael, 32-33 Postharvest Group)

Finally we found a number of examples of *retention* in the field studies. This concept is defined by Burgelman (1991) as the identification of distinctive competences, an action domain. The examples of retention we found are presented in Appendix two. Because of

the presence of variation, selection and retention with regard to distinctive competences, we argue that expertise development in the groups in the field studies is of an evolutionary nature.

So far we have presented various examples of variation, selection and retention. However we have not produced an example in which variation, selection and retention could be followed as part of the development of the body of knowledge in one of the groups, thus reinforcing our argument that expertise development is of an evolutionary nature. The development and application of models in the Ecology Group is an example of a body of knowledge that can be followed in time. In 1987 the development of models was started in order to overcome the shortcomings of empirical studies (Table 6.1, instance C8). But at this time it is still experimental as the group has only attracted one developer and has no experience in modelling. This can be interpreted as “variation”. Due to the success of these experiments (Table 6.1, instance C13) they are continued and the relative importance of modelling increases. The number of researchers specialized in developing models is rising (from one in 1987 to nine in 2001). Models are linked with geographical information systems (GIS, Table 6.1, instance C20), knowledge of regions (Table 6.1, instance C23) and developed for three kinds of ecosystems (sources: Table 6.1, instance C19 and Vision on the research of the Department of Landscape Ecology after 1995, 1993). Since 1994, modelling expertise has been concentrated in one subgroup of the Ecology Group. The models are used in analyses, policy evaluations, the development of norms and the description of conditions in (parts of) the National Ecological Main Infrastructure, in green/blue veins in culture landscape and for nature development in regions inside and outside the Netherlands. After the experimental phase, these examples in the development trajectory of the research line particularly reveal repeated selection and retention. We also find examples of selection in the various plans that were made in the period 1983-2001. A draft personnel plan in 1994 states that “the largest constraint in the work of the group is a structural lack of capacity for one of the strong elements of the department: models” addressing the relevancy of the modelling work and expressing (repeated) selection of this kind of work. In the strategic plan for the period 1996-1999, the group defines one of its goals as the development of additional expertise for the development of models.

From 1990, the group also started to develop “dynamic” models (a new example of variation) besides the grounding (validation) and quality improvement of models (Table 6.1, instance C25-1, C28, C35-1 and C37). In addition to the models developed for “fauna”, the group gradually developed models for the dispersion of plants (another example of variation). In the Year Plan of 2001, the group aimed at the development of integrated

models integrating vegetation and fauna models (to predict the effect of cattle grazing on the development of protected plants in nature areas, for example). These examples show that within a research line there are also new examples of variation. However there are also new examples of selection and retention. Two examples of continued selection: in the Year Plan 2001 the group addresses the development of interactive versions of the models to be made available by the internet. This places more emphasis on the selection criterion “scientific challenge in the content of a project” and should prevent the work of the group becoming repetitive. Another example of selection is provided by Andrew in discussing how priorities are set. Although he does not make clear why priorities were set as they were, it illustrates that a selection is made within modelling research. With regard to the development of models, Andrew states: “[M] was developed at the beginning of the nineties. Everyone thought it was great. In general people were enthusiastic for an elaboration of this model. But it never happened, because other priorities came up. That is a pity, because we were the first group to develop a dynamic model. Now other groups also have dynamic models at their disposal” (Andrew, Ecology Group, 253-256). And finally Kim provides an example of a change with regard to retention: “in the past I often used model [Y]. But now I have taken some distance. Now I take also other options into consideration to solve a problem, like expert knowledge or rules of thumb” (Kim, Ecology Group, 106-110).

Linking our findings to literature: the evolutionary character of expertise development

With regard to the evolutionary character of the process of expertise development, our findings reflect results reported in literature. Our findings match the criteria for an evolutionary process as defined by Poole et al. (2000): “a recurrent, cumulative progression of variation, selection and retention of organizational entities...while one cannot predict which individual entity survives or fails, the aggregate population persists and evolves through time according to the specified population dynamics. The entities interact and there is a conflict for the available resources” (p. 64). Our findings match these criteria in general and they are easily recognized, particularly in the example we provided of the development of a body of knowledge into the development and application of models in the Ecology Group. These findings show a recurrent, cumulative progression of variation, selection and retention of projects and research lines. These projects and research lines interact and conflict for the available resources.

Our findings are supported by literature with regard to the development of science. The activities of the groups can be considered to take place in the domain of “science”. In this respect Ziman (2000) argues, referring to Campbell (1960), that the evolution of science

should be understood as an on-going, never-ending cyclic process of “Blind Variation and Selective Retention” (p. 282). What the results of this process are and how science changes is unpredictable according to Ziman and a non-linear path-dependent process, because science should be understood as a complex evolutionary system. Zollo and Winter (2002) distinguish between (generative) variation, (internal) selection, replication and retention as the means by which knowledge evolves. Replication is not only meant as “to copy”, but also to provide new information that can provide the diversity needed to start a variation phase of a new knowledge cycle. We have not distinguished a separate stage of replication, as we consider it to be selective retention.

With regard to the *selection criteria*, in the introduction of section 6.1 (p. 151) we argued that the environment selects (Hannan & Freeman, 1977). However, we have addressed selection criteria used by the groups. Barnett and Burgelman (1996) argue however, that “Those [organizations, FB] that continue to survive have an internal selection environment that reflects the relevant selection pressures in the external environment and produces externally viable new strategic variations that are internally selected and retained” (p. 7). This is also congruent with the results found by Cockburn, Henderson & Stern (2000) and Henderson & Stern (2004). As the groups have survived, we suggest that we can use the internal selection criteria we have found in the field studies to argue for the presence of an evolutionary process.

Our findings with regard to the selection criteria are only partially supported by literature (Fujimora, 1987; Yahata, 1995; Hargadon & Sutton, 1997; Weggeman, 2000; Roussel, Saad and Erickson, 1991; Martino, 1995; Kavadias & Loch, 2004). Literature expresses strong teleological characteristics, whereas our findings express evolutionary characteristics. Our findings are supported by literature to some extent with regard to the role of (strategic) goals and risks and revenues of projects as selection criteria. We did not find clearly specified results and synergy and coherence in the project portfolio as selection criteria.

With regard to the role of goals as a selection criterion, our findings that goals have a role in the deepening of expertise (a continuation of present research lines; a repeated selection and retention) and in the development of new competences (for example the start of expertise development into internal quality features like vitamins in Postharvest Group; providing variation) is supported by literature (Hargadon & Sutton, 1997; Weggeman, 2000; Roussel, Saad and Erickson, 1991; Martino, 1995). However, in the next section we will argue that in the set of selection criteria, the criteria related to the external environment

(as “the financial coverage of all costs of a project” and “opportunities in the market”) dominate selection criteria of an internal nature in general (such as the goals of the group). However the selection criterion of “goals” does have an important function for the group: it does not make the group totally dependent on what stakeholders in the niche would like it to develop expertise in. By developing goals (teleological process, Chapter Seven) and integrating goals as a selection criterion for projects, the group can direct expertise development to some extent, working towards their envisioned future position in the niche and in their field of research.

With regard to risks and revenues (Fujimora, 1987; Yahata, 1995; Kavadias & Loch, 2004; Martino, 1995; Roussel, Saad and Erickson, 1991; Weggeman 2000), our findings suggest that the groups in the field studies have less explicit criteria for evaluating risks related to the execution of projects. Projects must be scientifically challenging, adding new expertise to existing expertise. But projects will also need to be in alignment with the present expertise, otherwise the groups will not be able to deliver quality within the budget and time constraints agreed with the client. The field studies have not made clear how this balance is weighted. Nor have the selection criteria in the field studies made clear how costs and (future) revenues of a project are evaluated and balanced, referring to the opportunity for a follow up or entrance to new markets, although the (strategic) plans contain clear goals for turnover in existing and new markets.

The first criterion we did not find in the field studies, i.e. clearly specified results to be realized in a specific period of time, seems to have been replaced by one of the social rules: “involve the client in making a project proposal” in order to approach the risk involved in non-specified results. We did not feel we found the criterion of synergy and coherence in the project portfolio in the field studies, as the groups can only partially influence the coherence in the project portfolio by their acquisition activities. The groups are dependent on clients who grant projects to the group.

In evaluating our findings with regard to the selection criteria and their meaning, we suggest that the researchers in the field studies have considerable room for improvisation and decision-making by intuition (non-codified rules, Eisenhardt & Martin, 2000). Consequently, researchers can develop new insights, share these with colleagues and stakeholders in the niche, receive feedback and discover the size of the market and the quality and features required by the market. This practice corresponds with the findings of Eisenhardt and Martin (2000). Based on a review of literature and previous research, they found that simple routines (often) provide enough structure, “so that people can focus their

attention amid a cacophony of information and possibilities, help provide sense making about the situation and be confident enough to act in these highly uncertain situations where it is easy to become paralyzed by anxiety” (p. 1112). “Firms with the most successful product development process relied on limited routines for priority setting (project selection FB), a business vision that bounded possible products, and adherence to deadlines, but little else in the way of routines” (p. 1112).

Finally, with regard to the *stability* of the set of selection criteria and the application of selection criteria for projects our findings are supported by literature (Eisenhardt & Martin, 2000; Roussel, Saad & Erickson, 1991). In the field studies, we have noticed that both the set and how the selection criteria are judged and balanced are dynamic in time. For example, the coverage of project costs was not a selection criterion in the period 1983 – 1990. In the period 1990 – 1995 this criterion was added to the set of selection criteria (Chapter Three) and more recently (1999-2001) its application became stricter. Roussel, Saad and Erickson (1991) describe the development from first and second generation R&D management towards a third generation. This development also implies changes in the set of selection criteria. Errors (such as the loose application of the criterion for the coverage of project costs) will result in adjustments on how to judge and balance selection criteria. The groups learn by doing (Eisenhardt and Martin, 2000; Zollo & Winter, 2002; Brown & Eisenhardt, 1997; Brady & Davies, 2004).

In this section we discussed the general outline of expertise development in the field studies. We also discussed our findings with regard to examples of variation, selection and retention and argued that the main findings are supported by and extent literature. We can therefore define the character of the process of expertise development as evolutionary. In the next section we will argue that this process is even of a co-evolutionary nature, implying that the environment evolves too, alongside expertise development in the group.

6.2 The co-evolutionary nature of expertise development

In this section we discuss the co-evolutionary nature of expertise development as our second main finding. Firstly, we argue that our findings suggest that the groups have adopted a practice of close interaction with their environments. This practice is the combination of (a) a recurrent process of position creation and meeting the raised expectations and (b) enacting the environment based on personal contacts with stakeholders. Secondly, we will argue that the process of expertise development is co-

evolutionary in nature. The stakeholders in the niche evolve alongside the groups. From a study of Burgelman (2002) we learn that a co-evolutionary process holds the risk that a firm becomes 'locked in'. A lock implies that the emergence of a competitive group competence develops into the emergence of a core rigidity (Leonard-Barton, 1995). Based on a comparison of our findings with literature, we will argue that we did not find that this process had the character of a "co-evolutionary lock in" (Burgelman, 2002).

Position creation and personal interaction with stakeholders

From Tables 6.1 and 6.2, it can be derived that the groups have developed a practice of interacting with the stakeholders in their environments. Table 6.1 shows that the Ecology Group has "persuaded" its environment with the concepts of cutting up, isolation, connectivity and ecological infrastructure (instance C11). This has resulted in the anchoring of these concepts in the National Nature Policy Plan (instance E3) and raised expectations about future contributions. In this respect the Ecology Group created a position, by which we mean that they convinced their environment of the viability of new concepts developed by the group to solve problems of their stakeholders. This strengthened their fit with the environment and created support (to work on these concepts) and budget (allocated for work on these concepts by stakeholders, but yet to be acquired by the group). Table 6.1 also shows that in the next period the group works on issues to meet the expectations raised by the new concepts, for example by expertise development into regional and national scales (instance C18) and expertise development in three ecosystems (instance C21) defined in the National Nature Policy Plan (instance E4). In the next period something similar happens. The group develops guidelines and norms for the spatial structure of landscapes and instruments to link the results of research to the planning process of landscape design (instance C21). This is anchored in formal requests from stakeholders in the environment from 1995 (instance E5). And finally instance C25-3 is another example, "persuading" stakeholders in the formulation of the policy document "Nature for the people, people for nature" (instance E10) and contributing to the realization of the goals defined in this plan (instances C26, C27, C36, and C37). The data from Table 6.2 with regard to the Postharvest Group do not show the same pattern of position creation and meeting the expectations about new concepts at this level of abstraction. However Table 6.2 does show that there is a close fit between the (formal) needs in the niche for expertise and expertise development in the group, for example the instances C57 and E34/E35 and C60/C61 and the instances E38 and C62. The Postharvest Group experiments, tests, stimulates and considers the environment as containing opportunities, in particular by applying new technologies like ICT and biotechnology. Persuasion of stakeholders in the niche occurs at a more detailed

level. As Laura states: “I make contact with several potential clients and ask them if they are interested in becoming involved in a project I want to start” (134-136).

Both groups have personal contacts with stakeholders in the niche in order to experiment, to test, stimulate and finally to “persuade” stakeholders. This is not immediately evident from Tables 6.1 and 6.2, but in Chapter Seven we will argue that the most important stakeholders are also involved in the development of strategic plans, providing direction for a number of years. This also implies experimenting, stimulating and persuading stakeholders, finding out what is attractive for the stakeholders and the quality and features required by stakeholders. Personal contact is also revealed from the social rules we discussed in Chapter Four, as in the example of Laura (Postharvest Group) in the previous paragraph. But although the groups are able to create a position (previous paragraph), expertise development is not only directed by the scientists but also by the stakeholders, affecting its content as well as the conditions of scientific production (Chapter Three; but also in Tables 6.1 and 6.2 in the examples C34, C36 and C62). These conditions also affect progress. An example is the addition of the criterion that all project costs should be covered. This means that researchers are no longer able to work on topics (formulated in projects) whose costs have not been totally covered (e.g. mushrooms and forest birds).

Related to the environment, the process of expertise development presented in Tables 6.1 and 6.2 can be understood as a continuous pattern (in time) of position creation and meeting expectations raised by this position. By position creation, the groups affect the ideas, needs and kind of solutions appreciated by the stakeholders. But expertise development is also affected by political, economic and social evolutions in the world of their stakeholders, creating an “autonomous” agenda for knowledge.

The co-evolutionary character of expertise development

As we discussed in the previous paragraphs, expertise development in the groups in the field studies does not take place in isolation and is not only driven by curiosity. Based on their mission and funding structure (Chapter Three), expertise development is also affected by the environments in which the groups operate. Gradual changes also take place in the environment, to some extent based on learning from previous experiences. This process is based on the use of the expertise (packed in solutions) provided by the groups, remaining problems and new problems raised by the use of the provided solutions and autonomous developments. This is illustrated in Tables 6.1 and 6.2. For instance by the emergence of the need for norms and guidelines (instance E 4-2, reflected in C21), the establishment of the Nature Planning Bureau (instance E8, reflected in C25-1 and C30) and private

guarantee systems (instance E36 reflected in C62 with regard to transparency). The influence of the niche is also visible in expertise that is diminished because stakeholders in the niche have other priorities that have to be solved. We found for instance that there is still an expert on butterflies present in the Ecology Group, but that this expertise is pending due to a decline in the number of projects related to butterflies (interview Andrew, 199-202 and interview Ken, 114-115). Another example is a decline in expertise relating to forest birds due to the tragic decline in the number of projects in this field (interview Andrew, 31-32). And finally, we see a decline in the level of expertise relating to various small fruits (strawberries, berries) and mushrooms (analysis of projects in the years 1983-2001 executed in the Postharvest Group).

The examples we found in the field studies show that changes in the niche can stimulate the development of new competences and new combinations of expertise (see Table 6.1, C36). However changes in the niche can also stimulate decline or loss of expertise (previous paragraph). Next we see in both groups that the niche confirms and strengthens the research lines that have been developed (Tables 6.1 and 6.2 and our discussion in the previous section). As we have argued, both groups can create a position by discussing the options of new concepts and research lines and by experimenting and testing. Gradually they “persuade” the niches with their ideas and concepts. In return they are “rewarded” with grants for projects that help them further develop their ideas and concepts and meet expectations. Niche and expertise development reinforce each other in the same direction. This practice is also responsible for the development of more focus in research lines. But the niche also affects expertise development in the groups as our examples of the decline in expertise in butterflies, forest birds and mushrooms show. We therefore argue that the process should be considered to be co-evolutionary: group and environment gradually and in close interaction develop expertise and learn what works and what does not.

Linking our findings of position creation and personal interaction with stakeholders to literature

We have argued that the groups have developed a pattern of interaction with the stakeholders in their niche defined by position creation and meeting expectations raised by this position. Based on our findings, we defined position creation as successfully convincing the environment of the viability of new concepts developed by the group to solve problems of their stakeholders. This strengthens their fit with the environment and provides support (to work on these concepts) and budget (allocated for work on these concepts by the stakeholders, but yet to be acquired by the group). Weggeman (1997) addresses position creation as a very effective strategy to interact with the environment.

This strategy allows the organization to think (also) inside out according to Weggeman, as long as it is based on the emergence of one or more core competences. In this respect it is remarkable that the groups have adopted this strategy since 1983, because as Weggeman argues, when there is no emergence of a core competence this strategy is very risky. As the development of expertise, especially the scientific grounding, started after 1983 our findings suggest that the competitive group competence did not emerge at that time.

Besides this strategy of position creation, we have also argued that the groups developed personal contacts with their stakeholders to test whether they can persuade stakeholders and to test how solutions provided by research projects fit the expectations of stakeholders. This way of interacting is defined by Daft & Weick (1984) by the concept of enacting. "It reflects both an active, intrusive strategy and the assumption that the environment is unanalyzable. These organizations construct their own environments. They gather information by trying new behaviors and seeing what happens. They experiment, test, and stimulate [...]" (p. 288). In this mode, personal contacts with stakeholders are often used according to Daft & Weick to collect and interpret environmental clues and to decide what works and what does not. The environment is seen as changing and as containing opportunities. Supportive in this respect is that as the groups have focused on a particular set of problems, they are able to test what works and does not work in relatively short time frames. We therefore conclude that related to literature our findings suggest that the groups have adopted a combined strategy of position creation and enacting (the environment). Based on the definition of each of these concepts, we suggest that these strategies fit very well, because both are based on approaching the environment "inside out", creating a demand. In the following paragraphs, we will link this strategy with our finding that the development of knowledge is of a co-evolutionary nature. Due to this pattern of interaction, the stakeholders in the niche can be considered to be part of the community that creates knowledge. In Chapter Eight we will incorporate this pattern of interaction as being part of the context in which the competitive group competence emerges and how the four processes accommodate dynamics and change.

Linking our finding of the co-evolutionary character of expertise development to literature

Burgelman (2002) also found a co-evolutionary process between a company's strategy and its product-market environment. Although a strategy often presupposes strong strategic intent and goals, it can also be considered an emerging strategy, based on many individual decisions. He also found a focus on a specific product-market combination and that the firm's strategy and strategic choices were strengthened by positive feedback from its environment. The examples we provided earlier in this section, illustrate that our findings

correspond with the findings of Burgelman and therefore that the process of expertise development in the field studies is of a co-evolutionary nature.

Contrary to the study of Burgelman (2002), our findings do not suggest that this co-evolutionary process also has the character of a “lock in”: “a positive feedback process that increasingly ties the previous success of a company’s strategy to that of its existing product-market environment, thereby making it difficult to change strategic direction” (p. 326). This finding is important because it helps explain how to prevent the emergence of a core rigidity (Leonard-Barton, 1995). To some extent we found elements that are related to the phenomenon of a “lock in”. For example, we found that the groups concentrate on a limited part of the field in which they work (next section). This can be interpreted as a positive feedback which makes the groups focus on existing product-market combinations. In the interviews, both the researchers in the Postharvest Group and the Ecology Group stated that their approach to the field is *one* approach, but that other approaches are also possible. And within this perspective they have also created a focus. The Postharvest Group focused on interactive storage systems and the Ecology Group focused on the development of models (Tables 6.1 and 6.2). We also found that the groups do not develop activities that extend very far beyond their – formulated and experienced – mission (and product-market combination), although the expertise development into genetic techniques in the Postharvest Group could be an example of an activity on the edge of its mission. Some group members reiterate this, while others feel that it fits with trends in science: “Who doesn’t work on genomics? [...] In my opinion it is very natural. I don't think it is very innovative. You have to follow developments in science. It is the same as installing a new Windows program in time” (Michael, Postharvest Group, 333-336). The Ecology Group however does not develop activities into the spread and survival of diseases in livestock (cows, pigs, chickens), which might have been an option considering their expertise. The Postharvest Group does not develop new packaging concepts. Nor – even further away from its mission – does it develop expertise in human applications of their knowledge of affecting aging processes in plant products, apart from the authority of the groups that traditionally work in these fields and the characteristics of their practice. However, data from both groups show that they are broadening their horizon and their competences towards new applications, based on the expertise they have developed. If necessary, the organization of the group is adjusted. In the Ecology Group this occurs in a more formal way (Table 6.1, instance C33); in the Postharvest Group this is more informal and almost continuous (Table 6.2, instance C63). Important drivers for these changes (Chapter Seven) are scientific progress as well as developments in the market.

Another element of the phenomenon of “lock in” is that the fit between firm and environment declines. In his study, Burgelman (2002) found that Intel no longer met the demands in the market at a certain point in time, due to the dominance of internal selection criteria over external ones. We did not find this feature of “lock in” in our field studies. The role of the selection criterion of “coverage of all costs” for projects has become more important over the years. This criterion addresses quite strongly the dominance of an external selection criterion, as it prevents the group from working on projects in which clients are not interested. The selection criterion of “opportunities in the market” for research themes also has a strong external orientation. As we argued, these opportunities are evaluated in discussions with clients, by testing ideas and persuading clients in enacting the environment. As we will discuss in Chapter Seven, the goals of the group (an internal selection criterion) are also discussed with clients. Furthermore, as we will discuss in Chapter Seven, goals provide a moderate direction for initiating new activities and acquiring projects. There is still room for new initiatives. We found for instance an example in the Ecology Group in which a researcher was asked by a stakeholder to develop expertise into dune landscapes (interview and conversations with Peter, Ecology Group). Based on this expertise, new projects in dune landscapes were granted. The projects developed into a new line of research.

Besides the dominance of internal selection criteria over external ones, Burgelman found other characteristics of Intel he related to the phenomenon of “lock in”. Firstly, he found that strategic planning was driven by the CEO of Intel creating a very directive top-down prescription of the strategic direction. The group leaders in the field studies did not have this role. In the Ecology Group, the leader gave an impulse to the group when he was appointed in 1985. He addressed a scientific approach in the theme of landscape ecology; he was able to stimulate coherence in the group and persuade clients (interview Andrew, Ecology Group). He was appreciated for his management style of working “bottom up” combined with providing “top-down” direction. As one of the group members stated: “He made you think you had come up with an idea all by yourself” (Kimberly, Ecology Group, 313). In the Postharvest Group, the role of the leader was even less important in prescribing strategic direction. The group members did not make specific remarks regarding the role of the (various) group leaders. We found no examples in either field study in which the group leader prevented or abandoned initiatives developed “bottom up” as did the CEO of Intel in Burgelman's study. Secondly, Burgelman found a centralization process “funnelling things up” (p. 338) to the CEO (especially with regard to coordinating product-market groups and functional groups) and interdependency on other groups and related products to serve the end users. In the field studies, we found no centralization

process or interdependency on other groups or related products to serve the end users of the knowledge as well as possible. However, the direction in which the groups have developed has provided “space”, filled in by other (adjoining) research groups. These have limited the search for new development options, when the groups do not want to compete with other groups or exclude other groups from an existing market. In this sense we recognize the statement of Burgelman (2002) in the field studies that “strategic context determination processes thus appear to be the crucial nexus between exploration and exploitation and key to balancing induced and autonomous strategy processes effectively” (p. 355).

Again, different from the study of Burgelman (2002) is the (strategic) change process in the groups in the field studies. This is not (only) time-paced, but more event-paced. In time-paced evolution, change is keyed to the passage of time, not the occurrence of particular events (Brown & Eisenhardt, 1997). Burgelman states that a time-paced change process dictates the pace of strategic change to which other players (as customers and competitors) must adhere. It is a powerful alternative to an event-paced strategy as it creates a regular, explicit opportunity to reassess actions (Brown & Eisenhardt, 1997). In contrast, event-paced change emphasizes reactive change in response to failure. In the field studies however, the event-paced evolution is not passive, i.e. a reactive change in response to failure, because change is related to new scientific breakthroughs that make new developments possible. Fujimura (1987) characterizes these new developments as making problems doable and they can also be interpreted as sequenced steps (Brown & Eisenhardt, 1997). These breakthroughs act as a “driving force” towards the niche, allowing for testing and discussing new ideas and concepts. Links in time create the direction, continuity and tempo of change as in the study of Brown & Eisenhardt (1997). Change is also time-paced, because the research programs funded by the Ministry have a duration of four years. In the last year the outline of a new research program is established and in general this also implies change. Burgelman argues that although a time-paced strategy strengthens the competitive position of a firm, it also contributes to the development of a co-evolutionary lock in. In contrast to the findings of Burgelman, our findings suggest that a pro-active event-based evolution process can also strengthen the competitive position of a group.

Our findings with regard to the dominance of external selection processes, the possibilities for developing autonomous initiatives (bottom-up), the absence of a centralization process, the absence of interdependency on other groups or related products and the combined event-paced and time-paced evolutionary process suggest that the interaction process with the environment cannot be characterized as a “co-evolutionary lock in”. These findings also suggest why the phenomenon of “lock in” has not emerged in the field studies. However we

must be careful. It could be too early to conclude definitively that there is no “lock in”. Perhaps we should take a longer time span into account, not backwards in time, but forward in time. The period we have taken into account is characterized by a relatively low level of dynamics (Tables 6.1 and 6.2) and we cannot be certain that the groups can make adjustments in their expertise soon enough when more dynamics are created in the environment. In this respect there can be insufficient variation (Ahuja & Katila, 2004), the groups can suffer from competency traps (Levitt and March, 1988) and the emergence of the competitive group competence could develop into a core rigidity (Leonard-Barton, 1995). In section 6.3 we will reflect briefly on this aspect of the process of expertise development related to the emergence of a competitive group competence. In the Chapters Eight and Nine we will reflect on this phenomenon more extensively, related to the characteristics of all processes underlying the emergence of a competitive group competence.

In this section we discussed the co-evolutionary nature of expertise development. Firstly, we argued that the groups in the field studies have developed a practice of interaction with their stakeholders that can be interpreted as “enacting” and “position creation and meeting expectations”. Secondly, we argued that the process of expertise development is co-evolutionary in nature and did not have the character of a “co-evolutionary lock in”. By linking our findings to literature, we learned that our findings are not only supported by literature but also extend literature.

6.3 Normal science and path-dependency

In this section we will discuss our third (main) finding with regard to expertise development, addressing the evolutionary character and the co-evolutionary nature as the first and second (main) findings. We will argue that the groups focus on a particular set of problems and methods and that expertise development is path-dependent.

What we learn from Tables 6.1 and 6.2 is that the groups have committed themselves to a particular set of problems and methods which helps them deepen their expertise while providing their clients with new or better solutions in a relatively short time frame. Table 6.1 shows, for example, that the Ecology Group uses concepts like “cutting up”, “the connection of ecological niches”, “the survival of species” and models to define research into landscape ecology. They adopted the “Island Theory” (Table 6.1, C4, C8) and developed a modelling approach as a standard technology, which also provides focus on a

particular set of problems and solutions. In the Ecology Group new models are developed, based on existing expertise. These models provide answers for new types of landscapes and the protection of species other than “indicator” species. In particular, the choice of models allows the group to provide new or better solutions in a relatively short time frame: “empirical studies alone are not appropriate for investigating all relevant variables e.g. the number, size, distance and connectivity of landscape patches, in relation to their effects on long-term population dynamics. In empirical studies the number of variables must be restricted and, moreover, such studies cannot take decades” (Annual Report 1987, p. 72; Table 6.1 issue C8).

Table 6.2 shows that the Postharvest Group defines research into post harvest quality by concepts like storage systems, storage problems, physiological processes, measurement and prediction of quality. The Postharvest Group focuses on a particular set of crops and links the need for solutions for quality problems in the market to the availability of new technologies like ICT, sensor technology, packaging materials and, more recently, by the application of genomics techniques. They make new technologies applicable in their field of research. As Kevin stated: “the technologies we use to solve problems have changed, but the problems themselves are still the same. We try to solve these problems with more nuance” (Kevin, Postharvest Group, 112-114). In the Postharvest Group several laboratory practices can be considered to be standardized technologies: photosynthesis measurements, measurements of hormones and, more recently, the measurement of DNA profiles packaged in micro-arrays.

From Tables 6.1, 6.2 and Appendix Two, it can be derived that the groups work on three kinds of problems in particular, using the scheme of Hoyningen-Huene (1993). Firstly, the groups work on the theoretical or experimental determination of facts, such as parameters. This knowledge is essential for any concrete application of the dominant scientific theory adopted by the groups, like the Ecology Group's Island Theory. Following the adoption of the Island Theory, the Ecology Group developed methodology for research into landscape ecology (Table 6.1, instance C4). It focused on knowledge about processes in the landscape providing more knowledge than studies of a descriptive and comparative nature. In this period they also conducted studies directed at gaining a better understanding of the function of small elements in the landscape. Based on this expertise and knowledge of several species, the group developed simulation models (Table 6.1, instance C8). But as our data show, research to determine facts is still continuing, for example the development of quantitative measures to measure the resistance in the landscape for various species. The group also works on the development of qualitative measures for the long-term effects of

the landscape being cut up (Table 6.1, examples C25-1, C35-1). An example in the Postharvest Group is research into the role of hormones on the aging of cut flowers (Table 6.2, instance C52). In this research, expertise is developed about the aging of cut flowers due to the level of hormones in the air of a cell or freight truck (which resulted in the advice not to combine the storage of fruits and cut flowers in one cell or freight truck). Secondly, the groups work on problems relating to the improvement of correspondence between theory and observation, as in the validation of models (Table 6.1, instances C25-1 and C35-1). Thirdly, the groups work on problems that address the articulation of theory employed in problem solving. This involves the more precise determination of physical constants, measurements in the service of a quantitative formulation of laws previously only formulated qualitatively and experimental efforts towards applying theory to classes of phenomena for which the possibility of such application has been posited but not yet accomplished. For the Ecology Group, this is reflected in making knowledge applicable by developing quantitative and qualitative directives and the guidance of the application of these directives in spatial planning trajectories, policy evaluations and methods for application (Table 6.1, instances C25-2, C35-2). For the Postharvest Group, this is reflected in the development of direct quality measuring methods based on genetic features of the product. These internal quality parameters were posited, but until the development of genomics and the related development of micro-arrays as a measuring technology, these measurements could not be accomplished and the development of a theory based on genetic features of the product was constrained. In Table 6.2 this research is reflected in the instances C60 and C62.

Our findings with regard to the commitment of the groups to a particular set of problems and methods build on findings reported in literature. Fujimura (1988), referring to Gerson (1983), states that scientific problem solving and fact making are collective enterprises generally organized along different lines of research, research traditions and disciplines. When individuals and organizations commit their resources to a line of research, they are committing themselves to a particular set of problems and often methods. According to Fujimura, it helps to construct problems which will produce novel information and marketable products within short time frames. This supports our findings in the field studies, discussed in the previous paragraphs. Dosi (1982) applies the development trajectory of science to explain technological development. He presents the concept of a technological paradigm as a set of procedures, a definition of the relevant problems and of the specific knowledge related to their solution. This is comparable to the theory, methods and problems addressed by Fujimura (1988). The approach of the groups, committed to a particular set of problems and methods, accentuates consensus within a scientific

community, consensus on foundational issues according to Hoyningen-Huene (1993). The three kinds of problems we found – using the scheme of Hoyningen-Huene – express the focus of groups working on “normal science” defined by adherence to general propositions like theories, laws, definitions and concepts; a multitude of commitments to preferred types of instrumentation and to the ways in which accepted instruments may legitimately be employed; convictions regarding the nature of that which physically exists; adherence to scientific norms and no intention of fundamental innovation (Hoyningen-Huene, 1993).

Our findings also express path-dependency, which stands for a learning process in which what is learned today is based on the group’s historic development (i.e. Leonard-Barton, 1995). The development of a body of knowledge in modelling in the Ecology Group is one example. Path dependency is also present in the work of Dosi (1982). He introduces the concept of a technological trajectory, as the direction of advance within a technological paradigm, expressing a pattern of “normal” problem solving activity (i.e. “progress”, p. 152). This pattern also expresses path-dependency. In accordance with our findings, the result of path-dependency is a gradual shift in competences, based on redesign, experiments and the regular practice (Leonard-Barton, 1995; Quinn, 1992; Nelson & Winter, 1982; Teece et al., 1994).

At first sight, linking our findings regarding the commitment of the groups to a particular set of problems and methods to literature supports a further interpretation related to concepts already known in literature: normal science and path-dependency. However the concepts also raise questions related to the emergence of a competitive group competence. How are normal science and path-dependency related to the emergence of a competitive group competence? Is the emergence of a competitive group competence only possible if a group works on “normal” science? And with regard to path-dependency, how is this related to the continuation of the emergence of a competitive group competence? How do groups prevent a trend towards non-emergence or the emergence of a core rigidity? These questions will be addressed in Chapters Eight and Nine in reflections on the developed theory and providing an (integrated) answer of the context in which a competitive group competence emerges.

To summarize, in this section we discussed our findings with regard to the focus of the groups on a particular set of problems and methods. We argued that our findings build upon findings reported in literature. In the next and final section we will reflect on the significance of the co-evolutionary process of expertise development we found in the field studies for the emergence of a competitive group competence.

6.4 The significance of the co-evolutionary process of expertise development

In the previous three sections we reported our findings on the co-evolutionary process of expertise development in the field studies. We found that the groups had committed themselves to a particular set of problems and methods. This enabled the groups to provide their clients with new or better solutions in a relatively short time frame. We also found that the groups work on “normal science”, which means that there is consensus within the scientific community on foundational issues. We also found that the groups adopted a combined strategy of position creation (and meeting expectations) and enacting in interacting with the stakeholders in their niche. The development of expertise appeared to be co-evolutionary, which means that the stakeholders in the niche evolve along with the groups. We argued that this co-evolutionary character should be understood as a continuous cycle of position creation, affecting ideas and needs of stakeholders and meeting expectations raised by this position.

Reflecting on the significance of this co-evolutionary process of expertise development for the emergence of a competitive group competence, we think of two functions. Firstly, this process is responsible for gaining a deep understanding in the field of research. Secondly, this process is responsible for the renewal of distinctive competences. Both functions are also found in literature (Quinn, 1992; Teece et al., 1994; Cockburn, Henderson & Stern, 2000; Barnett & Burgelman, 1996).

With regard to the *development of a deep understanding* in the field of research, we have seen from the selection criteria that research themes were selected by applying three selection criteria: a) their fit with the mission of the group; b) opportunities in the market and c) the maturity of the expertise of the group (Table 6.3). This third criterion in particular shows that a new research theme is not fully developed at once, but that its emergence is characterized by a gradual development, by the execution of a number of projects in time (Brady & Daries, 2004). A research theme grows gradually, groups develop competence in time. The co-evolutionary nature of the process gives the groups a relatively stable platform and time in which to develop distinctive competences. It also explains the role of clients in the development of expertise and implicitly in the emergence of a competitive group competence. They co-develop as new ideas and concepts are discussed with them, when they are persuaded and grant projects to the groups. The selection criteria also provide guidance to some extent, especially by complying with the mission and goals

of the group and by applying the selection criterion of “scientific challenge in the content of a project”. This helps to gain more understanding within (emerging) themes in research.

In section 6.1, we stated that projects differ in duration. We found that the average duration is one and a half years (Postharvest Group) and two and a half years (Ecology Group). For a distinctive competence to develop, at least some projects have to be executed. The average duration of projects therefore implies that the time horizon for a theme of research to develop is at least three to five years. This means that the development of a distinctive competence takes quite a long time. It is relatively long considering the business environment in which the groups have to operate and the dynamics we experience in our society. By the time groups have developed a distinctive competence, their expertise may already be obsolete. A strong link with the environment, a relatively stable environment in which changes develop in a more co-evolutionary and incremental way rather than in a revolutionary way and “normal science” allows this process to cover such a time span. Without these characteristics, the emergence of a competitive group competence would probably be difficult, if not impossible (see Chapter Nine).

With regard to the *renewal function* of this co-evolutionary process of expertise development, we found that the group can affect the direction in which expertise development takes place, especially by starting new initiatives (related to the needs of clients or based on goals addressed in the strategy) and by persuading clients of the potential of new ideas and concepts to solve existing and emerging problems. Due to the financing structure of the groups, the options to adjust and accelerate expertise development directly are constrained. This also means that we can hypothesize that it is hard to prevent the non-emergence of the competitive group competence when the dynamics in the environment become greater than the dynamics of expertise development the group has at its disposal, because the development of a distinctive competence takes some years. When the speed with which the stakeholders in the niche want to have new distinctive competences at their disposal exceeds the ability of the group to develop these distinctive competences, the fit with the environment declines. The competitive advantage will subsequently decline and products will no longer be experienced as extraordinary, implying the non-emergence of the competitive group competence. It does not necessarily mean that the groups are vulnerable for the development of a core rigidity (Leonard-Barton, 1995), as we have argued that the groups in the field studies do not (yet) experience a “co-evolutionary lock in”. A core rigidity supposes that the group continues in its way of acting and offering expertise which is no longer required (“a lock in”). What we refer to here is that they have noticed but are unable to adjust in the required time span. Obsolete expertise

can be banished relatively easily by dismissing group members, but acquiring the required expertise is only possible by developing one or more alliances with other groups or by the availability of relatively large budgets and large numbers of available group members to develop the required expertise. But especially in a situation where the fit between a research group and its environment declines (groups operating in a similar context as the groups in the field studies), these budgets are often not available.

The operation of this process also shows, for both deepening and renewal of expertise, that the development of distinctive competences is the result of a "bottom-up" process. It is the result of all activities that take place in the group: the execution of numerous projects, discussions about the design, the research approach, the results that were accomplished and the evaluation of what was learned.

Finally, with regard to the body of literature discussed in Chapter One and our research problem, we found that most of our findings regarding the separate elements that describe the process of expertise development and the context in which this takes place are supported by and provide evidence for literature. In particular the *combination* of these elements relating to the emergence of a competitive group competence is a contribution to literature and enhances our understanding. Literature (Chapter One) does not address the co-evolutionary character of expertise development as underlying the emergence of a competitive group competence. Nor does literature (Chapter One) address the fact that this process takes place in a context characterized by working on "normal science" (implying consensus on foundational issues), an environment with relative low level of dynamics and a pattern of interaction with the environment defined by "enacting" and "position creation and meeting expectations". Our findings also provide an answer to how this process accommodates dynamics and change. We found that the groups can start new projects (and develop new expertise) at the instigation of clients, projects that can develop into new research themes in time. We also found that the groups can start new projects based on goals defined in their strategy. This underlines the relevance of the inclusion of goals as one of the selection criteria, even if goals only provide limited guidance. In reflecting on characteristics of the process of expertise development (and particularly with regard to its duration and the gradual development of expertise), we hypothesize that the co-evolutionary process of expertise development cannot accommodate rapid changes in needs for expertise in the environment. This makes the groups vulnerable to the non-emergence of the competitive group competence when this kind of dynamics in the environment increases.

Our findings regarding this process of expertise development also provide an answer to how the groups succeed in maintaining fit with the environment. In Chapter One we addressed fit with the environment as crucial for the emergence of a competitive group competence. As we argued, the strategy of position creation and meeting expectations supported by enacting the environment and a “pro-active event-paced” trajectory provides the groups a platform to discuss new ideas and concepts with clients, enabling them to probe what works and what does not and how expectations of clients can be met. Combined with the social rules (Chapter Four) “respect the client” and “provide a satisfied client” and the selection criteria of “financial coverage of all costs of a project” and “opportunities in the market” (this chapter), a practice is developed that provides many opportunities to reach and maintain fit with the stakeholders in the environment. The practice of expertise development (this chapter), the social practice of interacting with clients (this chapter and Chapter Four) and the social practice of knowledge integration (Chapter Four) strengthen each other in this respect.

Chapter 7 An envisioned future as the result of a teleological process

In this chapter we discuss the fourth process underlying the emergence of a competitive group competence. As we will argue in this chapter, this process provides the groups with an envisioned future that acts as a frame of reference and is applied as an input in the other three processes. We therefore define this process by its result: an envisioned future as the result of a teleological process. We outlined this process in the introduction to Chapter Four as the process in the lower right-hand corner (Figure 7.1).

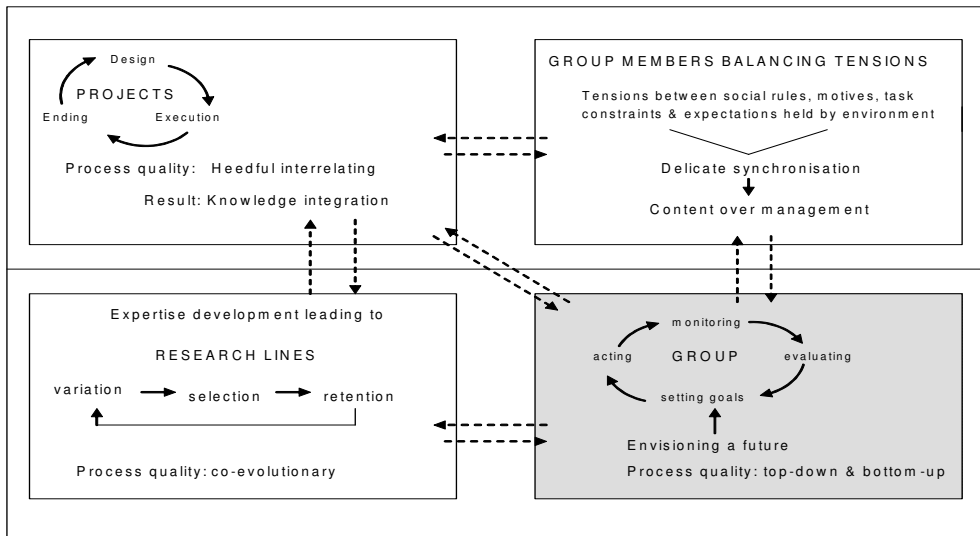


Figure 7.1: The four processes responsible for the emergence of a competitive group competence and the focus of this chapter

We will argue that this process is of a teleological nature as defined by Poole et al. (2000). They define a teleological process as a “motor” that explains change “based on the assumption that development proceeds toward a goal or end state. It assumes that the entity is purposeful and adaptive; by itself or in interaction with others, it constructs an envisioned end state, takes action to reach it, and monitors its progress. Thus, this theory views development as a repetitive sequence of goal formulation, implementation, evaluation, and modification of goals based on what was learned or intended by the entity” (p. 61).

Related to the research problem addressed in Chapter One, in this chapter we focus on the characteristics of this process, the context in which it operates and how it accommodates dynamics and change. With regard to the context, our findings not only address the situation *in* the group, but also how the group interacts with stakeholders in the niche. In Chapter Six we also discussed some elements of how the groups interact with stakeholders in the niche. In this chapter we discuss additional elements. Firstly, the groups deliberately choose to involve stakeholders in the strategic planning trajectory aimed at developing or strengthening commitment to (new) research lines. Secondly, they translate signals that were captured in the environment into (research-related) competences into (the need for) collaboration with other groups to position their research in a broader context and in an adapted organization of the group (and as we will argue, this is often the final stage of a change that had already taken place). This adds new elements to the explanation of how the groups manage to maintain fit with their environment (which we addressed as one of the elements involved in the emergence of a competitive group competence in Chapter One). Finally, our findings provide an answer to how this process accommodates dynamics and change.

The teleological process we found addresses adaptation of the group towards its environment. In the field studies we found that this teleological process actually addresses many management initiatives and management interventions. This is not only addressed in strategic and year plans, but also in topics like the “strategic” acquisition of projects, discussed in a meeting of the Ecology Group; actions to stimulate researchers to account for the time spent on projects (or otherwise treating cake), and assessments of researchers. The teleological process therefore addresses many aspects of group life.

Within the scope of the teleological process, we found that in achieving the envisioned future position of the group two distinctions must be made. Firstly, we have to distinguish goals that are achieved bottom-up. These goals particularly concern expertise development, future research lines, clients to be served and the modification of social practices. The teleological process provides a frame of reference here. It supports the researchers in their daily activities as it focuses their attention. Secondly, we have to distinguish goals aimed at achieving the envisioned future position that are achieved top-down. We particularly found two kinds of goals that were achieved top-down: (1) a HRM practice directed at the development of specialist profiles and a broad availability of researchers and (2) a practice of reorganizing researchers into teams to raise the recognition of distinctive competences for clients.

This distinction forms the basis for the discussion of our findings in this chapter. In section 7.1 we will discuss the existence of a teleological process, especially by referring to the development of plans, their monitoring and evaluation (section 7.1.1). We also will argue that future research lines, distinctive competences and social practices are not actually realized within this process and that the teleological process therefore provides a frame of reference for the co-evolutionary process of expertise development, the repeated project life cycle process and the dialectical process of balancing tensions (section 7.1.2). We will argue that the impact of the teleological process for the goals achieved bottom-up is only modest.

In section 7.2 we will discuss the goals aimed at achieving the envisioned future of the group that are achieved top-down. We particularly found two kinds of goals that were achieved top-down: (1) a HRM practice directed at the development of specialist profiles and a broad availability of researchers and (2) a practice of reorganizing researchers into teams to raise the recognition of distinctive competences for clients.

In section 7.3 we will reflect on the meaning of the teleological process for the development and emergence of the competitive group competence. Based on the discussion in section 7.1, we will argue that the result of the teleological process is an envisioned future which acts as a frame of reference and which is applied in the other three processes. In addition we will argue that the HRM practice and the practice of reorganizing the researchers stimulate the development of the process quality of heedful interrelating.

7.1 A teleological process and goals achieved bottom-up

In this section we will discuss the existence of a teleological process (section 7.1.1) and its significance for goals that are achieved bottom-up (section 7.1.2).

7.1.1 The presence of a teleological process

In the introduction to this chapter, we stated that the teleological process we found in the field studies addresses many management initiatives and management interventions. These are not only addressed in strategic plans and year plans, but also in all kinds of meetings. For example, we found that the “strategic” acquisition of projects was discussed in a meeting of the Ecology Group (May 2001). The Postharvest Group stimulated researchers

to account for the time spent on projects (or otherwise they had to treat cake). In both groups management meetings were organized. Furthermore the Postharvest Group organized acquisition meetings and meetings to discuss project budgets. Finally both groups assessed researchers. These initiatives can also be considered as part of the teleological process because they are linked to goals to develop a market position (and therefore “strategic” acquisition has to take place and acquisition meetings are organized), of goals to achieve a positive financial result (and therefore researchers must account for the time spent on projects and therefore management organizes meetings to discuss project budgets) and goals to strengthen the scientific position (for which assessments of researchers are required). As these examples illustrate, the teleological process addresses many aspects of group life.

In this section however, we will particularly address the establishment, the execution, monitoring and evaluation of plans. Although they do not address all aspects of group life, they provide a clear framework to argue for the presence of a teleological process, to discuss the meaning of these plans for the group members and the meaning of the teleological process for goals that are achieved “bottom-up”.

With regard to the presence of plans, the two groups involved in the field studies vary somewhat. The Ecology Group defines a strategic plan with a horizon of about four years. Besides these strategic plans, the group writes year plans in which goals from the strategic plan are worked out for that year and in which modified or new goals can be proposed. The Postharvest Group works with a progressive strategic plan, which is updated each year. Their year plan thus fulfils both a function as year plan and as strategic plan. In addition both groups work on one or more research programs funded by the Ministry. These programs last four years and are directed towards a number of goals and products defined in interaction with the Ministry. Because of the length of these programs they can also be considered to be part of the strategy process, because the groups influence the research that is being programmed and executed (Chapter Six). Finally, both groups are subject to a process in which they are formally reviewed every four years¹. A review committee reviews the scientific quality of the research of the groups (taking into account the group's mission) and makes recommendations to be implemented within the first two years after the review. This cycle is also part of the strategy process, because the groups tune their goals towards the recommendations of the review and anticipate coming reviews. The content of

¹ Subsidiary conditions (Appendix three)

the strategic plans and the (progressive) year plans in the field studies are presented in Table 7.1.

With regard to the process of developing strategic plans (and year plans), we found that this is a process involving the group members. For example, we found a report of a strategic conference of the Ecology Group in which they discussed its mission, its strengths and weaknesses and its future direction. In this strategic conference, all researchers were involved. In the Postharvest Group the (concept) Year Plan is discussed in yearly assessments of the researchers (Larry, Postharvest Group). However other groups are also involved in the establishment of plans. Other relevant research groups are consulted in order to coordinate plans. Stakeholders from the environment are also involved in the establishment of plans, especially by discussing draft plans in advisory committees in which stakeholders participate². For research programs funded by the Ministry, a research programming process has been developed since 1990. In this process the Ministry and other clients are invited to discuss themes in research in the near future. There is also a formal approval of new research programs before they start³.

Making strategic plans (and year plans) is only part of the process. Plans are also monitored and evaluated. The evaluation of plans is part of the process of making new plans. This applies to strategic plans, year plans as well as developing new research programs funded by the Ministry⁴. The review of the quality of the work of the groups every four to five years can also be interpreted as monitoring and particularly as a moment of evaluation. Both groups also have a system of “management reports” with a frequency of two to four times a year⁵.

² Source: Annual Reports ‘Rijksinstituut voor Natuuronderzoek’, 1987 – 1991; Yearbook Alterra 2000, stating that the advisory board consists of members from trade and industry, government, social organizations and research and educational organizations. The board provides solicited and unsolicited advice. In 2000 the board had 19 members (p. 56).

³ Description of programming process of programs funded by the Ministry of Agriculture, Nature and Food Quality, 1995 and Appendix three (subsidiary conditions)

⁴ Based on informal discussions with group heads of Ecology Group and Postharvest Group, a description of programming process of programs funded by the Ministry, 1995 and Appendix three (subsidiary conditions)

⁵ Based on informal discussions with group heads of Ecology Group and Postharvest Group, my own involvement in this process, the report ‘Implementation of the management model in the Institute of Forest and Nature Research’, June, 1995 and footnote 3 in Chapter Three

The discussion that accompanies these reports has two directions. Firstly, it is directed towards the institute management. In these discussions the group head accounts for actions taken and the results achieved. Secondly, it is directed towards the senior researchers in the group with managerial responsibilities. In these conversations, the goals of the group are translated into the contribution of teams in the group and ultimately into the contribution of individual researchers. This also creates possibilities for agreements with individual group members regarding their contribution to the achievement of the group's goals and to stimulate and motivate team members. These agreements are monitored and evaluated in yearly appraisal assessments (Table 7.2). This process of planning, monitoring and evaluating is summarized in Figure 7.2.

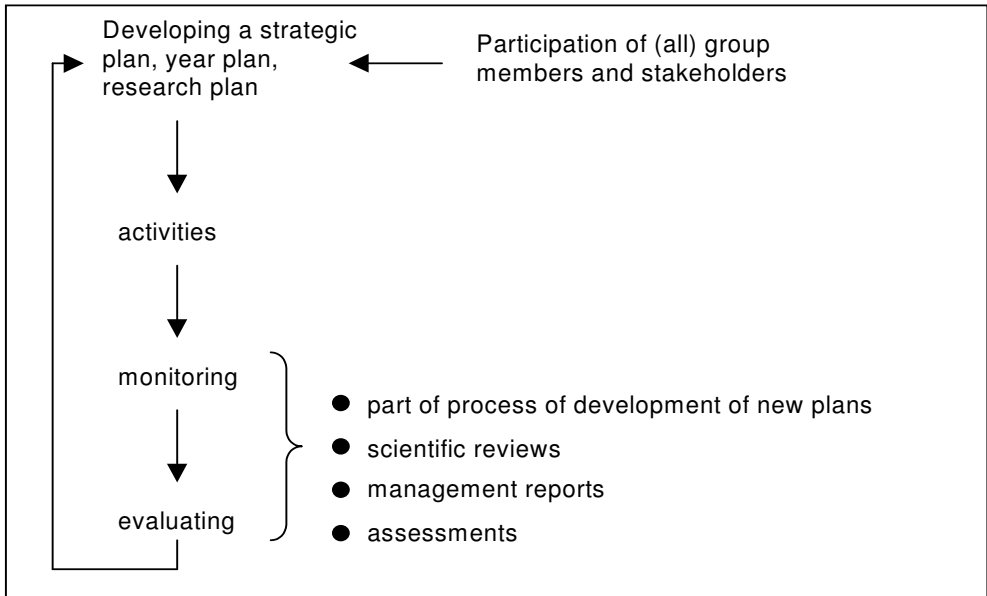


Figure 7.2: Process of planning, monitoring and evaluation

Table 7.1 Contents of strategic plans and year plans

Year plan Postharvest Group 2001

- Introduction (in which the mission is addressed)
- Developments in the market and technological developments
- Significance of the work of the group for the market, now and in the future
- Organization of the group
- Goals and strategies with regard to the market
- Projects on which the group works, projects in acquisition, goals in the market
- Acquisition strategies
- Goals and strategies with regard to science
- Developments in publication behaviour and goals with regard to the number and kind of publications
- Scientific congresses
- Ph.D.-trajectories
- Expertise development and its organization
- Personnel
- Composition of the group
- Leave and entrance of new group members
- Research equipment
- Financial aspects

Year plan Ecology Group 2001

- Strategic frame of reference (which addresses trends in the market, trends in research, trends in cooperation with other research groups and which provides a description of strategic goals)
- Research
- Product development and acquisition activities
- Expertise development for new products
- Responsibilities with regard to the expertise of species
- Financial aspects (including investments)
- Personnel
- Educational plan
- Developments in the composition of the group, bottlenecks
- Rewarding group members and strategies with regard to absence due to illness
- Organization and management
- Quality
- Publication policy
- Cooperation with universities and goals with regard to Ph.D.-trajectories
- Quality assurance
- Communication

Continuation of Table 7.1 Contents of strategic plans and year plans
<p><i>Strategic plans Ecology Group</i></p> <ul style="list-style-type: none"> • Mission and collective ambition • Strategic point of departure (position in the market and in science, core competence, products, clients, competitors, SWOT) • Themes in research (A) • Expertise development (goals related to new expertise to be developed) • Goals related to the market (turnover) (B) • Scientific profile (goals with regard to publication behaviour, Ph.D.-trajectories, cooperation with universities) • Competence development of personnel • Cooperation (A) / Strategic alliances (B) • Implementation (B) (product development, priorities in acquisition, personnel, investments, scientific products, knowledge management, budgets) <p>A = strategic plan Ecology Group 1996-1999, June 1996 B = strategic plan Ecology Group 2000-2003, October 1999</p>

Table 7.2 How the role of the team leader (a senior researcher with managerial responsibilities) is interpreted
<ul style="list-style-type: none"> • Kimberly: "As a team leader I am responsible for the turnover of the team and its expertise development" (Kimberly, Ecology Group, 39-40) • Andrew: "In my opinion it is the task of the team leader to monitor acquisition activities (are they sufficient and effective), with a certain strategy in his mind with regard to the direction of acquisition activities" (Andrew, Ecology Group, 86-88) • Joe: "I see my function as that of a senior researcher with managerial responsibilities. For 70% of my time I work on projects. In addition I have a number of coordinating tasks. These tasks concern the availability of work, the allocation of researchers to projects, personal guidance of group members, representing the team in the management team, developing a strategy for the team and communicating with group members and the management team" (Joe, Ecology Group, 6-11) • Sarah: "You also have an appraisal assessment with your team leader. The team leader also has to support the members of this team. I think of personal development, moving obstacles, work load, setting priorities, supporting structuring of work" (Sarah, Ecology Group, 31-34) • Does the team leader also do appraisal assessments? Andrew: "Yes he does. Although that has changed because in the past the group leader was responsible for this activity" (Andrew, Ecology Group, 94) • "In addition priorities in acquisition have been defined and individual researchers are made responsible to achieve these goals" (Joe, Ecology Group, 78-79)

By discussing the elements of the strategic process as we did in the previous paragraphs, we also illustrated that the strategic process is of a teleological nature. We showed that there is a process of setting goals, referring to the development of strategic plans, year plans and research plans with a duration of four years. Table 7.1 and our discussion also show that goals and objectives are translated into actions (or are based on actions as we will discuss later in this section). The monitoring and evaluating component were also discussed. They take place in the form of evaluations in the process of making plans and research programs, management reports, scientific reviews, appraisal assessments and in the form of personal guidance of individual group members. In order to interpret our findings, we should emphasize that we particularly focused on the establishment, the execution, monitoring and evaluation of plans. However the number and kind of management initiatives and interventions is broader: anticipating or responding to issues relevant to the envisioned future position of the group and the continuation of the group.

The duration of this process is related to the kind of plan (year plan with a duration of one year; strategic plan with a duration of four years) or the kind of managerial initiative or intervention (generally several months to a year to complete the cycle of setting goals, acting, monitoring and evaluating).

So far we have discussed the teleological nature of this process, but not its result: an envisioned future for the group. By an envisioned future we mean that the groups project a future position for themselves, describing their position in the field of science, their market position related to competitors, the products they want to deliver, the clients they want to serve, the scientific quality they need in order to stay attractive and the equipment they need in order to achieve the envisioned position. This envisioned future is worked out in a mission and in goals in various fields (Table 7.1). In Table 7.3 we provide a number of examples that describe these goals.

Table 7.3 Envisioning a future: examples taken from the groups' plans in the field studies

Mission

"The department of Landscape Ecology supports the responsible (local) authorities in the spatial design of nature. The group draws attention to possibilities and problems regarding the achievement of biodiversity related to the spatial configuration of landscapes. The group offers solutions that provide a maximum chance of recovery and preservation of biodiversity in the long term and thus stimulates discussion about the feasibility of targets and the effectiveness of measures. [...] By the development of knowledge, the group contributes to the development of landscape ecology as a field of science and the spatial population dynamics as a new theme within the field of population dynamics. To that end the group emphatically presents itself at international scientific congresses, publishes in scientific journals, stimulates Ph.D.-trajectories and contributes to international scientific organizations" (Strategic Plan Ecology Group, period 1996-1999)

Products to be delivered

"We distinguish the following products:

- new knowledge about the coherence between the spatial structure of landscapes and the survival of species;
- methods and techniques to describe and predict this coherence quantitatively;
- indicators, guidelines and concepts for the spatial quality of landscapes;
- explorations of spatial solutions and chances for biodiversity related to expected spatial developments;
- evaluations of spatial plans with regard to biodiversity."

(Strategic Plan Ecology Group, period 1996-1999)

Clients to be served

"The group focuses on European, national, regional and local scale levels, inside and outside nature areas. Products of the group can be used by spatial planners and landscape architects working in governmental agencies and engineering agencies. The primary clients are national and regional authorities responsible for nature policy and its implementation. At national level, this is the Ministry, in cooperation with the Ministry of Rural Development and the Environment and the Ministry of Transport and Public Works. At regional level, the primary clients are the provinces and the regional directorates of the above-mentioned Ministries. On a European scale the clients are the EU, the Ministry and the European Nature Council" (Strategic Plan Ecology Group, period 1996-1999)

"Projects are executed for producers of agricultural products (growers, NAO), organizations of producers (...), auctions (Greenery, Fruitmasters, ZON), the industry that processes agricultural products (...) and businesses in transport (...). In addition projects are executed for firms focused on implementing technology: producers of chemicals that affect quality (...), producers of storage technology (...)" (Year Plan Postharvest Group, 2001).

Contributions to be made with regard to a line of research:

"[with regard to the research line 'biodiversity and spatial coherence in a changing rural area']:

- as the dominant role of agriculture declines and as citizens also become users of the rural area, the opportunities for creating nature in the cultivated landscape increase. The group addresses the chances to achieve bio-diversity taking into account different spatial structures and dynamics. The group develops methods to predict biodiversity, based on the causal relations between biodiversity and the mosaic pattern in multi-functional landscapes. This work includes the consequences of changes for the mosaic pattern in the landscape;
- the group develops spatial conditions for certain levels of general nature quality with regard to its spatial configuration and the coherence of green networks in cultivated landscapes with intensive agriculture as the dominant user of the landscape;

<p>Continuation of Table 7.3 Envisioning a future: examples from the plans of the groups in the field studies</p> <ul style="list-style-type: none"> • the role of small landscape elements as the bearers of biodiversity and their coherence take a central place [...]” (Strategic Plan Ecology Group, period 1996-1999) <p><i>Continuation of contributions to be made with regard to a line of research:</i> “Environmental developments create opportunities the group wants to address:</p> <ul style="list-style-type: none"> • the development of sensors to measure the reaction of the product to storage conditions • development of physiological / molecular tests to make quality measurable • the application of genomics techniques.” <p>(Year Plan Postharvest Group, 2001)</p> <p><i>A scientific or market position to be achieved</i> “The position of the group in the international scientific world will be addressed more significantly:</p> <ul style="list-style-type: none"> • by means of a literature scan and discussions the contribution of the group in the field in landscape ecology and spatial population dynamics will be addressed; • a publication plan will be set up to produce these papers; • Ph.D.-trajectories will be designed so that they contribute to this desired scientific contribution; • one or more additional Ph.D.-trajectories will be focused on this scientific contribution.” <p>(Strategic Plan Ecology Group, period 1996-1999)</p> <p>‘We want to strengthen our position as one of the world’s largest centres for landscape ecology. Related to this position we want to contribute to the development of landscape ecology as a problem-solving, integrating scientific field of research. In order to achieve this position the following indicators are defined:</p> <ul style="list-style-type: none"> • each year one Ph.D. thesis on average; • each researcher publishes an average of one paper each year in one of the top 20 journals in the field of landscape ecology; • each year one new Ph.D. student or a Post doc (on average) joins the Ecology Group in collaboration with a university research group; • each year a keynote address is presented at an international scientific congress or a symposium is organized as part of an international scientific congress; • one presentation every 3 years for each researcher to emphasize the core competence of the group internationally; • [...] • in addition, contributions to the international development of the field of landscape ecology are produced by participating in the boards of scientific organizations like the IALE and the WLO and by participating in editorial boards of international journals.” <p>(Strategic Plan Ecology Group, period 2000-2003)</p> <p>“In this year we still need to acquire new projects amounting to 2.3 million guilders. In order to generate new projects we will take a number of measures: strategic alliances, acquisition meetings, a market analysis and other methods. [...]. With regard to the market [...] we have made a list of clients and actions. These actions specify the reason for visiting these organizations, project ideas, the researcher responsible for contacting this organization and for which period new projects should be acquired. [...] With regard to the other methods, we will a) organize the congress CA2001 and the exhibition that accompanies this congress; b) ... “</p> <p>(Year Plan Postharvest Group, 2001)</p> <p>“In addition there are a number of researchers in the group with a strong interest in a Ph.D.-trajectory [list of names, research topics, expected end dates and co-promoters follow, FB].”</p> <p>(Year Plan Ecology Group, 2001)</p>

Continuation of Table 7.3	Envisioning a future: examples from the plans of the groups in the field studies
<p><i>Research related competences to be developed</i></p> <p>“We will develop expertise with regard to:</p> <ul style="list-style-type: none"> - techniques to design scenarios - presentation techniques to represent results in an appealing way, for publications, brochures and folders - ...” <p>(Strategic Plan Ecology Group, period 1996-1999)</p> <p>“We will strengthen our capabilities in the field of project management and acquisition” (Year Plan Postharvest Group, 2001)</p> <p><i>Behavioural aspects to be tuned</i></p> <p>“Problem: problems to make realistic arrangements with the client</p> <p>What goes wrong: projects overrun; researchers try to solve this problem by working harder or by working in their spare time</p> <p>Solution: development of standard modules; including a senior researcher in the design phase of a project; sharing risks in the execution of a project with the client”</p> <p>(Year Plan Ecology Group, 2001)</p>	

With regard to the content of strategic plans and year plans, the key elements we found (Table 7.1) are supported by literature: a mission and collective ambition (Weggeman, 1995, 1997; Badaway, 1988; Farris and Cordero, 2002; Rush et al., 1995); training (Badaway, 1988; Rush et al., 1995) and personnel management (Badaway, 1988; Farris & Cordero, 2002; Rush et al., 1995). However our findings with regard to the collective ambition are more specified and therefore deepen literature. From Tables 7.1 and 7.3 it can be derived that the collective ambition specifies products to be delivered, clients to be served, market positions to be achieved and addresses goals with regard to the number and kind of publications.

Not all HRM aspects are fully worked out in our findings at the same level as addressed by Badaway (1988). Our findings emphasize human resources planning and career management (in the form of education and Ph.D.-trajectories; section 7.2.1) and not rewarding scientists and appraising their performance. Within DLO there are standards for rewarding employees and appraising their performance. This considerably reduces the margin for the groups to develop a strategy on their own and we therefore think that these elements are not (or hardly) addressed in the plans.

Nor did we find (goals or strategies related to) the development of cross-functional teams, managing demographic diversity, information processing by electronic technology and outsourcing; elements addressed by Farris and Cordero (2002). In our opinion, managing demographic diversity is not relevant for the groups in the field studies and with regard to the other aspects, the groups seem to be content with what they have achieved: they are able to develop cross-functional teams (Chapter Four), they have electronic technology at their disposal for information processing and to some extent they outsource activities (such as the collection of data about the occurrence of species of butterflies in the Ecology Group). These elements are therefore not addressed in the plans.

Our findings with regard to the content of strategic and year plans also suggest that the groups develop in a direction defined by Nobelius (2004). He found that new managerial activities tend to be directed towards more collaboration, involving suppliers & lead customers, developing alliance strategies, leading to specialization of each specific group in a network in which a number of technological capabilities are present (also see Cesaroni, Di Minin and Piccaluga, 2004 and Rush et al, 1995, p. 25). In the field studies we have seen that the groups have close relationships with their clients (Chapter Six) due to the context in which the group has to work. As one of the recent strategic plans of the Ecology Group stresses, the group expects that participative ways of working, involving the client and others in the research process, will become more relevant in the near future. We have also seen that collaboration has become more important, particularly collaboration with other research groups. In Chapter Six (Tables 6.1 and 6.2) we described that in time both groups lost their “own” research program funded by the Ministry. Their contributions were placed in a broader perspective which also involved contributions of other research groups. By defining a mission statement and a collective ambition, the groups discuss their future specialization and the kind of contributions clients should expect.

To conclude, our key findings with regard to the content of strategic and year plans are supported by literature and therefore seem sufficient for further use.

7.1.2 Goals achieved bottom-up: providing a frame of reference

Now we have discussed the presence of a teleological process in the field studies, we turn to the goals addressed in this process that are achieved bottom-up. In the introduction to this chapter, we stated that these goals are one of the two types of goals we encountered. In this sub-section we will argue that the teleological process has a very specific function for

these goals: it provides a frame of reference. The actual support provided by the teleological process to achieve these goals is however modest.

In discussing the function of the teleological process for bottom-up achieved goals we start to discuss the meaning that strategic plans and year plans have for the researchers in the field studies. Next we will discuss the relationship between the teleological process and goals that are achieved bottom-up. Finally we discuss the function of the teleological process with regard to these goals.

The meaning of strategic plans and year plans

What struck us in the interviews was the meaning of the strategic plan and the year plan for the group members (Table 7.4). Despite their involvement in the development of these plans, they were hardly able to tell us about the content of these plans or the goals addressed in them. By means of a joint discussion about mission, ambition and goals, the group members image what research work in the group is about, how they (individually) can contribute and what is expected of them. Providing this image of research work seems to be more relevant than an operational function of the plans with regard to day-to-day activities. We encountered one example of a managerial intervention providing support for the envisioned future addressed in the plan of the Ecology Group in day-to-day activities. This example is a discussion about “strategic” acquisition in a group meeting, in which researchers were stimulated to acquire projects that contribute to specific goals with regard to expertise development in the group. A number of researchers gave an example of how they managed to fulfil all conditions with regard to the design of a new project and were able to link this project to one of the goals relating to expertise development addressed by the group. This is only one intervention; there are probably more. Based on the statements made by group members with regard to plans (Table 7.4), group members suggest that they do not associate the assessments with their team leader or the agreements reached in these talks as linked with the goals and ambitions formulated in a strategic plan or year plan. The plans do however provide direction for the group as a whole, for example with regard to the development of additional expertise (Chapter Six, Table 6.3) and the recruitment of new group members with expertise the group wants to acquire (section 7.2.1).

Table 7.4	The meaning of strategic plans and the year plan
	<ul style="list-style-type: none"> <li>• Does the group have a collective ambition? Sarah: “Yes, we formulated this ambition in a strategic plan. However I cannot tell you the core issues of our ambition” (60-61). But what is its significance then, if you can’t tell me? Sarah: “Well, that is your own responsibility” (67-69). Do you act according to the goals set by the team? Sarah: “Yes I do, for example in research with regard to forests and water” (74-76) (Sarah, Ecology Group) <li>• “Under supervision of the group leader, a year plan was made with the headlines for the group. People know they must be aware of the goals addressed in this plan. But if you ask me what they mean to me in practice, in the execution of projects, then I would have to admit that I find it difficult to focus on these goals. [...] We can contribute to goals addressed in this plan, but how people do that is very individual” (Edward, Postharvest Group, 108-111 and 119-120) <li>• Michael: “Each year plan looks very much like the one before. Of course they contain various more idealistic goals, but these do not have priority in normal life. The fact that we have these goals is fine, but ... One of these goals, for example, is a list of the number of scientific publications to be achieved. But this is one of the things that we ignore when money is tight”(Michael, Postharvest Group, 289-293) <li>• How do you translate the group’s ambition into activities? How is this ambition achieved? “I don’t think that these ambitions provide direction. We cannot choose our own direction; you have to follow the market.’ But do they help in creating a position? ‘Yes, they do. When you are designing a project, you try to involve more actors that are part of the chain” (This chain perspective is part of the group’s ambition, FB) (Laura, Postharvest Group, 343-345).

One explanation provided by literature for this phenomenon is that even when group members cannot describe the content and goals addressed in plans, they still can provide direction if the ambition of the group reflects individual goals. In this situation, the ambition of the group is internalized and it is quite “natural” for the individual group member. Subsequently, when we ask about the goals, they cannot distinguish between these goals and their own goals. Literature explains this by referring to the concept of a collective ambition, i.e. the shared ambition of the group. According to Clarke (2002), a participatory / consultative style in decision-making is one of the key attributes of a good R&D leader. Weggeman (1997) and Ketokivi & Castañer (2004) also argue that a participatory style is very relevant for developing a collective ambition and setting goals and objectives. With this approach they argue, the result should be a high correspondence between the organizational goals and the goals of the individual researcher. In this situation, the collective ambition provides direction and researchers commit themselves. When collective ambition, goals and objectives are developed this way, there is a good chance that the collective ambition is mentally activated when individual researchers make decisions. And when activated, the chance is high that this decision is in favour of the collective ambition.

The function of the teleological process for goals achieved bottom-up

According to Poole et al. (2000), the teleological process expresses a repetitive sequence of goal formulation, implementation, evaluation and modification of goals based on what was learned or intended by the entity. Implicitly one could assume that goal formulation and implementation occurs in this process, raising the question of how this process relates to the processes described in the Chapters Four to Six. In Table 7.3 we provided a number of goals we found in the field studies. Are all these goals achieved within the teleological process and if not, what does that mean for the teleological process? In Chapter Eight we will discuss the coherence between the processes more in detail. Here, however, we will argue that the teleological process provides a frame of reference for the repeated project life cycle process, the dialectical process of balancing tensions and the co-evolutionary process of expertise development and therefore that the four processes are nested.

What we found is that the content-related goals in particular (defined within the teleological process) are not achieved by separate actions executed in this process. The development of distinctive competences is accomplished by the design, the execution and the ending & evaluation of projects (Chapter Four) and by contributing to the further development of (established) lines of research (Chapter Six). In the design and execution of projects, the researchers meet all kinds of (new) possibilities, directions and constraints. It is therefore not certain that the defined goals are met. As we addressed in Chapter Six, referring to the set of selection criteria for projects and research themes, the co-evolutionary development of expertise is a “bottom-up” process affected by the teleological process but not completely defined by this process. The other way around, envisioned goals are not defined apart from established distinctive competences, established social practices (Chapter Four) and achieved goals. When goal A is not realised, but based on this “bottom up” process it is achieved as A¹, this result will be taken into consideration for the next sequence of goal formulation.

A second and related finding concerning this process is that the impact of the teleological process for achieving the envisioned future with regard to the development of distinctive competences and adjustments in the knowledge integration practice is moderate, because the actions to achieve this envisioned future are not part of the process itself, but rely (in essence) on the repeated project life cycle process, the (co-)evolutionary development of expertise and the gradual development of social rules. It is moderate because management does have some control. It is not only bottom-up. As we stated in Chapter Six, in their plans the groups generate priorities for expertise development. They have a small budget to execute projects in these priority areas. This is one way in which management directly

affects the achievement of goals with regard to the development of distinctive competences. Secondly, management can hire new researchers with the desired expertise (section 7.2.1) although this is constrained as these people need financial coverage. Thirdly, management is involved in decision-making regarding the execution of projects in the acquisition process, although sometimes the choice will be between a financial loss (because a project does not quite fit priorities addressed in the strategic plan) or the execution of a project that does not completely fit the envisioned goals of the group.

Our findings seem to oppose the way in which Donaldson (1987) addresses the teleological process. He addresses the teleological process as a pure top-down process in which goals are set by the “dominant coalition” in the organization, i.e. management. We found strong involvement of all group members and a strong interaction of the goal-setting process, current research activities and decisions made by individual researchers. Our findings also seem to be contrary to the findings of Rush et al. (1995), who found business planning vital for enabling R&D organizations to survive change and progress despite uncertainty. Their perspective on the achievement of content-related goals is to consider it as a master plan, to be implemented, audited and monitored regularly. Our findings are more similar to those of Weick (1987): strategy inferred from successful action that develops through experimentation or is discovered by luck. We found a teleological process in which goals are addressed (in part based on established distinctive competences), but in which the achievement of these goals cannot be guaranteed as they are achieved bottom-up. In their actions, researchers meet new opportunities, conditions and constraints.

Based on the discussion of the impact of the teleological process for goals achieved bottom-up, in the previous paragraphs we argue that the outcome of the teleological process - an envisioned future - provides a *framework* for the repeated project life cycle and the process of (co-)evolutionary development of expertise. The examples we present in Table 7.3 of how an envisioned future is viewed with regard to the group's mission, the products to be delivered, the clients to be served, the contributions to be made in a line of research and scientific or market positions to be achieved draw particular attention to actions and decisions taken by researchers in the repeated project life cycle and the process of (co-)evolutionary development of expertise. With regard to the acquisition of projects, for example, this is focusing on the clients to be served, the kind of products to be delivered and the contributions the group wants to make. But also in the (co-)evolutionary development of new expertise, as the goals that address the contributions to be made in lines of research and scientific positions to be achieved act as selection criteria (Table 6.3). This envisioned future also acts as a framework regarding the adjustment of social practice

as shown in the example in Table 7.3 (“behavioural aspects to be tuned”). These goals provide a frame of reference in the repeated project life cycle related to a number of social rules. The problem of “making realistic arrangements with clients” (and implicitly the goal to solve this problem), for example, relates to the social rule of “involve the colleagues you need” as one of the solutions for this problem refers to the involvement of a senior researcher in the design phase of projects. The goals relating to behavioural aspects can also imply new tensions with regard to the application of existing rules, motives, task constraints and expectations in society. But as the researchers participate in goal setting, the teleological process can also contribute to reducing tensions between individual goals and those of the group. This envisioned future therefore also acts as a frame of reference for the dialectical process we discussed in Chapter Five.

Because of the involvement of key stakeholders in the establishment of plans, the teleological process also contributes to position creation. Discussing ideas and new concepts can motivate clients and generate commitment for (new) themes in research. But the plans also help to promote trust among clients, by making clear how expectations are paid off. Both elements, position creation and making clear how expectations are met, contribute to an enhanced fit between the group and its environment. The Ecology Group provides some examples: the group's choice to concentrate on the discovery of the field of landscape ecology (1983-1987), the choice to develop models (1983-1987) and the development of the concept of a National Ecological Main Infrastructure has affected the stakeholders in the niche in their needs for expertise and their expectations with regard to the kind of solutions and the speed with which the group provides them (Table 6.1).

In this section (7.1) we discussed the presence of a teleological process, especially by referring to the development of plans, their monitoring and evaluation. We also argued that goals related to future research lines, distinctive competences and social practices are not actually achieved within this process and therefore that the outcome of teleological process (an envisioned future) provides a frame of reference for the co-evolutionary process of expertise development, the repeated project life cycle process and the dialectical process of balancing tensions. We also argued that the impact of the teleological process for the goals achieved bottom-up is only modest.

7.2 Goals achieved top-down

In this section we will discuss the goals to realize the envisioned future of the group that are achieved top-down. In particular we found two kinds of goals that were achieved top-down: (1) a HRM practice directed at the development of specialist profiles, a broad availability of researchers and the selection and socialization of new researchers (section 7.2.1) and (2) a practice of reorganizing researchers into teams to raise the recognition of distinctive competences for clients (section 7.2.2). We do not discuss the investments in equipment made by both groups. This is also achieved top-down, but its role with regard to the development and emergence of a competitive group competence should be related to the integration of knowledge as we will discuss in Chapter Eight. In this integration process, equipment has a supporting role.

7.2.1 Human resources management practices

In this section we will discuss the human resources management practice we found in the field studies. This practice was aimed at producing specialist profiles and a broad availability of researchers. As a side effect T-shaped profiles were also generated. We first present our findings and then relate them to literature.

The human resources management practice encountered in the field studies can be summarized in four sub-practices, presented in Table 7.5.

Table 7.5	Summary of the elements of the HRM practice
a)	recruiting future group members with desired competences, orientation and background
b)	selecting from members working in the group with a temporary contract
c)	stimulating (scientific) quality through specialization
d)	stimulating a broad availability of group members

The first sub-practice addresses the *recruitment* of group members with the desired competences, orientation and background. Recruitment of new group members is part of the plans we found in the field studies. Besides more technical competences relating to the field of research, the groups look for people with specific competences, a specific orientation or background. This might include the competence to manage big interdisciplinary projects (Ecology Group), marketing and acquisition competences (both

groups) or being able to work interactively (Ecology Group). Table 7.6 provides (other) examples from the field studies.

Table 7.6	Desired competences for new group members
<p>“Not only is the quality of research relevant; planning and financial management are also becoming more important. Therefore the present capabilities with regard to project management and acquisition must be strengthened. This will be done through courses and by training. We think of strengthening the group with someone with excellent qualities in the field of acquisition or project management.” (Year plan Postharvest Group, 2001, p. 10)</p> <p>“The largest bottleneck in the present composition of the group is the capacity that is structurally too small for one of the strong capabilities of the group: models.” (Draft Personnel plan Ecology Group, August 1994, p. 1)</p> <p>“There is a growing demand for GIS expertise. Although this demand is largely met by training [...] additional GIS expertise for more complex GIS work is required.” (Strategic Personnel Plan Ecology Group, August 1997, p. 7)</p>	

The groups do not only focus on the availability of competences, they also look at the educational background of future group members and their orientation towards science and clients. In 1989/1990 the Postharvest Group wanted to strengthen its share of group members with an academic background to strengthen its scientific position. Many group members with a different educational background left the group. The Ecology Group looked for people who could build and work with models and some years later, people who could strengthen the group's GIS expertise. The composition of the group with regard to distinctive competences and educational backgrounds is approached very consciously and addressed very explicitly in the plans (Table 7.7). Group members must supplement each other in a synergetic way, but the composition of the group is also evaluated from a competitive perspective: group members have a different ‘price tag’ related to their educational background when they are allocated to projects.

Table 7.7 Statements regarding considerations about the composition of the group	
Postharvest Group	“...the composition is as follows: research assistant [...], junior researcher [...], researcher [...], senior researcher [...]. We feel that this is a well balanced composition for the content of the work done in the group “(Postharvest Group, Year Plan 2001, p. 10)
Ecology Group	“We find that the balance between personnel with an academic background and personnel with a [...] background is sufficient. We do not see any trends in the work we acquire which suggest that adjustments necessary. In this group we do not have personnel with a [...] educational background, because [...]” (Ecology Group, Strategic Personnel Plan, August 1997, p. 7)

In addition to desired competences and educational background, the orientation of new group members is important. The group must balance between a more scientific orientation and a more client-based (problem-solving, practical) orientation. Group members who are more strongly oriented towards science can help strengthen the scientific profile. Members who are more strongly oriented towards clients can help strengthen the link with stakeholders in the environment. Edward addresses the differences in orientation in the following statement: “I notice that there is a gap between science and the practice of clients. I try to bridge that gap, because it is very hard for a scientist to concentrate on something very practical. Real scientists go for science and they are not stopped by all kinds of practical considerations. But you need that too” (Edward, Postharvest Group, 148-151).

Finally new group members must fit into the team. As Brian states: “With regard to his or her expertise, a new group member should complement the expertise we already have. As a person, he or she should fit into the team (from a social point of view). The social aspect is more important than networking competences and project management competences” (Brian, Ecology Group, 112-114).

With regard to the sub-practice of *selecting (and socializing)* new members, we found that new members were generally selected from the pool of researchers working on a temporary basis in the group. In part, this strategy was born out of a lack of other options. In the first period (1983-1989) neither group could hire new researchers on a permanent contract. But after 1990 this strategy continued. The Postharvest Group also had another reason for continuing this practice. The field in which this group works and the desired expertise of new group members do not correspond with educational programmes. The strategy of selecting new group members from a pool of researchers working on a temporary basis increases the chance of selecting the most valuable persons.

In Table 7.8 we provide data supporting this practice for the Ecology Group. For the Postharvest Group we have no data available that can be presented in the same way due the development trajectory of the group (Chapter Three). The data supporting this practice in the Postharvest Group are derived from interviews with the group head and one of the recently selected group members (Chris).

	Number of researchers working on a temporary contract	Hired on a temporary basis in	Number (between brackets) selected as a new group member in
Ecology Group	1	1987	(1) 1990
	3-4	1987	(0)
	1	1988	(1) 1989
	2	1990	(1) 1993 and (1) 1995
	4	1991	(1) 1994 and (1) 1995 and (1) 1996
	5	1993	(3) 1996
	3	1995	(1) 1996 and (2) 1997

With regard to the *socialization* of new group members, the Ecology Group has a protocol (also visible on a centrally positioned notice board) for the introduction of new group members. In part this protocol concerns the preparations for the arrival of the new group member (a workplace, availability of a computer). It also concerns how the new group member is introduced (information package, introduction in a news bulletin, conversations with colleagues, introducing the new group member to all colleagues). An important part of this protocol is a coach who accompanies the new group member during the first six months of his/her employment. The presence of a “room mate” is also highly appreciated by the researchers we interviewed, as a mechanism to get to know the group and learn about the practice of the group and the field of research. During the field study in the Ecology Group, three group members had recently joined the group: Simon (2000), Sarah (1999) and Joe (2000). Joe had previously worked in another department in the same institute and was asked to join the group for his managerial qualities and his knowledge of one of the fields of the group. Simon and Sarah came from another organization. Simon was already familiar with the group as a Ph.D. student. In Chapter Four we quoted these group members in Table 4.6 (social rules). These quotes illustrate that they have adopted the social rules.

In the Postharvest Group there is no formal protocol for introducing new group members to the practice of the group, but it also has a coach who accompanies a new group member. Chris – a research assistant who worked just a couple of months with the group – already knew the group before he started working. He had joined the group during a work placement period in his educational program. During this period he got to know the practice of the group. Stephanie and Cindy, who were also fairly new to the Postharvest Group, emphasized the relevance of a coach to learn about the practice of the group. All three new group members recognized the collective orientation in the group and talked positively about this orientation.

The practice in the field studies shows that the link with a room mate and the presence of a coach enables discussions about the practice. Furthermore, the new group members also participate in group meetings. As the social rules are also made explicit in these meetings, they provide another opportunity for new members to learn about the practice. In addition, the selection of people who have been partially socialized under unequal social conditions contribute to the incorporation of the social rules in their style of working.

The third and fourth sub-practice from Table 7.5 concern the policies applied by the groups regarding the development of group members: stimulating (scientific) quality by specialization and stimulating broad availability. Both groups have developed a strategy of offering options for specialization (see the profiles in Appendices eight and nine), reacting to the motivation of researchers to become more mature in designing and conducting research and to develop a position in science by specialization. It also contributes to the goal of strengthening the scientific quality of the work. Allocating group members to certain types of projects and offering Ph.D.-trajectories are the means by which specialization is achieved. The data in the field studies show that the groups aim for an average of one Ph.D. thesis a year. This means that in both groups, four to five group members were working on a thesis during the field studies (Table 7.9). By studying the Ecology Group's plans and the annual reports of the Postharvest Group we noticed that this practice was not established recently, but that it had been in operation for a longer period of time. In addition to the development of stronger, science-based profiles, a side effect is a rise in the number of scientific publications.

Table 7.9		Data relating to group members working on a thesis	
	<i>Who</i>	<i>will finish in / was finished in</i>	
Postharvest Group	Thomas	2002	
	Larry	2002	
	John	2001	
	Norris	2001	
	Group members interested, but not yet started: 4		
	Source: Year Plan 2001		
Ecology Group	Kimberly	1996	(Strategic Personnel Plan 1996)
	Rita	1997	(Annual Report 1997)
	Maurice	1997	(Annual Report 1997)
	Bruce	1998	(Strategic Personnel Plan 1997)
	Gunther	1999	(Strategic Personnel Plan 1997)
	Rebecca	2000	(Strategic Personnel Plan 1997)
	Ian	2001	(Strategic Personnel Plan 1997)
	Donald	2002	(Year Plan 2001)
	Philip	2004	(Year Plan 2001)

Since 1995/1996 attention has also been directed at creating broad availability of group members. This need became apparent from the development and (stricter) application of business economic rules stipulating that all costs must be covered (Chapter Three). This means that if a researcher cannot participate in a project (with a budget), he or she makes costs that are not financially covered. To anticipate fluctuations and changing demands in the niche, the group needs members who are specialists in their field (to provide quality) and who also have broad availability to minimise the difference between the expertise required by the niche and the expertise currently at the disposal of the group. Group members are therefore stimulated (by checking or correcting the allocation of group members in projects) to contribute to projects that may not be exactly in the core of their specialist profile but that are sufficiently interesting. Furthermore group members are encouraged to acquire projects that need the participation of all research teams in the group. The group leader may choose to switch researchers between teams and researchers can be seconded (Table 7.10). Specialization and stimulating broad availability are both present in the development trajectory of the group members at the same time. This practice contributes to the development of “T-shaped profiles”.

Table 7.10 The aim to create a broad availability of researchers

- Strategic Personnel plan Ecology Group, June 1996:
 “Researchers have broad availability and have expertise in fieldwork and spatial analysis (application of statistics, models, GIS methods)” (p. 5) and “The broadening of expertise will be stimulated. Researchers can think of the development of additional knowledge of other organisms in addition to their own specialist profile, or expertise development in the problems of spatial planning. [...] Some knowledge of vegetation processes and the relation between soil, water and vegetation is necessary to cooperate with others” (p. 6) “The following means are present in order to achieve this goal:
 - projects requiring the involvement of the whole group [...]
 - sometimes transferring persons to other teams, or changing the composition of teams
 - secondment to other departments of the institute or to other institutes
 - courses outside their own personal core competences” (p. 7)
- Do you try to get involved in new projects, to broaden your profile? Sarah: “Yes, I do, because I enjoy it. For example, projects focusing on robust connection zones, so that I also acquire this competence” (Sarah, Ecology Group, 168-175)
- Do you try to broaden your expertise profile? Ken: “Yes I do, because I like variety” (Ken, Ecology Group, 59)
- “I have been working here for four years and when I started I focused on vegetables, fruits and bulbs. Not on flowers, not on molecular processes, not on measuring equipment. In the future, I will focus more on flowers and measuring equipment. Why? Because the group needs more of this kind of expertise (conclusion of the group leader; FB). I have conducted a lot of measurements concerning the breathing of products, so I like this change” (Larry, Postharvest Group, 10-15).

Linking our findings with regard to the HRM practice to literature

Our findings with regard to the four HRM practices are supported by literature addressing HRM practices in R&D (Allen and Katz, 1986; McKinnon, 1987; Badaway, 1988; Roberts, 1988; Tuininga, 1990; Hargadon & Sutton, 1997; Farris and Cordero, 2002; James, 2002). We extend this literature by linking it to the emergence of a competitive group competence.

With regard to *human resources planning*, our findings are supported by Farris and Cordero (2002) and Roberts (1988). They argue that in the past scientists and engineers were hired for their specialized technical skills. In contrast, today’s R&D laboratories hire scientists and engineers for more varied skills like teamwork, communication skills and the ability to perform one or a number of roles critical for project success.

With regard to the *reward* of scientists and engineers, our findings are supported by Farris and Cordero (2002), James (2002) and Tuininga (1990). They argue that it is the technical challenge or the opportunity to pursue their own research interests which motivates

scientists and engineers. This is congruent with one of the motives we found (“work on what you like” Chapter Five). It also is congruent with our finding that projects should also be scientifically interesting (Chapter Six).

The practices we found in the field studies with regard to the *selection and socialization* of group members are congruent with the practices Hargadon and Sutton (1997) found. In their study experienced group members came into contact with potential candidates for the group, candidates did internships and were assigned to temporary contracts. The practices we found also enable discussions on the practice of heedful interrelating. The relevance of these practices is supported by Weick and Roberts (1993) who conclude that “whether heedful images survive or die depends importantly on interactions among those who differ in their experience with the system” (p. 342).

With regard to *career management* our results reflect the findings of Allen and Katz (1986) and McKinnon (1987) more than the statements made by Farris and Cordero (2002), Weggeman (1997, 2000) and Badaway (1988). We did not find a dual or triple ladder or career paths (Weggeman, 1997, 2000; Badaway, 1988; Farris and Cordero, 2002). Our findings seem to be better interpreted as a project orientation (the desire to work on challenging projects; Farris & Cordero, 2002; Allen and Katz, 1986; McKinnon, 1987).

To summarize, the human resources management practices we found are supported by literature. They are aimed at a careful selection and socialization and at achieving a specialist profile and a broad availability of researchers. As a side effect, T-shaped profiles are achieved. A “project orientation” as a career path seems to be sufficient for the emergence of a competitive group competence; apparently a dual or triple ladder is not necessary. In section 7.3 we will argue that these practices contribute to the development of a pattern of heedful interrelating and the development of a deep understanding of the field of research and therefore contribute to the emergence of a competitive group competence. This link between the HRM practices and their relevance for the emergence of a competitive group competence also expand literature.

7.2.2 The practice of organizing the research group

In this section we will discuss the practice of organizing the research group. This practice was aimed at strengthening the recognition of distinctive competences in the group for clients. We first present our findings and then relate them to literature. We will argue that literature supports our findings with regard to the way researchers are organized and with

regard to our finding that the internal organization follows the developments in the environment. We will argue that the groups strive for a structure that facilitates the implementation of the goals addressed by the teleological process and that this structure does not harm organization culture.

Sometimes as part of a strategic (year) plan, sometimes in other documents, we encountered propositions and decisions about the organization of the researchers in the groups involved in the field studies. These have been partially presented in Tables 6.1 and 6.2 in Chapter Six (instances C32, C33, C38, C50, C53, C55, C56, C57, C59).

Systematically and placed in time, the organization of the groups changed as follows. Between 1983 and 1987, the Ecology Group functioned as one group, for its size was small. After this period the group grew and the researchers of the Ecology Group were grouped by species. In 1994 there were four teams: birds and plants, mammals and amphibians, insects and a fourth team focusing on models. As this (modelling) team had to provide the other teams with models, strong interaction with the other teams was assumed. In 1996 a plan was made to organize the Ecology Group into themes (this choice became effective in 1997). In the choice for themes the group aimed at fit with the environment: themes recognized by the stakeholders. To preserve the expertise of species, this kind of expertise was attributed to researchers in the group with an (implicit) assignment to keep that knowledge up to date. The integration of the knowledge of species was directed by the themes. In 1997 the researchers in the Ecology Group were organized in three thematic teams (culture landscape, ecological main infrastructure and model research).

In 1998 / 2000 the organization of the researchers of the group was changed again, due to the establishment of a new institute of which the Ecology Group became part (Chapter Three). The organization by themes continued, but the number of teams was expanded to seven. One of the teams was shared with another research group. The 1998 Annual Report stated that reorganizing the research groups had contributed to a better fit with the problems of stakeholders in policy making and in the management of nature, because environmental quality and spatial quality were basic conditions for nature. Appendix twelve shows the growth of the Ecology Group and its organization in teams.

For the researchers, these teams provide an organizational “home”. More than in other meetings, here they receive attention for their personal wellbeing. As Appendices six and seven show, organizing researchers in teams has not contributed to a strong orientation on the team. The group members still collaborate with each other, despite their team. From the

interviews we learned that the teams can also have ambitions, which are achieved as a team (Table 7.11). Improved communication was referred to as goal for 2001 by the modelling team and the development of a model by the team operating in the field of multifunctional landscapes.

Table 7.11	How the function of teams is interpreted in the Ecology Group
<ul style="list-style-type: none"> • Is each team member necessary to the others in terms of their competences? “Well, I don't really work with my team colleagues. I tend to work more with colleagues outside the team. For me the team is where I receive information and where I can inform my colleagues and team leader about issues I feel may be important to them. In addition it is an organizational home for highlighting things that aren't OK” (Sarah, Ecology Group, 78-83); • Do you need each other in the team with regard to the competences of each team member? “We need several fields of expertise in our work. We do not limit ourselves to the team, but we try to bring all the necessary expertise together”; “We also need expertise from other teams, for example about amphibians and reptiles” (Andrew, Ecology Group, 48-50 and 65); • Do you need each other to achieve the team's ambition? Joe: “Yes we do. However, the work is organized in projects and they can cross teams”. “I think it is valuable when researchers work in changing (project) teams, but we have also formulated some actions we want to achieve as a team” (Joe, Ecology Group, 84 and 85-87); • Peter: “The team has a role with regard to the content of the work. The team is responsible for development of expertise (developing models, expertise of effect studies)”. “The added value of the team is of a social nature, colleagues with whom you have more contact than with others. They provide social support” (Peter, Ecology Group, 67-68 and 72-74). 	

As Table 6.2 shows, the history of the Postharvest Group is quite different. Appendix thirteen shows the growth of the group and its organization in detail. When the Postharvest Group was developed in 1999 as we encountered it in 2001, the group was organized as one group with teams that reflected two dimensions. The first dimension was an organization directed at groups of crops (ornamentals & plants, potatoes, vegetables & fruits). The second dimension was an organization directed at physiology and molecular work (genomics). These teams, however, were not formally described. There were senior researchers who were responsible for a group of researchers and who organized thematic meetings, but these senior researchers had no hierarchical responsibilities. The researchers of the group therefore talked about this way of organizing as a way of presenting the expertise of the group to the stakeholders in the environment; a presentation that could change with a frequency of “every six months” (Table 7.12). They did not experience the teams as an organizational home. In naming the teams, it is important that the stakeholders in the environment recognize these labels and that they contribute to the acquisition of projects.

Table 7.12 How the grouping of the Postharvest Group is experienced

- “That’s what funny about this group: once every 6 months the way in which we are organized changes. The field in which we work and the work itself stays the same, but the organization is different. The changes are more cosmetic than radical, with people changing jobs or starting completely new things”. But what does it mean to you? “Well, as I said, this organization is arbitrary. The thematic meetings however are organized according to this scheme. But that is arbitrary too” (Edward, Postharvest Group, 15-28);
- Michael: “We have made a kind of matrix organization, distinguishing products and disciplines. One discipline is genomics (I don’t agree with the word molecular, because physiology is also very molecular. It is about the use of genomics tools) and the other discipline is physiology”. What does it mean to you? “It doesn’t mean very much to me”. What is the function of the product dimension? “It is directed towards clients [...]. Behind a product group is a group of clients”. [...]“Actually, it is a paper construction” (Michael, Postharvest Group, 19-23, 31-35 and 68);
- Do you have goals or an ambition as a team? “No. It is only a team because we produce solutions together, but we all work with colleagues from other teams. You now show me what my team is, but there are no strict borders” (Larry, Postharvest Group, 76-78);
- Laura: “[That scheme], has something to do with the composition of the group and how you can visualize it in a scheme, how it is supposed to work” [...] “It is always difficult to organize this research group and finally this scheme came up” [...] How does it work now? Are the teams real teams? “No, there are no formal teams beneath the group head. But there are theme leaders, so there is some informal hierarchy [...]”. What does this scheme mean to you? “Well, that’s a bit vague. This organization is discussed continuously. [...] To present the group to the stakeholders, you must have some kind of organization, but I don’t feel it’s that important to the members of the group” (Laura, Postharvest Group, 5-24).

In the organization of the researchers, it is striking that the establishment of teams did not create borders between the teams in the acquisition and execution of projects. The researchers collaborate very well, even when they are members of different teams. For the acquisition of projects, the field studies taught us that organizing is relevant to present the expertise of the group to stakeholders (i.e. Table 7.12). This is preferably achieved using labels that are recognized by the stakeholders, that can be used in communication, that provide trust in the quality of the group and therefore support acquisition activities. Furthermore, it was remarkable that the groups follow their environment in organizing teams and in attributing labels to teams. Despite the strategy of position creation (Chapter Six), the groups choose to maintain fit with their environment by labelling the teams with labels recognized by the environment. Therefore organizing the group *follows* the environment. Table 7.13 presents an analysis of developments in the environment compared to the labelling of teams of the Ecology Group.

In addition to the annual reports referred to in the previous paragraphs, this Table supports our interpretation that the groups follow the environment. One explanation for this strategy is that the choices made by the groups with regard to their organization will affect the expectations of the stakeholders concerning the kind of expertise and how the expertise of the group fits with their daily practice. In addition to this strategy towards the environment, the expertise developed by a team or the group as a whole will affect the ideas about the labels and the organization of the researchers. This will support the choices that are made. Labels not only present the “front office”; they are supported by the expertise present in the “back office” of the group.

Table 7.13 Grouping and labelling of groups follows developments in the environment	
Niche	Organization of the group
<p>1983 – 1990: Discovery of the theme of landscape ecology</p> <p>E1: raised political awareness E2: raised attention for the possibilities to connect isolated populations of one species E3: (1990) development of the National Nature Policy Plan E3-1: development of the NEMI E3-2: formulation of policy of protection of species E3-3: announcement of intensifying research E3-4: announcement of start of research program into nature research, focusing on the NEMI</p> <p>1990 – 1997: Implementation of the National Nature Policy Plan (= NNPP)</p> <p>E4: elucidation of goals and targets in NNPP E4-1: [1990-1993]: focus on realization of the NEMI and focus on spatial scales E4-3: focus on three kind of ecosystems: (1) forests (2) heath & moors, (3) swamps E-5: (from 1995) need for expertise to evaluate policies in the preservation of biodiversity; need for development of guidelines for policy making into biodiversity preservation and a need for models that support the evaluation of policy options in the field of biodiversity preservation.</p>	<p>1983-1987: Discovery of the theme of landscape ecology and 1987-1990: Developing a scientific position</p> <p>O1: Researchers are organized as one group, with a species oriented specialism</p> <p>1991-1996: First period of growth</p> <p>O2: (1994): 4 groups: birds & plants, mammals & amphibians, insects and models</p> <p>O3: (1996/1997): regrouping of the Ecology Group towards themes: - culture landscape - NEMI - model research</p>

Continuation of Table 7.13		Grouping and labelling of groups follows developments in the environment	
Niche		Organization of the group	
<p>1997 – 2004 Linking and broadening nature policy</p> <p>E-9: Aim to achieve combinations of functions in spatial areas. Provinces and municipalities must take stronger responsibility to enhance ecological richness and diminishing the number of ecological niches.</p> <p>E10: policy document 'Nature for the people, people for nature' is published (1997). Is the successor of National Nature Policy Plan. Nature Policy Plan.</p> <p><i>Focus:</i> (1) preservation, restoration and development of a sustainable use of nature and landscape. Government wants to focus on the implementation of NEMI, improvement of the linking of spatial areas and general environmental quality, strengthening the identity of landscapes, policy making with regard to green elements in urban areas and a sustainable use of biodiversity (2) integration of nature in other areas of policy making: water, living, industrial areas and infrastructure (3) increase of number of stakeholders that contribute to this policy</p>		<p>1996-1999 Second phase of Growth</p> <p>O4: (1998/2000): regrouping of the Ecology Group in 7 thematic teams:</p> <ul style="list-style-type: none"> - Urban and rural areas - Biodiversity and the environment - Multifunctional landscapes - Nature and landscape in Europe - Future scenarios - Spatial models <p>1999-2001 Exploitation and deepening of sub-themes</p>	
<p><i>Sources:</i> Strategic Plan Ecology Group 1996-1999; Strategic Plan Ecology Group 2000-2003; Year Plan Ecology Group 2001, Vision on the research of the department of Landscape Ecology after 1995; Proposal for reorganizing the sections of Landscape Ecology, 1996; Research lines Landscape Ecology 1989-1993; Description of the department of Landscape Ecology 1992; Policy document 'Nature for the people, people for nature', 1997; Policy document 'National nature policy plan'.</p>			

Relating our findings with regard to the organization of the group to literature

Based on literature (Roberts, 1988; Cesaroni, Di Minin and Piccaluga, 2004; Weggeman, 1997) we can interpret our findings with regard to the organization of the groups in the field studies as a mix of functional grouping, operational grouping and a matrix form of organizing. The main way the Ecology Group and the Postharvest Group are organized is by a functional organization: all landscape ecologists or post harvest physiologists are grouped. Within this way of organizing the group members are grouped towards end products (operational grouping; more formally in the Ecology Group and more informally in the Postharvest Group) while at the same time work is organized by a matrix (projects

and programs versus the organization of group members in teams). Therefore we conclude that our findings with regard to the organization of the groups are supported by literature.

Our findings also suggest that the groups in the field studies reorganize by a practice of “structure follows strategy” (Chandler, 1962). Weggeman (1997) argues that this practice is very relevant for research groups, as interventions in the organization structure should not harm organization culture. According to Weggeman, structure should facilitate the execution of the strategy, and if it does, interventions in structure will be experienced as formalizing a practice that has already developed. Our findings suggest that this practice is present in the groups, as we have found no limitations for collaboration resulting from the practice of re-organizing researchers. What we have found is that the groups follow their environment in reorganizing. This is a practice in which the actual situation gradually develops and is subsequently formalized.

To summarize, in this section we discussed the practice of organizing the research group. We found that the groups followed their environment in organizing the distinctive competences in the group. The aim of organizing and reorganizing the group is to strengthen the recognition of distinctive competences for stakeholders in the niche to support the acquisition of projects. We also found that this way of organizing supports the implementation of the goals addressed in the teleological process and does not harm organization culture with regard to collaboration between researchers. Our findings are supported by literature. In section 7.3 we will argue that these practices contribute to the development of a pattern of heedful interrelating and the development of a deep understanding of the field of research and therefore contribute to the emergence of a competitive group competence. This link between the practice of organizing the research groups and its relevance for the emergence of a competitive group competence also expands literature.

7.3 The significance of the teleological process

In this section we reflect on the significance of the teleological process for the emergence of the competitive group competence. In this chapter we discussed how the groups envision their future and set goals to realize this future position. We identified this process as a teleological process. This process is to some extent responsible for the alignment of the groups with the needs and demands of their environment (besides the practice we described in Chapter Four and Chapter Six). As the groups are dependent on assignments from the

market, they must adapt to changing needs for knowledge and solutions in the market. Based on our findings, we argued in this chapter that this process reflects a combination of a top-down managerial planning process and a bottom-up participatory process. The collective ambition of the group, including future research lines and priorities with regard to expertise development, is created in a participatory process, bottom-up, leading to an emerging strategy evolving from activities taking place throughout the group. The actions by which the groups work on the achievement of these goals are to some extent part of the co-evolutionary process of development of expertise (Chapter Six) and the process of the repeated project life cycle (Chapter Four). For another part activities are initiated by management (this chapter). We argued that the teleological process plays a modest role with regard to expertise development, as expertise is developed in the co-evolutionary process of expertise development. In the teleological process, the research lines (the distinctive competences) which are the result of the co-evolutionary process of expertise development are (often) confirmed. They have been developed in time, are linked to individual researchers and aligned with the environment. Conversely, the teleological process can set goals with regard to new research lines, but they must be achieved bottom-up in the co-evolutionary process of expertise development. As the groups only have very modest financial means to steer their development, the achievement of these goals is not certain and partly depends on the market. We also found that the plans that address the future of the group with regard to its field of research not only contribute to fit with the environment because of its conscious reflection of the present distinctive competences and changes in the near future, but also because it contributes to position creation and generating trust with clients, as stakeholders are involved in its development.

The top-down managerial process addresses goals and actions which can be directly affected by management. In the field studies we especially found a deliberate HRM practice (and actions) and a deliberate practice on how to organize the researchers in the group. With regard to the HRM practice, we found that management simultaneously supported a development trajectory of group members towards specialization and a broad availability. This strategy contributed to the development of “T-shaped profiles”. With regard to the practice of organizing researchers, we found that structure facilitated the implementation of the envisioned goals and that it did not harm organization culture with regard to collaboration. Therefore, interventions in structure were experienced as very logical, formalizing a practice that had already developed.

How does this practice contribute to the development and emergence of a pattern of heedful interrelating, a deep understanding of the field of research and the emergence of a competitive group competence?

Our findings suggest that the teleological process especially provides a frame of reference for the other processes involved in the development and emergence of a competitive group competence (section 7.1). Because the teleological process addresses the future position of the group with regard to its distinctive competences and client(s) (groups) to be served, it directs the acquisition trajectory that precedes the project life cycle process (Chapter Four). In doing so, it also affects the co-evolutionary process of expertise development (Chapter Six), in two ways. Firstly, it provides selection criteria for projects (Table 6.3). What we have seen for example, is that due to the development and a stricter application of business economic rules, new selection criteria were added to the existing set (Chapter Six). Secondly, it addresses priorities (and funds) for expertise development. The teleological process also affects the development and adjustment of social practices by defining goals to develop modified (behavioural) competences (particularly research-related competences like the ability to perform participative research) and to adjust practices. The frame of reference provided by the teleological process can also address practices with regard to collaboration in the group, collaboration with partners and interaction with clients. It can also address management aspects of research work, for example how strictly project leaders have to manage their budgets or making everyone accountable for the research time spent on projects. This frame of reference is also applied in the dialectical process in which the individual researcher balances tensions. Moreover, because the future position of the group is envisioned in a bottom-up process, it reduces tension between individual goals and group goals.

More specifically with regard to the HRM practice and the practice of organizing researchers, we argue that both practices contribute to the development of a pattern of heedful interrelating and the development of a deep understanding of the field of research. Firstly, the strategy to stimulate researchers to start a Ph.D.-trajectory or develop a specialist profile creates differentiated expertise profiles. Combined with needs for expertise in the environment, it becomes important to integrate expertise in the design and execution of projects. This promotes the development of a pattern of heedful interrelating, because the researchers have to interact frequently and in order to provide quality there is not much room for heedless interrelating. Although the Postharvest Group formally operates as one group, it is informally divided into subgroups (related to crops) and the researchers also have a specialist profile (for example measuring equipment [Larry] and

plant hormones [Michael]). The choices in reorganizing the Ecology Group into subgroups working on a theme (1994, 1996/1997, 1998/2000) underlined the need to involve the expertise of colleagues and promoted the development of a pattern of collaboration.

Secondly, the strategy to stimulate a broad availability of researchers helps to develop a better understanding of the expertise of colleagues, to develop a mutual language and generate transactive memory (Appendices eight and nine). This facilitates the development of a pattern of heedful interrelating. Besides, the development of “T-shaped profiles” reduces the risk of researchers becoming pigeon-holed in one area or end up in a specialty that is being phased out. Thirdly, the strategy to hire researchers who had previously worked on a temporary basis in the Ecology Group or Postharvest Group facilitates the transfer of a dominant pattern of behaviour, as these group members are not in an equal position at the time they are socialized and as the practices of heedful interrelating (and content over management) are discussed, made visible and rewarded.

Both the HRM practice and the practice of organizing group members cannot command the development of a practice, but promoted its development in the direction of heedful interrelating. Because these practices also encourage researchers to develop a specialist profile, they are synergetic with and support the development of high quality expertise and the development of a deep understanding of the field in which the groups operate.

Finally, with regard to the body of literature discussed in Chapter One and our research problem, we argue that our main findings concerning the separate elements that describe the process of envisioning a future and the context in which this takes place are supported by literature. In particular, the *combination* of these elements relating to the emergence of a competitive group competence deepens and expands literature and enhances our understanding. Literature (Chapter One) does not address the fact that this process reflects a combination of a top-down managerial planning process and a bottom-up participatory process, including major clients, promoting the development of “T-shaped profiles” and a practice of structure following strategy. The literature addressing HRM practices and organizing research groups does not address the implications of our findings for the development of a pattern of heedful interrelating and the development of a deep understanding in the field of research and thereby for the emergence of a competitive group competence. Our findings also provide an answer to how this process accommodates dynamics and change, as we found that this process provides a frame of reference for the other three processes underlying the emergence of a competitive group competence. New

demands and developments are translated in this process of envisioning a future in goals that act as a frame of reference in the other three processes.

The practices of including major clients, the development of “T-shaped profiles” and “structure follows strategy” also provide a partial answer how the groups succeed in maintaining fit with the environment which is crucial for the emergence of a competitive group competence (Chapter One). In the development of “T-shaped profiles”, the groups contribute to a broad availability of the expertise of researchers, which helps to maintain the fit with the environment. The practice of “structure follows strategy” also helps to maintain fit, as the structure is formalized later, thus strengthening recognition of the expertise of the group in the market but not constraining a practice of heedful interrelating. These practices make the group less vulnerable for dynamics in their environment.

Chapter 8 A grounded theory of the emergence of a competitive group competence

In this chapter we will present and discuss a grounded theory on the emergence of a competitive group competence by integrating our findings with regard to the four processes. The focus in this chapter is particularly on the coherency and interplay of the four processes, the context in which they operate and their ability to accommodate dynamics and change.

In the next part of this introduction we formulate the key issues relating to the coherence and interplay of the four processes to be addressed in this chapter. Grounded in the data in the field studies we have identified four processes that explain the emergence of a competitive group competence. In Chapter Four we discussed the process of design, execution and ending of projects, in which knowledge integration takes place. We identified this process as a repeated life cycle process. In Chapter Five we discussed the process of balancing tensions. We identified this process as a dialectical process. In Chapter Six we discussed the development of expertise and identified it as a co-evolutionary process. In Chapter Seven we discussed how the groups envision their future and execute activities to realize this future position. We identified this process as a teleological process.

Because the processes address different models of development and change, questions are raised about the coherence and interplay of the processes. What is the coherence between the processes with regard to their in- and output? What is the interplay between the processes in their operation? Do the processes reinforce each other in their interplay and why? Why did we find these four processes and are the central subjects in the processes always linked to a specific type of process? Is it possible to switch process type and subject? Answering these questions deepens the theory we have developed, because they specify the relations between the processes involved in the emergence of a competitive group competence. Answering these questions also integrates our findings with regard to the four processes.

We have organized the answering of these questions in six sections. In section 8.1 we address the question of the coherence between the processes with regard to their in- and output. Based on an analysis of the in- and output relations between the processes we will conclude that the teleological process of envisioning a future, the repeated project life cycle

process and the co-evolutionary process of expertise development are closely linked. We also will conclude that the dialectical process of balancing tensions is linked with the repeated project life cycle process and the teleological process of envisioning a future. This analysis specifies and strengthens our finding that the social practices in the development, the application and integration of expertise are highly interrelated in the emergence of a competitive group competence.

In section 8.2 we address the other questions with regard to the interplay between the processes, especially with regard to their operation. Based on Poole et al. (2000) we have distinguished four aspects: (1) the time horizon on which each of the processes operates and its consequences for the combined operation of the processes; (2) a parallel or serial operation of the processes; (3) the relative impact of the four processes on the emergence of a competitive group competence and (4) the leveled or nested operation of the four processes.

To summarize, our arguments in the sections 8.1 and 8.2 will lead to a further specification of the relations between the four processes, providing a theory on the emergence of the competitive group competence. Besides our conclusions with regard to the linkage of the processes we will conclude that the processes operate in a parallel way on a relatively long time horizon, that the co-evolutionary and repeated project life cycle process were relatively more important in the field studies than the other two and that the dialectical process of balancing tensions is nested (to a large extent) in the repeated project life cycle process, which is nested in the co-evolutionary process of expertise development which in turn is nested in the teleological process of envisioning a future. With regard to the emergence of a competitive group competence we will argue that these specifications of the relations between the four processes imply that the emergence of a competitive group competence takes a relatively long period.

In section 8.3 we turn our attention to the context. What are the characteristics of the context in which the processes operate, how do these characteristics affect the operation of the processes and what does this mean for the emergence of the competitive group competence? Main characteristics of the context we found is that the groups work on normal science, an environment characterized by a low level of dynamics, high consensus on social norms and values, a dependency on clients and a positioning on more complex problems. They suggest a threefold role for the context to support the emergence of a competitive group competence: a) enabling the development of distinctive competences, b)

an orientation on more complex problems and c) stimulating knowledge integration by a practice of heedful interrelating.

In section 8.4 we turn to the aspect of how the processes accommodate dynamics and change, and what this means for the emergence of the competitive group competence. We will conclude that the combination of processes is able to respond to gradual changes very well and we hypothesize that in a situation of rapid changing demands for knowledge or rapid changing demands for social practices of knowledge integration (supported by social rules) the combination of processes is unable to facilitate these demands, implying a decrease in the emerging of the competitive group competence and perhaps the non-emergence of the competitive group competence.

In section 8.5 we reflect on the archetypical form of the four processes. Why did we find the four processes we found? Are the four central subjects in the processes always linked to a particular type of process? Can process types and subjects be switched? Based on a discussion of each of the four processes we will argue that the nature of the subject is responsible for the type of process we found. Other processes are less suitable, because they do not cover all characteristics.

In section 8.6 we present the theory on the emergence of a competitive group competence with its foundation in the preceding chapters and previous sections in this chapter. In terms of Van de Ven and Poole (1995) and Poole et al. (2000) this theory is an example of a quad-motor theory explaining change *in* an organization. A taxonomy of process theories developed by Poole et al. (2000, p. 74) presents theories of organizational change and development. In this taxonomy they present the theory of Riegel (1976) as a quad motor theory. But as this theory (about human development progression) is not particularly bound to organizations, our grounded theory provides an example of a quad motor theory explaining change *in* an organization. From all studies building upon the framework of Van de Ven and Poole (1995), this is – to our best knowledge - the first study addressing a quad-motor theory in the field of organization science.

Becoming apparent in the organization of this chapter, it provides the answer to the research problem we posed in Chapter One: which combination of processes explains the emergence of a competitive group competence, what are the characteristics of these processes and how do they interrelate? What are the characteristics of the context in which these processes operate and how does it affect the operation of the processes and the emergence of the competitive group competence? How do the processes accommodate

dynamics and change and how does that affect the emergence of the competitive group competence?

8.1 Coherence between the processes regarding their in- and output

In this section we present our findings with regard to the coherence between the processes with regard to their in- and output. We have visualized these relations in Figure 8.1.

In analyzing the input- and output relations between the processes we start with the *co-evolutionary process of expertise development*. Central subject in this process is the co-evolutionary development of expertise (leading to distinctive competences in the field of research). We argued in Chapter Six that due to the process of variation, selection and retention research themes come up, themes are continued and others decline. The selection mechanisms we discussed in Chapter Six are one of the inputs coming from the teleological process of envisioning a future. The distinctive competences developed in this co-evolutionary process of expertise development are applied in projects (repeated project life cycle). As the repeated project life cycle organizes research work, distinctive competences are also the result of the design, the execution and the ending & evaluation of projects.

The *teleological process of envisioning a future* focuses on adaptation of the organization to maintain or regain alignment with the needs and demands of its environment. Because the groups in the field studies are dependent upon assignments from the market, they must adapt to changing needs for knowledge and solutions for problems in the market. The role of the teleological process is modest with regard to the development of research lines as we discussed in Chapter Seven. The research lines (the distinctive competences) which are the result of the co-evolutionary process of expertise development are (often) confirmed in the teleological process, related to the desired future position. These research lines have been developed in time, are linked to individual researchers and aligned with the environment.

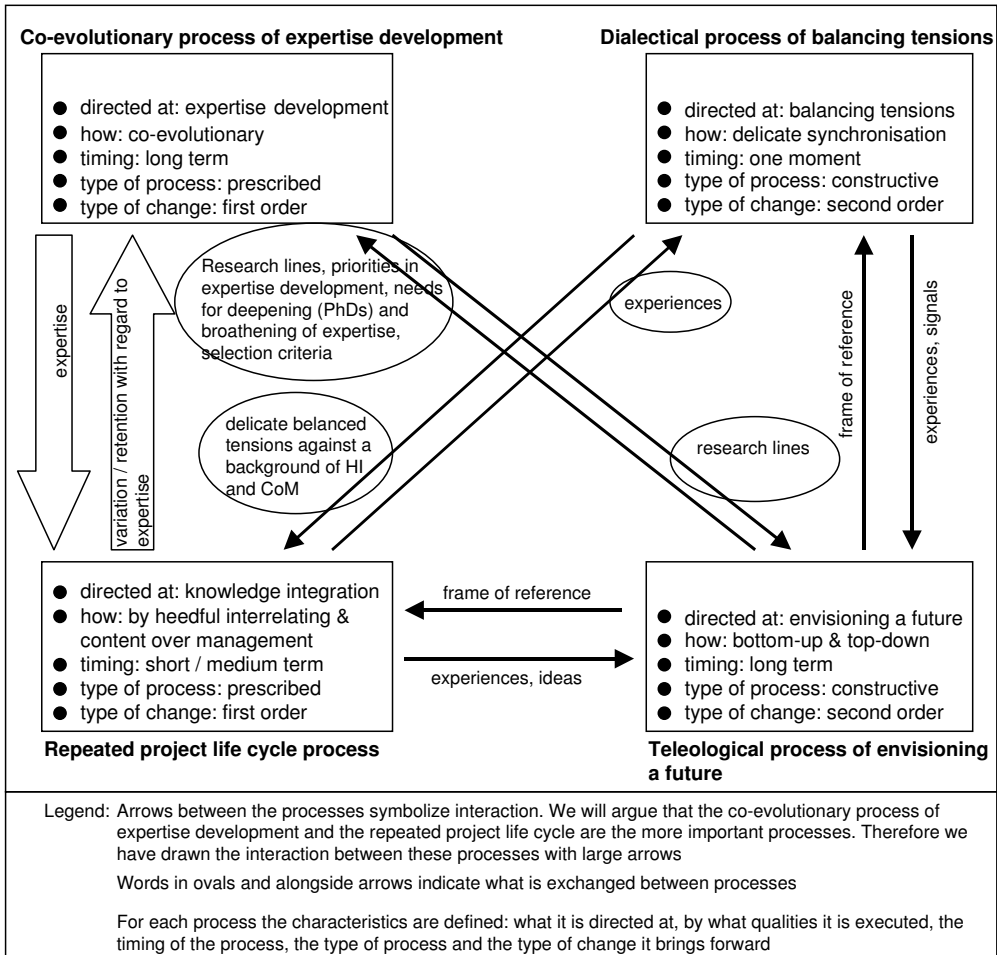


Figure 8.1: Coherence between the processes with regard to their in- and output

The changing needs of clients also indicate a continuing demand for additional expertise, partly of a technical nature, partly with regard to research related competencies (Chapter Six). In order to appeal to clients, the groups need the desired competencies, but should also be able to deliver research work of high quality, based on actual scientific insights, methods and techniques. Therefore the groups have to take care that they also develop themselves from a scientific point of view, that they write papers to be published in scientific journals, that they are involved in scientific boards and that they organize and attend scientific meetings. Because the development of additional expertise is to some extent related to

budgets that are provided by group management, these needs are made explicit in the teleological process and prioritized. In this respect, the teleological process provides input (priorities for new expertise development and budgets) for the co-evolutionary process of expertise development. Because of the availability of budgets it affects this process.

Although the role of the teleological process of envisioning a future is modest with regard to the development of research themes, it does provide a frame of reference for the individual researchers with regard to what the group stands for and what the group needs. This frame of reference is reflected in the selection criteria for projects. What we have found for instance, is that projects have to fit within the research lines addressed in the strategic plan. We also found that the package of selection criteria for projects changes in time. Due to the development and a more severe application of business economic rules, we found for instance that new selection criteria were added to the existing package (Chapter Six).

In the *dialectical process* the balancing of tensions is the central subject. In this process the individual continuously makes decisions to comply with the social rules or to act otherwise, related to a specific situation and personal preferences. Different from the co-evolutionary and teleological process, the timing of this process is related to a specific moment and a specific situation: do I comply with social rule “Y” in this situation at this moment in time? The teleological process addresses especially “values” the group aims for, as for instance sufficient budget for the execution of projects (Chapter Seven), and a high involvement of clients in the design and execution of projects. These values to some extent express the relevance of the related social rules. These elements (position and aims of the group and relevance of the social rules) together with the actual situation and personal preferences provide a frame of reference in which the individual makes a decision. Also the dialectical process provides the teleological process with individual experiences of the social practices and signals what works and what does not (due to changing circumstances) and what social practices should be developed more strictly in the near future. Based on these signals the frame of reference with regard to the characteristics of the environment, what is needed to work in this environment and to create a position can be confirmed or adjusted.

Finally we analyze the *life cycle process*. In the life cycle processes the central subject is the project. In the design and execution of a project the *social practices* (of heedful interrelating and content over management) and the integration of *expertise* are combined. *With regard to expertise* the co-evolutionary process of expertise development provides this process with the expertise present in the group (personalized in the researchers working in

the group). In a project the present expertise is not only combined and applied, but projects also provide new expertise which deepens or widens the present expertise. Therefore a project provides variation or retention with regard to expertise in the co-evolutionary process. The co-evolutionary process of expertise development not only provides expertise, it also provides selection criteria for the design and execution of projects. The teleological process of envisioning a future provides a frame of reference of what the group stands for and what it aims at to realize its envisioned future with regard to for instance research lines, priorities in expertise development and the kind of clients to be served.

The repeated project life cycle process provides input for the teleological process with regard to experiences (with regard to the social practice and expertise), results that projects have provided and ideas for the continuation of expertise development in a field of research. Signals of clients, collected in the design and execution of a project also provide input for the teleological process.

With regard to the social practices (of heedful interrelating and content over management) we have found a close relationship with the dialectical process. For the emergence of a competitive group competence it is important that the kind and amount of knowledge integration fits with the expectations of clients, leading to a satisfied client. This means that the individual researcher has to comply with the social rules repeatedly, ensuring that knowledge integration can take place during the design and execution of the project. This repeated compliance is not restricted to one individual researcher, but to all researchers involved in a project. The repeated project life cycle fuels the dialectical process of balancing tensions with all kind of situations researchers meet in designing and executing projects. The outcomes of the dialectical process of balancing tensions are applied in the repeated project life cycle, whether this outcome is compliance or non-compliance with the social rules.

We can conclude that the teleological process of envisioning a future, the repeated project life cycle process and the co-evolutionary process of expertise development are closely linked. We also can conclude that the dialectical process of balancing tensions is linked with the repeated project life cycle process and the teleological process of envisioning a future. This strengthens our finding that each of the processes performs a specific role, as in- and outputs are closely interrelated. Poole et al. (2000) provide another explanation for the linkage between processes, although more abstract. They state that in general, each of the single archetypical processes is inherent incomplete: “each of the motors [...] has one or more components whose values are determined exogenous to the model” (p. 72). In the

evolutionary model variations are assumed to arise randomly, but the process which gives rise to variation is exogenous to the model according to Poole et al. The same applies to the source of tensions related to the social rules in the dialectical process, the source of dissatisfaction in the teleological model and the processes that launch the start and termination in the life cycle model. Other processes (motors in the terminology of Poole et al.) can be used to account for the origin of these terms. This matches with our findings. To some extent the in- and output relations between the processes account for the origin of exogenous components. There are however also components that are exogenous to one process and that are not delivered by one of the other three processes. Hypothesizing about the launch of a project in the life cycle model we consider a sub-process linked to the 'design phase' of a project in which a number of considerations are made, as for instance the availability of expertise (an input from the co-evolutionary process), a goal about the kind of clients to be served (an input from the teleological process) but also an (approved) assignment from a client and a budget. Sources of tensions related to the social rules (Chapter Five) are supplied by the present social practices, related to the situation at hand, personal preferences and personal ambitions. As discussed in Chapter Six, variation (in the orientation of projects) is provided by priorities for future projects (an input from the teleological process), but also by assignments from the niche and personal ambitions (for instance to continue the expertise in the field of forest birds or butterflies). As these examples show, there are also components that are exogenous to the developed theory, like assignments from the niche and personal preferences.

Theorists working on process theory also address the presence and effect of exogenous components. Although Poole et al. (2000) define a process theory as a theory that "...offers an explanation of development and change that encompasses continuous and discontinuous causation, critical incidents, contextual effects [underlining FB] and effects of formative patterns" (p. 4), they do not address very thoroughly the issue how to cope with exogenous components. Poole et al. state that "The narrative captures the particular causal factors that influenced the case, the order in which they occurred, and how long they operated....The narrative provides a larger frame that lends coherency to the event sequence and to the causal forces that come to bear through these events" (p. 13). This statement expresses that Poole et al. address the narrative as the core issue in order to understand the process theory, including exogenous components. It raises the question of how to determine the borders of a process theory: what to include and what to treat as an exogenous component. This question is also related to the task of the researcher to distinguish between necessary and sufficient conditions (Chapter Two). Mohr (1982) provides another answer in this respect. Mohr states that "these processes [the process theory, FB], together with the external

directional forces, bring a definite action into the theory” (p. 52). In order to be a theory Mohr states, “...one must also supply the external forces [...] constituting the means by which that sequence of events is understood to unfold” (p. 53). In the Chapters Four - Seven we followed Mohr and also (modestly) discussed components that we now address as exogenous in order to understand each process and its contribution to the emergence of a competitive group competence. We did not however label these components as exogenous in these chapters.

The input and output relations we identified between the processes also imply, based on empirical findings, that the social practices in the development, the application and integration of expertise are highly interrelated in the emergence of a competitive group competence. In Chapter One we argued that the emergence of a competitive group competence appears in the interaction processes between group members, where the focus of the interaction process is on the development, exchange, application and – especially - on the integration of expertise (Grant, 1996a; Hamel & Prahalad, 1994; Kogut & Zander, 1992). This includes to some extent the expertise and expectations of the client (Danneels, 2002; Ethiraj et al., 2005). The emergence of a competitive group competence in this respect, we argued, is not a static property or stable disposition but an enacted capability, a situated and an ongoing accomplishment that emerges from people’s (collective) everyday actions (i.e. Orlikowski, 2002, p. 269). We argued in Chapter Two that this ongoing accomplishment should take place with a high frequency and not just now and then. It should be considered to be a routine (Tece et al., 1994; Nelson & Winter, 1982; Howard-Grenville, 2005).

In our analysis of the coherence between the processes with their in- and output we have integrated the findings in the Chapters Four - Seven to some extent and have started to present an integrated theory of the emergence of a competitive group competence (Figure 8.1). In the next section we will deepen features of this integrated theory by discussing the interplay between the processes in their operation.

8.2 Interplay between the processes in their operation

In this section we will deepen the analysis of the interplay between the four processes we started in the previous section. Based on Poole et al. (2000) we have distinguished four aspects: (1) the time horizon on which each of the processes operates and its consequences for the combined operation of the processes; (2) a parallel or serial operation of the

processes; (3) the relative impact of the four processes on the emergence of a competitive group competence and (4) the leveled or nested operation of the four processes.

We will conclude that the processes operate in a parallel way on a relatively long time horizon. We will also conclude that the co-evolutionary and repeated project life cycle process were relatively more important in the field studies than the other two and that the dialectical process of balancing tensions is nested (to a large extent) in the repeated project life cycle process, which is nested in the co-evolutionary process of expertise development which in turn is nested in the teleological process of envisioning a future. With regard to the emergence of a competitive group competence we will argue that these specifications of the relations between the four processes imply that the emergence of a competitive group competence takes a relatively long period and that therefore that an environment with a low level of dynamics is helpful.

The time horizon on which the processes operate and its consequences

What we have found in the field studies is that the processes differ in the time horizon in which they operate. The time horizon of the repeated project life cycle process is related to the duration of projects. What we have seen is that projects differ in their duration (Chapter Six). On average we found in the field studies that the duration of projects is two years¹. Related to the duration of an average project the time horizon of the co-evolutionary process – in order to develop a distinctive competence – is at least three to five years, because for a distinctive competence to develop a number of projects have to be executed. The time horizon of the teleological process depends on the kind of topic that is addressed and varies from one to five years (Chapter Seven). Where it addresses the development of a distinctive competence or a position in a field of research the teleological process links up with the co-evolutionary process (three to five years). Where the teleological processes addresses end states related to personnel, finance or the organization of researchers in the group, the time horizon covers a few months up to one year (the budget period). Finally, the dialectical process addresses individual decision making to solve tensions. The time horizon of this process will be short in general, as is it related to a specific situation.

But what do these time horizons and the differences between the time horizons of the four processes mean for the emergence of a competitive group competence? Our findings suggest that the co-evolutionary, the repeated project life cycle and the teleological process

have a relatively long duration and therefore that the development of expertise has a relatively long duration. Especially if one considers the business environment in which the groups must operate and the dynamics we experience in our society. The groups will experience a risk that by the time they have developed a distinctive competence their expertise is already obsolete. A strong linkage with the environment, an environment with a low level of dynamics in which changes take place in a co-evolutionary and incrementally way instead of in a revolutionary way allows these processes to cover such a time span. Although the dialectical process has a very short duration compared to the other processes, the frequency with which this process is executed for each of the dilemmas is not necessarily higher. Involving the client in the design of a project and deciding about complying with the social rules for this activity or acting otherwise only occurs once in the life cycle of a project. That means, when the average time of duration of a project covers two years, this dilemma is for each project met only once in this time span.² Even when a project leader works on the design of more projects in one year (Appendices six and seven), the frequency with which the dialectical process is executed for each dilemma can be low related to the time span the repeated project life cycle process covers (although this does not hold for all dilemmas we presented in Tables 5.1 and 5.2; a number of dilemmas will be encountered more frequently).

As we already argued, for a distinctive competence to develop (expressed as a theme in research) a number of projects have to be executed. Assuming that these projects are not executed completely parallel, this takes a long period of time (three to five years at least). As we discussed, the financial structure of the groups requires that the groups acquire projects in the environment to cover their costs. Therefore there are not many options in the teleological process to stimulate new themes in research and speed their development by managerial interventions in a direct way. What remains is an indirect way, by interventions in the domain of personnel, finance and the organization of researchers in the group. However, the effect of these options to stimulate expertise development should not be overrated. Although personnel and expertise are closely linked, the possibilities to speed

¹ Where the average duration of projects in the Ecology Group is closer to two and a half year and where the average duration of projects in the Postharvest Group is closer to one and a half year

² Remark: the average time of duration of a project addresses the way projects are organized in the administration of the group. Of course a project leader can break a project that takes 3 years up into shorter phases that allow to deliver 'probes' to discover what works and what not. This can raise the frequency of expertise development (also in the social domain) considerably.

expertise development are constrained by the financial structure of the groups. The groups have very limited financial resources of their own. Reducing the expertise the stakeholders do not need anymore (as for instance expertise of mushrooms) is possible through managerial interventions, for instance by resigning or transferring individual researchers. But the terms of employment often constrain these options in the field studies. The options to interfere with the process of expertise development (and its application) by interventions in the domain of finance are also constrained. What we found in the field studies is that management can try to persuade clients to make larger budgets available for (future) research in a particular area³. This can speed up expertise development. Other interventions often mean a stricter control of costs, which can constrain knowledge integration in projects. By changing the organization of the researchers in the group (a change in the names and composition of teams), management can strengthen the recognition of distinctive competences for stakeholders in the environment, but this by itself does not strengthen expertise development, its application or integration as the field studies have shown (Chapter Seven). In addition the horizon of the processes shows that the development of a shared vision on the future of the group, what the group stands for, what it wants to contribute and what is needed in order to realize this vision is very important, as researchers have to behave accordingly in the repeated project life cycle and the dialectical process. All chances to act in a way that contributes to the achievement of this vision should be captured.

A parallel operation of the processes

Following from the time horizon of three of the four processes and the linkage of the processes we argue that the operation of the processes is parallel and not serial. The execution of the repeated project life cycle process delivers outputs with regard to expertise. This fuels the co-evolutionary process of expertise development. The criteria used in the selection of projects and the development of themes in research are specified in the teleological process of envisioning a future. During the operation of the repeated project life cycle and the co-evolutionary process new adjustments can be made in the teleological process with regard to this future position, affecting these two processes. As we discussed, during the design and execution of a project researchers make choices to follow the social rules or to act otherwise. The operation of the dialectical process is therefore parallel to the other three processes.

³ Source: observation and personal experiences of the researcher

Mohr (1982) acknowledges that there can be a prescribed order of events in a process theory, but also that events can take place parallel. He refers to a martini that can be prepared by adding the vermouth first, than the olive, and then the gin, or by adding all three at once. One can argue that Mohr refers to “events” that must take place and that a process description can bind these events together in a certain order. However, we have not found a number of events tied together by one process, but we have found four processes and therefore one could argue that there is no instruction to combine them. However, one can also argue that the output of a process is input for another process, suggesting that the processes should take place in a prescribed order and suggesting the presence of a “meta-process” of a higher level. We have however not found this prescribed order or a meta-process in the field studies.

In our discussion of the parallel operation of the processes up to now, we have focused on the operation in the present with implications for the emergence of the competitive group competence for “today” and “tomorrow”. But, this issue of a parallel or serial operation of the processes also raises questions of how the emergence of a competitive group competence actually unfolded the first time. As the competitive group competence had already emerged for some time in the groups in the field studies, we could not experience the emergence of the competitive group competence for the first time. We tried although to reconstruct its emergence in the collection of our data. We have not completely succeeded in this endeavor, but based on the data we presented in Tables 6.1 and 6.2, the history of the groups (Chapter Three) and the organization of the groups (Chapter Seven) we have developed a hypothesis.

What we found was that the process seemed to start within a context represented by an environment with a need for integrated knowledge. In addition there seemed to be a close relationship of the group with this environment which enables the group to discuss new concepts and ideas with the stakeholders in the environment and persuade or commit them to these concepts (co-evolutionary development of expertise, teleological process of envisioning a future). After persuading and committing the stakeholders to interesting ideas or concepts the groups develop more expertise into this concept (teleological process of envisioning a future, co-evolutionary process of expertise development, organized in its execution by the repeated project life cycle process). And while they develop expertise they balance their position: strengthening their scientific position and providing practical results (co-evolutionary process of expertise development). This offers opportunities to the group to start a HRM strategy focused on the deepening of expertise, especially by offering Ph.D.-trajectories and broadening the expertise of individual researchers by measures

elucidated in Chapter Seven (teleological process of envisioning a future). When their body of knowledge grows and the need for integrated solutions in the environment rises, the groups start the strategy we described in Chapter Seven with regard to the selection and socialization of new group members (teleological process of envisioning a future). Finally they adapt the structure of the group to the developments in the niche (teleological process of envisioning a future) to strengthen the recognition of their expertise by the environment. Parallel to the process of the deepening and the broadening of expertise the groups develop social practices of heedful interrelating and content over management (which provide background in the dialectical process of balancing tensions).

This hypothesis also expresses a parallel operation of the processes. In Chapter Nine we address to what extent the unfolding of a competitive group competence can be managed by careful interventions in the processes and their sequence in time.

The relative weight of the processes

Another aspect of the interplay between the processes is their relative impact on the emergence of the competitive group competence. Poole et al. distinguish between constructive and prescribed processes. They define the teleological and dialectical process as constructive; as processes that produce new action routines that may (or may not) create an original (re)formulation of the entity (p. 68). Constructive processes tend to create second order change, change in basic assumptions or frameworks which represent a break with the past. These processes are emergent as new goals or end states are enacted. Those undergoing such changes experience a high degree of uncertainty and they need to make sense of the changes (p. 69). The other two processes, the life cycle and the evolutionary process are defined by Poole et al. as prescribed. These processes evoke a sequence of change events in accord with a pre-established program or action routine. They tend to create first-order change, change within an existing framework that produces variations on a theme. The processes by which these variations are produced are prescribed and hence, predictable because they are patterned on the previous state. Over the longer term, small changes may cumulate to produce a larger change in degree or even in quality of the entity (p. 68).

We addressed in Chapter Five, that balancing tensions in the dialectical process takes place against a background of established practices of heedful interrelating and content over management. In the *period in which we executed the field studies*, this background was stable, as (most of) the social rules were anchored in the motivation of the researchers and as compliance was forced by the context in which the groups operated. Besides, we did not

find conflict in the dialectical process, as it was focused on balancing tensions in a delicate way. This makes the effect of the dialectical process in the theory of the explanation of the emergence of a competitive group competence smaller, compared to the repeated life cycle process and the co-evolutionary process of expertise development. A theory of the emergence of a competitive group competence needs this process however to explain why individuals choose for a repeated compliance with the social rules and to explain findings that not all the group members follow the social rules at all moments in all situations. With regard to the teleological process we have discussed in Chapter Seven and in the previous paragraphs that with regard to expertise development the possibilities to interfere as the result of the operation of the teleological process are relatively small (in a short timeframe). A theory of the emergence of a competitive group competence needs this process however to explain the presence of a frame of reference that is applied in the other three processes and to address how many aspects with regard to the future of the group are managed. The emphasis therefore, *evaluated on a short time frame, as for instance the period in which we executed the field studies*, is on the co-evolutionary process of expertise development and on the repeated project life cycle process. Because both processes are prescribed and produce first order change, “over the longer term, small changes may cumulate to produce a larger change in degree or even in quality of the entity”. The development of distinct competences and the execution of projects (with the practices of heedful interrelating and content over management) become smoother changing “the degree in the quality” of the routine (Teece et al., 1994; Nelson & Winter, 1982; Howard-Grenville, 2005). More emphasis on processes that produce first order change contributes to an explanation of the emergence of the competitive group competence as an ongoing accomplishment, taking place with a high frequency and not just now and then. To represent this balance in the processes, we have drawn large arrows between the co-evolutionary and repeated project life cycle process in Figure 8.1.

The nesting of the processes

The parallel operation of the processes also reveals the question whether the processes are operating next to each other or that they are nested (Poole et al., 2000, p. 79). By nesting Poole et al. mean to what extent the motors all operate on the same level of analysis. One motor, for example, may characterize the development of the group as a whole, while another motor may pertain to actions of individuals in the group. When motors are all on the same level of analysis according to Poole et al., relationships among them represent simple influences; however, when motors are nested, working out the relationships among them requires specifying macro-micro linkages (p. 79). The nesting of processes adds another dimension to the relations between the processes relevant for the presentation of the

theory of the emergence of a competitive group competence. Based on the discussion of the input and output relations of the processes in the previous section and the discussion of the time horizons and the parallel operation in this section, we argue that the processes we have identified are nested. To be more precise, we argue that the co-evolutionary process of expertise development, the repeated project life cycle process and the dialectical process of balancing tensions are nested *within* the teleological process of envisioning a future (Figure 8.2). We provide three arguments. *Firstly* and most important, we have discussed in this chapter and in Chapter Seven that in the teleological process goals with regard to future position of the group and related goals with regard to the desired expertise (and social practices) are formulated, but that the implementation or execution of the activities needed to realize these aims take place through the operation of the repeated project life cycle, the co-evolutionary process of expertise development and the dialectical process of balancing tensions. The results are monitored and evaluated in the teleological process and when necessary activities with regard to expertise development and the emerging social practices are adjusted. In Chapter Six for instance we provided an example in the Ecology Group of how expertise development into the development of models and to raise the quality of models was addressed repeatedly. In Chapter Seven we provided an example of how the Ecology Group addresses adjustments with regard to the practice of making arrangements with clients. These examples mean that the repeated project life cycle, the co-evolutionary process of expertise development and the dialectical process of balancing tensions do not operate next to the teleological process, but that they are nested within the teleological process (“to implement goals”). *Secondly*, the teleological process addresses the future of the *group*; its scope is the group and includes many aspects of group life. The other three processes address aspects of group life: projects, expertise and balancing tensions. This also implies a nesting of the project life cycle, the co-evolutionary and the dialectical process within the teleological process as they address a different level of analysis. *Thirdly*, we have illustrated that the result of the teleological process is a frame of reference (“the envisioned future of the group”) for the other three processes.

In continuing this line of reasoning, we also argue that the repeated life cycle process is nested in the co-evolutionary process of expertise development. For the acquisition of projects is based on the selection criteria which are embedded in the co-evolutionary process, the design and execution of projects are based on the distinct competences in the group (coming from the co-evolutionary process) and the execution of projects add new expertise to the (distinct) competences present in the group (Chapter Six). There can be no development of distinct competences without or completely separate from projects.

Finally, we argue that the dialectical process of balancing tensions is nested in the repeated life cycle process to a large extent. For most of the tensions that are balanced (Chapter Five) are met in the design, the execution and the ending & evaluation of projects. The results (often content over management) are also embedded in the repeated life cycle process. There are however some dilemmas met by the researchers that are positioned between projects (as for instance dilemma l, o and p). Therefore it is not completely nested within the life cycle process.

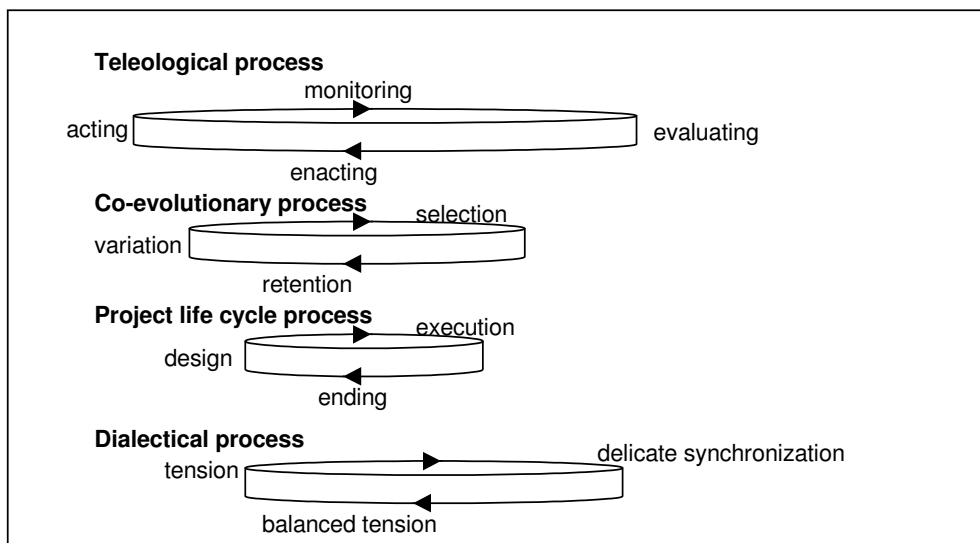


Figure 8.2: The nesting of processes

To summarize, we concluded in this section that the four processes operate parallel, on a relatively long time horizon, that the co-evolutionary process of expertise development and the repeated project life cycle process are relatively more important than the other two (during the period of the field studies) and that the dialectical process of balancing tensions is (to a large extent) nested in the repeated life cycle process which is nested in the co-evolutionary process of expertise development which in turn is nested in the teleological process of envisioning a future (Figure 8.2). These specifications of the relations between the four processes mean that the emergence of a competitive group competence takes a relatively long period and that an environment with a low level of dynamics supports its emergence. In the next section we turn to this context.

8.3 The context and its effect

In this section we turn to the context in which (the groups and) the processes underlying the emergence of a competitive group competence operate. What are the characteristics of the context in which the processes operate, how do these characteristics affect the operation of the processes and what does this mean for the emergence of the competitive group competence? The main characteristics of the context we found are that the groups work on normal science, an environment characterized by a low level of dynamics, high consensus on social norms and values, a dependency on clients and a positioning on more complex problems. They suggest a threefold role for the context to support the emergence of a competitive group competence: a) enabling the development of distinctive competences, b) an orientation on more complex problems and c) stimulating knowledge integration by a practice of heedful interrelating.

To start with, our findings with regard to the context address the field of research and the setting in which the groups operate. The groups work in an interdisciplinary field of research. There are, of course, a large number of group members working on post harvest physiology and landscape ecology as a discipline, but in the setting of the group this disciplinary expertise is combined with knowledge in the field of modeling, GIS, bio-molecular sciences, physics, information technology, and species-related biology. Another aspect of the groups' field of research is that they work on application-driven (and applied) research that requires scientific knowledge, knowledge of the problems that clients experience, and solutions that are applicable in practice. Within this interdisciplinary field of research, the groups have committed themselves to a research approach and lines of research that we defined as "normal science," implying consensus on foundational issues (Hoyningen-Huene, 1993). Finally, the groups have positioned themselves as groups that work on research problems that require broad knowledge of the field of research, the integration of this knowledge, and innovative concepts and ideas. In addition, the Ecology Group works on problems that are politically sensitive, that are meant to prioritize the political agenda or support policy processes, or that require a combination of processes and application (Chapter Three). Both groups (Chapter Three) work in a setting in which they are dependent on a network of clients for their continuation. They must provide results on time and within budget. The conditions under which they have to provide results are quite strict. On the one hand, they are regulated by the arrangements made with the client, while on the other hand they are guided by the business economic rules in the groups (Chapters Four, Six and Seven). We also found that the setting in which the groups work are characterized by a low degree of formalization (Chapter Four) and that researchers

specialize in order to make scientific contributions (Chapter Four). Finally, we found with regard to the setting that the groups have established a stable social practice of knowledge integration guided by heedful interrelating and content over management and that they try to transfer this practice over time by means of a careful procedure of selecting and socializing new group members (Chapter Seven).

With regard to the role of equipment (which is also a part of the context in which the processes operate), we found that its role is experienced as moderate by the group members. The models of the Ecology Group and the equipment of the Postharvest Group are important and unique, but they do not provide added value by themselves. They support the group members in generating and integrating knowledge in practical solutions. It is the integration of the knowledge developed by the application of these resources with the expertise of the group members in projects that makes the constellation unique. The moderate relevance of the tools and equipment themselves is evinced by, for instance, the discussion in the Ecology Group about making the models available on the Internet, “free for use,” because a number of group members feel that the application of these models itself provides insufficient added value for the group (in terms of scientific progress) and their clients (Chapter Six). The members of the Postharvest Group have some unique storage cells and some unique laboratory equipment, but a number of group members feel that the clients themselves could build this equipment. Laura stated in this respect: “I think it’s the combination of scientific expertise in the group, knowledge of the practice of clients, facilities and being part of ATO that allows us to perform high-quality and highly appreciated research” (Laura, 325-327). It is the integration of the expertise required to build and apply models and to use equipment with other expertise in the group that provides a unique constellation of resources.

Finally, we found that the groups work in an environment characterized by a low level of dynamics. We found that clients experience problems for a longer period of time and that new concepts, ideas, and insights developed by the research groups help to provide better solutions and more differentiated answers. Of course, the problems clients experience change over time, as discussed in Chapter Six (Tables 6.1 and 6.2), but only gradually.

When we discussed literature in Chapter One, we stated with regard to the context in which a competitive group competence emerges, that the accomplishment of the emergence of a competitive group competence is related to a unique constellation of resources (Leonard-Barton, 1995) or the practices (i.e., Orlikowski, 2002). Our findings suggest that the unique

combination of resources is in fact the expertise present in the groups, combined and integrated by a practice of heedful interrelating. Therefore, our findings are closer to those of Orlikowski (2002) than to those of Leonard-Barton (1995). Tools, equipment, and technology played only a moderate role in the field studies. Their primary function is that they help one to arrive at results based on scientifically acceptable methods. We also found that the context in which the processes take place enhances creativity and innovation (Leonard Barton, 1995) and includes the expectations of clients (Danneels, 2002; Ethiraj et al., 2005). As the research groups are experienced as expensive by clients, they have to provide additional value. They achieve this by focusing on more complex issues and by including the expectations of their clients (Chapter Three). The groups are confronted by a continual flow of problems that need various combinations of expertise to be solved (as in the study by Hargadon & Sutton, 1997). These problems require not only existing knowledge (combinations), but also new knowledge (combinations). The environments require innovations and the groups want to work on problems that are scientifically challenging. This enhances their creativity. We positioned the practice of including clients not as part of the context, but as part of the process characteristics. In Chapter Four, we discussed the practice of heedful interrelating, which includes the client. In Chapters Six and Seven, we discussed the interaction with stakeholders in the environment, which we can summarize as a combined strategy of enacting, position creation, a comprehensive strategy, and the application of external oriented selection mechanisms for the selection of projects and research themes. This combined strategy is very supportive in maintaining or strengthening fit with the environment and contributes to the development of a stable position to develop expertise, as expertise development requires a number of years in order to lead to distinctive competences. Finally, our findings match the main findings reported in literature with regard to the role of the organizational context to support knowledge integration. Literature (Weick & Roberts, 1993; Hargadon & Sutton, 1997; Ockhuysen & Eisenhardt, 2002; Carmeli & Tishler, 2004; Zárraga & Bonache, 2005) refers to an organizational context supporting individual goals and norms for collaboration, a practice of knowledge integration stimulated by the structure of work, and a way of selecting and socializing new employees that supports heedful interrelating. The establishment of goals “bottom up,” the social rules, projects as a vehicle to integrate expertise of individual researchers, and the practices of selecting (from a pool of group members with a temporary contract) and socializing (from a somewhat uneven position, under the supervision of a mentor) support knowledge integration by heedful interrelating.

With regard to the context, our findings suggest a threefold role to support the emergence of a competitive group competence in the field studies. Firstly, the context enables the

development of distinctive competences as the environment is characterized by a low level of dynamics with regard to the kind of problems that clients experience. The problems clients experience and prioritize and the kind of solutions they prefer gradually develop over time. Secondly, the context stimulates knowledge integration, especially by a practice of heedful interrelating, for the dependency on clients stimulates the groups to serve all clients to their best efforts. Because of the kind of research questions acquired from these clients, the best way to serve them is to enhance a practice of heedful interrelating and to integrate the desired expertise. The specialization of researchers, related to the kind of research projects the groups acquire, also stimulates a practice of heedful interrelating to combine and integrate all the expertise needed to solve research problems. Thirdly, the context supports a positioning on more complex problems, to be solved within normal science. As the research groups are experienced as expensive, they have to provide additional value. They achieve this by focusing on more complex issues (Chapter Three). The quality – price equation becomes higher due to this positioning, which contributes to products being experienced as extraordinary. By positioning their work within normal science, the groups are able to deliver solutions to clients within a reasonable amount of time (Chapter Six), which also contributes to the pay-ability of research (results within a reasonable period of time and for a reasonable price).

8.4 The accommodation of dynamics and change

In this section we turn to the aspect of how the processes accommodate dynamics and change, and what this means for the emergence of a competitive group competence. This section particularly focuses on the findings in the field studies and therefore explores some limitations with regard to the conditions under which a competitive group competence emerges. We will conclude that the combination of processes is able to respond to gradual changes very well. We will also hypothesize briefly that in a situation of rapid changes the combination of processes is unable to facilitate these changes. We will refer to rapid changing demands for knowledge and rapid changing demands for social practices of knowledge integration (supported by social rules) in particular. We will hypothesize that as the combination of processes is unable to facilitate rapid changes, this will imply a decrease in the emerging of the competitive group competence and perhaps the non-emergence of the competitive group competence. In section 9.2 we will elaborate on this hypothesis more in detail, as section 9.2 focuses on situations different from those in the field studies.

In the Chapters Four - Seven, we reflected on how dynamics and change were accommodated in each of the processes. In Chapter Four, we concluded with regard to the repeated project lifecycle process, that the process can handle dynamics and change very well, as flexibility is one of the effects accomplished by a practice of heedful interrelating. Due to this practice, the groups are able to make new combinations of expertise related to the needs of clients in the environment very rapidly. In Chapter Five, we found with regard to the dialectical process of balancing tensions that this process in itself is able to make rapid reactions to specific situations researchers meet in the design, execution, and ending of projects. Our findings suggest that this process operates against a background of established social practices of heedful interrelating and content over management.

With regard to the co-evolutionary process of expertise development (Chapter Six), we found that the groups are able to start new projects (and develop new expertise) at the instigation of clients, assuming that these projects are related to existing, distinctive competences. The execution of these projects contributes to the development of new research themes over time. We also found that the groups are able to start new projects based on goals defined in their strategy. This underlines the relevance of the enclosure of goals as one of the selection mechanisms. But in reflecting on characteristics of the process of expertise development (and particularly with regard to its duration and the gradual development of expertise), our findings suggest that the process is not able to accommodate rapid changes in needs for expertise in the environment.

With regard to the teleological process of envisioning a future (Chapter Seven), we found that this process accommodates dynamics and change by defining new or adjusted goals with regard to the mission of the group and its position in the scientific field and in the market, by defining goals with regard to research lines and research-related capabilities, behaviors, products, and clients to be served. This envisioned future acts as a frame of reference for the other three processes that underlie the emergence of a competitive group competence. By stimulating the development of T-shaped profiles, the groups contribute to a broad availability of the expertise of researchers, which helps to maintain fit with the environment. The practice of “structure follows strategy” also helps in this respect, because due to this practice the structure is formalized afterwards, strengthening the recognition of the expertise of the group in the market but not constraining a practice of heedful interrelating. Our findings suggest that this process is able to accommodate rapid changes in the environment by evaluating present goals and positions and defining new or adjusted goals.

Our findings correspond with those of van de Ven and Poole (1995) and Poole et al. (2000). In section 8.2, we discussed the distinctions Poole et al. make with regard to the kind of change the four processes create. The archetypical teleological and dialectical process are defined by Poole et al. as constructive processes that produce new action routines that may or may not create an original formulation/reformulation of the entity. These processes tend to create second-order change, namely a change in basic assumptions or frameworks that represents a break with the past. Those undergoing such changes experience a high degree of uncertainty and need to make sense of the changes (p. 69). In accordance with our findings, these processes enable rapid changes.

The archetypical lifecycle and the evolutionary process are defined by Poole et al. as prescribed processes that evoke a sequence of change events in accordance with a pre-established program or action routine. They tend to create first-order change, that is, change within an existing framework that produces variations on a theme. The processes by which these variations are produced are prescribed and, hence, predictable because they are patterned on the previous state. Over the longer term, small changes may cumulate to produce a larger change in degree or even in quality of the entity (p. 68). These main features match our findings. We did not focus on changes in phases or activities in a project lifecycle. But our findings suggest (Chapters Four and Five) that gradual changes in the execution have taken place, leading to the process qualities of heedful interrelating and content over management. With regard to knowledge integration, the content part of the project lifecycle process, rapid changes can be accommodated as heedful interrelating supports flexibility. With regard to the co-evolutionary process of expertise development, our findings also suggest that distinct competences are developed over time (first-order change).

In section 8.2 we also argued that the relative influence of the co-evolutionary process of expertise development and the repeated project lifecycle is larger than the relative influence of the teleological process of envisioning a future and the dialectical process of balancing tensions. Due to this relative balance of the processes, they can accommodate the gradual changes we found in the field studies very well. However, the relative balance of the processes and the time needed to adjust social rules imply that the four processes in their joint operation are not able to accommodate rapid changes in demands for expertise in the environment or rapid changes in demands for social practices, or a combination of the two, for the development of new distinctive competences takes time and can hardly be speeded up by the teleological process of envisioning a future. We hypothesize that in a situation of rapid changes in demands there will be a lack of distinctive competences. Due to this lack

there will be insufficient integration of knowledge in the repeated project lifecycle and the quality of the product will decline, which means that it will no longer be experienced as extraordinary. Rapid changes in demands for changing social practices cannot be accommodated very well because the development of new social rules takes time. In the short term, this will harm the practice of knowledge integration and the quality of the product will decline, which means that it will no longer be experienced as extraordinary. Therefore we hypothesize that the characteristics of the processes suggest that in situations of rapid changes in demands for expertise or social practices, the competitive group competence will no longer emerge, as the realized knowledge integration does not meet the demands of clients. Although we can reason for a lack of support to accommodate rapid changes by the processes, we position this reasoning as a hypothesis, as we actually did not collect data to ground this reasoning in data (also see section 9.2).

8.5 A reflection on the central subjects and the form of the processes

In this section we reflect on the archetypical form of the four processes. Why did we find the four processes we found? Are the four central subjects in the processes always linked to a particular type of process? Can process types and subjects be switched? Based on a discussion of each of the four subjects we will argue that the nature of the subject is responsible for the type of process we found. Other processes are less suitable, because they do not cover all characteristics.

We will firstly reflect on (the subject of) projects. Secondly, we reflect on expertise development and thirdly on the envisioned future of the group. We will end with a reflection on (the subject of) balancing tensions. In our reflection we will relate our findings to those of Poole et al.⁴

⁴ Poole et al. discuss a large number of theories in the presentation of the sixteen possible kinds of process theories. But they make an important remark when they start (p. 58/59): ‘The classification of management and organization literature into the life cycle and other ideal types of theories [...] is very loose and done for illustrative purposes only. Since very little attention has been given to underlying theories of change processes in the management and organization literature, it is difficult to know what specific theories of change the authors had in mind’. That makes a comparison difficult. Because every time the question is raised what the authors of the theory had in mind. In addition we have noticed that Poole et al. often start from a specific theory and try to find one or a number of

Projects

By definition projects will have the character of a life cycle process. Projects can be considered to be a form in which the *primary work in an organization is organized*. More in general all forms in which (primary) work is organized in a knowledge intensive organization will represent a repetitive pattern, following a life cycle process. The forms in which work in a knowledge intensive organization can be organized can be projects, assignments, programs or treatment plans. They all have a life cycle and can be considered to be a unity of reproduction (Bakema & Weggeman, 2002). They structure the organization and raise the predictability of the organization (as a system). The characteristics of the other three processes are less suitable for representing the way work is organized in an organization. As Bakema & Weggeman (2002) argue, referring to Luhmann (1984), the way work is organized can change in type, especially by means of an evolutionary process. But in itself an evolutionary process is insufficient to define the way work is organized in a repetitive way, due to its characteristics (variation, selection, retention). It works on a meta-level, taking into account a population of work-units. The dialectical process refers to sensemaking and preferences, acting in the social domain. Therefore it is not suitable to describe the way work is organized. Of course discussion can take place about the way work is organized, but that is something different. Finally a teleological process is insufficient to describe the way work is organized. Although it is also cyclical in nature and works on a single entity, it is less suitable to represent the way work is organized. For it is of a constructive nature, describing purposeful enactment, new action routines, change in basic assumptions which represents a break with the past. As we stated in section 8.4, those undergoing such changes experience a high degree of uncertainty and they need to make sense of the changes. That is not the nature of the organization of work on a regular basis; it would be too expensive for organization members to make sense of how work is organized over and over again. Because the organization of work can be considered to be a coordination mechanism that regulates behavior, formalizes behavior and reduces behavior in its variability (Mintzberg, 1983), a theory that describes the organization of work as a teleological process is less suitable. The role of a teleological process is especially to influence the way work is organized and to make adjustments (Bakema & Weggeman, 2002). These considerations meet the arguments of Weick (1979) with regard to his theory of organizing, interpreted by Poole et al. as a combination of a life cycle, evolutionary and teleological motor.

interacting processes where we have followed the other way around: from the study of a phenomenon towards the development of a process theory.

Expertise development

In Chapter Six we argued that expertise development in a *strict* sense is a process of an evolutionary nature, because of the presence of variation, selection and retention, path dependency and its cumulative development. The other process theories are not able to capture this phenomenon sufficiently, although they can play an additional role in theories in which expertise development is a central phenomenon. In Chapter Six we did not only discuss our findings, but also related our findings to literature (Fujimura, 1987, 1988; Dosi, 1982; Hoyningen-Huene, 1993; Ziman, 2000). In interpreting this literature again, two additional motors (in addition to an evolutionary process) seem to interact in the development of expertise, related to change and development in organizations. A teleological motor providing choices for specific areas, methodologies, techniques and (an) approach(es) and a dialectical motor to provide debate about the added value and truth of new insights, theories, technologies and interpretations. In addition one can find a life cycle process, expressing the way expertise development is organized in an operational way (experiments, problem solving). This raises the suggestion that related to change and development in organizations, expertise development in a *broad* sense can be defined as a tri-motor or a quad-motor theory (Poole et al. 2000).

How do our findings relate to these insights? In our theory the evolutionary process also has a central place with regard to expertise development (expertise development in a strict sense). We also found an interaction with the teleological motor to provide choices for specific areas and approaches (Chapter Six). And we also found interaction with a life cycle motor with regard to the organization of expertise development in an operational way (Chapter Four). We have however not found a related dialectical process focusing on the debate of new hypotheses, theories, technologies and interpretations *in* the groups. A debate adds to a deep understanding of the area(s) in which a research group operates (Quinn, 1992). We suggest that the groups are involved in these debates, at least with colleagues around the world who also perform scientific research in the field of landscape ecology and post harvest physiology by means of scientific publications. We also asked researchers how they experienced the emergence of new research lines as for instance the emergence of applied genomics in the Postharvest Group. In Chapter Six we referred to Michael (working on physiological issues and not on bio-molecular issues) stating in this respect: “Who doesn’t work on genomics? [...] In my opinion it is very natural. I don’t think it is very innovative. You have to follow developments in science. It is the same as installing a new Windows program in time” (Michael, Postharvest Group, 333-336). We also asked Kevin (also working in the field of physiological issues) for a dialectical discussion about

genomics, asking if group members understand each other. Kevin answers: “Well, yes, we understand each other. In the first instance you evaluate these colleagues with a bio-molecular background as somewhat awkward. But the fields of physiology and bio-molecular work become more and more related. Perhaps I should make a picture to explain [draws a picture]. Talking about the quality of a product you want to maintain or improve quality. After the harvest a product is transported through a chain before it reaches its final destination and during this period the quality of a product changes. In this field we operate, in all sorts of ways. [...] In the past we measured external features and chemical characteristics that could be measured simply. Often we are already too late to make predictions about changes in quality before the product reaches its final destination. But you would like to, in the beginning of the chain, in order to support the client. Therefore you need bio-molecular work to make predictions: is the product able to pass a chain? Because genomics is promising in this respect we developed this expertise. It will become clear that this field makes contributions with regard to some aspects but that it will not make contributions with regard to other aspects. [...]. As a group we will have an advantage by combining these insights” (Kevin, Postharvest Group, 51-66). These statements do not address a dialectical discussion *in* the group. Perhaps the visibility of the dialectical process *in* the group was quite low as the groups work on “normal” science (Chapter Six), in which debate takes place within accepted “adherence to general propositions as theories, laws, definitions and concepts; a multitude of commitments to preferred types of instrumentation and to the ways in which accepted instruments may legitimately be employed; convictions regarding the nature of that which physically exists; scientific norms and no intention of fundamental innovation” (Hoyningen-Huene, 1993). Because, when there is much debate about these fundamental issues and a dialectical process with regard to this debate should be part of the theory, the amount and kind of knowledge integration necessary to provide clients with highly appreciated answers could be affected and the added value of products towards clients and the commitment of the organization towards such a research line (including financial means and careers of researchers) could be at stake.

Congruent with the suggestions raised in literature Lee and Cole (2003) found a tri-motor theory with regard to expertise development. They studied the development of Linux as a model of knowledge creation in purposeful, loosely coordinated, distributed systems. Because the network is purposeful, it can also be considered to be an organization, although not a firm. Therefore one can argue that this paper also addresses knowledge creation in organizations. They also found the combination of a teleological, dialectical and evolutionary motor. In our evaluation of the 160 references to Van de Ven and Poole

(1995) we did not find other process theories addressing expertise development in a strict or in a broad sense; neither as a dual, tri- or quad-motor theory.

Envisioning the future of the group

Envisioning the future of the group is the central subject in the teleological process. Envisioning the future of the group addresses images of a desired end situation, socially constructed by the researchers in the group and agreed upon. It also implies employing activities to realize this end state, to monitor its progress and if necessary to make adjustments. In our discussion of the other processes we have seen examples of how the contributions of this process become apparent (sections 8.1 and 8.2).

The characteristics of the other three processes are less suitable to represent the character of envisioning a future and actions to realize this future. An evolutionary process focuses on a population of entities and presupposes competitive selection. This is a problem because there is only one entity, the envisioned future of the group. This holds also for the dialectical process, which also focuses on multiple entities. A dialectical process could however be part of a teleological process with regard to goal setting when different visions on the future of the group are confronted before the group reaches consensus. We have however not found such a dialectical process in the field studies (maybe due to the way we collected data). Finally the life cycle process is less suitable to describe the future of the group because it is of a prescribed nature. Once started, a prescribed routine in the realization of the end state takes place, where the teleological process allows for interruptions, redefinitions, new action routines and changes in basic assumptions which represents a break with the past. As we have seen the teleological process is closely interrelated to the other three processes. That is perhaps why Poole et al. found this process to be the most common process in theories of organizational change and development.

Balancing tensions

Balancing tensions by individuals is the central subject in the dialectical process. In Chapter Five we explained that these tensions especially relate to the interaction between content and management and that this process takes place against the background of established practices of heedful interrelating and content over management, implying compliance with the social rules. As we argued, this is important as the social rules support the emergence of heedful interrelating which in turn supports a frequent and high level of knowledge integration necessary to provide products to customers that are experienced as extraordinary. As we showed in Chapter Five, the tensions reflect a “thesis” and “antithesis” which are synthesized in order to reach a solution. We also showed that the

dialectical process addresses multiple entities (social rules, motives, constraints and demands posed by the environment).

The characteristics of the other three processes are less suitable to represent the character of balancing tensions. Both the life cycle and the teleological process focus on one entity and cannot address multiple entities. As the dialectical process addresses the question for individual researchers to comply with the social rules or act otherwise in one specific situation in time, an evolutionary process description to capture this phenomenon is not obvious. For an evolutionary process describes development *in* time and not decisions at one moment in particular. Besides, behind an evolutionary process is a prescribed motor, which evokes a sequence of change events in accord with a pre-established program or action routines. Solving well-known tensions and meeting new tensions can require new action routines, highly novel features, unpredictable outcomes discontinuous with the past. An evolutionary process could however define how social rules are established, in which repeated solutions to solve tensions are anchored. But then it focuses on the development of social rules and not on the way individuals handle tensions. This is why we found a dialectical process.

As we discussed in Chapter Five, Poole et al. interpret a dialectical process in terms related to Marx and Hegel using phrases as opposition, contradiction, confrontation, conflict and struggle. Riegel (1975, 1976) however, addresses a dialectical process wider and less in terms of conflict. He addresses this process in terms of delicate synchronization, balance and imbalance. This widens the perspective to search in organizational change processes for dialectics. Poole et al. present Benson (1977) as an example of a process theory addressing dialectics. In our opinion however, Benson does not address a process theory but pleads for a dialectical view in organizations. In reflecting on dialectical process theories (building on Van de Ven and Poole, 1995) in organizations we found it remarkable that none of these theories addresses how organization members deliberate and what factors are involved in these deliberations (Sabherwel & Newman, 2003; Sabherwel, Hirschheim & Goles, 2001; Cule & Robey, 2004; Marcus & Geffen, 1998; Robey, Ross & Boudreau, 2002; Sminia, 2003).

Our reflection on why we found the processes we found suggests that the description of change (processes) in organizations is not just a coincidental process or combination of processes, but that the *nature* of central subject(s), its *content*, affects what process or combination of processes can explain change the best. This is an addition to the present process theory that defines theories of change by two dimensions: does the subject of

change address a single entity or multiple entities and does the process of change address a constructive or prescribed nature. When a process of change addresses for instance a single entity and is of a prescribed nature, then it is always a life cycle theory. Our findings however suggest that for each process and the central subject in this process there are arguments why the other three archetypical processes are insufficient to explain its features. Thereby we provide a content related explanation why we find a particular kind of process theory.

In the next section we will summarize our findings with regard to the features of the processes involved in the emergence of a competitive group competence, their interplay, the context and its effect, how the processes accommodate dynamics and change and the effect on the emergence of the competitive group competence. This is the result of the study which answers the research question we posed in Chapter One.

8.6 A grounded theory of the emergence of a competitive group competence: conclusions

After discussing each of the four processes in the Chapters Four - Seven and discussing the coherence between these four process in this chapter, the effect of the context and the way the processes accommodate dynamics and change we can come to conclusions with regard to a process theory that explains the emergence of a competitive group competence. But before we come to conclusions, we first turn to the requirements process theory poses with regard to the necessity of the processes and the conditions for a process theory. This places the conclusions with regard to our theory into perspective.

In Chapter Two we explained that process theory is a special kind of theory, because process theory is only grounded in the necessary conditions (Mohr, 1982). Therefore we took several measures to ensure the necessity of the processes we found (Chapter Two). In the research approach as well as by a critical reflection on our findings. In Chapter Two we explained that with regard to the research approach we evaluated if we achieved saturation by the execution of the second case study. With regard to a critical reflection, in sections 8.1 and 8.2 we reflected on the coherence between the processes in terms of their inputs and outputs. In section 8.1 our reflection learns that the coherence between the processes is high, all four processes are closely linked and have an evident function in the emergence of a competitive group competence. Furthermore we discussed in section 8.2 the specific role

of the dialectic process of balancing tensions and the specific role of the teleological process of envisioning the future. In addition to the coherence between the processes in terms of their inputs and outputs, we reflect in section 8.2 on (1) the time horizon on which each of the processes operates and the consequences for a combined operation; (2) a parallel or serial operation of the processes; (3) the relative impact of the four processes; and (4) the leveled or nested operation of the four processes. This reflection strengthened our findings of a close linkage between the processes and a coherent operation. The hypothesis we developed in section 8.2 of how the emergence of the competitive group competence unfolded for the first time in the field studies also provides support for the necessity of the four processes. Finally we reflected on the form of the processes and the exchangeability of the central subjects in the processes related to the form of the process. From this reflection we learned that the description of change (processes) in organizations is not just a coincidental process or combination of processes, but that the nature of the central subject(s), its content, affects what process or combination of processes can explain change the best. This strengthens our argument for the necessity of the processes, particularly with regard to their form but also with regard to the role of the central subjects in each of the processes to explain the emergence of a competitive group competence.

In Chapter Two we have explained the characteristics of process theory, in particular with regard to its grounding in necessary conditions. Related to these characteristics of process theory our theory explains situations in which a competitive group competence emerges. If it emerges, one should also find the four processes with their qualities and under the conditions we found. This theory does not explain the absence of a competitive group competence (Chapter Two), including situations in which the four processes are present.

The theory we developed in this study is defined as substantive by Glaser & Strauss (1967), which implies that it should not attempt to explain outside of the immediate field of study, as there are no data of situations outside this field of study (we elaborate on these situations in section 9.2). The substantive area in which this research is grounded is defined by the context in which the research groups we studied operate (sections 8.3 and 8.4): they work on normal science (Hoyningen-Huene, 1993), conduct application oriented and applied research in a multidisciplinary research area, operate in an environment characterized by a low level of dynamics, are dependent on clients for the continuation of their research activities (and therefore need knowledge of the practice of their clients and the applicability of the solutions they provide), have positioned themselves on more complex problems which require knowledge integration, have to operate under strict business-economic conditions and have accomplished high consensus on social norms and values. Therefore

we limit the application area of this theory to research groups that meet these characteristics. By providing arguments for the necessity of the processes and the application area of the theory (the substantive area) we meet the requirements posed by process theory (Chapter Two). Nevertheless we suggest in Chapter Nine to conduct more field studies to strengthen the external validity of the results and develop the substantive theory towards a formal theory (sections 9.2 and 9.5).

Conclusion: four interrelated processes

The emergence of a competitive group competence is explained by the coherent operation of four processes (1) a repeated life cycle process of the design, the execution and the ending of projects, executed with process qualities of heedful interrelating and content over management; (2) a co-evolutionary process of expertise development leading to distinctive competences; (3) a dialectical process of balancing tensions against a background of established practices of heedful interrelating and content over management and (4) a teleological process of envisioning the future that provides a frame of reference to the other three processes.

In terms of Van de Ven and Poole (1995) and Poole et al. (2000) this theory is an example of a quad-motor theory explaining change *in* an organization. It can replace the theory of Riegel (1976; this theory addresses human progression development) as an example of a quad motor theory in the taxonomy of theories of organizational change and development developed by Poole et al. (2000), as the theory of Riegel is not particularly bound to organizations. From all 160 studies⁵ building upon the framework of Van de Ven and Poole (1995), this is – to the best of our knowledge – the first study addressing a quad-motor theory in the field of organization science.

Our grounded theory has not provided a fifth or sixth motor of change (Langley, 1999). We found the four motors provided by Poole et al. sufficient to explain the emergence of a competitive group competence. Based on a discussion of each of the four subjects as central elements of change (one in the in each of the processes, section 8.5) our reflection on why we found the processes we found, suggests that the description of change (processes) in organizations is not just a coincidental process or combination of processes, but that the *nature* of central subject(s), its *content*, affects what process or combination of processes can explain change the best. This is an addition to the present process theory that addresses theories of change by two dimensions: does the subject of change address a single entity or

⁵ Period: 1995 up to December 2005

multiple entities and does the process of change address a constructive or prescribed nature. Our findings however suggest that for each process and the central subject in this process there are arguments as to why the other three archetypal processes are insufficient to explain its features. Thereby we provide a content related explanation why we find a particular process theory.

Our findings with regard to the characteristics of the process of co-evolutionary development of expertise and the teleological process of envisioning a future add new elements to the existing literature. Most of our findings with regard to the separate elements that describe the process of expertise development and the context in which this takes place are supported by literature and provide evidence for literature. Especially the *combination* of these elements related to the emergence of a competitive group competence provides new insights and deepens literature. For literature (Chapter One) does not address the co-evolutionary character of expertise development as underlying the emergence of a competitive group competence, but adds to our understanding. Literature (Chapter One) also does not address that this process takes place in a context characterized by working on “normal science” (implying consensus on foundational issues), an environment with a relatively low level of dynamics and a pattern of interaction with the environment defined by “enacting” and “position creation and meeting expectations” and therefore our findings provide new insights. This also holds for the process of envisioning a future and the context in which this takes place. Most of the elements we found are supported by literature, but the *combination* of these elements related to the emergence of a competitive group competence contributes to our understanding and deepens literature. For literature (Chapter One) does not address that this process reflects a combination of a top-down managerial planning process and a bottom-up participatory process, including major clients, stimulating the development of “T-shaped profiles” and a practice of structure following strategy.

Conclusion: a parallel and nested operation, balanced towards gradual development

We found that the processes operate in a parallel way with a relatively long duration. The co-evolutionary process of expertise development and the repeated project life cycle process were relatively more important in the field studies than the other two (due to a context with a low level of dynamics and consensus about main social norms and values). Therefore the emergence of a competitive group competence is especially based on the development and integration of knowledge in close interaction with the environment (enacting, position creation, heedful interrelating, a comprehensive strategy, external oriented selection mechanisms for the selection of projects and research themes). The other two processes are supportive in this respect. This balance between the processes enhances

gradual development. The processes operate coherently in the sense that the dialectical process of balancing tensions is nested (to a large extent) within the repeated life cycle process which in turn is nested in the co-evolutionary process of expertise development which is nested in the teleological process of envisioning a future.

Conclusion: all processes contribute to maintaining fit with the environment

All processes contribute to maintain or strengthen fit with the environment and to provide the clients with extraordinary products. The application of the social rules in the repeated project life cycle process in the pattern of heedful interrelating stimulates a flexible, effective and efficient way of knowledge integration, involving and committing clients by a comprehensive strategy (Ancona & Caldwell, 1992). The way tensions are solved in the dialectical process also contributes to maintain fit with the environment. As it takes place against a background of established practices of heedful interrelating and content over management the balance is still in support of the emergence of heedful interrelating and content over management and thereby it supports the emergence of the competitive group competence. But balancing tensions also stimulates adaptation of social rules to meet changing circumstances. The teleological process and the co-evolutionary process contribute to fit with the environment as their characteristics include discussing new concepts, ideas and research lines with clients, persuading and committing clients to these ideas and thereby developing a platform to meet the expectations that are raised. But also because they embed a strategy of enacting and position creation, probing what works. These strategies enhance the understanding of the groups of the environment. The strategy of organizing researchers in the teleological process in reaction to changes that have taken place in the environment to raise recognition of distinctive competences also contributes to maintain fit with the environment. This holds also for the HRM practice of developing a T-shaped profile, which not only stimulates heedful interrelating but also contributes to the recognition of distinctive competences by clients. Fit with the environment is also enhanced by the dominance of external selection mechanisms over internal ones for projects and research lines (co-evolutionary process of expertise development). This contributes to a strong market and client orientation. More in particular, by the application of the selection mechanism of projects being scientifically interesting the groups enhance that they stay attractive to clients.

Conclusion: the context in which the processes operate has a threefold role

What we contribute to literature with regard to the context is that we have provided more insight into the role of the context for the emergence of a competitive group competence. Our findings suggest a threefold role. *Firstly*, the context enables the development of

distinctive competences as the environment is characterized by a low level of dynamics with regard to the kind of problems that clients experience. The problems clients experience and prioritize and the kind of solutions they prefer gradually develop over time. *Secondly*, the context stimulates knowledge integration, especially by a practice of heedful interrelating, for the dependency on clients stimulates the groups to serve all clients to their best efforts. *Thirdly*, the context supports a positioning on more complex problems, to be solved within normal science. As the research groups are experienced as expensive, they have to provide additional value. They achieve this by focusing on more complex issues, but positioned within normal science which enables the groups to deliver solutions within a reasonable amount of time. A highly formalized work setting is not particularly necessary, as our study showed.

Our findings suggest in particular that the unique combination of resources (Leonard-Barton, 1995) is in fact the expertise present in the groups, combined and integrated by a practice of heedful interrelating. Models and equipment can be important and unique, but do not provide additional value by themselves. They support the group members in generating and integrating knowledge in practical situations. It is the integration of the knowledge developed by the application of these resources with the expertise of the group members in projects which makes the constellation unique.

Conclusion: the processes accommodate gradual changes well

Our findings with regard to the way the processes accommodate dynamics and change correspond with those of van de Ven and Poole (1995) and Poole et al. (2000). The archetypical teleological and dialectical processes are defined by Poole et al. as constructive processes, which tend to create second-order change (namely a change in basic assumptions or frameworks that represents a break with the past). In accordance with our findings, these processes enable rapid changes. The archetypical lifecycle and the evolutionary processes are defined by Poole et al. as prescribed processes that tend to create first-order change, that is, change within an existing framework that produces variations on a theme. These main features match our findings.

We argued that the relative influence of the co-evolutionary process of expertise development and the repeated project lifecycle is larger than the relative influence of the teleological process of envisioning a future and the dialectical process of balancing tensions. Due to this relative balance of the processes, they can accommodate the gradual changes we found in the field studies very well. However, the relative balance of the processes and their characteristics imply that the four processes in their joint operation are

not able to accommodate rapid changes in demands for expertise or social practices. Based on our findings we hypothesize that the competitive group competence will no longer emerge in these situations, as the realized knowledge integration does not meet the demands of clients.

Conclusion: there is a need for additional tools for the development of a process theory

As we argued in this chapter, the present tools how to develop a process theory need a number of additions to provide more help. The first issue is how to deal with elements of which the value is defined exogenous to the process and related to this problem how to define the border of the system that has to be taken into account (Pettigrew, Woodman, Cameron, 2001). A second issue is how to deal with the identification of a trajectory of change in a dual motor, tri-motor or quad motor theory that explains the change process when the processes operate in a parallel way. With regard to exogenous defined elements and the border of the system Poole et al. (2000) argue that the narrative has to capture the particular causal factors that influenced the case. But that leaves a lot of room for interpretation for the researcher and affects the validity (especially the repeatability) of the results. In addition to the tests Poole et al. provide to analyze and control for the kind of process responsible for the change process we suggest the development of guidelines on how to deal more systematically with exogenous factors, and in extension, how to deal with system borders.

With regard to the identification of a trajectory that captures the change process in case of a dual, tri- or quad-motor theory in which the processes operate parallel, we have already emphasized that we did not find such an overall trajectory (a meta-process) for the emergence of a competitive group competence. Although we provided a narrative (hypothesis) how the emergence of a competitive group competence unfolded in the field studies for the first time (section 8.2), we also argued that there is no specific order in which the four processes are executed. At the same time this is puzzling. At first sight it seems that the processes that explain the change only describe this change in part. We argued that the processes operate in parallel. Our hypothesis of how the emergence of a competitive group competence comes about confirms this, but our narrative (hypothesis) is clearer than could be derived from the operation of the processes. Poole et al. and Mohr do not make clear how to handle the construction of an overall trajectory or a meta-process if there is one. On the other hand, Pentland (1999) argues that since narrative and process both involve sequences of events, each should inform the other. We suggest that guidelines would raise the validity of the construction of a meta-theory, and by implication of a process theory.

Chapter 9 Conclusions and discussion

In this chapter we present our conclusions with regard to the emergence of a competitive group competence to answer the research problem we posed in Chapter One. In Chapter One, we argued that relatively little was known about the emergence of a core competence at a micro level, addressing the processes involved, the practices, and the context relevant for its emergence. The study reported on here has provided these insights. Furthermore we discuss a number of issues related to our findings, the research approach, the application of our findings and future research.

In section 9.1, we summarize our findings related to the research problems and reflect on what we have contributed to literature. In section 9.2, we elaborate on our findings by developing hypotheses about the theory we developed to be studied in other “substantive areas”. We elaborate on changes at a micro level and how these affect the emergence of a competitive group competence. We also elaborate on the specificity of the context we found in the field studies.

In section 9.3, we elaborate on our findings in another direction, namely how to stimulate the emergence of a competitive group competence. We present four kinds of managerial interventions: (1) co-envisioning a future of the group and stimulating a collaborative culture; (2) developing a competence-enhancing HRM strategy; (3) implementing a facilitating management style; and (4) organizing resources for expertise development.

In section 9.4, we reflect on the research approach taken in this study. We have demonstrated that the approach of this empirical study has supported the development of knowledge about basic processes in research groups that explain the emergence of a competitive group competence. But the research approach chosen for this study also has its drawbacks. We discuss a number of these drawbacks in this section.

In the final section (9.5), we make suggestions for future research. These suggestions concern (1) the development of a theory of the non-emergence of a competitive group competence, (2) the strengthening of the external validity of the theory, (3) characteristics of process theory, and (4) the management of the emergence of a competitive group competence.

9.1 A theory of the emergence of a competitive group competence

Many studies have contributed to our knowledge of the phenomenon of a core competence. However, relatively little was known about the emergence of a core competence at a micro level, addressing the processes involved, the practices at group level, and the relevant context for its emergence. We decided to concentrate on the group level, focusing on the emergence of a competitive group competence as the specification of a core competence. In addition, we focused on research groups. The goal of the study was to answer the research question which combination of processes underlies the emergence of a competitive group competence, including the context in which these processes operate and its effect and the way these processes accommodate dynamics and change. The concepts of a repeated project lifecycle process, a co-evolutionary process of expertise development, a dialectical process of balancing tensions, and a teleological process of envisioning the future of the group yield the basis for a rich description and explanation of its emergence. These processes show that its emergence is a joint accomplishment embedded in the practices of a research group. In the next part of this section we present our conclusions and contributions to literature. In order to put our conclusions into perspective we first bring back to memory the competitive group competences that emerged in the Ecology and Postharvest Group.

The competitive group competence that emerged in the Ecology Group was defined by the group members as the capability to develop and integrate knowledge of spatial and environmental conditions of species and ecosystems towards spatial images of sustainable nature within the context of the multifunctional use of space. The images are developed at any scale for signaling problems, problem solving, the prediction of effects, policy evaluation and prediction of the future (Chapter Three). Compared to competitors, the group is stronger focused on projects that have to do with the process of prioritizing the political agenda, that support policy processes or have to do with questions that have political consequences (for instance planning new roads or railroads). These projects all need a broad ecological knowledge base and models that support the results. Furthermore the group is hired for problems that need innovative research at a high professional level. In many projects knowledge has to be integrated, focusing on isolated ecological niches and developing 'robust connections'. Their clients ask for contributions that require scientific knowledge as well as knowledge of the practice of the client.

The members of the Postharvest Group defined their competitive group competence as the capability to provide practical solutions in the field of post harvest physiology, based on scientific knowledge of (the linkage between) physiological processes in fresh products

(produced by plants), environmental factors and the decline of quality in the post harvest phase of the chain (Chapter Three). Compared to competitors, the group has a stronger focus on assignments directed at the interaction between features of fresh harvested products and technical equipment used to accompany these products from the producer to the consumer. These assignments also have to do with a scientific support of practical solutions and the application of the knowledge of physiological processes in fresh products. This is partially expressed in assignments directed at developing new concepts. The clients of the Postharvest Group ask for contributions that require scientific knowledge as well as knowledge of the practice of the client.

Four interrelated processes

We found four processes responsible for the emergence of these competitive group competences. Four processes or motors (of change, Poole et al., 2000), operating parallel, jointly and coherent: (1) a repeated lifecycle process of the design, execution, and ending of projects, executed with process qualities of heedful interrelating and content over management; (2) a co-evolutionary process of expertise development leading to distinctive competences; (3) a dialectical process of balancing tensions executed against a background of established practices of heedful interrelating and content over management; and (4) a teleological process of envisioning the future that provides a frame of reference for the other three processes.

Their operation comes together in the design, execution and ending of projects through which the competitive group competence emerges. Take for instance Brian, a project leader in the Ecology Group, working on the (imaginary) project of the development of a concept for an “ecoduct” to connect two habitat areas of the viper. At the start of this project, Brian has consulted the client (a large institution managing nature areas), inquired for the demands and needs of the client and involved Kimberly and Rebecca for their expertise of modeling respectively snakes (repeated project life cycle, Brian interrelating heedful). Brian acquired this project instead of a project on the dispersion of a butterfly species, because the Ecology Group decided to focus on complex types of ecoducts to connect habitat areas, especially with regard to snakes as the Minister intends to put all species of snakes on the list of endangered animals in his next nature policy plan (frame of reference provided by the teleological process of envisioning the future). It is not the first project the Ecology Group has acquired on complex ecoducts or snakes. In the last twenty years the expertise of the group in these fields has developed to distinctive competences and the execution of this project adds additional expertise to these competences. In these twenty years the needs of clients have gradually developed from (simple) single-species ecoducts

to (complex) multi-species ecoducts (co-evolutionary process of expertise development). Yesterday Brian spoke to Rebecca about the time she accounted on the project. She spent more time than Brian had counted upon, but as her contribution is very innovative and essential for the project she can continue her activities (dialectical process of balancing tensions, Brain putting content over management). Until now the client is very enthusiastic about the ideas of Brian and his team: this is just what they needed and where they had been waiting for..... Together with his colleagues of the Ecology Group Brian is not only working on this project, but the group works in parallel on 63 other projects (Chapter Four), all in different stages of progression, all affected by the frame of reference provided by the teleological process of envisioning a future and most projects based on the distinct competences developed by the Ecology Group and executed with the process qualities of heedful interrelating and content over management.

In section 8.6, we defined the grounded theory we developed to explain the emergence of a competitive group competence as a quad-motor theory. Of the 160 studies¹ that build upon the framework of Van de Ven and Poole (1995), this is – to the best of our knowledge - the first study to address a quad-motor theory *in* the field of organization science. Reflecting on the grounded theory we had developed, we also concluded that we have not found a fifth or sixth motor of change (Langley, 1999). The four motors provided by Poole et al. (2000) are sufficient to explain the emergence of a competitive group competence. In explaining why we found this combination of processes, we argued that the nature of the central subject of each process – its content – affects what process or combination of processes can best explain change. This is an addition to the present process theory that addresses theories of change by two pre-defined dimensions (section 8.5). We also argued for additions to the present tools to develop a process theory. We suggest additions with regard to the tools to guide the involvement of exogenous elements in theories and tools for the identification of a path of change in a duo-, tri-, or quad-motor theory in which the motors operate in a parallel way.

A parallel and nested operation

In Chapter Eight we also concluded that the processes operate in a parallel way and that they are nested. They are nested in the sense that the dialectical process of balancing tensions is nested (to a large extent) within the repeated life cycle process which in turn is nested in the co-evolutionary process of expertise development which is nested in the teleological process of envisioning a future.

¹ Period: 1995 up to December 2005

The connection with stakeholders in the environment

In section 8.6, we argued that all processes contribute to maintain or strengthen fit with the environment and to provide clients with extraordinary products. We also argued that the processes operate in a parallel way on a relatively long time horizon, which stresses the relevance of maintaining fit with the environment. We found a combined strategy of enacting, position creation, a comprehensive strategy, and the application of externally oriented selection mechanisms for the selection of projects and research themes to maintain fit with the environment. Although most elements that describe the interaction pattern with the environment are described in literature, this combination, related to the emergence of a competitive group competence is an addition to literature as it enlarges our understanding.

The context in which the processes operate and its effect

We characterized the groups in the field studies as dependent upon clients for their continuation, working in an interdisciplinary field of science, focusing on application driven (and applied) research, and as being committed to a research approach and lines of research that we defined as “normal science”. We found that the groups have positioned themselves as groups that work on research problems that require broad knowledge of the field of research, the integration of this knowledge, and innovative concepts and ideas. Furthermore we found that the groups work in an environment with a low level of dynamics and that they had consensus about main values and attitudes regarding their social practices.

What we contribute to literature is that we have provided more insight into the role of the context for the emergence of a competitive group competence. Our findings suggest a threefold role. *Firstly*, the context enables the development of distinctive competences as the environment is characterized by a low level of dynamics with regard to the kind of problems clients experience. The problems clients experience and prioritize and the kind of solutions they prefer gradually develop over time. *Secondly*, the context stimulates knowledge integration, especially by a practice of heedful interrelating, for the dependency on clients stimulates the groups to serve all clients to their best efforts. *Thirdly*, the context supports a positioning on more complex problems, to be solved within normal science. As the research groups are experienced as expensive, they must provide additional value. They achieve this by focusing on more complex issues, but positioned within normal science which enables the groups to deliver solutions within a reasonable amount of time. A highly formalized work setting is not particularly necessary, as our study showed.

Our findings suggest in particular that the unique combination of resources (Leonard-Barton, 1995) is in fact the expertise present in the groups, combined and integrated by a practice of heedful interrelating. Models and equipment can be important and unique, but do not provide additional value by themselves. They support the group members in generating and integrating knowledge in practical situations. It is the integration of the knowledge developed by the application of these resources with the expertise of the group members in projects which makes the constellation unique.

The accommodation of dynamics and change

Our findings with regard to the way the processes accommodate dynamics and change correspond with those of Van de Ven and Poole (1995) and Poole et al. (2000). In Chapter Eight, we discussed the distinctions Poole et al. make with regard to the kind of change the four processes create. The archetypical teleological and dialectical process are defined by Poole et al. as constructive processes that produce new action routines that may or may not create an original formulation/reformulation of the entity. These processes tend to create second-order change, namely a change in basic assumptions or frameworks that represents a break with the past. Those undergoing such changes experience a high degree of uncertainty and need to make sense of the changes (p. 69). In accordance with our findings, these processes enable rapid changes.

The archetypical lifecycle and the evolutionary process are defined by Poole et al. as prescribed processes that evoke a sequence of change events in accordance with a pre-established program or action routine. They tend to create first-order change, that is, change within an existing framework that produces variations on a theme. The processes by which these variations are produced are prescribed and, hence, predictable because they are patterned on the previous state. Over the longer term, small changes may cumulate to produce a larger change in degree or even in quality of the entity (p. 68). These main features match our findings. We did not focus on changes in phases or activities in a project lifecycle. But our findings suggest (Chapters Four and Five) that gradual changes in the execution have taken place, leading to the process qualities of heedful interrelating and content over management. With regard to knowledge integration, the content part of the project lifecycle process, rapid changes can be accommodated as heedful interrelating supports flexibility. With regard to the co-evolutionary process of expertise development, our findings also suggest that distinct competences are developed over time (first-order change).

In Chapter Eight, we argued that the relative influence of the co-evolutionary process of expertise development and the repeated project lifecycle is larger than the relative influence of the teleological process of envisioning a future and the dialectical process of balancing tensions. Due to this relative balance of the processes, they can accommodate the gradual changes we found in the field studies very well. However, the relative balance of the processes and their characteristics imply that the four processes in their joint operation are not able to accommodate rapid changes in demands for expertise or social practices. We hypothesized that the competitive group competence will no longer emerge in these situations, as the realized knowledge integration does not meet the demands of clients.

Other contributions to literature

We have also made some other contributions to literature. Our first contribution is, that we provided an example of a fine-grained model of the appearance of social rules that guide behavior in a research group. As we argued in Chapter Four, these models are sparse. We were not able to find in literature an example of a model of social rules that addresses routines, the behavior of groups, or changes in behavior. Recent literature that addresses continuous change in organizations as a fundamental characteristic, stresses the need for these kinds of models in order to understand change (Tsoukas & Chia, 2002). Our description of the social rules expresses the attitude of the researcher (taking his or her work very seriously), interacting respectfully with clients, partners, and colleagues; thinking along; open for advice; applying the expertise of others; involving colleagues and the client; not making promises that cannot be fulfilled; respecting the contributions of others in a project; and embodying recommendations learned from previous projects. The rules contribute to an explanation of how individuals in a group contribute to an effective, efficient, and flexible operation of knowledge integration.

Our second contribution is that we have deepened the concept of heedful interrelating. In Chapter Four, we argued that the identification of a number of social rules added a new dimension to the definition of the concept of heedful interrelating: The concept no longer depends only on a certain attitude that reflects such qualities as “noticing, taking care, attending, applying one’s mind, concentrating, putting one’s heart into something, thinking what one is doing, alertness, interest, intentness” (Weick & Roberts, p. 335), but now also depends on a practice that is grounded in and directed by social rules. This contribution helps to explain why a group is able to design, execute, and end projects with a process quality of heedful interrelating during a longer period of time.

Our third contribution is that the concept of the social rules underlying heedful interrelating and content over management also expands the theory of distributed cognition, because it provides an explanation of why a strong integration of cognitive work is able to emerge in a work setting with a low degree of formalization. We argued in Chapter Four that the body of knowledge of the situations in which collective mind develops and emerges is defined by a work setting with a high degree of formalization: a strict work setting, with strict roles for all the actors involved, a high task interdependency, a low autonomy, a system that is concrete and has clear boundaries, and in which the members have experienced a long period of training (e.g., Hutchins, 1991; Weick & Roberts, 1993; Hutchins & Klausen, 1996). A strong integration of cognitive work in situations with a low degree of formalization adds a new dimension to the theory of distributed cognition. The social rules in particular explain how heedful interrelating emerges in a context characterized by a low degree of formalization.

9.2 From substantive towards formal theory

To the question ‘What does theory consists of?’, Strauss and Corbin (1994) state that “Theory consists of *plausible* relationships proposed among *concepts* and *sets of concepts*. “ (p. 278). This plausibility becomes strengthened through continued research. Insofar this theory is able to specify conditions and their related consequences, they argue, the theorist can claim predictability for it, in the limited sense that *if* elsewhere approximately similar conditions obtain *then* approximately similar consequences should occur. This reasoning is congruent with the statement we made in Chapter Two, that our results are probably also valid for other research groups operating with a comparable focus and within comparable conditions. In section 8.6 we defined this focus and these conditions.

The theory developed in this study is defined as substantive by Glaser & Strauss (1967): “since substantive theory is grounded in research on one particular substantive area (...) it might be taken to apply only to that specific area. A theory at such a conceptual level, however, may have important general implications and relevance, and become almost automatically a springboard or stepping stone to the development of a grounded formal [or is more usually said, “general”] theory... Substantive theory is a strategic link in the formulation and generation of grounded formal theory” (p. 79). A substantive theory should not attempt to explain outside of the immediate field of study, as there are no data of situations outside this field of study. Therefore it should not try to generalize (Goulding, 2002). A formal theory, on the other hand, has explanatory power across a range of

situations. Formal theory is usually the end product of longitudinal research, normally on the part of a team of researchers engaged in the collection of data across a range of situations and locations according to Goulding (2002).

Glaser and Strauss define a substantive area as a work-area or a societal issue (e.g., juvenile delinquency, medical education, mental health). Goulding (2002) also addresses a particular type of organization as a substantive area. We have defined the substantive area of this study in section 8.6 by the context in which the research groups we studied operate: they work on normal science, conduct application oriented and applied research in a multidisciplinary research area, operate in an environment characterized by a low level of dynamics, are dependent on clients for the continuation of their research activities (and therefore need knowledge of the practice of their clients and the applicability of the solutions they provide), have positioned themselves on more complex problems which require knowledge integration, have to operate under strict business-economic conditions and have accomplished high consensus on social norms and values. Therefore we limited the application area of our theory to research groups that meet these characteristics. Additional field studies (section 9.5) can lead to a more elaborated substantive theory or to a formal theory developed in conjunction with multi-area data.

In this section we discuss changes at a micro level that affect the emergence of a competitive group competence and the specificity of the context we found in the field studies. We limit ourselves to research groups (previous paragraph), but based on the developed insights we develop and discuss hypotheses that help to expand the theory beyond the substantive area of this study. Insofar this section differs from the sections 8.3 and 8.4 that focused on the findings in the field studies (and therefore the substantive area of this study). Firstly, we will argue that, when studied at a micro level, there is continuous change in a research practice. Related to continuous change we will develop the hypothesis that the autopoietic nature of the practice of the groups helps to explain how the groups are able to accomplish continuity and to handle “interruptions”. Secondly, with regard to the context, we will argue that due to the characteristics of the processes, the emergence of a competitive group competence suggests an environment with a low level of dynamics, normal science, and consensus about main values and attitudes with regard to behaviors. Thirdly and finally, we reflect on the concept of a dynamic capability.

Continuous change on a micro level of study

In this subsection, we reflect on the qualities of the concept of a competitive group competence with regard to change / resistance to change related to the theory we developed

and the context we encountered in the field studies. How stable is the emergence of a competitive group competence explained in our theory, what kind of changes take place, and what are the consequences of those changes for the emergence and the prevention of the non-emergence of a competitive group competence? What if the context changes, especially with regard to working in normal science, a gradual changing environment, and consensus about main values and attitudes?

When we reflected on these issues, we realized that there is an enormous body of literature that addresses change in organizations. Here, we involve only a very small part of this body of literature. Our focus is not on change in organizations as a temporary process in which an organization moves from A to B, as something extraordinary, alternating with long periods of stability. Therefore, the focus is not on the literature that addresses adaptation, resistance to change, immobility, planned change processes, and so on, but on an emerging literature that addresses continuous change as a basic characteristic of organizations, something that is embedded in and emerges from activities, routines, processes, and agents in the organization (Tsoukas & Chia, 2002; Orlikowski, 1996; Feldman, 2000, 2004; Pentland & Reuter, 1994; Weick & Quinn, 1999; Howard-Grenville, 2005). As we will argue, our theory not only explains the emergence of a competitive group competence, but also addresses the continuous dynamics affecting its emergence in the present. Unlike the reflections and discussions in the previous chapters, this discussion has more of a hypothetical nature and makes suggestions for future research rather than providing statements about our contribution to this body of literature.

A first argument why we suggest that our theory addresses continuous change and not only change (development and emergence) toward a competitive group competence, is that our theory is not specifically bound to one period of time. Our process theory can be compared to, for instance, the example provided by Mohr (1982), who defined the processes involved in the dissemination of malaria. These processes, too, are not bound to a specific period in time. Of course we have studied the emergence in the field studies in a specific period of time (1983-2001), but the final theory is not bound to that period: there are no “distinct states” (Tsoukas & Chia, 2002). Because there was an emergence of the competitive group competence in the groups in the field studies in 2001 (Chapter Two), our narrative explains its emergence in 2001, but it could also explain its emergence in one or more other years. Second, our theory addresses a number of endogenous characteristics that point toward continuous change. For example, there always will be a combination of heedful and heedless interrelating in the group, as we demonstrated in Chapter Five and worked out in a reflection on the emergence of heedful interrelating. We hypothesize that this will not be

constant but will vary over time, related to the process of the adaptation of social rules. A second example is the translation of new administrative rules (task constraints) into adjusted social rules that fit the professional norms. In Chapter Four, we provided an example of the translation of the administrative rule to manage the project within budget into the rule “work decently and as a good colleague.” A third example is the openness of the social rules, which provides room for improvisation. The social rules describe the kind of behavior, rather than the exact behavior, that is expected. A fourth example is the use of a restricted number of selection mechanisms when choosing projects (Chapter Six), which provides room for innovation. A fifth and final example is changes in the package of selection mechanisms for projects (Chapter Six), for instance including the demand that project budgets cover all costs. Therefore, our theory includes open-ended micro processes that capture the distinguishing features of change, its fluidity, pervasiveness, open-endedness, and indivisibility (Tsoukas & Chia, p. 570).

Changes in how the social rules are applied and in how projects are selected are not necessarily a consequence of outside pressures or interventions by management, but can also be the result of experiments, improvisation, expansion, or opportunistic behavior. They can be initiated endogenous to the practice, as we emphasized in Chapter Five by discussing individual preferences in the application of the social rules. This corresponds with the ideas of Tsoukas and Chia, who state that “although managers certainly aim at changing established ways of thinking and acting through implementing particular plans, nonetheless change in organizations occurs without necessarily intentional managerial action as a result of individuals trying to accommodate new experiences and realize new possibilities” (p. 578). This also means that changes continuously take place at a micro level, with individuals experimenting, improvising, and following their personal preferences. At this individual level, they are still small. But when these micro-level changes are input for the process of the development or adjustment of social rules and become part of the practice, the implications become larger. At the micro level, the behavior of individuals that differs from heedful interrelating or content over management affects the emergence of the competitive group competence, though not very seriously (Chapter Five). However, when new behaviors are institutionalized in the practice of the group, they can affect the emergence of the competitive group competence more seriously. In both cases, the emergence of the competitive group competence is strengthened or weakened. In this respect, the findings of Feldman (2000, 2004) and Howard-Grenville (2005) fit with findings in our study. Routines can be adapted, by adapting social rules or by making room for improvisation in the application of the rules.

If the behavior of individuals is different from heedful interrelating and content over management and is not (continuously) repeated, then it can be considered to be an incident. Tsoukas and Chia define incidents that do not become part of the regular practice as organizational closure. This is always temporary, in their opinion. However, when continuous change is interpreted very strictly, there is no organizational closure. In the continuous stream of variation (in the application of the social rules), some behaviors become part of the practice, while others remain incidents. Interpreting change as something that is endogenous to the practice of the group, as we do here, also means that managers can induce change (e.g., by introducing other selection criteria for projects), but it is not clear beforehand how these incentives are embedded in the practice. These incentives become part of the continuous stream of variation in the practice and will be interpreted and modified by the individual researchers in order to make them fit within the practice. This refers to the autopoietic nature of a practice (Maturana & Varela, 1984; Luhmann, 1984), meaning that a practice is open to data, but closed to information.

This autopoietic nature of the practice helps to explain how the groups are able to accomplish continuity and to handle “interruptions” from outside, just as the selection criteria (for projects) help to explain why the groups are able to accomplish continuity while handling variation from within the practice. Based on this discussion of the micro level of change, we expect that there are constant, small changes in the practices of the group. But the field studies also suggest that the emergence of the competitive group competence is quite stable. Although the autopoietic nature of the practice and the selection criteria for projects help to explain the continual emergence of the competitive group competence, we feel that the explanation for the continual emergence of the competitive group competence should include more. The effect of working in a field of “normal science,” the effect of the low level of dynamics in the environment, consensus about main values and attitudes, the effect of the time horizon of the processes, and a combination of these effects have not completely emerged in our study (at a micro level) as we deliberately did not vary these dimensions. A study into these effects is a suggestion for future research. Tsoukas and Chia define this kind of research as studies with a performative account (p. 572).

Hypotheses with regard to the context in which a competitive group competence emerges

In section 8.2 we argued that the four processes operate in a parallel way on a relatively long time horizon, that the evolutionary and lifecycle process are relatively more important than the other two, and that the evolutionary, lifecycle, and dialectical process are nested within the teleological process. With regard to the consequences for the emergence of a

competitive group competence, we argued that these specifications of the relations between the four processes mean that the emergence of a competitive group competence takes a relatively long time. We found (section 8.3) that the groups work in an environment with a low level of dynamics, that they work in a field characterized by “normal science,” and that they have consensus about main values and attitudes regarding the social practice. We also argued that management has very limited resources available to directly affect the emergence of a competitive group competence, or to speed up its emergence. Here, we will discuss the possible consequences of a different context for the emergence of a competitive group competence, focusing on the absence of normal science, a high level of environmental dynamics, and the absence of consensus about main values and attitudes in the social practice. We will relate these issues to the features of the processes with regard to how they accommodate dynamics and change.

We will discuss these situations related to the emergence or non-emergence of a competitive group competence, rather than to the development of a core rigidity in particular (Leonard-Barton, 1995). A core rigidity supposes that the group continues in its way of acting and offering expertise that is no longer required. What we refer to here is that they have noticed change but are unable to adjust within the required time span.

Normal science

In the field studies, we found that the groups work on normal science, implying consensus on foundational issues. In situations where groups do not work on normal science, we question the possibility of the emergence of a competitive group competence. Because when there is much debate about fundamental issues, the value of the developed knowledge and its application in order to solve the problems of clients will be at stake. And when there is discussion about the value of the developed competences, the amount and kind of knowledge integration necessary to provide clients with highly appreciated products will be affected. Furthermore, the commitment of the organization toward such a research line (Fujimura, 1987; including financial means and careers of researchers) could be at stake. This makes the emergence of a competitive group competence hard, if not impossible. It also means that we hypothesize that it is not possible to develop a competitive group competence in heavily debated technologies or techniques (in a context where the continuation of the organization depends on resources provided by clients), such as the cloning of animals or human tissues for commercial (non-medical) purposes or in nuclear technology. The dialectical process, related to the development of distinctive competences (section 8.5) will be prominent in these situations. This dialectical process will possibly include not only the scientific community, but also clients and societal pressure groups.

Environmental dynamics

In Chapter Six we found that the groups operate in an environment with a low level of dynamics with regard to the kind of research problems and the solutions appreciated by clients. As the development of expertise takes a relatively long time (three – five years), this low level of dynamics creates a context in which the co-evolutionary process of expertise development can take place. Furthermore, the groups contribute to a stabilization of this context by a number of strategies that stimulate position creation and persuade and commit clients, as discussed in Chapter Eight. But in an environment with a high level of dynamics – defined by rapid changes in the research problems posed or the kind of solutions appreciated by clients – the development of distinct competences to meet these problems cannot be met by the groups through the process of the co-evolutionary development of expertise. Therefore, the integration of knowledge in the repeated project lifecycle will be insufficient and the products will not be experienced as extraordinary. When this happens for a broad package of research problems, the competitive group competence no longer emerges. The dismissal of obsolete expertise can be arranged relatively easily by dismissing group members, but acquiring the required expertise is only possible by developing one or more alliances with other groups or by the availability of relatively large budgets and a large group of available group members to develop the required expertise. But especially in a situation where the fit between a research group and its environment declines, these budgets are often not available (Chapter Six). Therefore, we hypothesize with regard to environmental dynamics that in a situation with a high level of environmental dynamics, the emergence of a competitive group competence will be hard, if not impossible.

Consensus about main values and attitudes regarding the social practice

The discussion of the dialectical process in Chapter Five suggests that the emergence of a competitive group competence in research groups requires at least a “stable social practice,” in which consensus is reached about fundamental values and attitudes. This is because when there is much debate about these fundamental issues in the dialectical process, the amount and kind of knowledge integration necessary to provide clients with highly appreciated answers is affected.

Our hypotheses with regard to the process or processes involved in the adjustment or development of social rules imply that this process or these processes has/have a relatively long duration in the groups. It takes some time before new demands with regard to interaction and behavior are translated into adjusted or new social rules. This implies that

rapid and large changes in expected behavior will be accommodated only moderately. The tensions and imbalance between the four dimensions in the dialectical process will initiate a search for structural adaptation. In the short term, these tensions will be solved by the dialectical process, in the longer run the other process(es) will have to provide a structural solution by adjusted or new social rules. This also implies that a high level of dynamics in expected behaviors can destabilize the established practice and therefore diminish heedful interrelating and, by implication, knowledge integration. In these situations, there can be a non-emergence of the competitive group competence.

In order to meet changed demands with regard to the social practice, we suggest the group develops a shared vision on the desired social practice and an active role of management in the training and execution of this behavior, its monitoring, and its adjustment. As Tsoukas and Chia (2002) state: "Being endowed with declarative powers, managers are *ex officio* in a privileged position to introduce a new discursive template that will make it possible for organizational members to notice new things, make fresh distinctions, see new connections, and have novel experiences, which they will seek to accommodate by reweaving their webs of beliefs and desires" (p. 579). But, as we have argued, the practice is of an autopoietic nature and therefore it is hard for management to achieve radical changes in a short period of time. The result therefore is "complex, multilayered, and evolving, rather than simple, fixed, and episodic" (ibid., p. 578), which also indicates that it is hard to prevent the non-emergence of a competitive group competence. Defined in terms of the processes in our theory, the relevance of the dialectical process and the teleological process should gain more weight. Management can stimulate their relevance by addressing the question what the group stands for, by formulating goals and actions (teleological process), by changing the composition of the group, which activates the dialectical process (stimulating individual sense making of the changed situation and stimulating a new group development process), and by stimulating discussion about interaction between researchers and interaction with clients.

In the previous paragraphs, we especially referred to dynamics imposed by the niche. But endogenous micro-level changes induced by individuals in the group can also create a situation in which basic assumptions about the social practice become heavily debated. We suggest that in this situation, the emergence of the competitive group competence will also be impeded, because the added value of the products for clients is at stake, related to the required level of knowledge integration to provide valuable answers.

Based on the arguments we provided in the previous paragraphs, we hypothesize that a competitive group competence only emerges in a context characterized by a low level of dynamics, normal science, and consensus about main values and attitudes with regard to behavior. In a context in which management does not place an extra accent on the teleological process of envisioning the future or the dialectical process of balancing tensions, the processes underlying the emergence of a competitive group competence can best accommodate the gradual changes that take place in this context. In this respect, the context of the field studies was quite specific. However, based on our arguments, we hypothesize that groups in all service-providing firms require a similar context for the emergence of a competitive group competence.

As the literature argues that firms (or groups in firms) should also develop a dynamic capability in order to adapt to changing circumstances, a remaining question is to what extent have the groups in the field studies actually developed this capability and why can the application of this capability not help to overcome more dynamics in the environment, in the field of research, or in values and attitudes? This is the subject of the following paragraphs.

A dynamic capability to meet changing demands?

The concept of a dynamic capability is defined as the ability to integrate, build, and reconfigure competences due to changing circumstances (Teece et al., 1997; Zollo & Winter, 2002). The concept of “an evolutionary learning capability” (Fujimoto 2001) also seems to address this kind of capability. A dynamic capability is not addressed as a quality in itself, but the value of a dynamic capability, “for competitive advantage lies in the resource configuration that they create” (Eisenhardt & Martin, 2000, p. 1106). What strikes us, as a first critique of the concept, is that not all the definitions in literature involve timing and the speed of changing circumstances. Teece et al. (1997) do explicitly, as they address the relation with “rapidly changing environments” (p. 516) in the definition of a dynamic capability. Zollo and Winter (2002) deliberately leave the timing aspect out, and in Fujimoto (2001) the aspect of timing is left implicit. The groups in the field studies have developed a mature dynamic capability in an environment that develops gradually. Through the project lifecycle process, the groups can integrate and reconfigure the technical competences present in the group in various combinations, related to the demands of clients. They can also gradually develop new technical competences by the co-evolutionary process of expertise development. The dialectical process of balancing tensions makes rapid and ad hoc responses to the present circumstances possible. Gradually, the group can adjust the social rules to the new circumstances. The processes represent a systematic

method for modifying operating routines (Zollo & Winter, 2002). However, in a situation of rapid changes (a high level of dynamics) in the demands of clients with regard to research problems, required solutions, required interaction patterns, rapid changes in scientific theories and methods, or rapid changes in social values and attitudes regulating the interaction between researchers, we suggest that the dynamic capability of the groups is immature; we hypothesize that they cannot respond to these changes. Therefore, the concept of a dynamic capability is not an absolute quality but has to be related to the environmental dynamics. In dynamic situations, the groups cannot build, integrate, and reconfigure their social and technical competences quickly enough to meet environmental demands. Therefore, as a second critique of the concept, our findings suggest that, different from the suggestions in literature, the presence of a dynamic capability is not in itself sufficient to prevent the non-emergence of a competitive group competence or to stop the trend toward a core rigidity. The capability to recognize rapid environmental changes and demands, to make collaborative sense of these changes and their implications (by raising the relative importance of the dialectical process of balancing tensions, the teleological process of envisioning a future, and the development of new or adapted social rules) seems to be an important condition for the operation of a dynamic capability. In addition, we suggest that competences to initiate rapid and intensive collaboration with other research groups when the dynamics in the environment become stronger are also very important in order to acquire new technical knowledge or to integrate additional knowledge relevant to the added value of the products to be delivered to clients.

9.3 Suggestions on how to stimulate the emergence of a competitive group competence

The following are some suggestions on how to stimulate the emergence of a competitive group competence. These suggestions need some introductory remarks. Firstly, this study was focused on developing theory, and not on testing theory or on developing managerial handles to design or implement a competitive group competence. Therefore, the suggestions we provide are not always directly based on and grounded in the results of this study. Secondly, as Berends (2003) states, in the field of organization science, “descriptive and explanatory theories are not directly translatable into prescriptions. An adequate theory does not automatically yield adequate management implications. Management problems are situated. Not all factors that play a role in a specific situation will be incorporated in a theory. General guidelines that follow from a theory need to be combined and adapted to specific

situations” (p. 199). Therefore, our suggestions will have to be modified and supplemented in order to meet specific, local situations. Thirdly, as we argued in Chapter Eight, we have not found evidence for a meta process that explains how the emergence of a competitive group competence has come about. We have developed a narrative in which conditions and managerial activities have been placed in time but, as we have argued, this is still a hypothesis. In this hypothesis, all the processes involved operate at the same time. Therefore, the suggestions we provide should be considered as incentives, intended to stimulate the emergence of a competitive group competence. There is no guarantee that a competitive group competence will emerge, because – as we have explained – its emergence is only for a small part dependent on managerial interventions and is particularly based on the day-to-day practice of all group members.

Because of these restrictions, the suggestions we provide are especially based on the personal experience of the author. They are, however, coherent with literature (Weggeman, 1997; Davenport & Prusak, 1998). The suggestions are especially intended for research groups.

Conditions

The field studies suggest that there are a number of preconditions for the development and emergence of a competitive group competence. Before management intervenes, it should check that these preconditions are present. Firstly, are the stakeholders convinced of the added value of research? This added value is affected by economic developments (e.g., the oil price: It is only interesting to search for agricultural substitutes for products based on oil when the oil price is high), technological developments (as the field study in the Postharvest Group demonstrated, technological developments in the field of ICT and genomics induce new problems for the clients in the niche), and political developments, reflecting the relevance for society to solve societal issues (e.g., the preservation of biodiversity). Secondly, is the environment interested in knowledge integration and, if so, for which part of the portfolio of research problems? Is this share of the portfolio sufficient to develop a specific profile? Thirdly, is there a well-developed relation with the stakeholders (Chapter Eight)? Fourthly, does the group operate in a context in which it has to provide high-quality solutions within a strict budget and a restricted time span (Chapter Eight)? If not, then there is no incentive to act heedfully in applying and integrating individual expertise. We do not suggest that if these conditions are not met that the emergence of a competitive group competence is impossible, but the field studies and our experience suggest that it will be hard.

Four kinds of managerial interventions

Based on the hypothesis of the way a competitive group competence emerges (Chapter Eight) and on our personal experience, we suggest four kinds of managerial interventions: (1) co-envisioning a future of the group and stimulating a collaborative culture; (2) developing a competence-enhancing HRM strategy; (3) introducing a facilitating management style; and (4) organizing resources for expertise development. There is no specific order in which these should be executed (Chapter Eight). By their joint operation, in coherence, they can stimulate the emergence of a competitive group competence

Co-envisioning a future of the group and stimulating a collaborative culture

As we learned from the field studies, the presence of a vision on the future of the group is very important, as it acts as a framework for the researchers, helping them to understand what the group stands for, what products it wants to deliver, which clients it wants to serve, and what is needed to create a future for the group in which it can continue its activities. As we explained, this framework guides operational actions. Although management can initiate the development of a vision, we emphasize that it should be a process in which the members of the group fully participate; we therefore define this intervention as “co-envisioning a future of the group.” A bottom-up and participative process will contribute to a higher fit between the individual ambitions and ideas of the group members and those of the collective. As Weggeman (1997) argues, a high fit between individual ambitions and those of the collective is supportive for the activities group members want to initiate when these are dependent upon their own motivation. The chance that they will work on the realization of the vision, and commit themselves and act in accordance with the rules and procedures, is the highest in this situation. This process is more important than a document in which the future of the group is envisioned, and should lead to an “embodied” collective ambition (Weggeman, 1997). The relation between the ambition of the group and individual ambitions can be strengthened even more by translating the collective ambition into individual contributions. We found some examples in the field studies, such as Ph.D. studies, a researcher starting to participate in a group for measurement technology, and with regard to the acquisition of projects (which also reflects personal preferences). Weggeman (1997) defines this translation process as the development of “personal commitment statements.”

Central in this envisioned future are the solutions provided for clients and an approach to the field of research (central theory, scientific methods, kind of solutions). These are not envisioned out of the blue: Present lines in research and present solutions provided to clients fuel these ideas, for this is the body of knowledge that is present in the group.

Furthermore, initiatives aimed at acquiring additional expertise in fields that have to be strengthened can be defined in order to realize this envisioned future. Selection criteria for projects should also be part of this envisioned future. What requirements should newly acquired projects meet? The field studies showed that meeting the criterion of the presence of a scientific challenge and meeting the criterion of fit with defined lines of research for the future were important. A third element of this envisioned future is the expression of a strong orientation toward clients, supported by a collaborative culture. This culture addresses collaborative behavior toward other group members and toward clients. Allow group members to keep in contact with important clients and interesting prospects – not only to make the products fit with the expectations of clients, but also to pick up signals and to experience what works and what does not (“enacting the environment”; Daft & Weick, 1984).

As stated, a collaborative culture is important. We assume that the need for this culture is addressed in the envisioned future for the group. But how to stimulate such a culture? We have thought of a number of initiatives. Firstly, by stimulating the commitment of employees to the group and not to one of its organizational clusters. Weakening the role of organizational clusters (to solely a practical home base) and strengthening the role of the group is one way to strengthen this commitment. Secondly, by stimulating group members to meet each other in meetings in diverse compositions, with a frequency of two – four times a month. Thirdly, by discussing projects in the acquisition, design, and execution phase at some of these meetings. Fourthly, by stimulating group members to ask for help and support at these meetings. In order to tempt the group members to ask for help and support, they should be confident enough to behave openly and vulnerably, and they should experience support as a reward. Fifthly, by evaluating the composition of teams, stimulating group members to collaborate in differently composed teams, taking into account the expertise that is needed to execute the project successfully. Sixthly, by stimulating group members to give each other feedback (in addition to feedback from management) – not only when things could have been better, but also when successes have been accomplished. Another managerial tool to stimulate a collaborative culture could be the design of a “code of conduct” to act as an explicit frame of reference. One of the largest drawbacks of such a code of conduct is, in our opinion, that collaboration is brought into a sphere of control and bureaucracy, more or less imposed on group members. In such a sphere, it will not be experienced as intrinsically rewarding. In our opinion, collaboration should be experienced as intrinsically rewarding, because it allows the group to design and execute complex projects in a natural manner. Only then does it contribute to the achievement of the envisioned future of the group. Finally, we suggest discussing

collaborative behavior in assessments and rewarding this kind of behavior (e.g., involvement in more complex projects, granting a group member a trajectory to deepen his or her expertise, or granting extra money to participate in an extra scientific meeting).

Development of a competence-enhancing HRM strategy

Another field of managerial interventions is the development of a competence-enhancing HRM strategy. We feel it is not necessary for this strategy to be based on a “double” or “triple” ladder (Weggeman, 1997); the field studies have demonstrated that there are also other means to stimulate competence development.

We recommend management to stimulate the deepening and broadening of expertise. The deepening of expertise enables the employee to become an expert, and (as witnessed in our field studies) contributes to the further enhancement of science. It also allows the group to acquire more complex projects in which this expertise is a core issue. In the field studies, expertise was deepened by Ph.D. studies, although other activities or studies are also possible. When scientific publications are also an output, such contributes to the scientific profile of the group member and that of the group. In addition, it contributes to the development of distinguishing profiles of group members, which stimulates the seeking of each other’s expertise in the design and execution of projects. Besides the deepening of expertise with regard to science, the deepening of expertise can be oriented toward research management or knowledge of the market. We saw in the field studies, for instance, that researchers were seconded to a large client, not as much for the transfer of knowledge (although it was a side effect), but especially to gain more knowledge of the world of the client.

For groups that operate in a context in which they are strongly dependent on the market, it is also important that group members are widely available for projects. Management can contribute by stimulating the broadening of group members, for instance by evaluating how group members are involved in projects. Sometimes they should stimulate the involvement of a group member other than the specialist, in order to provide an opportunity for other group members to develop a broader field of expertise. In addition to an individual and group effect with regard to the availability of group members, it also contributes to the development of a mutual language. This, in turn, contributes to a strengthening of interaction. With regard to the collaborative behavior of group members, activities that contribute to the deepening of expertise and those that contribute to the broadening of expertise create a somewhat contradictory effect. For while the deepening of knowledge requires collaboration, the broadening of knowledge could be experienced as an incentive

to reduce collaboration, to work more independently, and to stimulate competition. However, the specialist should not be afraid to lose his or her status. Assigning another group member to a project does not mean that the same level of expertise is realized.

In the process of selecting and hiring new group members, management should focus not only on the expertise that is needed, but also on research-related competences and attitudes, as the field studies showed. New group members were hired on a temporary basis, sometimes by deliberately searching for students or a Ph.D. candidate. This strategy has as the advantage that management and group members can evaluate the fit of the new candidate in the group, and that he or she can be indoctrinated with the social rules that regulate collaboration between group members and collaboration with the client from a somewhat uneven position. Furthermore, the field studies demonstrated that new group members should be socialized carefully, for instance by assigning a mentor who accompanies each new group member for the first half year.

A facilitating management style

In support of a climate in which the researcher takes most of the initiatives (fitting with the envisioned future that has been accomplished bottom up), in which they search for and apply each other's qualities as well as possible, we suggest management adopts a facilitating leadership style. Here we refer to a style in which initiatives are rewarded and that focuses on strengthening the fit between the individual motives and goals of the group. This style stimulates collaborating behavior, because help and support is provided when researchers encounter questions or problems in their work. A focus on the content of work is relevant, because it fits with the interest of researchers. Often researchers work with rules that express content over management and a strong focus on time and money will soon raise questions about what is really important in the group: the content or profits? On the other hand, management should not neglect these aspects. Management can facilitate also in this respect, providing support in making the state of affairs with regard to budgets transparent and providing support in ending projects in time and within budget.

Organizing resources for expertise development

In order to stimulate the development of both general and more specific expertise, it is important that groups have resources that they can devote to projects by themselves, as such diminishes the dependence on clients when these projects are relevant to the development of expertise in the group, but do not directly provide solutions to clients. Besides, it stimulates researchers to work on realizing the envisioned future. It also provides the group with a means to develop new, interesting concepts that can be used to

persuade the stakeholders in the niche (again). It is, however, hard to make suggestions concerning the size of these resources.

9.4 Reflection on the research approach

We have demonstrated that the approach of this study supports the development of knowledge about basic processes that explain the emergence of a competitive group competence, their coherence, the context in which a competitive group competence emerges, and how the processes accommodate dynamics and change in research groups. The study has acknowledged additions to the concept of heedful interrelating and to process theory, and has explored existing concepts. But the research approach chosen for this study also has its drawbacks. Firstly, process theory combined with GTM does not start with much theory, which may lead to research results that are detached from current theorizing. We have tried to avoid this problem by increasing our theoretical sensitivity and by reflecting on existing theories and bodies of literature with regard to our results. Secondly, process theory is only moderately helpful in distinguishing processes from the 100 codes established by GTM. The techniques provided by process theory help in distinguishing one change process at a time, but when there are more motors (a duo-, tri-, or quad-motor theory) operating in parallel, their support is moderate. Thirdly, as discussed, process theory has limited tools available to distinguish between the essential, necessary processes and processes that are just “sufficient”. In Chapter Two we discussed how we solved this problem and in section 8.6 we elaborated on this problem discussing the implications of reflections for our findings. Fourthly, process theory has no tools available to identify a path of change in a duo-, tri- or quad-motor theory when the motors operate in a parallel way. We solved this problem by shifting our attention to a narrative that explains how the emergence of the competitive group competence unfolded, but we could only formulate a hypothesis. Fifthly, process theory and GTM are very helpful in creating theory, but additional approaches are needed to test theory.

This study focused on finding the basic processes responsible for the emergence of competitive group competence. Part of the study comprised two field studies, both of which were conducted in 2001. We did not follow the groups for a long period of time. Although we argued in section 9.2 that the study is not restricted to a specific period or time, this approach reflects some distance from what really happened and happens in the groups. The history was reconstructed. Longitudinal studies could add very interesting findings, especially with regard to micro changes and their effect on the emergence of the

competitive group competence. How large is the variation in the application or adjustment of social rules over time? How long does it take to develop social rules that fit with the professional norms of the researchers? Which process or combination of processes is responsible for the adjustment of social rules and the development of social rules? Also the width of variation in expertise development over time is interesting for further study, as is its effect on a continuous emergence of the competitive group competence. Are the groups able to prevent a situation of a “co-evolutionary lock in” (Burgelman, 2002)?

Finally, a more micro-oriented approach combined with a longitudinal approach could provide additional insights. We did not study how the expertise of the group members was integrated in projects. We found a number of social rules, but did not focus on how they were applied in projects or project activities, that is, how they were applied in various situations, related to the size and the type of project (and perhaps the type of client), or in specific situations. We also did not study the specific strength of the various conditions (such as time, budget, administrative rules) and how strongly they affected the practice of the groups. Of course, the study provided some ideas and feelings about the strength of the conditions, but this aspect was not studied systematically.

9.5 Suggestions for future research

The results of this study and the constraints with regard to the research approach suggest several directions for future research. Of course, the developed theory should be tested, because our research approach was directed only at theory development. In this section, we make some suggestions for testing the theory. Apart from theory testing, our reflection on process theory provided some suggestions for future research. But we feel that it would also be interesting to perform research into the management of the emergence of a competitive group competence and to develop a theory of the non-emergence of a competitive group competence.

Developing a theory of the non-emergence of a competitive group competence

As explained in Chapter Two, the theory we have developed focuses on the emergence of a competitive group competence. As Mohr (1982) argues that this process theory is specific to situations in which a competitive group competence emerges, we are curious about the process theory that explains the non-emergence of a competitive group competence in research groups. According to Mohr, this could be a completely different theory, although it could also be a theory with the same four processes in their joint operation, as only one of

the outcomes of a process theory is defined to be the outcome, reflecting the probabilistic nature of a process theory. If this theory is identical to the theory we have developed with regard to the processes and their joint operation, but different with regard to the outcomes or process qualities of one or a number of the processes, this would help in two ways. Firstly, to identify the specific differences between a situation of non-emergence and emergence of a competitive group competence, and secondly, to study change and its effects on the performance of a research group on a more continuous basis. We could then study a situation in which periods in which a competitive group competence emerges alternate with periods in which there is no emergence of such a competence. This would contribute to the study of continuous change in organizations.

Strengthening the external validity of the theory

A second suggestion for future research is to extend the external validity. Obviously, we refer to additional case studies of research groups in which a competitive group competence emerges, operating under the same conditions but positioned in another research organization. More importantly is to take groups and contexts with other characteristics into account to broaden the substantive character of the theory and develop it into a more elaborated substantive theory or into a formal theory (section 9.2). As was addressed in Chapter Two, the study focused on internal validity. We especially propose two situations. The first situation is one of a research group working in a mono-disciplinary field of research, working in the same context as the groups involved in this study did, in which a competitive group competence emerges. This would make clear whether the theory is bound to groups working in a multidisciplinary field of research and the reasons to express heedful interrelating in mono-disciplinary groups. The second situation is of a group working in a multidisciplinary field of research but in a different context. A first dimension of this context is a research group not working in a field of research that can be defined as “normal science.” A second dimension of this context is an environment with a high level of dynamics with regard to the kind of research problems posed by clients or the kind of solutions appreciated by clients. A third dimension of this context is a lack of consensus on shared values and attitudes with regard to behaviors. We hypothesized in section 9.2 that in these contexts there will probably be no emergence of a competitive group competence. It would be interesting to test the theory in these contexts.

Research into the characteristics of process theory related to change in organizations

In Chapter Eight, we argued that the description of change (processes) in organizations is not just a coincidental process or combination of processes, but that the *nature* of central subject(s) – its *content* – affects what process or combination of processes best explain

change. Because we suggested that this is an addition to the present process theory, it would be interesting to study whether the nature – the content of the central subject – also determines the process or combination of processes in other change theories.

A second field for future research with regard to process theory is a hypothesis that the taxonomy of Poole et al. could be too wide, that the number of combinations of processes that explain change *in* organizations is smaller, that change in organizations cannot be explained by one process, and that the description of change processes in organizations is always explained by a *nested* set of processes, where the teleological process is the embracing process. For Weggeman (1997) defines an organization as a group of people of which most have chosen to strive for the same ideal or goal which can be tested by them (p. 67). This means, that whatever change process we study, we always will find a teleological process that expresses the ‘strive for the same ideal’. This also means that the change process that is studied will introduce one or a number of processes, nested within the teleological process. This also makes the taxonomy of Poole et al. smaller.

A third field of future research with regard to process theory is how to develop process theories that also explain continuous change. Our first suggestion in this respect is to focus on temporary stability (“closure;” Tsoukas & Chia, 2002) and change (Howard-Grenville, 2005). As the field studies suggest, the emergence of the competitive group competence is not unstable. But we do not know exactly why. It is because of the “normal science” the group works on, an environment with a low level of dynamics, the duration of the processes, the translation of disturbances (e.g., new administrative rules) into professional norms, or a combination of these factors? Our study has not provided clear answers in this respect. The second suggestion is to focus on change related to performance, by research on a micro level. As Tsoukas and Chia (2002) argue: “through [...] focus on situated human agency unfolding in time, offer us insight into the actual emergence and accomplishment of change. They are more directly connected to practitioners’ lived experiences and actions” (p. 572). Our study has not made clear how the four processes interact at a micro level and what this means for the emergence of a competitive group competence as time goes by.

Research into the management of the emergence of a competitive group competence

We argued in Chapter Eight that the four processes underlying the emergence of a competitive group competence operate in a parallel way. Therefore, their combined effect on the emergence of the competitive group competence is more complex to control than it would be where they to operate in a serial way. Besides, management in a research group is not concentrated in the person of the leader of the group, but is a shared activity, for in its

widest interpretation all group members also perform management activities to some extent. In section 9.3 we made some suggestions for management to stimulate the emergence of a competitive group competence. Research into the management of the emergence of a competitive group competence would provide valuable additional insights into the parallel operation of the processes: is our hypothesis of how the emergence of a competitive group competence unfolds correct or can alternative narratives be developed? It would also provide more insight into the applicability and completeness of our suggestions and would close the management cycle with regard to the emergence of competitive group competence: not only looking backward, analyzing what happened in the emergence of a competitive group competence (as we did), but in applying this knowledge in designing for the emergence of a competitive group competence.

References

- Adler P. and S.W. Kwon, 2000, Social capital: prospects for a new concept, *Academy of Management Review*, 27, 1, p. 17
- Ahuja G. and R. Katila, 2004, Where do resources come from? The role of idiosyncratic situations, *Strategic Management Journal*, 25, special issue, p. 887-907
- Allen T.J. and R. Katz, 1986, The dual ladder: motivational solution or managerial delusion?, *R&D Management*, 16, 2, p. 185-198
- Alterra, 2000, *Jaarboek Alterra 2000*
- Ancona D.G. and D.F. Caldwell, 1988, Beyond task and maintenance, defining external functions in groups, *Group & Organization Studies*, 1988, 13, 4, p. 468-94
- Ancona D.G. and D.F. Caldwell, 1990, Improving the performance of new product teams, *Research Technology Management*, 33, 2, p. 25-29
- Ancona D.G. and D.F. Caldwell, 1992, Bridging the boundary: external activity and performance in organizational teams, *Administrative Science Quarterly*, 37, 4, p. 634-66
- Ash S.E., 1952, *Social Psychology*, Englewood Cliffs, NJ: Prentice-Hall
- ATO-DLO, 1994 *Jaarverslag 1993*
- ATO-DLO, 1999, *Jaarverslag 1998*
- ATO-DLO, 2000, *Jaarverslag 1999*

- Badaway M.K.; 1988, What We've Learned: Managing Human Resources, *Research Technology Management*, 31, 5, p. 19-35
- Bakema F. and M. Weggeman, 2001, Implicaties van de Santiago-theorie voor de inrichting en besturing van kennisintensieve organisaties, in: *Kennis en Management*, P. van Baalen, M. Weggeman, A. Witteveen (eds.), Schiedam, Scriptum
- Bales R.F., 1953, The equilibrium problem in small groups, in : T. Parsons, R.F. Bales and E.A. Schills, *Working papers in theory of action*, Glencoe, Free Press
- Barnett W.P. and R.A. Burgelman, 1996, Evolutionary perspectives on strategy, *Strategic Management Journal*, 17, p. 5-19
- Barney, J.B., 1986, Strategic factor markets: expectations, luck and business strategy, *Management Science*, 32, p. 1231-1241
- Barney, J.B., 1991, Firm resources and sustained competitive advantage, *Journal of Management*, 17, p. 99-120
- Benson J.K., 1977, Organizations: A dialectical view, *Administrative Science Quarterly*, 22, p. 1-21

- Berends H., 2003; *Knowledge sharing in industrial research*, Eindhoven University Press, Eindhoven
- Berends H., H. van der Bij and M. Weggeman, 2005, Knowledge integration, in: *Encyclopedia of Knowledge Management*, Schwartz D.G. (ed.), London, Idea Group Reference, p. 352-359
- Bettenhausen K. and J.K. Murnighan, 1991, The development of an intragroup norm and the effects of interpersonal and structural challenges, *Administrative Science Quarterly*, 36, 1, p. 20-35
- Blau P., 1964, *Exchange and power in social life*, New York: Wiley
- Boland R.J., R.V. Tenkasi and D. Te'eni; 1994, Designing Information Technology to support distributed cognition, *Organization Science*, 5, 3, pp. 245-279
- Brady T. and A. Daries, 2004, Building project capabilities: from exploratory to exploitative learning, *Organization Studies*, 25, 9, p. 1601-1621
- Braithwaite J., 2004, An empirically-based model for clinician-managers' behavioural routines, *Journal of Health Organization and Management*, 18, 4/5, p. 240-261
- Brandon D.P. and A.B. Hollingshead, 2004, Transactive memory systems in organizations: matching tasks, expertise, and people; *Organization Science*, 15, 6, p. 633-644
- Bresnen M., A. Goussevskaia and J. Swan, 2004, Embedding new management knowledge in project based organizations, *Organization Studies*, 25, 9, p. 1535-1555
- Bresnen M., A. Goussevskaia and J. Swan, 2005, Organizational routines, situated learning and processes of change in project-based organizations, 2005, *Project Management Journal*, 36, 3, p. 27-41
- Brown J.S. and P. Duguid, 1991, Organizational learning and communities of practice: toward a unified view of working, learning and innovation, *Organization Science*, 2, 1, p. 40-57
- Brown J.S. and P. Duguid, 2001, Knowledge and organization: a social practice perspective, *Organization Science*, 12, p. 198-213
- Brown S.L. and K.M. Eisenhardt, 1997, The art of continuous change: linking complexity theory and time-paced evolution in relentlessly shifting organizations, *Administrative Science Quarterly*, 42, 1, p. 1-34
- Burgelman, R.A., 1991, Intraorganizational ecology of strategy making and organizational adaptation: theory and field research, *Organization Science*, 2, 3, p. 239-262
- Burgelman R.A., 2002, Strategy as vector and the inertia of co-evolutionary lock in, *Administrative Science Quarterly*, 47, p. 325-357

REFERENCES

- Burt, R.S., 1997, The contingent value of Social Capital, *Administrative Science Quarterly*, 42, p. 339-365
- Busby J.S., 2001, Error and distributed cognition in design, *Design Studies*, 22, 3, p. 233-254
- Caldwell, R., 2005; Things fall apart? Discourses on agency and change in organizations, *Human Relations*, 58, 1, p. 83-114
- Campbell D.T., 1960, Blind variation and selective retention in creative thoughts as in other knowledge processes, *Psychological Review*, 67, p. 380-400
- Carlile, P.R., 2002, A pragmatic view of knowledge and boundaries: boundary objects in new product development, *Organization Science*, 13, 4, p. 442-455
- Carmeli A. and A. Tishler, 2004, The relationships between intangible organizational elements and organizational performance, *Strategic Management Journal*, 25, p. 1257-78
- Castells M., 1996, *The rise of the network society*, Oxford, Blackwell
- Cesaroni F., A. Di Minin and A. Piccaluga, 2004, New strategic goals and organizational solutions in large R&D labs: lessons from Centro Ricerche Fiat and Telecom Italia Lab, *R&D Management*, 34, 1, p. 45-56
- Chandler A.D., 1962, *Strategy and structure: chapters in the history of the American industrial enterprise*, Cambridge, Mass.: MIT press
- Cicourel, A.V.; 1990, The integration of distributed knowledge in collaborative medical diagnosis, in: *Intellectual Teamwork*, J. Gallegher, R.E. Kraut and C. Edigo (eds), p. 221-242
- Clarke T.E., 2002, Why do we still not apply what we know about managing R&D personnel?, *Research Technology Management*, 45, 2, p. 9-25
- Cleland, 1990, *Project management, strategic design and implementation*, first edition, New York, McGraw Hill
- Cockburn, I.M., R.M. Henderson and S. Stern, 2000, Untangling the origins of competitive advantage, *Strategic Management Journal*, 21, p. 1123-1145
- Cohen S.G. and D.E. Bailey, 1997, What makes teams work: group effectiveness research from the shop floor to the executive suite, *Journal of Management*, 23, 3, p. 239-90
- Conner, K., 1991, A historical comparison of resource-based theory and five schools of thought within industrial organization economics, *Journal of Management*, 17, p. 121-154

- Conner K.R. and C.K. Prahalad, 1996; A resource-based theory of the firm: knowledge versus opportunism, in: *Organization Science*, 7, 5, p. 477-501
- Cook S.D.N. and J.S. Brown, 1999, Bridging epistemologies: the generative dance between organizational knowledge and organizational knowing, *Organization Science*, 10, 4, p. 381-400
- Crossan M.M., H.W. Lane and R.E. White, 1999, An organizational learning framework: from intuiting to institution, *Academy of Management Review*, 3, p. 522-537.
- Cule P.E. and D. Robey, 2004, A dual-motor, constructive process model of organizational transition, *Organization Studies*, 25, 2, 229-260
- Cunha M.P.E., and J.V. da Cunha, 2003; Organizational improvisation and change: two syntheses and a filled gap, *Journal of organizational change management*, 16, 2, p. 169-185

- Daft R.L. and R.H. Lengel, 1986, Organizational information requirements, media richness and structural design, *Management Science*, 32, 5, p. 554-571
- Daft R.L. and K.E. Weick, 1984, Toward a model of organizations as interpretation systems, *Academy of Management Review*, 9, 2, p. 284-295
- Danneels, 2002, The dynamics of product innovation and firm competence, *Strategic Management Journal*, 23, 12, p. 1095-1121
- Davenport T.H. and L. Prusak, 1998, *Working knowledge, how organizations manage what they know*, Boston, Harvard Business School Press
- Deckop J.R., C.C. Cirka and L.M. Andersson, 2003, Doing unto others: the reciprocity of helping behavior in organizations, *Journal of Business Ethics*, 47, 2, p. 101
- Demsetz H., 1991; The theory of the firm revisited, in: O.E. Williamson and S.G. Winter (eds.), *The Nature of the Firm*, Oxford University Press, New York, p. 159-178
- Denis J.L., L. Lamothe and A. Langley, 2001; The dynamics of collective leadership and strategic change in pluralistic organizations, *Academy of management Journal*, 44, 4, p. 809-837
- Denzin N.K., 1978, *The research act: a theoretical introduction to sociological methods*, New York, Mc Graw Hill
- Dierikx I. and K. Cool, 1989, Asset stock accumulation and sustainability of competitive advantage, *Management Science*, 35, p. 1504-1511
- DLO, 1998, *CCS-1-6, 1998, Management rapportage voor het Ministerie van Landbouw, Natuurbeheer en Visserij*; juni 1998

REFERENCES

- Donaldson, L., 1987, Strategy and structural adjustment to regain fit and performance: in defence of contingency theory, *Journal of Management Studies*, 24, 1, p. 1-24
- Dörnyei Z and I. Otto, 1998, Motivation in action: a process model of L2 motivation. *Working Papers in Applied Linguistics* (Thames Valley University, London) 4: 43-69
- Dosi G., 1982, Technological paradigms and technological trajectories, a suggested interpretation of the determinants and directions of technical change, *Research Policy*, 11, p. 147-162
- Dougherty D., 1992, Interpretative barriers to successful product innovation in large firms, *Organization Science*, 3, 2, p. 179-202
- Drucker P.F., 1993, *Post-capitalist society*, Oxford, Butterworth-Heinemann
- Dutton J.E., J.M. Dukerich and C.V. Harquail, 1994, Organizational images and member identification, *Administrative Science Quarterly*, 39, p. 239-263

- Eckvall G., 1988, Förnyelse och friktion, *Natur & Kultur*, Stockholm
- Eisenhardt K.M., 1989, Making fast strategic decisions in high-velocity environments, *Academy of Management Journal*, 32, 3, p. 543-576
- Eisenhardt K.M. and J.A. Martin, 2000, Dynamic capabilities: what are they?, *Strategic Management Journal*, 21, p. 1105-1121
- Ethiraj S.K., P. Kak, M.S. Krishnan and J.V. Singh, 2005, Where do capabilities come from and how do they matter? A study in the software services industry, *Strategic Management Journal*, 26, 1, p. 25-45

- Faraj S. and L. Sproul; 2000, Coordinating expertise in Software Development Teams, *Management Science*, 46, 12, p. 1554-68
- Farris G.F. and R. Cordero, 2002, Leading your scientists and engineers 2002, *Research Technology Management*, 45, 6, p. 13-25
- Feldman M.S., 2000, Organizational routines as a source of continuous change, *Organization Science*, 11, 6, p. 611-629
- Feldman M.S., 2004, Resources in emerging structures and processes of change, *Organization Science*, 15, 3, p. 295-309
- Feldman M.S. and A. Rafaeli, 2002, Organizational routines as sources of connections and understandings, *Journal of Management Studies*, 39, 3, p. 309-331
- Festinger L., 1954, A theory of social comparison processes, *Human Relations*, 7, p. 117-140
- Fiol C.M., 1994, Consensus, diversity and learning in organizations, *Organization Science*, 5, 3, p. 403-420

- Foss N.J., 1996; Knowledge-based approaches to the theory of the firm: some critical comments, *Organization Science*, 7, 5, p. 470-477
- Fosstenlokken S.M., B.R. Lowendahl and O. Revang, 2003, Knowledge development rough client interaction: a comparative study, *Organization Studies*, 24, 6, p. 859-879
- Fujimoto T., 2001, Multi-path emergence, an evolutionary framework to analyze process innovation, ECIS, conference on 'The Future of Innovation Studies'
- Fujimura J.H., 1987, Constructing 'do-able' problems in cancer research: articulating alignment, *Social Studies of Science*, 17, p. 257-293
- Fujimura J.H., 1988, The molecular bandwagon in cancer research; where social worlds meet, *Social Problems*, 35, 3, p. 261-283

- Gerson E.M., 1983, Scientific work and social worlds, *Knowledge*, 4, p. 357-377
- Giddens A., 1984, *The constitution of society*, Cambridge, Polity Press
- Glaser B.G., 1992, *Basics of grounded theory analysis*, Mill Valley, The Sociology Press
- Glaser B.G. and A.L. Strauss, 1967, *The discovery of grounded theory*, Chicago, Aldine
- Goulding C., 2002, *Grounded theory, a practical guide for management, business and market researchers*; Sage Publications, London
- Gouldner A.W., 1960, The norm of reciprocity: a preliminary statement, *American Sociological Review*, 25, p. 161-78
- Granovetter M., 1973, The strength of weak ties, *American Journal of Sociology*, 78, 6, p. 1360-80
- Grant R.M., 1996a; Prospering in dynamically-competitive environments: organizational capability as knowledge integration, *Organization Science*, 7, 4, p. 375-387
- Grant R.M., 1996b, Towards a knowledge-based theory of the firm, *Strategic Management Journal*, 17, p. 109-122

- Haas M.R. and M.T. Hansen, 2005, When using knowledge can hurt performance: the value of organizational capabilities in a management consulting company, *Strategic Management Journal*, 26, 1, p. 1-24
- Hannan M.T. and J. Freeman, 1977, The population ecology of organizations, *American Journal of Sociology*, 82, p. 929-964
- Hamel G. and A. Heene, 1994, *Competence-based competition*, New York, Wiley

REFERENCES

- Hamel G. and C.K. Prahalad, 1994, *Competing for the future*, Boston, MA, Harvard Business School Press
- Hammersley M. and P. Atkinson, 1983, *Ethnography*, London, Routledge
- Hargadon A. and R.I. Sutton, 1997, Technology brokering and innovation in a product development firm, *Administrative Science Quarterly*, 42, p. 716-749
- Helfat C.E. and R.S. Raubitschek, 2000, Product sequencing: co-evolution of knowledge, capabilities and products, *Strategic Management Journal*, 21, 10-11, p. 961-79
- Henderson R. and I. Cockburn, 1994, Measuring competence? Exploring firm effects in pharmaceutical research, *Strategic Management Journal*, 15, p. 63-84
- Henderson R. and I. Stern, 2004, Selection based learning: the co-evolution of internal and external selection in high-velocity environments, *Administrative Science Quarterly*, 49, p. 39-75
- Hoegl M., K. Weinkauff and H.G. Gemuenden, 2004, Interteam coordination, project commitment, and teamwork in multiteam R&D projects: a longitudinal study, *Organization Science*, 15, 1, p. 38-55
- Hogg M.A. and D. Abrams, 1993, Towards a single-process uncertainty-reduction model of social motivation in groups, In: M.A. Hogg & D. Abrams (Eds.), *Group motivation: social psychological perspectives*, London, Harvester Wheatsheaf, p. 172-190
- Howard-Grenville J.A., 2005, The persistence of flexible organizational routines: the role of agency and organizational context, *Organization Science*, 16, 6, p. 618-636
- Hoyningen-Huene P., 1993, *Reconstructing Scientific Revolutions, Thomas S. Kuhn's philosophy of Science*, Chicago, The university of Chicago Press
- Huang J.C. and S. Newell, 2003, Knowledge integration processes and dynamics within the context of cross-functional projects, *International Journal of Project Management*, 21, p. 167-176
- Huber G.P., 1991, Organizational learning: the contributing processes and literatures, *Organization Science*, 2, p. 88-115
- Hutchins E., 1991, Organizing work by adaptation, *Organization Science*, 2, 1, p. 368-404
- Hutchins E. and T. Klausen; 1996, Distributed cognition in an airline cockpit, in: *Cognition and communication at work*, Y. Engeström and D. Middleton (eds), Cambridge, Cambridge University Press, p. 15-33
- Hutjes J.M. and J.A.van Buuren, 1996, *De gevalsstudie, strategie van kwalitatief onderzoek*, Meppel, Boom

- Inkpen A.C. and A. Dinur, 1998, Knowledge management processes and international joint ventures, *Organization Science*, 9, 4, p. 454-468
- IBN, 1991, Jaarverslag 1990
- IBN, 1998, Jaarverslag 1997

- James W.M., 2002, Best HR practices for today's innovation management, *International Journal of Project Management*, 22, p. 369-375

- Karnoe P., 1996, The social process of competence building, *International Journal of Technology Management*, 11, 7/8, p. 770-789
- Kavadias S. and C.H. Loch, 2004, *Project selection under uncertainty; dynamically allocating resources to maximize value*, Dordrecht, Kluwer Academic Publishers
- Ketokivi M. and X. Castañer, 2004, Strategic planning as an integrative device, *Administrative Science Quarterly*, 49, p. 337-365
- King N., 1994, The Qualitative Research Interview, in: *Qualitative methods in organizational research, a practical guide*, C. Cassell and G. Symon (eds.), Sage Publications, London, p. 14-36
- Kogut B. and U. Zander, 1992, Knowledge of the firm, combinative capabilities, and the replication of technology, *Organization Science*, 3, 3, p. 383-397
- Kogut B. and U. Zander, 1996, What firms do? Coordination, identity, and learning, *Organization Science*, 7, 5, p. 502-518
- Krijnen H.G., 1986, *Strategie en management*, Groningen, Wolters-Noordhoff

- Langley A., 1999, Strategies for theorizing from process data, *Academy of Management Review*, 24, 4, p. 691-710
- Lawrence T.B., 1995, Power and resources in an organizational community, *Academy of Management Journal*, p. 251-255
- Leana, C.R. and H.J. van Buren III, 1999, Organizational social capital and employment practices, *Academy of Management Review*, 24, 3, p. 538-555
- Lee G.K. and R.E. Cole, 2003; From a firm-based to a community-based model of knowledge creation: the case of the Linux kernel development, *Organization Science*, 14, 6, p. 633-649
- Leonard-Barton D., 1995, *Wellsprings of knowledge, building and sustaining the sources of innovation*, Boston, Harvard Business School Press

REFERENCES

- Levitt, B. and J.G. March, 1988, Organizational learning, *Annual Review of Sociology*, 14, p. 319-340
- Lewis K., D. Lange, and L. Gillis, 2005, Transactive memory systems, learning, and learning transfer, *Organization Science*, 16, 6, p. 581-598
- Lippman S.A. and R.P. Rumelt, 1982, Uncertain Imitability: An Analysis of Interfirm Differences in Efficiency under Competition, *Bell Journal of Economics*, 13, p. 418-438
- Luhmann N., 1984, *Soziale Systemen, Grundriss einer allgemeinen Theorie*, Frankfurt am Main: Suhrkamp
- Madhavan R., B.R. Koka and J.E. Prescott, 1998, Networks in Transition: how industry events (re)shape interfirm relationships, *Strategic Management Journal*, 19, p. 439-459
- Mahoney J.T. and J.R. Pandian, 1992, The resource-based view within the conversation of strategic management, *Strategic Management Journal*, 13, 5, p. 363-380
- Marcus A. and D. Geffen, 1998, The dialectics of competency acquisition: pollution prevention in electric generation, *Strategic Management Journal*, 19, 12, p. 1145-1168
- Martino J.P, 1995, *Research and development project selection*, New York, Wiley & Sons Inc.
- Matthijssens P. and P. Pauwels, 2000, Uncovering international market-exit processes: a comparative case study, *Psychology and Marketing*, 17, 8, p. 697-719
- Maturana H.R. and F.J. Varela, 1984, *Autopoiesis and cognition, the realization of the living*, Dordrecht, D. Reidel Publishing Company
- Matusik S.F. and C.W.L. Hill, 1998, The utilization of contingent work, knowledge creation and competitive advantage, *Academy of Management Review*, 23, 4, p. 680-697
- Maylor H., 2003, *Project Management*, 3th edition, Pearson Education Limited
- McEvily B. and A. Marcus, 2005, Embedded ties and the acquisition of competitive capabilities, *Strategic Management Journal*, 26, p. 1033-1055
- McGrath J.E., 1984, *Groups: Interaction and performance*, Englewood Cliffs, NJ: Prentice-Hall
- McGrath R.G., I.C. MacMillan and S. Venkataraman, 1995, Defining and developing competence – a strategic process paradigm, *Strategic Management Journal*, 16, 4, p. 251-275

- McKinnon P.D., 1987, Steady-state people: a third career orientation, *Research Management*, 1, p. 26-29
- Miles M.B. and A.M. Huberman, 1984, *Qualitative data analysis*, London, Sage
- Miller D., 1988, Challenges in leading professionals, *Research Technology Management*
- Ministerie van Landbouw, Natuurbeheer en Visserij, 1987, Ontwikkelingsplan Landbouwkundig Onderzoek
- Ministerie van Landbouw, Natuurbeheer en Visserij, 1990, Natuurbeleidsplan
- Ministerie van Landbouw, Natuurbeheer en Visserij, 1990, Structuurnota Landbouw
- Ministerie van Landbouw, Natuurbeheer en Visserij, 1997, Natuur voor mensen, mensen voor natuur
- Ministerie van Landbouw, Natuurbeheer en Visserij, 1999, Kracht en kwaliteit
- Ministerie van Landbouw, Natuurbeheer en Visserij, 2000, Voedsel en Groen
- Mintzberg H., 1983; *Structures in Fives, Designing effective organizations*, Prentice-Hall Inc., Engelwood Cliffs
- Mohr L.B., 1982, *Explaining organizational behavior*, San Francisco, Jossey-Bass
- Moreland R.L., 1999, Transactive memory: learning who knows what in work groups and organizations, in: *Shared Cognition in Organizations, the management of knowledge*, ed. Thompson, Levine & Messick, p. 3-31
- Mosakowski E., 1993, A resource-based perspective on the dynamic strategy-performance relationship: an empirical examination of the focus and differentiation strategies in entrepreneurial firms, *Journal of Management*, 19, 4, p. 819-840
- Mosakowski E., 1998, Entrepreneurial resources, organizational choices and competitive outcomes, *Organization Science*, 9, 6, p. 625-643
- Nahapiet J. and S. Ghoshal, 1998, Social capital, intellectual capital and the organizational advantage, *Academy of Management Review*, 23, 2, p. 242-66
- Nelson R.R. and S.G. Winter, 1982, *An evolutionary theory of economic change*; Cambridge, MA, Harvard University Press
- Nerkar D. and P.W. Roberts, 2004, Technological and product-market experience and the success of new product introductions in the pharmaceutical industry, *Strategic Management Journal*, 25, special issue, p. 779-799
- Nickerson J.A. and T.R. Zenger, 2004, A knowledge-based theory of the firm: the problem-solving perspective, *Organization Science*, 15, 6, p. 617-632
- Nobelius D., 2004, Towards the sixth generation of R&D management, *International Journal of Project Management*, 22, p. 369-375

REFERENCES

- Ockhuysen G.A. and K.M.Eisenhardt, 2002, Integrating knowledge in groups: how formal interventions enable flexibility, *Organization Science*, 13, 4, p. 370-386
- Orlikowski W., 1996, Improving organizational transformation over time: a situated change perspective, *Information Systems Res.*, 7, p. 63-92
- Orlikowski W., 2002, Knowing in practice: enacting a collective capability in distributed organizing, *Organization Science*, 13, 3, p. 249-273
- Orr, J., 1990, Sharing knowledge, celebrating identity: war stories and community memory in a service culture, in D.S. Middleton and D. Edwards (eds.), *Collective remembering*, Beverly Hills, Sage Publications
- Owen, W.F. 1985, *The Psychology of Social Influence*, Cambridge: Cambridge University Press
- Pascale R.T., 1985, The paradox of 'corporate culture': reconciling ourselves to socialization, *California Management Review*, 27, p. 26-41
- Pauwels P. and P. Matthijssens, 1999; A strategy process perspective on expert withdrawal, *Journal of International Marketing*, 7, 3, p. 10-37
- Pearson G.J., 1979, Setting corporate objectives as a basis for action, *Long Range Planning*, 12, 4
- Penrose E.T., 1959, *The theory of the growth of the firm*, New York, Wiley
- Pentland B.T. and H.H. Reuter, 1994, Organizational routines as grammars of action, *Administration Science Quarterly*, 39, p. 484-510
- Pentland B.T., 1999, Building process theory with narrative: from description to explanation, *Academy of Management Review*, 24, 4, p. 711-724
- Peteraf M.A., 1993, The cornerstones of competitive advantage: a resource-based view, *Strategic management Journal*, 14, p. 179-191
- Pettigrew A.M. and E.M. Fanton, 2000 ; *The innovating organization*, Sage, London
- Pettigrew A.M., R.W. Woodman. and K.S. Cameron, 2001, Studying organizational change and development: challenges for future research, *Academy of Management Journal*, 44, 4, p. 697-713
- Podolny J.M. and J.N. Baron, 1997, Resources and relationships: social networks and mobility in the workplace, *American Sociological Review*, 62, 5, p. 673-693
- Polley D., 1997, Turbulence in organizations: new metaphors for organizational research, *Organization Science*, 8, 5, p. 445-457

- Poole M.S., A.H. van de Ven, K. Dooley, M.E. Holmes, 2000, *Organizational change and innovation processes, theory and methods for research*, Oxford, Oxford University Press
- Porter M.E., 1990, *The competitive advantage of nations*, The Macmillan Press LD, London
- Portes A., 1998, Social Capital: its origins and applications in modern society, *Annual Review of Sociology*, 24, p. 1-124
- Project Group Detachment DLO, 1992, *Report on the detachment of DLO*
- Putnam R.D., 1993, *Making democracy work: civic traditions in modern Italy*, Princeton, NJ: Princeton University Press

- Quinn, J.B., 1992, *Intelligent Enterprise, a knowledge and service based paradigm for industry*; New York, The Free Press

- Riegel K.F., 1975, From traits and equilibrium toward developmental dialectics, in J. Cole and W.S. Arnold (Eds.), *Nebraska Symposium on Motivation 1975*, p. 349-408, Lincoln, NE: University of Nebraska Press
- Riegel K.F., 1976, The dialectics of human development, *American Psychologist*, 30, 10, p. 689-700
- RIN, 1998, Jaarverslag 1987
- RIVM, DLO, IKC-Natuurbeheer, 1997, *Natuurverkenning 1997*
- RIVM, DLO, 1998, *Natuurbalans 98*
- Roberts E.B., 1988, Managing Invention and Innovation, *Research Technology Management*, 31, 1, p. 11-29
- Robey D., J.W. Ross and M.C. Boudreau, 2002, Learning to implement enterprise systems: an exploratory study of the dialectics of change, *Journal of Management of Information Systems*, 19, 1, p. 17-46
- Rothman K.J. and S. Greenland, 1998, *Modern Epidemiology*, Philadelphia, Lippincott-Raven publishers
- Roussel PA., K.N. Saad and T.J. Erickson, 1991, *Third Generation R&D. Managing the link to corporate strategy*, Boston, Harvard Business School Press
- Rubin P.H., 1973, The Expansion of Firms, *Journal of Political Economy*, 81, p. 936-949
- Rumelt R.P., 1991, How much does Industry matter?, *Strategic Management Journal*, 12, p. 167-185

REFERENCES

- Rush, H., M. Hobday, J. Bessant and E. Arnold, 1995, Strategies for best practice in research and technology institutes: an overview of a benchmarking exercise, *R&D Management*, 25, 1, p. 17-31
- Sabherwal, R., R. Hirschheim and T. Goles, 2001, The dynamics of alignment: insights from a punctuated equilibrium model, *Organization Science*, 12, 2, p. 179-197
- Sabherwal R. and M. Newman, 2003, Persistence and change in system development, a dialectical view, *Journal of Information Technology*, 18, 2, p. 69-92
- Sadler P. and K. Milmer, 1993, *The talent-intensive organization*, London, The Economist
- Salancik G.R., 1995, Wanted: a good network theory or organizations, *Administrative Science Quarterly*, 40, 2, p. 343-349
- Schein E.H., 1996, Three cultures of management: the key to organizational learning, *Sloan Management review*, 38, 1, p. 9-20
- Shapero, 1985, *Managing professional people: understanding creative performance*, New York, The Free Press
- Sminia H., 2003, The failure of the Sport7 TV-channel: controversies in a business network, *Journal of Management Studies*, 40, 7, p. 1621-1649
- Solla Price D.J. de, 1963, *Little science, big science*, New York, Columbia University Press
- Spender J.C., 1996, Making knowledge the basis of a dynamic theory of the firm, *Strategic Management Journal*, 17, p. 45-62
- Spender J.C. and R.M. Grant, 1996, Knowledge and the firm: overview, *Strategic Management Journal*, 17, Winter Special Issue, p. 5-9
- Spradley J.P., 1980, *Participant Observation*, New York, Holt, Rinehart and Winston
- Stangor C., 2004, *Social groups in action and interaction*, New York, Psychology Press
- Steyn H., G. Basson, M. Carruthers, Y. du Plessis, D. Kruger, B. Prozesky-Kuschke, S. van Eck, and K. Visser, 2003, *Project management, a multi-disciplinary approach*, Pretoria, FPM Publishing
- Strauss A. and J. Corbin, 1990, *Basics of qualitative research*, Newbury Park, Sage Publications
- Strauss A. and J. Corbin, 1994, Grounded Theory Methodology: an overview, in: *Handbook of Qualitative Research*, N.K. Denzin & Y.S. Lincoln (eds), Sage Publications, Thousand Oaks, p. 273-285

- Sturdy A., 2004; The adoption of management ideas and practices – theoretical perspectives and possibilities, *Management Learning*, 35, 2, p. 155-179
- Suitor, J.J., B. Wellman and D.L. Morgan, 1997, It's about time: how, why, and when networks change, *Social Networks*, 19, p. 1-7
- Swanborn P.G., 1987, *Methoden van sociaal-wetenschappelijk onderzoek*, Meppel, Boom
- Swanborn P.G., 1996, A common base for quality control criteria in quantitative and qualitative research, *Quality & Quantity*, 30, p. 19-35
- Tajfel H., 1957, Value and the perceptual judgement of magnitude, *Psychological Review*, 64, p. 192-204
- Tajfel H., 1959, Quantitative judgement in social perception, *Britisch Journal of Psychology*, 50, p. 16-29
- Tajfel H. and J.C. Turner, 1979, An integrative theory of intergroup conflict, In: W.G. Austin and S. Worchel (eds.), *The Social Psychology of Intergroup Relations*, Monterey: Brooks-Cole, p. 33-47
- Teece D.J., 1982, Towards an Economic Theory of the Multiproduct Firm, *Journal of Economic Behavior and Organization*, 3, p. 39-63
- Teece D.J., R. Rumelt , G. Dosi, and S. Winter, 1994, Understanding Corporate Coherence, Theory and Evidence, *Journal of Economic Behavior and Organization*, 23, p. 1-30
- Teece D.J., G. Pisano, and A. Shuen, 1997, Dynamic capabilities and strategic management, *Strategic Management Journal*, Winter Special Issue, 17, p. 27-43
- Teece D.J. and G. Pisano, 1998, The Dynamic Capabilities of Firms: an Introduction, in: *Economic Performance and the Theory of the Firm*, Edward Elgar Publishing, Cheltenham, p. 56-75
- Terrion J.L. and B.E. Ashforth, 2002, From 'I' to 'we': the role of putdown humor and identity in the development of a temporary group, *Human Relations*, 55, 1, p. 55-88
- Tsoukas H., 1996, The firm as a distributed knowledge system: a constructivist approach, *Strategic Management Journal*, 17, p. 11-25
- Tsoukas H. and R. Chia, 2002, On organizational becoming: rethinking organizational change, *Organization Science*, 13, 5, p. 567-582
- Tuininga E.J., 1990, Social management in professional organizations: searching for new impulses, *R&D Management*, 20, 2, p. 139-153

REFERENCES

- Turner J.C., 1982, Towards a cognitive redefinition of the social group, in: H. Tajfel (ed.), *Social Identity and Intergroup Relations*, Cambridge, Cambridge University Press, p. 15-40
- Turner J.C., 1991, *Social Influence*, Milton Keynes: Open University Press
- Tushman M.L., 1978, Technical communication in R&D laboratories: the impact of project work characteristics, *Academy of Management Journal*, 21, 4, p. 624-645
- Tyre M.J. and W.J. Orlikowski, 1994, Windows of opportunity: temporal patterns of technological adaptation in organizations, *Organization Science*, 5, 1, p. 98-118

- Van de Ven A.H. and M.S. Poole, 1995, Explaining development and change in organizations, *Academy of Management Review*, 20, p. 510-540
- Van den Bosch F.A.J., H.W. Volberda and M. de Boer, 1999; Co-evolution of firm absorptive capacity and knowledge environment: organizational forms and combinative capabilities, *Organization Science*, 10, 5, p. 551-568
- Von Krogh, G., M. Lyles, V. Mahnke, and B. Rogulic, 1999, Preparing the organization for new competencies: a process perspective of integrating knowledge and competence, in: *Advances in managerial cognition and organizational information processing*, Stamford, JAI Press Inc, p. 57-78

- Wageningen UR, 1998, *Strategic Vision Wageningen UR*
- Weggeman M.C.D.P., 1995, *Collectieve ambitie ontwikkeling*, Tilburg, Tilburg University Press
- Weggeman M.C.D.P., 1997, *Kennismanagement, inrichting en besturing van kennisintensieve organisaties*, Schiedam, Scriptum Management
- Weggeman M., 2000, *Kennismanagement: de praktijk*, Schiedam, Scriptum Management
- Weick K.E., 1979, *The social psychology of organizing*, Reading, MA: Addison-Wesley
- Weick K.E., 1987, Substitutes for corporate strategy, in: David Teece (ed.), *The competitive challenge*, Cambridge Mass.: Ballinger, p. 22-33
- Weick K.E. and K.H. Roberts, 1993, Collective mind in organizations: heedful interrelating on flight decks, *Administrative Science Quarterly*, 3, p. 357-81
- Weick K.E. and R.E. Quinn, 1999, Organizational change and development, *Annual Rev. Psychology*, 50, p. 361-386
- Wenger E., 1998, *Communities of Practice, learning, meaning and identity*, Cambridge, Cambridge University Press

- Wernerfelt B., 1984, A resource-based view of the firm, *Strategic Management Journal*, 5, p. 171-180
- White D. and J. Fortune, 2002, Current practice in project management – an empirical study, *International Journal of Project Management*, 20, p. 1-11
- Wilke H.A.M., 1980, Informatieverwerking en sociale vergelijking, in: J.B. Rijsman en H.A.M. Wilke (eds.), *Sociale vergelijkingsprocessen, theorie en onderzoek*, Deventer, Van Loghum Slaterus
- Willem A. and H. Scarbrough, 2002; *Structural effects on inter-unit knowledge sharing: The role of coordination under different knowledge sharing needs*, Paper submitted to the Third European Conference on Knowledge, Learning and Capabilities
- Yahata S., 1995, The organization and management of corporate research and development, In: Shapira P. (ed.), *The R&D Workers, managing innovation in Britain, Germany, Japan, and the United States*, Westport Connecticut, Quorum Books
- Yin R.K., 1984, *Case Study Research, design and methods*, Beverly Hills, Sage
- Zajonc R.B., 1966, *Social Psychology: an experimental approach*, Boorcks/Cole, Belmont California
- Zárraga C. and J. Bonache, 2005, The impact of team atmosphere on knowledge outcomes in self-managed teams, *Organization Studies*, 26, 5, p. 661-681
- Ziman J., 2000, *Real science what it is, and what it means*, Cambridge, Cambridge University Press
- Zollo M. and S.G. Winter, 2002, Deliberate learning and the evolution of dynamic capabilities, *Organization Science*, 13, 3, p. 339-351

Appendices

Appendix 1 The results of the application of the tests proposed by Poole et al.

In this appendix we discuss the results of the application of the tests proposed by Poole et al. (2000) on our data. In Table One we have addressed the answers the application of the tests should provide according to Poole et al. In Table Two we present our answers to the tests, based on our findings in the field studies. In addition we discuss why we decided for a number of answers we present in Table Two.

Table 1: Pattern of answers to the six tests according to Poole et al.

Test	Life Cycle	Teleological	Evolutionary	Dialectical
A	Yes	No	Possible	Possible
B	Yes	No	Yes	No
C	Possible as one stage	Yes	Possible in units	Possible in units
D	Individual	Individual	Set	Set
E	No	No	Yes	Possible
F	Possible as one stage	No	Yes	Yes

A = does the process exhibit an unitary sequence of stages which is the same across cases?

B = is there a patterning device?

C = is there a goal setting process?

D = is (are) the central subject(s) an individual entity or a set of interacting entities?

E = are individual cases to some extent unpredictable?

F = do conflict or contradictions influence the development or change process?

Table 2: Our pattern of answers to the six tests

Test	Repeated Project Life Cycle Process	Teleological Process of Envisioning the Future	(Co-)Evolutionary Process of Expertise Development	Dialectical Process of Balancing Tensions
A	Yes	No (1)	No (2)	No (3)
B	Yes	No (4)	Yes (5)	No (6)
C	In the first stage	Yes	No	No
D	Individual	Individual (7)	Set	Set (8)
E	No	No	Yes	Yes and no (9)
F	No	No (10)	Yes	Yes

(1) the question here is how the groups proceed towards their envisioned end state. Is there a pattern in the way they proceed, do they take step A as a first step, step B as a second and so on; is that how they accomplish their envisioned goals? What we have found is that there are some patterns in the groups, like developing a close interaction with stakeholders and eventually “persuading” stakeholders (co-evolutionary development of expertise, Chapter Six), positioning research themes (Chapter Six), enacting stakeholders (Chapter Six), adapting the structure to support the strategy (Chapter Seven) and the selection of new group members from a pool of members working on a temporary basis (Chapter Seven). The order seems to be (i) temptation, (ii) positioning of themes, (iii) selection of group members and (iv) changing structure. But this is not a prescribed order (Chapter Eight).

(2) what we have found in the development of a new theme in research is that this theme develops gradually in time (Chapter Six). Themes start small (one project) and develop in time towards larger clusters (or they decline). If they develop (in size) they become more dominant and start to affect neighboring themes. The Ecology Group does develop models in several themes of research. In the Postharvest Group genomics techniques are widely applied. We have not found a regular pattern in the development of themes however (Chapter Six).

(3) we were not able to provide a definitive answer to this question; in the dilemmas we found we have not distinguished an unitary sequence of stages.

(4) the procedures for the review of the scientific quality of the work (once every five years, Appendix four) and the approval of the Minister with the Strategic Plan of Wageningen UR could be addressed as patterning devices. They affect the activities and goals of the groups (scientific output, publications). But although they affect goals and activities they do not prescribe the nature of the change sequence.

(5) yes, because we were able to address the selection criteria that work on the process of expertise development (Table 6.3).

(6) no, we have not found such a characteristic (Chapter Five).

(7) what we address is the group as a whole. The group strives for survival. This is coherent with the definition of a teleological process in which Poole et al. assume that the individuals that form the group are sufficiently like-minded to act as a single collective entity. To survive, the groups envision a future in which they explicate where they stand for

and what they need to survive (with regard to market oriented activities, scientific performance, equipment, etcetera).

(8) the set are interacting entities, being the dilemmas experienced by researchers (Chapter Five).

(9) yes, in the sense that each case is influenced by factors or dynamics that are difficult to measure or access, such as private preference distributions and the situation at hand. This answer refers to one unique situation of one individual at one moment in time, in one activity where this individual balances a tension. No, in the sense that “While individuals may be difficult to explain or predict, the behavior of a population of individuals may exhibit more regularity and allows the construction of theories of the population” (Poole et al., p. 97). This answer refers to the pattern, multiple situations, multiple persons and multiple moments in time. As we discuss in Chapter Five, the dialectical process takes place against a background of established practices of heedful interrelating and content over management.

(10) the model assumes according to Poole et al. that the consensus which underpins concerted actions can be achieved; conflict is either nonexistent or short-lived in a process governed by the teleological model. That is also what we found in the field studies, due the interactive and participative process used in the development of plans (Chapter Seven).

Appendix 2: Retention in the development trajectory of expertise in the field studies

In this appendix we will present a number of instances of retention in the development trajectory of expertise in the groups in the field studies. We will argue that these instances make clear that the maturity of the expertise in the groups deepens and that we found new applications of this expertise.

The concept of retention is defined by Burgelman (1991) as the identification of distinctive competences, an action domain, ex-post embedded in the vision on the field in which the organization operates. This “sense” of competence guides the strategic process, building a future on the factors that explain past success.

In Table A we have linked the instances presented in the tables 6.1 and 6.2 and the key-words that describe the field of expertise in the groups (Chapter Three). Therefore this table does present a number of distinctive competences the groups have developed in time.

Table A		
Key-words and instances of retention		
Group	Key words	Instances
Ecology Group	Spatial and environmental conditions	C21
	Valuable species	C14, C17, C33
	Predict effects, evaluate policies, explore future developments	C25, C37
	Cutting up	C11
	Connection of ecological niches	C11, C37
C28, C37	Connectivity	C11, C37
	Models	C8, C13, C20, C25-1,
	NEMI	C16, C26, C37
Post harvest Group	Physiological processes	C56, C60
	Fruits, ornamentals, vegetables, potatoes	C53, C59, C63
	Storage systems	C57, C60
	Storage technology and environmental factors	C60
	Measurement and prediction of quality	C57, C60, C62

Retention also implies that the developed knowledge is applied in a wide range of applications. We found that the expertise of the groups is applied in a number of products (table B). And not only for one object, but for a number of different objects (table B).

Table B Products and objects		
Group	Products	Objects
Ecology Group	Models	NEMI Green/blue veins in culture landscape Green/blue veins in urban areas Species (animals) Species (plants) Regions (< and > Netherlands)
	Scenarios	
	Evaluations	
	Indicators	
	Norms	
	Process descriptions	
	Analyses	
	Guidelines	
Conditions		
Post harvest Group	Methods for storage and transport	Cut flowers (many crops) Potted plants (ibid) Bulbs (ibid) Vegetables (ibid) Fruit (especially apples / pears) Potatoes (Onions, mushrooms)
	Descriptions of biological processes	
	Post harvest treatments	
	Measurement methods of product quality	
	Climate control in storage facilities related to biological processes	
	Models for decline of quality in the chain	
<i>Sources:</i>	Research program 383 "Natural biodiversity and management of species", 2001-2004; Report of the strategic conference of April 1999; Strategic Plan Ecology group 1996-1999; Strategic Plan Ecology Group 2000-2003; Year Plan Post harvest Group 2001, Research program 391 "Safe and healthy food from a transparent production process", 2001-2004; Research program 289 "Post harvest physiology and product quality", 1996-2000.	

Retention also implies that the groups have developed a competence in time. According to the groups, they have (statements in tables 3.1 up to 3.6). We also analyzed strategic plans (especially of the Ecology Group) and by finding a shift in "strong" and "weak" points between plans in different periods we assume that competence development has taken place. An example is the development of GIS-expertise. This is brought forward as a weak point in the strategic plan of the Ecology Group of 1996-1999 (page 7). In the plan for the period 2000-2003 it is evaluated as strong (p. 6): "...integration of empirical knowledge, spatial models and GIS-applications". Finally we have studied reports of (international) evaluation committees. They have evaluated the scientific quality of the research of the

groups (but taking the mission of the groups into account) and their remarks also illustrate competence development (table C).

Table C	Remarks from the report of (international) evaluation committees
Ecology Group	
1995:	“The committee was impressed with the work of this small group. It has become Internationally well-known, is clearly a leader in this aspect in the field of landscape ecology in Europe, and has demonstrated high quality scientific work” (p. 6, Report of the visiting committee IBN-DLO, evaluation of the research of IBN-DLO, January 1995)
2002:	“The department produces scientific papers at a regular basis and these papers are frequently published in high ranking scientific journals, indicating the quality of the science in the department. In the field of landscape ecology the department has a prominent position both nationally and internationally” (p. 39, Review Report Alterra, Institute for Green World Research, 2002).
Postharvest Group	
1997:	“In the field of physiological research the group has a prominent position (storage systems, measurements);The project to apply biotechnology in order to gain progress in objectifying quality is challenging and interesting... There is a large number of publications” (p. 12, report of the review committee of ATO, 1997).

Appendix 3: A number of elements from the subsidiary conditions

Source: Staatscourant 6th of april, 1999: Regeling subsidie Stichting Dienst Landbouwkundig Onderzoek, p. 9-10

Article 5:

1. The Minister decides about [the size and content of] the research programs executed by DLO at the utmost of the 15th of December of the year before the subsidiary year (and the year of execution of the programs, FB)
2. As part of his decision the Minister can set up a board that accompanies the execution of of a program.
3.

Article 10:

DLO is obliged to have:

- a) a valid strategic plan which is approved by the Minister
- b) ...

Article 17:

1. DLO has the scientific quality of its research (or parts of this research) examined by a commission of external experts in a way that guarantees that at least once every four years all research areas on which DLO works have been subjected to this examination
2. The assignment as well as the composition of this commission requires approval of the Minister
3. DLO reports the findings of the committee to the Minister (confidentially)

Article 18:

1. The Minister evaluates the design, execution and results of research programs in the fourth year of their execution.
2.

Appendix 4: Results of the studies of Ancona & Caldwell

Ancona & Caldwell (1988, 1990, 1992) have studied patterns of external communication teams engage in to manage their organizational environment beyond their teams. The studies were performed in teams in high-technology companies working on the development of new products. They have found that not just the amount, but the type of external communication determines performance. Over time, teams follow a specific kind of strategy responsible for their performance and long-term team success. Ancona & Caldwell have developed a taxonomy of 15 distinct activities in these studies, including mapping, gathering information and resources, scanning, feedback seeking, opening up communication channels, informing, coordinating, negotiating, molding, allowing entry, translating, filtering, classifying, delivering, and protecting (Ancona & Caldwell, 1988).

In addition these distinct activities were clustered into larger categories of related activities to create a typology of external initiatives. This resulted into 5 categories (Table 1).

Boundary activity	Definition
Ambassador activities (1988, 1990, 1992)	Members taking on this set of activities protect the team from outside pressure, persuade others to support the team, and lobby for resources. These activities include both protective and persuasive goals. These activities include opening up communication channels; informing; coordinating and negotiating (especially independent schedules) and molding (influencing the external environment to suit the agenda of the group).
Task coordinator activities (1990, 1992)	Interactions aimed at coordinating technical or design issues. This includes discussing design problems with others, obtaining feedback on the product design and coordinating and negotiating with outsiders. These activities define lateral communication in particular
Scout activities (1988, 1990, 1992)	General scanning for ideas and information about the competition, the market, or the technology. These activities include (many aspects of) mapping the environment (or modeling the environment); information gathering (focused search, directed at decision making); scanning activities (unfocused search) and feedback seeking on progress, products, team members, functioning of the team
Guard activities (1988, 1990, 1992)	Activities to avoid releasing information from to group to the environment. They include classifying, delivering and protecting.
Sentry activities (1988)	Activities that focus on policing the boundary by controlling the information and resources that external agents want to send into the group, avoiding distraction of the work. Key sentry activities are allowing entry, translating and filtering (external information)

Table 1: Five categories of boundary activities

APPENDICES

Ancona and Caldwell (1988, 1990) have found a number of strategies (patterns) in which effective groups differ from non-effective groups. In their 1988 paper they state that greater levels of “ambassador”, “task” and “scout” activity (compared to “sentry” and “guard” activities) were seen in organizations whose strategies stressed close alignment with customers. In their 1992 paper they discuss their findings that teams with high levels of “ambassador” and “task” activities, and a low level of “scout” activities have a higher performance, not only in the short run but also over time. This pattern or strategy is defined as a “comprehensive strategy”.

The results of a comparison between the boundary activities of Ancona & Caldwell and the *activities* found in the project life cycle are presented in Table 2.

Boundary activity	Activity in the project life cycle
Ambassador activities (1988, 1990, 1992)	<ul style="list-style-type: none"> • Specifying the request of the client in interaction with the client (opening up communication channels, molding, negotiating) • Translating the request of the client into the expertise needed (informing, negotiating, molding) • Transferring the results to the client (especially informing) • Project management (especially informing)
Task coordinator activities (1990, 1992)	<ul style="list-style-type: none"> • Translating the request of the client into the expertise needed (discussing project design issues) • Transferring the results to the client (besides transfer it includes obtaining feedback on the results) • Post project work for the client (related to feedback of the client)
Scout activities (1988, 1990, 1992)	<ul style="list-style-type: none"> • Searching for and committing colleagues with the expertise needed (especially outside the group)
Guard activities (1988, 1990, 1992)	<ul style="list-style-type: none"> • Transferring the results to the client (especially with regard to transfer of results to other interested stakeholders than the client)
Sentry activities (1988)	<ul style="list-style-type: none"> • Transferring the results to the client (especially with regard to transfer of results during the execution of the project)

Table 2: Results of a comparison of the activities found in the field studies with the boundary activities found by Ancona & Caldwell

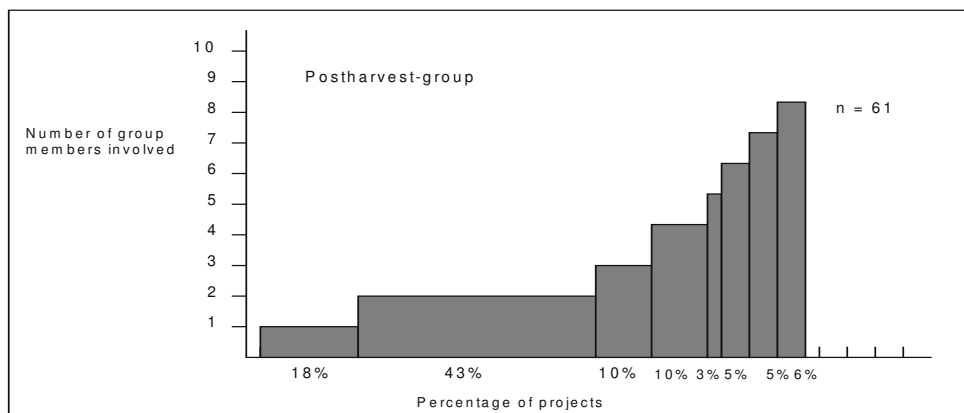
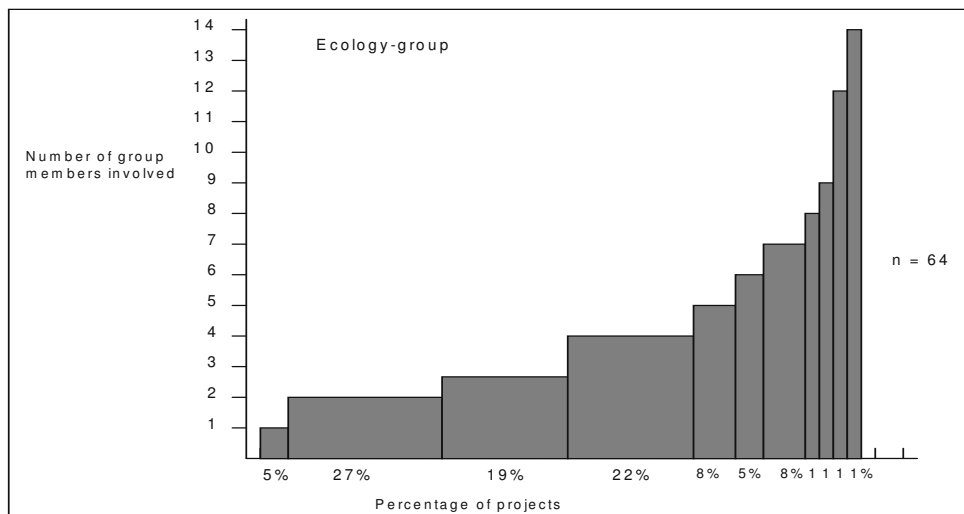
The results of a comparison between the boundary activities of Ancona & Caldwell and the *social rules* found in the field studies are presented in Table 3.

THE EMERGENCE OF A COMPETITIVE GROUP COMPETENCE IN A RESEARCH GROUP

Boundary activity	Social rule found in the field studies
Ambassador activities (1988, 1990, 1992)	<ul style="list-style-type: none"> • Provide a satisfied client • Respect the client • Involve the client in making a project proposal
Task coordinator activities (1990, 1992)	<ul style="list-style-type: none"> • Respect the client • Involve the client in making a project proposal • Involve the colleagues you need in your research project (especially researchers outside the group)
Scout activities (1988, 1990, 1992)	<ul style="list-style-type: none"> • Provide a satisfied client • Involve the colleagues you need in your research project (especially researchers outside the group)
Guard activities (1988, 1990, 1992)	
Sentry activities (1988)	

Table 3: Results of a comparison between boundary activities of Ancona & Caldwell and the social rules found in the field studies

Appendix 5: Project portfolio of the Ecology and Postharvest Group



Figures 1 and 2 : Distribution of the project portfolio with the number of researchers involved.
 Figure 1: Ecology Group. Figure 2: Postharvest Group

Note to Figure 2: Due to the available data, the percentage of projects executed by two researchers seems quite large in the Postharvest Group. These data are based on the registration of time spent on projects in the first quarter of 2001. However, there can be more researchers involved than the number mentioned in Figure 2. It is possible that they have not worked on these projects in the first quarter of 2001. In that case, their involvement is not in our data. The projects that are executed by one researcher are projects that are executed 'solo'. Often these projects are focused on consulting. Of course colleagues can get involved (ad hoc) and their knowledge will be applied. But this research time was not registered on behalf of these projects.

Appendix 6 Contacts of group members in projects and in management meetings (Ecology Group)

On the next pages we present an analysis of the contacts of group members in projects and in management meetings in the Ecology Group. Because of the size of the table in which we present this analysis, we have split the table up in six sections. Alongside the table (first row, first column) the members of the Ecology Group are coded with a unique number from 1 up to 51. In the cells of the table the results of the analysis are provided. The six parts of the table are presented in the following way:

1	2.2	2.3	4.0	4.1	5.1
35	p . 311		p . 312		p . 313
36	p . 314		p . 314		p . 315
51					

Legend

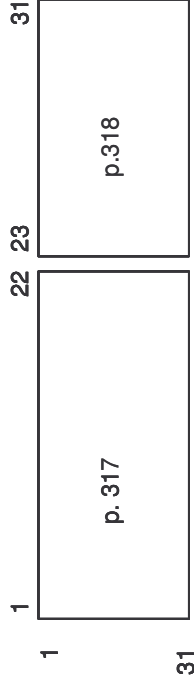
- 1 / 2 / 3 / 4 = number of projects in which a project leader (row) has contact with other group member (column) that participates in that project
(number) A = number of projects in which a member of a project team (row) has contact with another group member that participates in the same project
C or C = group member (row) meeting another group member (column) in a specialist team regarding the theme of 'connectivity'
M = group member (row) with managerial responsibilities meeting another group member (column) in a management team meeting
P = has (also) a role as a project leader
½ = indicating one or more projects in which a project member (row) has contact with another group member (column) who acts as project leader in one of more projects in which he/she participates. Is the inverse of 1 / 2 / 3 / 4
Each group member is coded with a unique number alongside the table (first row and first column)

	23	24	25*	26	27	28*	29	30	31	32*	33*	34	35	36	37	38	39	40
1																		
2				M					M						M			
3																		
4	A																	
5																		
6																		
7	A										A							
8	A-1/2			2A-1/2							A						A	
9						C		1C										C
10					1			1							2-1/2			1A
11	A				A			2A-1/2	1/2	2A-1/2	A			A	A-1/2			
12															1			
13						C		C	M		1/2	1/2		1	M			C
14	A		1						1/2		A-1/2				A			A
15										A								
16	A										A				A			2A
17								AC		1/2	1/2				A			2AC
18	1/2				A-1/2			2A-1/2							A			
19				2A													A	
20				1														1
21				A						1								A
22	1/2			3A-1/2														
23	P			2							A	1/2						A
24																		
25				P									1					1
26	1/2			P					M						M		1A	A
27					P			1A							A			
28								C										C
29																		
30					A-1/2		C	P		A-1/2					A			AC
31												1/2						
32				M					P	1					M			
33	A							1A	1/2	P								1A
34	1								1		P	P			1			1
35			1/2											2-1/2				A

	41	42	43	44	45	46*	47	48	49*	50	51*
1											
2									M		
3									1/2		
4											
5											
6											
7		A	A	A	A	A	A	1/2			
8		A	A	A	A	A	A	1/2		2A	
9	1					1		C	1C		
10											
11		2A	A	A	2A	5A	2A	2A-1/2			
12	A					1		1	A		A
13						1		C	CM		
14	A	A	A	A	A	A	A	1/2	A		A
15								A			
16	2A	A	2A	A	A	A	A	1/2	A-1/2		A
17	22A	A	A	A	A	2A	A	1/2	12A		1
18						2A	A				
19										A	
20	1A		A			1			1-1/2		
21	A	1				A			A-1/2		
22										2A	
23		A	A	A	A	A	A	1/2		1	
24											
25				1							
26	A					A			AM	12A	
27						1A	1				
28								C	C		
29											
30	A		A		A	4A	A	C	12AC		
31					1			1	M	A	1/2
32		A	1A		12A	1A		A	1A		
33		A	A	A	A	A	A	1/2			
34	1										
35				A							

Appendix 7 Contacts of group members in projects and in management meetings (Postharvest Group)

On the next pages we present an analysis of the contacts of group members in projects and in management meetings in the Postharvest Group. Because of the size of the table in which we present this analysis, we have split the table up in two sections. Alongside the table (first row, first column) the members of the Postharvest Group are coded with a unique number from 1 up to 31. In the cells of the table the results of the analysis are provided. The two parts of the table are presented in the following way:



Legend:

- 1 / 2 / 3 / 4 = number of projects in which a project leader (row) has contact with other group member (column) that participates in that project
 - (number) A = number of projects in which a member of a project team (row) has contact with another group member that participates in the same project
 - Q = group member (row) with managerial responsibilities meeting another group member (column) in a Q-kind of management team meeting
 - S = group member (row) with managerial responsibilities meeting another group member (column) in a S-kind of management team meeting
 - P = has (also) a role as a project leader
 - 1/2 = indicating one or more projects in which a project member (row) has contact with another group member (column) who acts as project leader in one of more projects in which he/she participates. Is the inverse of 1 / 2 / 3 / 4
- Each group member is coded with a unique number at the borders of the table (row and column)



	23	24	25	26	27	28	29	30	31
1									
2									
3	1/2QS	A	A	A		A			
4	1/2	A	A	A		A			
5		1	3	2	5				
6		A	A						
7									
8	QS								
9		A		A					
10			A	A					
11		A	2A						
12	QS	1		1					
13	Q		1						
14			A	A					
15				A					
16									
17	QS	2A	1A	A		1/2	A	A	A
18	1/2	2	A	2					
19		A	A	2A					
20									
21				1					
22									
23	P	1	3	2	3	2	1	2	1
24	1/2		3A	5A		1/2A	A	2A	A
25	1/2	3A		4A	3A	1/2A	A	2A	2A
26	1/2	5A	5A		A	1/2	2A	3A	2A
27	1/2	2A	6A	3A		A	A	A	A
28	1/2	1A	1A	1A		P	1A	1	1
29	1/2	A	2A	2A	2A	1/2	1P	1/2A	2A
30	1/2	A	3A	2A	A	1/2	12A	P	12A
31	1/2	A	2A	2A	A	1/2	2A	1/2A	

Appendix 8 Expertise profiles of members of the Ecology Group

In the following table the expertise profiles of the members of the Ecology Group are defined. These are based on statements made by at least two group members in the interviews. In addition we have searched for statements with regard to the expertise profile in other sources (sometimes statements of a third of four colleague, sometimes statements made in plans). Each group member is coded with a unique number (first column).

	First group member	Second group member	Other sources
1	-		Grassland plants
2	-		
3	-		
4	-		
5	-		
6	Knowledge of vegetations, biotopes, herbivores, larger mammals		
7	Knowledge of vegetations, practical ecological knowledge, modeling knowledge		
8	GIS	GIS	
9	Landscape Ecology		Reptiles
10	-		
11	Fauna (knowledge of species), GIS	Landscape ecology (very broad)	
12	Project management		
13	Landscape ecology , policy with regard to species, nature policy	Landscape ecology, urban ecology, spatial planning, policy with regard to species, nature policy	
14	Spatial networks, knowledge of species, practical ecological knowledge, NEMI		Birds liffing in moors, dragon flies
15	Landscape ecology, rivers		Fish
16	Fauna (knowledge of species), GIS		
17	Spatial networks, population dynamics, fauna (knowledge of species)		Amfibians
18	Crop protection, models, experiments		
19	Recreation and tourism		
20	Ecology of plants, population dynamics		

Continuation of Appendix 8

	First group member	Second group member	Other sources
21	Landscape ecology	Ecology of plants, practical knowledge of species	Forest plants
22	The application of models, GIS		
23	Landscape ecology, fauna, flora, practical ecological knowledge	Landscape ecology, fauna, flora, practical ecological knowledge	Ecology of plants
24	Insects, practical ecological knowledge		Ants, bees, wasps
25	Forest birds, population dynamics, green-blue veins	Forest birds	Forest birds
26	Knowledge of vegetations, sea dykes, landscape ecology	Knowledge of vegetations	
27	Crop protection, practical ecological knowledge, insects, agricultural systems		Crickets, grasshoppers
28	Development of models, landscape ecology		
29	-		
30	Application of models, landscape ecology		Butterflies
31	-		
32	Application of models, landscape planning		
33	Nature policy, spatial planning	Landscape ecology	
34	NPB		
35	Green-blue veins		
36	NPB	Management	
37	Landscape ecology, fauna, development of models, project management		The quality of software
38	NPB		
39	Landscape ecology		
40	Landscape ecology	Landscape ecology	
41	Development of models		Population dynamics, dispersion, mosaic landscapes
42	Programming (development of models)	Programming (development of models)	Large and semi-large mammals
43	Programming (development of models)	Programming (development of models)	
44	Programming (development of models)		The quality of models
45	Programming (development of models)		The quality of software
46	GIS		
47	GIS	GIS	GIS
48	LARCH	LARCH, spatial networks	LARCH

	First group member	Second group member	Other sources
49	Population dynamics, development of models	Development of models	Population dynamics, measures of landscapes
50	-		
51	Landscape ecology, urban ecology		

Appendix 9 Expertise profiles of members of the Postharvest Group

In the following table the expertise profiles of the members of the Postharvest Group are defined. These are based on statements made by at least two group members in the interviews. In addition we have searched for statements with regard to the expertise profile in other sources (statements of a third of four colleague, statements made in plans). Each group member is coded with a unique number (first column).

	First group member	Second group member	Other sources
1	Molecular background, laboratory techniques		
2	Molecular biologist	Tomatoes, Lelies, laboratory techniques	
3	Molecular biologist, genomics	Designing projects	
4	Molecular, laboratory techniques	Irises, Lelies, trees	
5	-		
6	-		
7	Flowers	Fotosynthesis	
8	Ethylene, biomolecular knowledge	Molecular physiology, ageing, ethylene	Flowers / Tomatoes
9	Fotosynthesis measurements, equipment	Equipment	Equipment
10	Flowers, plants	Fotosynthesis	
11	Fotosynthesis measurements	Apples	
12	Fotosynthesis measurements, acquisition	Physiology of flowers	Flowers / Fotosynthesis
13	Physiology of flowers	Physiology	
14	Storage of fruits, practical knowledge, consultancy	Consultancy, apples, pears	
15	Laboratory techniques		
16	Breathing, CO2 interaction, storage of bulbs	Apples, pears	
17	Vegetables, fruits, storage		
18	Storage of fruits, practical knowledge, physiology of fruit	Apples, pears, consultancy	
19	Laboratory techniques		
20	Research techniques	Apples, pears	
21	Vitamin C	Apples, pears	
22	Laboratory techniques		
23	Physiology of potatoes		
24	Physiological measurements, storage (laboratory techniques)		

Continuation of Appendix 9

	First group member	Second group member	Other sources
25	Potatoes, laboratory techniques		
26	Physiological measurements, storage, (laboratory techniques)	Potatoes	
27	Potatoes, storage, (laboratory techniques)		
28	-		
29	-		
30	-		
31	-		

Appendix 10 Analysis of publication behavior of the members of the Ecology Group 2001-2003

In the following table an analysis of publication behavior of the members of the Ecology Group is presented for the period 2001-2003. Because of the size of the table in which we present this analysis, we have split the table up in six sections. Alongside the table (first row, first column) the members of the Ecology Group are coded with a unique number from 1 up to 51. In the cells of the table the results of the analysis are provided. The six parts of the table are presented in the following way:

	1	18	19	32	33	51
1						
35						p. 325
36						p. 326
51						p. 327
						p. 328
						p. 328
						p. 329

Legend

- 1 / 2 / 3 / 4 / = number of publications published in 2001 which included participation of member (row) and member (column). When more than one group member participated (column), these publications were scored separately (a, b, c, etc.).
- 1 / 2 / 3 / 4 / = number of publications published in 2002 which included participation of member (row) and member (column). When more than one group member participated (column), these publications were scored separately (a, b, c, etc.).
- 1 / 2 / 3 / 4 / = number of publications published in 2003 which included participation of member (row) and member (column). When more than one group member participated (column), these publications were scored separately (a, b, c, etc.).
- * = publication included participation of researchers which were not part of the Ecology Group (in 2001, 2002 or 2003).

Research assistants: numbers 6, 8, 11, 22, 42, 46 and 47

Appendix 11 Analysis of publication behavior of the members of the Postharvest Group 2001-2003

In the following table an analysis of publication behavior of the members of the Postharvest Group is presented for the period 2001-2003. Because of the size of the table in which we present this analysis, we have split the table up in four sections. Alongside the table (first row, first column) the members of the Postharvest Group are coded with a unique number from 1 up to 31. In the cells of the table the results of the analysis are provided. The four parts of the table are presented in the following way:

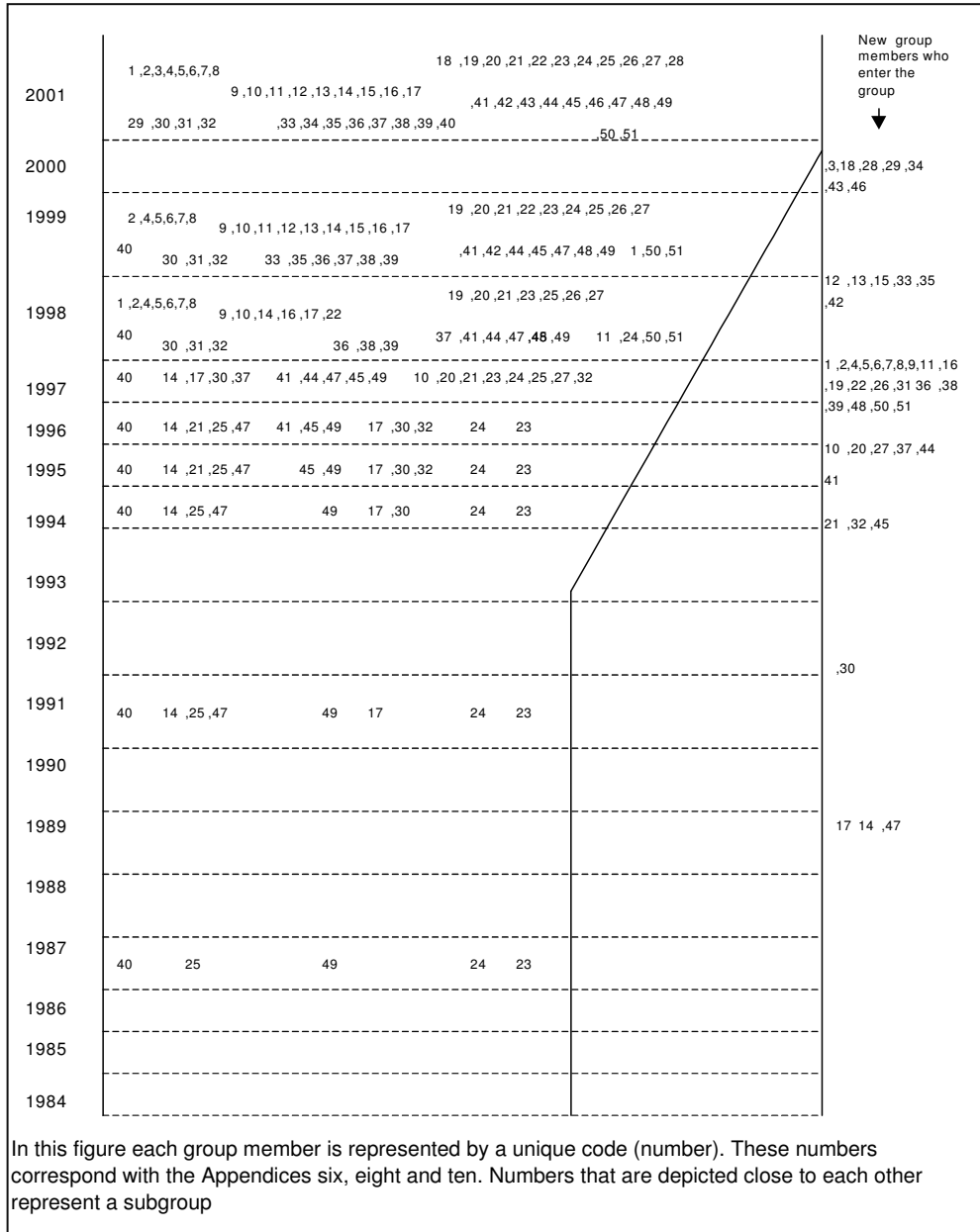
	1	18	19	31
1				p. 331
27				p. 332
28				p. 333
31				p. 333

Legend

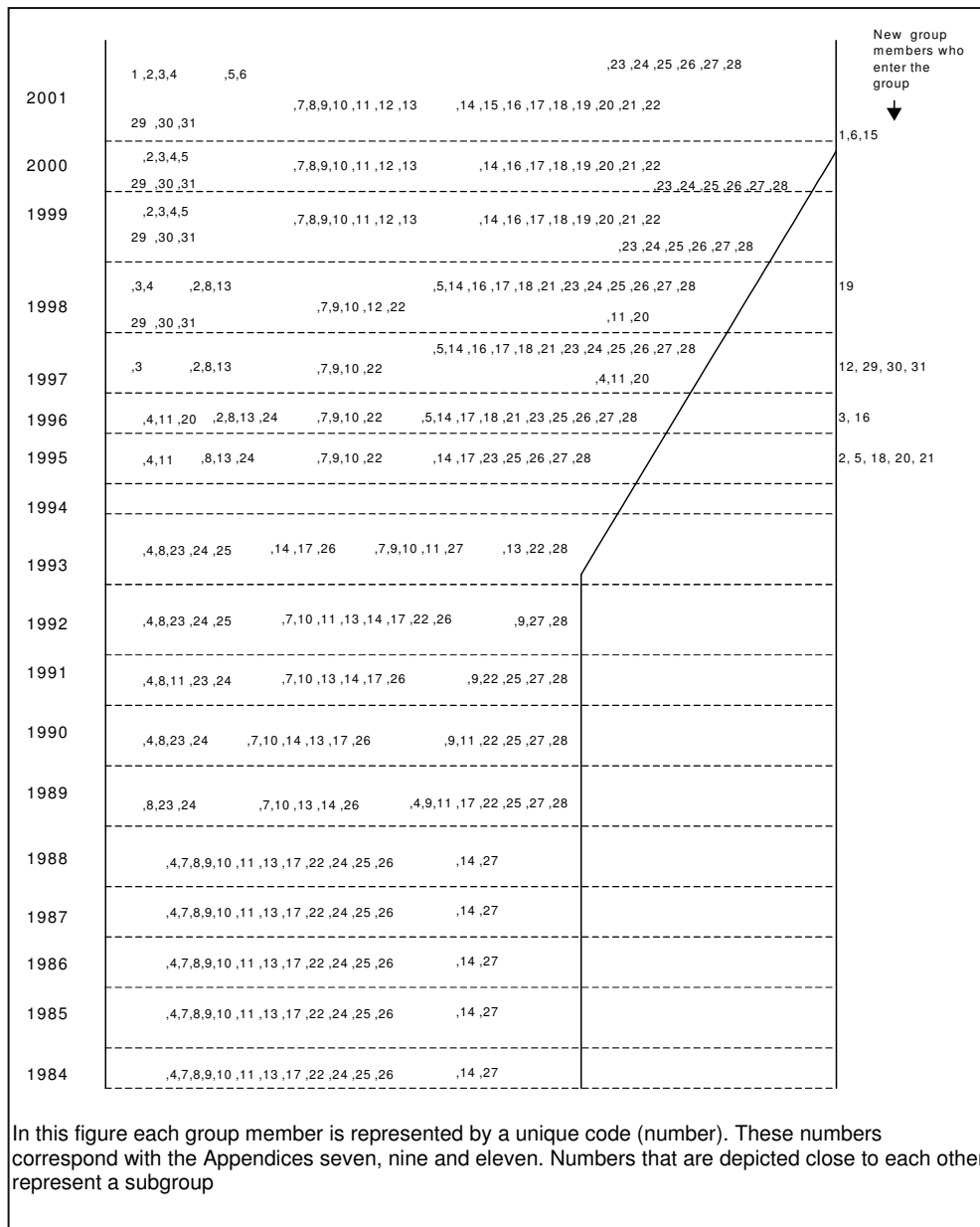
- 1 / 2 / 3 / 4 / = number of publications published in 2001 which included participation of member (row) and member (column). When more than one group member participated (column), these publications were scored separately (a, b, c, etc.).
- 1 / 2 / 3 / 4 / = number of publications published in 2002 which included participation of member (row) and member (column). When more than one group member participated (column), these publications were scored separately (a, b, c, etc.).
- 1 / 2 / 3 / 4 / = number of publications published in 2003 which included participation of member (row) and member (column). When more than one group member participated (column), these publications were scored separately (a, b, c, etc.).
- * = publication included participation of researchers which were not part of the Postharvest Group (in 2001, 2002 or 2003).

Research assistants: 1, 4, 6, 7, 9, 10, 11, 15, 19, 20, 24, 25, 26, 27, 30, 31

Appendix 12: Composition of and grouping within the Ecology Group



Appendix 13: Composition of and grouping within the Postharvest Group



Summary

This study focuses on the concept of a core competence. A core competence is a(n) unique competence of an organization, which underlies leadership in a range of products or services, which is non-substitutable and hard to imitate. Honda for example, defines its core competence as “recycling innovations in motor technology in a broad array of products” (like cars, lawn-mowers, generators, and motor-bikes) and Casio defines its core competence as “integrating LCD- and semi-conductor technology” (applied in for example keyboards, calculators, small TV-sets and camcorders) (source: Weggeman, 1997). As a core competence provides a strong competitive advantage related to competitors, it is very attractive for organizations to possess. A core competence is not a stand alone phenomenon, but it is the result of an effective and efficient integration of a number of competences of the organization (i.e. Hamel & Prahalad, 1994). In order to be successful and to achieve a competitive advantage, the integration of competences becomes a key issue for organizations (Grant, 1996a, 1996b, Okhuysen and Eisenhardt, 2002; Kogut and Zander, 1992).

What do we know about the development and emergence of a core competence? Literature argues that the emergence of a core competence supposes (1) fit between organisation and environment as the organization has to provide products or services that are highly appreciated by clients; (2) development of competences necessary to provide valuable products or services; (3) development of practices of knowledge integration; and (4) development of practices to maintain fit with the environment (Hamel & Prahalad, 1994; Teece & Pisano, 1998; McGrath, MacMillan & Venkataraman, 1995; Grant, 1996a, 1996b; Nerkar & Roberts, 2004; Haas & Hansen, 2005; Danneels, 2002; Orlikowski, 2002). With this literature argues for the relevance of a number of conditions and practices, but these arguments do not explain how a core competence actually develops and emerges. What happens in organizations, leading to the development and emergence of a core competence? McEvily and Marcus (2005) suggest that the set of organizing processes and principles in an organization underlies the emergence of competitive capabilities. This brings us to the perspective of this study. We have chosen to focus on the process or combination of processes in an organization responsible for the development and emergence of a core competence. A process or combination of processes that provides an explanation for the emergence of this phenomenon.

We chose to focus on the development and emergence of a specific kind of core competence, namely one emerging on a group level. We developed a concept that specifically addresses a core competence at group level: a competitive group competence. The “competitive” in this concept refers to the achievement of a competitive advantage. We narrowed our scope by focusing on the development and emergence of a competitive group competence in a research group. Finally, we decided to speak only of the emergence of a competitive group competence. We do so, because the emergence of a competitive group competence also implies development, as a developmental process has to take place before a competitive group competence is able to emerge. Once it emerges, the developmental process does not stop. In short, this thesis reports about the emergence of a competitive group competence.

From literature we learned that our knowledge of a process or a combination of processes responsible for the emergence of a competitive group competence is limited. We refer to knowledge of the kind of process or processes, the coherence and interplay between processes in case more processes are involved, how individuals participate and how knowledge integration is organized by this process or these processes. Another aspect of which we have limited knowledge is how the process or processes underlying the emergence of a competitive group competence accommodate dynamics and change. Also our knowledge of the context relevant for the emergence of a competitive group competence is limited. Therefore we formulated our research problem as: Which combination of processes explains the emergence of a competitive group competence and how is the emergence influenced by the context in which the processes operate?

Given the limited present knowledge of the emergence of a competitive group competence and the character of our research problem, we chose for an open, exploring and qualitative design, aiming for theory development based on an intensive study of a few cases. Furthermore, we chose for the development of a process theory (Mohr, 1982; Van de Ven and Poole, 1995; Poole et al., 2000) to answer our research problem. In addition to process theory we applied the Grounded Theory Method (Glaser and Strauss, 1967; Glaser, 1992; Strauss and Corbin, 1990) to collect and analyze data. We conducted two field studies in research groups in which a competitive group competence emerged, taking the group as the unit of analysis. Both field studies took place in Wageningen UR. The first field study was the study of the Ecology Group – working in the field of landscape ecology – and part of the research institute Alterra. The second field study was the study of the Postharvest Group – working in the field of post harvest physiology – and part of the research institute ATO. We participated passively in the groups for a period of 17 respectively 22 weeks, in

which we interviewed group members, made observations and studied all kinds of documents, parallel to an analysis of these data.

We found the coherent operation of four processes underlying the emergence of a competitive group competence: (1) a repeated process of the design, the execution and the ending of projects, executed with process qualities of heedful interrelating and content over management; (2) a process of balancing tensions against a background of established practices of heedful interrelating and content over management; (3) a process of expertise development leading to distinctive competences and (4) a process of envisioning the future that provides a frame of reference to the other three processes.

By reflecting on these processes, we interpreted the four processes as tokens of each of the four basic types of processes found by Van de Ven and Poole (1995): a life cycle process, a dialectical process, an evolutionary process and a teleological process. In terms of Van de Ven and Poole (1995) and Poole et al. (2000) the grounded theory we developed is an example of a quad motor theory explaining change *in* an organization. Poole et al. (2000) developed a taxonomy with examples of logical and possible process theories of organizational change and development. It also presents an example of a quad motor theory: the theory of Riegel (1976) of human development progression. Our theory can replace the theory of Riegel as an example of a quad motor theory in this taxonomy, as the theory of Riegel is not particularly bound to organizations. From all 160 studies (period 1995 up to December 2005) building upon the framework of Van de Ven and Poole (1995) this is – to the best of our knowledge - the first study addressing a quad-motor theory in the field of organization science.

In this paragraph we elaborate on the four processes. The *first* process defines a repeated cycle of the design, the execution and the ending & evaluation of projects (a life cycle process), executed with qualities of heedful interrelating and content over management. In this process knowledge integration takes place. We found 12 social rules underlying the process quality of heedful interrelating and – to some extent – content over management. Furthermore we found that the project life cycle process stresses close alignment with customers (a comprehensive strategy; Ancona & Caldwell, 1992). The *second* process is a process of balancing tensions. Tensions researchers experience within and between social rules, motives, task constraints and expectations from the environment. This process is executed against a background of established practices of heedful interrelating and content over management. We defined this process as a dialectical process. This processes stresses that the emergence of a competitive group competence is not a static property or stable

disposition, but an ongoing accomplishment (Orlikowski, 2002). The *third* process is a process of co-evolutionary development of expertise, executed with a pattern of variation, selection and retention. This process leads to a deep understanding of the field of research, which emerges in the form of distinctive competences. This process also underlies the renewal of competences. The “co-“ in the co-evolutionary character should be understood as a continuous cycle of position creation, affecting ideas and needs of stakeholders and meeting expectations raised by this position. In this process the groups adopted a strategy of enacting the environment (Daft & Weick, 1984), which means that they create their own environment by experimenting, testing, evaluating what works and by stimulating clients. Furthermore they apply external oriented selection mechanisms for the selection of projects and research themes, which supports the selection of projects and themes that fit with the environment and the strategy of the group. We argue that these strategies have prevented the groups to provide products that do not meet needs of the environment (a “lock in” (Burgelman, 2002)). The *fourth* process we found is a process in which a group envisions its future and defines activities to realize this future. We identified this process as a teleological process: a process of setting goals, executing actions, monitoring and evaluating. We argue that this process is fueled by experiences and ideas out of the other three processes and that it fuels the other three processes with objectives that are achieved bottom-up: needs for expertise, products to be delivered, clients to be served, positions to be developed and selection criteria for projects. We address this function by stating that it provides a frame of reference. We also found goals that are accomplished top-down to achieve the envisioned future of the group. Firstly a HRM practice leading to the development of T-shaped profiles (suggesting specialist knowledge in one discipline and some knowledge of adjoining disciplines). Secondly, a practice of organizing the group characterized by “structure follows strategy”, formalizing a gradually developed structure afterwards with the aim to strengthen the recognition of the group’s expertise.

These four processes are nested, operate in parallel, jointly and coherently on a relatively long time horizon. This time horizon stresses the relevance of maintaining fit with the environment. In explaining why we found each of these processes we argue that the nature of the central subject of each process, its content, explains the features of the process and provides arguments for the form of the process. This provides a content related explanation for the form of a process. Van de Ven and Poole (1995) do not provide such an explanation.

The competitive group competence emerges within a very specific context. The groups work on normal science, defined by adherence to general propositions like theories, laws, definitions and concepts; a multitude of commitments to preferred types of instrumentation

and to the ways in which accepted instruments may legitimately be employed; convictions regarding the nature of that which physically exists; adherence to scientific norms and no intention of fundamental innovation (Hoyningen-Huene, 1993). The groups conduct application oriented and applied research in a multidisciplinary research area, operate in an environment characterized by a low level of dynamics, depend on clients for the continuation of their research activities, position themselves on more complex problems and have high consensus on social norms and values. Our findings suggest a threefold role for the context to support the emergence of a competitive group competence. Firstly, the context enables the development of distinctive competences as the environment is characterized by a low level of dynamics with regard to the kind of problems clients experience and prioritize. This provides the groups time to develop distinctive competences. Secondly, the context stimulates knowledge integration, especially by a practice of heedful interrelating. A practice of heedful interrelating is stimulated by the multidisciplinary research questions the groups acquire (which need knowledge integration), the specialist expertise profiles of the researchers, and the need to serve clients to their best efforts. Thirdly, the context supports a positioning on more complex problems, as the groups provide additional value on these kinds of problems in particular. A highly formalized work setting is not particularly necessary as our study shows. Our findings suggest that the unique combination of resources which Leonard-Barton (1995) relates to the emergence of a competitive group competence is in fact the expertise in the groups, combined and integrated by a practice of heedful interrelating. Models and equipment can be important and unique, but do not provide additional value by themselves. They support the group members in generating and integrating knowledge.

The way the processes accommodate dynamics and change correspond with Van de Ven and Poole (1995) and Poole et al. (2000). They argue that teleological and dialectical processes can accommodate rapid changes well. They also argue that evolutionary and life cycle processes can accommodate gradual changes well. As we found that the relative influence of the co-evolutionary process of expertise development and the repeated project life cycle is larger than the relative influence of the teleological process of envisioning a future and the dialectical process of balancing tensions, the processes can accommodate the gradual changes we found in the field studies very well. We hypothesize that this combination of processes can not accommodate rapid changes very well.

We also made some other contributions to literature. Firstly, we provided an example of a fine grained model of the appearance of social rules that guide knowledge integration behavior in a research group. These models are sparse. Secondly, we deepened the concept

of heedful interrelating, by identifying social rules that add a new dimension to the definition of this concept. This contribution helps to explain why a group is able to design, execute and end projects with a process quality of heedful interrelating during a longer period of time. Thirdly, our findings with regard to the social rules related to heedful interrelating also expand the theory of distributed cognition, as they provide an explanation why a strong integration of cognitive work is able to emerge in a work setting with a low degree of formalization.

The application area of the theory we developed in this study is limited. Firstly, the theory we developed is defined as substantive by Glaser & Strauss (1967), implying that it should not attempt to explain outside of the immediate field of study, as there are no data of situations outside this field of study. The substantive area in which this research is grounded is defined by the context in which the research groups in the field studies operate: they work on normal science, conduct application oriented and applied research in a multidisciplinary research area, operate in an environment characterized by a low level of dynamics, depend on clients for the continuation of their research activities, position themselves on more complex problems and have high consensus on social norms and values. Therefore we limit the application area of this theory to research groups that meet these characteristics. Secondly, Process Theory is a special kind of theory only grounded in “necessary” conditions (Mohr, 1982). Therefore our theory only explains situations in which a competitive group competence emerges. If it emerges, one should also find the four processes with their qualities and under the conditions we found. This theory does not explain the absence of a competitive group competence, including situations in which the four processes are present.

Samenvatting

Dit proefschrift richt zich op het begrip “kerncompetentie”. Een kerncompetentie is een uniek vermogen van een organisatie die verantwoordelijk is voor een leidende positie in de markt voor een verscheidenheid aan producten of diensten. Een kerncompetentie is niet te vervangen en moeilijk te imiteren. Zo definieert bijvoorbeeld Honda haar kerncompetentie als “het hergebruik van innovaties in motortechnologie in een groot aantal verschillende producten” (zoals auto’s, grasmaaiers, generatoren en motorfietsen) en definieert Casio haar kerncompetentie als “het integreren van LCD- en semi-conductor technologie” (toegepast in bijvoorbeeld keyboards, rekenmachines, draagbare TV’s en camcorders) (bron: Weggeman, 1997). Doordat een kerncompetentie uniek is, moeilijk geïmiteerd kan worden en verantwoordelijk is voor een leidende positie in de markt is een kerncompetentie zeer gewild. Het verschaft immers een sterk concurrentievoordeel. Kerncompetenties staan niet op zich, maar vormen het resultaat van een effectieve en efficiënte integratie van een verzameling aan competenties die in een organisatie aanwezig is (bijvoorbeeld Hamel & Prahalad, 1994). De vaardigheid om competenties te kunnen integreren wordt daarmee voor organisaties een essentiële vaardigheid om succes te behalen en een concurrentievoordeel te realiseren (Grant, 1996a, 1996b, Okhuysen and Eisenhardt, 2002; Kogut and Zander, 1992).

Maar wat weten wij nu over de wijze waarop een kerncompetentie tot stand komt en verschijnt? De literatuur beschrijft een aantal zaken: (1) aansluiting tussen de organisatie en de behoeften in haar omgeving zodat er producten of diensten geleverd worden die door de klant erg gewaardeerd worden, (2) de ontwikkeling van competenties die nodig zijn om succesvolle producten of diensten te leveren; (3) de ontwikkeling van praktijken van kennisintegratie en (4) de ontwikkeling van praktijken om aansluiting op de omgeving te behouden (Hamel & Prahalad, 1994; Teece & Pisano, 1998; McGrath, MacMillan & Venkataraman, 1995; Grant, 1996a, 1996b; Nerkar & Roberts, 2004; Haas & Hansen, 2005; Danneels, 2002; Orlikowski, 2002). De literatuur beschrijft hiermee wel wat er van belang is, maar geeft geen verklaring voor hoe een kerncompetentie tot ontwikkeling komt en verschijnt. Wat gebeurt er in organisaties, waardoor een kerncompetentie tot ontwikkeling komt en verschijnt? McEvily en Marcus (2005) stellen dat de verzameling aan organisatieprocessen en principes hiervoor verantwoordelijk is. Dat brengt ons bij de invalshoek van deze studie. In deze studie is onderzocht welk proces of welke combinatie

van processen in een organisatie verantwoordelijk is voor het ontwikkelen en verschijnen van een kerncompetentie.

Wij hebben besloten ons te richten op de ontwikkeling en het verschijnen van een specifiek soort kerncompetentie, namelijk één op het niveau van een groep. Deze hebben wij gedefinieerd als een “concurrerende groepscompetentie” (*a competitive group competence*). Het woord “concurrerend” verwijst naar het realiseren van een concurrentievoordeel. Wij hebben ons werkterrein verder afgebakend, door ons te richten op de ontwikkeling en het verschijnen van een concurrerende groepscompetentie in een onderzoeksgroep. Tenslotte hebben we besloten om het “ontwikkelen” en “verschijnen” van een concurrerende groepscompetentie samen te nemen onder het woord “verschijnen” en alleen nog te spreken over het verschijnen van een concurrerende groepscompetentie. Immers, wanneer een concurrerende groepscompetentie verschijnt, veronderstelt dit dat er ontwikkeling heeft plaatsgevonden. En als een concurrerende groepscompetentie éénmaal verschijnt, stopt de ontwikkeling niet. Kortom, in dit proefschrift wordt verslag gedaan van een studie naar het verschijnen van een concurrerende groepscompetentie.

Literatuuronderzoek laat zien dat onze kennis over een proces of een combinatie van processen die verantwoordelijk is voor het verschijnen van een concurrerende groepscompetentie beperkt is. Dit heeft betrekking op de aard van de processen, hun samenhang en interactie, hoe individuele onderzoekers in deze processen participeren en in het bijzonder hoe kennisintegratie door deze processen wordt georganiseerd. Ook onze kennis van de context die van belang is voor het verschijnen van een concurrerende groepscompetentie is beperkt. Daarnaast is weinig bekend over hoe het proces of de combinatie aan processen die verantwoordelijk is voor het verschijnen van een concurrerende groepscompetentie dynamiek en verandering accommodeert. Daarom hebben wij onze onderzoeksvraag geformuleerd als: welk proces of welke combinatie van processen in een onderzoeksgroep is verantwoordelijk voor het verschijnen van een concurrerende groepscompetentie en hoe wordt het verschijnen beïnvloed door de context waarin dit proces of deze combinatie van processen plaatsvindt?

Gegeven onze huidige, beperkte kennis over het verschijnen van een concurrerende groepscompetentie en onze onderzoeksvraag hebben wij gekozen voor een open, exploratieve en kwalitatieve opzet van het onderzoek, met als doel te komen tot theorieontwikkeling gebaseerd op bestudering van een beperkt aantal casussen. Verder hebben wij besloten om een procestheorie te ontwikkelen (Mohr, 1982; Van de Ven and Poole, 1995; Poole et al., 2000) omdat daarmee de onderzoeksvraag het meest adequaat

beantwoord kan worden. Daarnaast hebben wij gebruik gemaakt van de gefundeerde theoriebenadering (Glaser and Strauss, 1967; Glaser, 1992; Strauss and Corbin, 1990) om data te verzamelen en te analyseren. Wij hebben twee empirische veldstudies uitgevoerd in onderzoeksgroepen waarin sprake was van het verschijnen van een groepscompetentie. Deze beide studies hebben plaatsgevonden in Wageningen UR. De eerste veldstudie vond plaats in de “Ecology Group” die werkzaam is op het terrein van de landschapsecologie en deel uitmaakt van het instituut Alterra. De tweede veldstudie vond plaats in de “Postharvest Group” die werkzaam is op het vlak van de naogst fysiologie en deel uitmaakt van het instituut ATO. Wij hebben op een passieve manier gedurende 17 respectievelijk 22 weken in deze groepen geparticipeerd. Gedurende deze tijd hebben we groepsleden geïnterviewd, observaties gedaan en vele documenten bestudeerd, parallel aan een analyse van de verzamelde data.

Wij hebben een combinatie van vier, in samenhang werkende processen geïdentificeerd die het verschijnen van een concurrerende groepscompetentie verklaart: (1) een zich herhalend proces van het ontwerp, de uitvoering en de afronding van projecten, dat wordt uitgevoerd met de proceskwaliteiten van “zeer zorgvuldige, betrokken interactie” (in het vervolg steeds aangeduid met de Engelse term *heedful interrelating*) en “inhoud boven management”; (2) een proces van het balanceren van spanningen die onderzoekers in hun werk tegenkomen tegen de achtergrond van de praktijken “heedful interrelating” en “inhoud boven management”; (3) een proces van expertiseontwikkeling dat leidt tot identificeerbare competenties en (4) een proces waarin een visie op de toekomst wordt ontwikkeld en dat een referentiekader vormt voor de andere drie processen.

Op basis van een reflectie, interpreteren wij deze processen als een voorkomen van elk van de vier typen processen die gedefinieerd zijn door Van de Ven en Poole (1995): een levenscyclus proces, een dialectisch proces, een evolutionair proces en een teleologisch proces. Op deze processen gaan we in de volgende paragraaf dieper in. In termen van Van de Ven en Poole (1995) en Poole en anderen (2000) is de gefundeerde theorie die wij ontwikkeld hebben een voorbeeld van een “vier motoren theorie” (*a quad motor theory*) die verandering in een organisatie verklaart. Poole en anderen hebben een taxonomie ontworpen met voorbeelden van logische en mogelijke processtheorieën. Daarin is ook een voorbeeld opgenomen van een “vier motoren theorie”, namelijk de theorie van Riegel (1976) over menselijke ontwikkeling. Onze theorie kan in deze taxonomie de theorie van Riegel vervangen, omdat deze niet specifiek aan organisaties verbonden is. Van alle 160 studies (periode 1995 tot en met december 2005) die gebaseerd zijn op het raamwerk van

Van de Ven en Poole (1995) is onze theorie – naar ons beste weten – de eerste “vier motoren theorie” in de organisatiekunde.

In het onderstaande gaan wij dieper op de vier processen in. Het *eerste* proces is een zich herhalende cyclus van het ontwerp, de uitvoering en afronding & evaluatie van projecten (een proces dat een levenscyclus beschrijft). Dit proces wordt uitgevoerd met proceskwaliteiten van “heedful interrelating” en “inhoud boven management”. In dit proces vindt kennisintegratie plaats. Wij hebben 12 sociale regels gevonden (die de interactie tussen onderzoekers onderling en tussen onderzoekers en klanten sturen) die onder het concept van “heedful interrelating” en in beperkte mate onder het concept van “inhoud boven management” liggen. Verder hebben wij gevonden dat de werkwijze in dit proces leidt tot nauwe afstemming op de wens van de klant. Door Ancona & Caldwell (1992) is deze werkwijze aangeduid met het begrip “*a comprehensive strategy*”. Het *tweede* proces beschrijft hoe onderzoekers omgaan met spanningen in hun werk tegen de achtergrond van de geïnstitutionaliseerde praktijken van “heedful interrelating” en “inhoud boven management”. Daarbij gaat het om spanningen tussen (en binnen) de sociale regels, motieven, opgelegde (bedrijfseconomische) beperkingen en verwachtingen die door de omgeving aan onderzoekers worden opgelegd. Wij hebben dit proces benoemd als een dialectisch proces. Dit proces maakt duidelijk dat het verschijnen van een concurrerende groepscompetentie geen statische eigenschap of een verworven positie is, maar iedere keer weer opnieuw gerealiseerd moet worden (Orlikowski, 2002). Het *derde* proces is een co-evolutionair proces van expertise-ontwikkeling dat plaatsvindt volgens een patroon van variatie, selectie en retentie. Dit proces leidt tot een diepgaand begrip van het onderzoeksveld, dat tot uitdrukking komt in benoembare competenties. Ook leidt dit proces tot de vernieuwing van competenties. Het “co-“ in het co-evolutionaire moet begrepen worden als een continue cyclus van positie-creatie, het beïnvloeden van ideeën en behoeften van (potentiële) klanten, en vervolgens het realiseren van de verwachtingen die daardoor zijn gewekt. In dit proces hanteren de groepen in de veldstudies in de relatie met hun omgeving een strategie van “enacting” (Daft & Weick, 1984), dat wil zeggen dat zij hun eigen omgeving creëren door te experimenteren, te kijken naar wat werkt en door (klanten) te stimuleren. Daarnaast passen zij op de omgeving georiënteerde selectiemechanismen toe voor de selectie van projecten en onderzoeksthema’s, zodat alleen die projecten en thema’s die passen bij de strategie en perspectiefvol zijn overblijven. Wij beargumenteren dat de groepen hebben voorkomen kennisproducten aan te bieden die niet meer aansluiten bij de omgeving (“a lock in”; Burgelman, 2002), door ondermeer deze strategieën toe te passen. Het *vierde* proces dat wij gevonden hebben is een proces waarin de groepen een visie op hun toekomst ontwikkelen en activiteiten definiëren om de beoogde

toekomstige positie te realiseren. Dit bleek een teleologisch proces te zijn, dat wil zeggen een proces van het formuleren van doelen, het uitvoeren van activiteiten om die doelen te realiseren, het monitoren van de voortgang en het effect van die activiteiten en het evalueren van de resultaten. Wij beargumenteren dat dit proces gevoed wordt door ervaringen en ideeën uit de andere drie processen en dat het op zijn beurt deze drie processen voedt met doelen die bottom-up gerealiseerd worden: behoeften aan kennisontwikkeling, te leveren producten, klanten waar de groep zich op wil richten, posities in het onderzoek die nagestreefd worden en selectiecriteria voor projecten. Deze functie van dit proces hebben wij aangeduid door te stellen dat het een “referentiekader” biedt. Naast doelen die bottom-up worden gerealiseerd hebben wij ook doelen gevonden die top-down geïnitieerd worden om de visie op de toekomst van de groep te realiseren. Ten eerste een praktijk van personeelsmanagement die leidt tot de ontwikkeling van expertiseprofielen van medewerkers die zich laten omschrijven als een “T”. Dat wil zeggen, een profiel dat zich kenmerkt door diepgaande, specialistisch kennis op één expertise – het staande streepje van de T - en enige kennis op aanpalende expertises – het liggende streepje van de T. Ten tweede een praktijk van organiseren die zich laat omschrijven als “structuur volgt strategie”, waarbij een structuur die zich geleidelijk heeft ontwikkeld achteraf wordt geformaliseerd. Doel hiervan is om de herkenbaarheid van de aanwezige expertise naar klanten te versterken.

De vier processen zijn genest (dat wil zeggen, liggen grotendeels in elkaar), zijn aan elkaar verbonden met hun in- en output, werken parallel aan elkaar en beslaan een relatief lange tijdshorizon. Deze lange tijdshorizon benadrukt nog eens het belang om de aansluiting op de behoeften van de omgeving zo sterk mogelijk te houden. Reflecterend op de vraag waarom we nu net deze processen hebben gevonden, beargumenteren we dat de aard van het onderwerp waar het proces om draait (een project, expertise, een toekomstvisie, een dilemma) bepalend is voor de eigenschappen van het proces en dat het onderwerp daarmee de vorm van het proces bepaalt. Dit biedt een inhoudelijke verklaring voor de vorm van processen die door Van de Ven en Poole (1995) niet wordt geleverd.

De concurrerende groepscompetentie verschijnt binnen een zeer specifieke context. De groepen verrichten “normal science” (Hoyningen-Huene, 1993). Dit begrip typeert de aard van de wetenschap die wordt bedreven, namelijk wetenschap die zich richt op kennisontwikkeling binnen bestaande theorieën en concepten en niet op fundamentele vernieuwing. De groepen voeren toepassingsgericht en toegepast onderzoek uit op een multidisciplinair onderzoeksveld; zij opereren in een omgeving die zich kenmerkt door een relatief laag niveau aan dynamiek; de groepen zijn afhankelijk van klanten voor het voort

kunnen zetten van hun onderzoeksactiviteiten; zij hebben zichzelf gepositioneerd op meer complexe problemen en hebben een hoge consensus bereikt wat betreft sociale normen en waarden. Wij suggereren een drievoudige rol van de context voor het verschijnen van een concurrerende groepscompetentie. Ten eerste maakt de context de ontwikkeling van competenties (expertise) mogelijk, omdat de omgeving zich kenmerkt door een relatief laag niveau aan dynamiek wat betreft de aard van de problemen die klanten ervaren en hoe die worden geprioriteerd. Dat geeft de groepen tijd om expertise te ontwikkelen. Ten tweede stimuleert de context kennisintegratie door een praktijk van “heedful interrelating”. Zowel door de multidisciplinaire vragen die de groepen verwerven, als door de specialistische expertiseprofielen van de onderzoekers, als door de noodzaak om klanten zo goed mogelijk te bedienen. Ten derde ondersteunt de context een focus op meer complexe problemen, omdat de groepen daar de grootste toegevoegde waarde kunnen bieden. Een sterk formele organisatie van het werk is niet nodig zoals ons onderzoek laat zien. Onze studie suggereert bovendien dat de unieke combinatie van middelen die Leonard-Barton (1995) gerelateerd acht aan het verschijnen van een concurrerende groepscompetentie, in feite de expertise in de groep is die gecombineerd en geïntegreerd wordt met de praktijk van “heedful interrelating”. Modellen en uitrusting kunnen belangrijk en uniek zijn, maar op zichzelf hebben deze geen (grote) toegevoegde waarde. Deze hulpmiddelen ondersteunen de groepsleden in het genereren en integreren van kennis.

De wijze waarop de processen dynamiek en verandering accommoderen komt overeen met de beschrijving van Van de Ven en Poole (1995) en Poole en collega's (2000). Volgens deze auteurs kunnen teleologische en dialectische processen snelle veranderingen goed inpassen. Evolutionaire en levenscyclusprocessen kunnen volgens hen geleidelijke veranderingen goed inpassen. Omdat de invloed van het “co-evolutionaire proces van expertiseontwikkeling” en het zich “herhalende project levenscyclusproces” op het verschijnen van competitieve groepscompetentie relatief groter bleek te zijn dan die van het “teleologische proces van het ontwikkelen van een toekomstvisie” en het “dialectische proces van het balanceren van dilemma's”, hebben wij daarmee een verklaring gevonden waarom de processen de geleidelijke veranderingen die wij in de veldstudies hebben aangetroffen goed kunnen accommoderen. Wij veronderstellen dat de combinatie van processen snelle veranderingen niet goed kan inpassen.

Naast de bovenstaande bijdragen heeft het onderzoek ook nog enkele andere bijdragen aan de literatuur opgeleverd. Ten eerste presenteren wij een voorbeeld van een vrij fijnmazig model van sociale regels dat kennisintegratie ondersteunt in een onderzoeksgroep. Deze modellen zijn schaars. Ten tweede hebben wij het concept van “heedful interrelating”

verdiept door sociale regels te identificeren. Deze voegen een nieuwe dimensie aan dit concept toe. Deze toevoeging verklaart waarom een groep in staat is om gedurende langere tijd projecten te ontwerpen, deze uit te voeren en af te ronden met een proceskwaliteit van “heedful interrelating”. Ten derde verbreden onze bevindingen met betrekking tot de sociale regels (en gerelateerd aan) “heedful interrelating” de gedistribueerde cognitie theorie, omdat zij een verklaring geven waarom een sterke integratie van cognitief werk mogelijk is in een werkorganisatie met een lage graad van formalisering.

Gegeven de eigenschappen van een procestheorie, heeft de in deze studie ontwikkelde theorie een beperkt toepassingsgebied. Ten eerste zijn er maar een beperkt aantal situaties bestudeerd en is het een “substantieve” theorie (Glaser & Strauss, 1967). De theorie mag dan ook niet toegepast worden op situaties die wezenlijk anders zijn dan de situatie die wij aangetroffen hebben in de veldstudies. De eigenschappen van de onderzoeksgroepen die in deze studie zijn bestudeerd kunnen als volgt gedefinieerd worden: de groepen werken aan “normal science” (Hoyningen-Huene, 1993); werken op een interdisciplinair onderzoeksterrein en verrichten toepassingsgericht en toegepast onderzoek; de groepen zijn afhankelijk van klanten voor het kunnen voortzetten van hun onderzoeksactiviteiten; zij werken in een omgeving die zich kenmerkt door een relatief laag niveau aan dynamiek; zij hebben zichzelf gepositioneerd op meer complexe problemen en hebben in de groep een hoog niveau van consensus over belangrijke sociale normen en waarden gerealiseerd. Daarom beperken wij het toepassingsgebied van de theorie tot dit type onderzoeksgroepen. Ten tweede is procestheorie een speciaal soort theorie die alleen gebaseerd is op “noodzakelijke” condities (Mohr, 1982). De theorie verklaart daarom alleen situaties waarin er sprake is van het verschijnen van een concurrerende groepscompetentie. Als deze verschijnt, zouden ook de vier processen met de bijbehorende kwaliteiten en condities aangetroffen moeten worden. Deze theorie verklaart niet de afwezigheid van een concurrerende groepscompetentie. De afwezigheid van een concurrerende groepscompetentie kan zich ook voordoen in een situatie waarin de vier processen wel aanwezig zijn, omdat de processen “noodzakelijk” zijn, maar niet “voldoende”.

About the author

Frank Bakema was born on September 13th, 1962, in Epe (the Netherlands). In 1984 he obtained a Bachelor degree in Horticulture and started working as a researcher in business administration at the Experimental Station for Floriculture in Aalsmeer. In 1987 he became the coordinator for research planning of this station. In 1990 he joined the Research Policy Unit of the Dutch Agricultural Research Department, where he advised the Board of Executives in matters of research strategy. In 1996 he obtained a Master degree in Business Administration from the Open University of the Netherlands. Since 1998 he works as Senior Officer Knowledge Management and Research Strategy in the department of Research & Education of Wageningen University and Research Centre (Wageningen UR). In 1999 he started a Ph.D. project at the sub-department of Organization Science and Marketing, department of Technology Management, Eindhoven University of Technology. This Ph.D. project was part of the research program of Eindhoven Centre for Innovation Studies (ECIS) and has resulted in the present dissertation. His research interests include strategic management, knowledge management, innovation management, organization culture and the design of organizations.

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