Open Innovation Competence

Towards a Competence Profile for Inter-Organizational Collaboration in Innovation Teams

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Thesis

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Open innovation competence: Towards a competence profile for inter-organizational collaboration in innovation teams

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For those individuals who have brilliant ideas,
but need others to realize them.

Preface

With great pleasure, I herewith present the results of more than four years of hard work. Personally, I think that this book contains useful information for anyone who finds him- or herself in a collaboration process - and this will likely apply to all of us at one time or another. Therefore, I can highly recommend further reading of this book. However, before jumping too zealously to the next chapters, the reader should know that many persons directly or indirectly contributed to this thesis. It has been a complex project, and without the help of others, this book would not have become what it is.

First of all, I would like to thank my supervisors. Martin, many thanks for entrusting this project to me, for allowing me the freedom to design and carry out the study, and for your own investments in the project. Onno, thank you for introducing me to the field of business, which was quite new to me, and your positive feedback on the research outcomes. Harm, thank you very much for your unwavering support, your empathy, and for protecting me from myself by setting clear boundaries and feasible goals. Jos, thanks for the many constructive discussions we had, your openness and willingness to help, whenever needed.

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Elise du Chatenier
Wageningen, September 2009

Contents

Chapter 1
General Introduction

1.1 Introduction

Not surprisingly, people are generally fascinated by and attracted to that which is seen as ‘new’. This explains to a large extent why the concept of innovation is so popular in business. Many companies form teams in which professionals collaborate to create new products or services. This PhD thesis will deal with the topic of innovation and will focus on a particular facet of a particular kind of innovation: open innovation competence. The current chapter will explain why and how ‘open innovation competence’ was investigated. Section 1.2 will present the specific research background, describing why the concepts of innovation, open innovation, and open innovation competence are so interesting. Section 1.3 will explain what the concept of competence actually means. Section 1.4 will present the research questions this thesis addresses and how they were investigated. Finally, section 1.5 will describe the structure of the book.

1.2 Research Background

1.2.1 Why Innovation?

Innovation is often defined as the creation of new combinations (Schumpeter, 1934). Innovations may concern new products, new methods of production, new sources of supply, the exploitation of new markets, or new ways to organize business. They may be very new, also called radical innovations, or adaptations of an existing product or situation, also referred to as incremental innovations. There are many developments in business today that push companies to innovate, for instance expensive production factors, critical consumers who want to be surprised, and the pressure to use safe production techniques. These developments also stimulate companies to avoid wasting money, to identify and exploit opportunities, and to operate in a socially responsible way. Take for instance the development of private labels by retailers. A-brands, like Coca-Cola or Côte d’Or, used to have a firm grip on consumer behaviour (Grievink et al., 2002). However, when supermarkets started to introduce their own labels, which were cheaper than the A-brands, something changed. Consumers, sensitive to the lower prices, started to buy the private labels. Companies that produced A-

brands were losing consumers and they had to come up with new products to get their consumers back and keep their turnover on track. Apart from price, consumers are sensitive to convenience products that make life easier. The Senseo Crema coffee maker developed by Douwe Egberts and Philips is an example of a product that meets consumer wishes in a smart way. It only takes the consumer a few actions and seconds to get a tasty cup of coffee. Innovation, however, is not only necessary for reducing prices and making life easier. It is also necessary to make our society healthier and more sustainable. The development of alternative sources of energy is a typical example. In brief, innovation can be seen as the core process within an organization associated with renewal – it refreshes what the company offers and how it creates and delivers that offering (Tidd et al., 2001). By studying innovation, scientists can support organizations in their efforts to enhance the quality of life.

1.2.2 Why Open Innovation?

It follows logically from the definition of innovation, mentioned above, that the greater the variety of available ideas, skills and resources, the more possibilities there will be to combine them and produce innovations which will be both more complex and more sophisticated (Fagerberg, 2005). During the first decades of the twentieth century, it became clear that innovations increasingly involve teamwork (ibid). Research in this area pointed to the necessity for innovative organizations to establish patterns of interaction within the organization that allow them to mobilize their knowledge bases when confronted with new challenges (Nonaka & Takeuchi, 1995). Until a few decades ago, these patterns of interaction stayed mainly within company walls. In this way, companies could prevent competitors from imitating their products, production methods or services, and retain competitive advantage in the market. However, successful innovations eventually appeared not only to be dependent on interaction patterns within the organization, but also on extensive interaction with the environment (Edquist & Hommen, 1999; Fagerberg, 2005; Gemünden et al., 1996; Malerba, 2002; Omta, 2004; Powell et al., 1996; Rigby & Zook, 2002; Ritter & Gemünden, 2003a). Effective collaboration with external partners, like buyers, suppliers and/or other organizations turned out to be one of the major success factors for innovation (Faems et al., 2005; Omta, 2002; Ritter & Gemünden, 2002).

Globalization is an important underlying reason for the need to collaborate with external partners in innovation. This development has caused increased competition, increased mobility of skilled workers and, consequently, shorter product life cycles, smaller profit margins and higher risks. To meet these challenges, companies need to spread risks and develop new products and services quickly and on an efficient scale, which they have often achieved by specializing in one domain (Chesbrough, 2003). The consequence of this specialization, however, is that companies increasingly rely on the input from

other companies in order to discover new combinations. Yet, they have also become more attractive to external partners, because of their specialized know-how, (patented) technology, efficient production scale and brand names. This 'mutual attraction' has led companies to develop new products, services or markets collaboratively, by using *each other's* know-how, technology, licenses, brands or market channels. Advantages of this strategy are that human resources, technology and customer information are pooled, which improves and speeds up the innovation process, spreads the risk for innovation failure, reduces the costs of technological development or market entry and improves the achievement of economies of scale in production (Tidd et al., 2001; Parkhe, 1991; Rigby & Zook, 2002; Ring & Van de Ven 1994). At the same time, exposure to external sources of technology can bring about other important organizational benefits, such as providing an element of 'peer review' for the internal R&D function and challenging in-house researchers with new ideas and different perspectives, which facilitates the creation of new knowledge and production of synergistic solutions (Hardy et al., 2003; Tidd et al., 2001). There is considerable evidence to show that innovation today has become significantly more of a networking process in which companies profit from external knowledge (Hagedoorn, 2002; Rothwell, 1994).

This phenomenon is also called 'open innovation': a paradigm that assumes that organizations can and should combine internal ideas, external ideas and paths to market, as organizations look to advance their technologies (Chesbrough, 2003). This is opposed to 'closed innovation', a process in which companies develop and market innovations by themselves (ibid). Other concepts related to this phenomenon are inter-partner learning (Hamel, 1991), networks of learning (Powell et al., 1996), learning alliances (Khanna et al., 1998), collective knowledge development in strategic alliances (Larsson et al., 1998), inter-organizational knowledge creation (Holmqvist, 1999), inter-organizational learning (Holmqvist, 2003; Lane & Lubatkin, 1998), shared new product development (Grant & Baden-Fuller, 2004), and collaboration in strategic alliances (Doz & Hamel, 1998; Dyer & Sing, 1998).

An example of open innovation is the Plantania project initiated by the wholesaler Royal Lemkes, a Dutch company that supplies potted plants to large-scale European retail organizations. Royal Lemkes felt that too much time and costs were involved in transaction matters and assumed that these could be organized more efficiently. To gain insight into how they could better organize their processes and develop a better transaction system they sought the help of one of their customers, OBI, a big German 'building market'. Together with OBI, Royal Lemkes developed a system that gave them automatic insight into the plants that were to be sold by OBI. It was therefore no longer necessary for OBI to send orders; with the new system Royal Lemkes could determine earlier and more accurately the number and kind of plants to send to OBI with the next delivery. Because of this innovative Plantania concept, the turnover of plants

vastly increased, and the failure percentage in the stores was reduced by almost 50% (Van der Vorst et al., 2002).

Although collaboration with external partners is claimed to have many advantages, there are also less positive signals. A survey in the UK, for instance, found that, although many organizations formed alliances in an effort to reduce the time, cost or risk of R&D, they did not necessarily realize these benefits from the relationship. In fact, the study concluded that around half of the respondents believed that collaboration made research and development more complicated and costly (Tidd et al., 2001). Despite the increase in the number of newly established strategic alliances, alliance performance has remained weak over the last decades, and thus disappointing (Das & Teng, 2000) in relation to the often rosy picture painted (Larsson et al., 1998). Most scholars report failure rates that vary between 40 and 70% (Duysters et al., 2004; Park & Ungson, 2001). Some scholars argue that the process is difficult, frustrating and often misunderstood (Crossan & Inkpen, 1995). They state that it rarely will be as neat and tidy as other scholars assume and its difficulties and challenges should not be underestimated (Inkpen, 2000). Consequently, there is a growing awareness that collaboration with external partners has a dark side (Omta & Van Rossum, 1999).

From research on teams it is already known that 'while working in teams can potentially create synergies so that the team produces an output which is better than could have been achieved by any individual member working alone, teams can also produce outputs which are worse than could have been produced by the most competent team members' (Newell & Swan, 2000: 1291). Inherent problems associated with teamwork include for instance conformity and obedience (Milgram, 1965), groupthink (Janis, 1972), or group polarization (Isenberg, 1986). In addition to these problems, open innovation teams face some extra challenges. In the first place, it appears difficult to get access to external partners (Omta & Van Rossum, 1999). Next, the innovation process itself is problematic, because of cognitive distances (Cohen & Levinthal, 1990), the risk of uncontrolled disclosure or leakage of information (Hamel, 1991; Inkpen & Beamish, 1997; Szulanski, 2000), lack of trust (Doz & Hamel, 1998; Ring & Van de Ven, 1992), unequal power distribution (Muthusamy & White, 2006), low transparency (i.e., openness toward partners), opportunistic learning behaviour (Larsson et al., 1998), free riding (Dyer & Nobeoka, 2000), the difficulty of balancing individual and alliance interests (Hamel, 1991), loss of control and diverging aims and objectives, resulting in conflicts and project failures (Tidd et al., 2001). A distinctive characteristic of open innovation is that professionals not only have to deal with the fundamental uncertainty inherent in innovation, but also with the pressure caused by the strategic importance of these projects, and on top of that, the uncertainty arising from alliance behaviour.

Thus, collaboration with external partners is a factor that can stimulate creativity as well as social and communicative dilemmas that can lead to project

failures. These dilemmas can occur in usual teamwork as well, but the chance that they will occur at all or more often in open innovation is greater. Moreover, since innovation is one of the core processes associated with survival and growth (Tidd et al., 2001), project failures caused by these dilemmas have a deep impact on the organization. It is therefore crucial to know how to deal with these dilemmas. Why do some open innovation projects succeed, while others fail? Which factors influence the success of open innovation? Which difficulties, or challenges, prevail and how should they be dealt with? Answers to these questions would help organizations better organize their open innovation activities and profit from the benefits of external cooperation. The focus of this thesis will therefore be on highly complex forms of open innovation, in which the chance of facing these challenges is high: co-development in strategic partnerships or pooled R&D collaborations. Co-development requires a mutual working relationship between two or more parties aimed at creating and delivering a new product, technology or service (Chesbrough & Schwartz, 2007:55). The following sections will refer to this kind of open innovation as *open innovation teams*. Teams are argued to be important means to achieve breakthrough innovations (Kasl et al., 1997) and are defined as 'a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and are seen by others as an intact social entity embedded in one or more larger social systems' (Cohen & Bailey, 1997: 241). Open innovation professionals are then those professionals who take part in a team to develop and implement a new product or service in collaboration with external actors, such as other companies, the government, universities and/or advisory agencies.

1.2.3 Why Open Innovation Competence?

Research in the domain of organizational studies reveals important success factors and governance mechanisms to deal with the problems and challenges in open innovation settings. A distinction can be made between formal governance mechanisms such as contracts and informal or relational governance mechanisms such as trust, which is influenced by for example the reputation of an organization (Poppo & Zenger, 2002), the kind of network structure needed to achieve a certain goal (Ritter & Gemünden, 2003b) and optimal cognitive distances (Nooteboom et al., 2007). Governing the project by formal rules and contracts could, for instance, reduce the problem of free riding and enhance the degree of trust between the team members (Dyer & Nobeoka, 2000). However, trying to eliminate all risks by means of formal rules, standards, and policies is not enough (Newell & Swan, 2000). In the end, it is always the individual participants who act as the driving force behind organizational processes, and who therefore in this case determine the success of the open innovation process (Senge, 1990). The various partners are represented in the collaboration not by static objects, but by thinking and reacting professionals (Ritter & Gemünden,

2003a). Not surprisingly, it appears that the way partners manage the collective learning process and the way they communicate and collaborate plays a crucial role in the success or failure of strategic alliances in innovation processes (Larsson et al., 1998). Studies in this area, however, often undervalue and under-investigate the human side of innovation (Moss Kanter, 2006). A large body of research on innovation projects mainly focuses on influential factors at the environmental, market, industrial or organizational level, and limit their analysis to project, group or team level (see for instance Chesbrough, 2003; Cooper, 1999; Hamel, 1991). But what about the individual level? What can the professionals who are involved in an open innovation team do *themselves* to cope with the challenges they face and to manage the open innovation process successfully?

Research on innovation management shows that high-performance innovation teams consist of members who are involved and committed to make the process a success (Paton & McCalman, 2000) and who posses strong communication and relationship skills (Moss Kanter, 2006). In open innovation literature or related areas, it is often stated that open innovation professionals can overcome the particular challenges mentioned above by creating trust, matching their own goals with the goals of their partners and compensating for power differences (Cooper, 1999; Hamel, 1991; Inkpen, 2000; Muthusamy & White, 2005; Ring, 1997; West & Gallagher, 2006). However, these authors do not elaborate on how one should actually go about building trust, aligning conflicting goals, etcetera. Lettl et al. (2006) were more specific in describing desired human qualities, but they only did this for *users* who are involved in open innovation projects and not for the open innovation professionals themselves. Even in research areas that focus on individual factors in business, such as organizational behaviour and Human Resource Management or Development (HRM/D, which will be further referred to as HR), no studies can be found on the personal qualities professionals need in open innovation teams. Profiles have been produced for general work performance (Bartram, 2005), management (Quinn et al., 1990), teamwork (Miller, 2001) and cultural diversity (Spitzberg, 1989), but profiles for innovation professionals are hard to find, not to mention profiles for *open* innovation professionals. Not surprisingly, the individual factor was recently put high on the agenda for research on open innovation (West et al., 2006).

Investigating the human side of open innovation is highly relevant not only for science, but also for practice. As open innovation becomes more and more common practice in organizations, there is an urgent need for professionals who understand how to acquire, develop, package, share, manage and exploit information and knowledge (Coulson-Thomas, 2004). For the effective selection, training and development of these professionals it is very important to define the range of skills and personal qualities needed in this process. Educational and HR studies often use the term ‘competence’ to describe the range of skills and personal qualities people need for a certain job or task, which

are usually clustered in a competence profile. Competence profiles have become popular in organizations (Athey & Orth, 1999; Dubois & Rothwell, 2004; Lievens et al., 2004; Rodriguez et al., 2002), since they can be used for strategic workforce planning, selection, training and development, performance management, succession planning, rewards and recognition, and compensation. Between 75 and 80% of surveyed companies, use some form of competence-based application (Schippmann et al., 2000). The research in this PhD thesis therefore aims at developing a competence profile for professionals in open innovation teams. The focus will be on a general profile that is applicable in many contexts, since such a profile will be most useful for the selection, training and development of open innovation professionals in general. Ultimately, the profile should contribute to greater success in open innovation teams.

Figure 1.1 depicts the input-process-outcome framework that forms the basis of the studies presented in this thesis. Individual competence needed to perform well in open innovation teams forms the bottom line in the figure, showing that they can be part of the input, process and results. The chapters to follow will elaborate on each cell in more detail, but first the concept of competence will be elaborated upon, by describing the history of the concept, approaches to the concept, and its measurement.

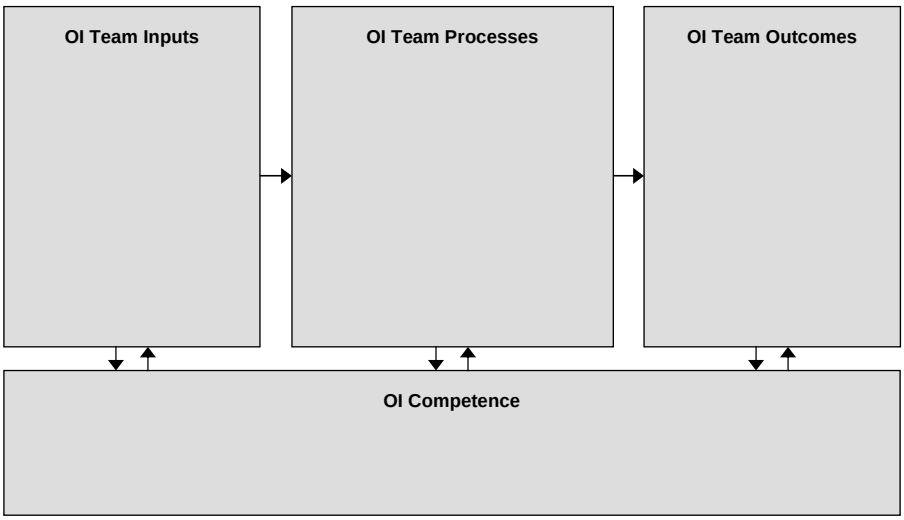

Figure 1.1: Input-Process-Outcome framework for open innovation (OI) teams

1.3 The Concept of Competence

1.3.1 History of the Concept

As mentioned above, the concept of competence has become popular in organizations, since it helps to frame human assets and train professionals in the specific assets that will enable them to achieve performance and sustained competitiveness (Lado & Wilson, 1994). Researchers have found the concept useful for identifying and describing essential human knowledge and skills at work, because of the concept's focus on the relation between people and work (Sandberg, 2000). Plato already spoke about competence in 380 BC, by which he meant the quality of being *ikanos* (capable) of acquiring the ability to achieve something (Mulder et al., 2007). However, the concept of competence has only recently been used more systematically in management studies (Sandberg, 2000). It was put forward by McClelland (1973), who originally intended to use the concept as a means to describe human behaviours that were necessary to attain high job performance. With this initiative, he was reacting to the common practice at the time of focusing only on intelligence and personality traits as a means to describe human qualities that lead to high job performance. Intelligence as a construct in itself does not explain high job performance, he argued, but rather the way one *uses* his or her intelligence. Moreover, personality traits are difficult to assess. Therefore, he was in favour of focusing on visible behaviours instead of intelligence and personality traits when testing professionals, and launched the competence modelling movement. His work mainly pertained to the education sector (Rothwell & Lindholm, 1999). Boyatzis (1982), Zemke (1982) and McLagan (1983) made the first link to HR practices, by developing competence profiles for training and development in organizations. The popularity of the concept is probably because it represents not only what an individual knows and does, but also what (s)he is. In this way, it avoids the conceptual confusion between skills, abilities or traits and other terms. Moreover, the concept is assumed to be recognizable, assessable and relevant for practice (Caird, 1992). Furthermore, it can be developed, learned and described at different levels, and a strong relationship is assumed to exist between competence and organizational effectiveness (Prahalad & Hamel, 1990).

1.3.2 Approaches to Competence

Since its introduction, divergent approaches to the concept of competence have been developed, based on different applications, theoretical backgrounds and national contexts. The different definitions of competence vary in the following dimensions: aggregation level, kind of human qualities involved, learnability, context-specificity, visibility and link to performance (compare for instance

Baum et al., 2001; Bartram, 2005; Boyatzis, 2008; Brownell, 2006; Escrig-Tena & Bou-Llusar, 2005; Gorsline, 1996; Hagan et al., 2006; Harvey et al., 2000; Heinsman et al., 2007; Lado & Wilson, 1994; Lahti, 1999; McClelland, 1973; Mulder, 2001; Prahalad & Hamel, 1990; Spencer & Spencer, 1993). These differences will be briefly elaborated. First, aggregation level: competence can be viewed at organizational (group of groups), team (group of persons) or individual (a person) level. As mentioned above, the focus of this thesis is on the latter, so the remainder of this chapter will only elaborate on competence at the individual level. At this level, competence is defined by various human attributes. These can be key strengths, individual characteristics, psychological attributes, behavioural attributes, work behaviour, personal traits and motives, a repertoire of capabilities, a set of behaviour patterns, or a combination or integration of knowledge, skills, attitudes and other characteristics (KSAOs). Some definitions state that a competence must be learnable. Such definitions are useful for a training centre, for example, which can direct its training programme to improving profile competencies, which are moreover preferably competencies applicable across many contexts, so that the programmes can cover a broad target group. A selection procedure at an HRM department, on the other hand, would be based on more context-specific competencies. Therefore, depending on the profile's intended purpose, some authors describe fundamental or universal competencies that are applicable across contexts and relevant to various specified jobs, whereas others describe unique or context-specific competencies. Some authors also state that competencies should be observable, visible, measurable and directly linked to high job performance or excellence.

Because of the various ways in which competence can be viewed, there is a lot of debate about what the concept actually means. To complicate matters, a distinction is also often made between competence and competency, each of which is defined in different and conflicting ways (Lahti, 1999). Since the competence and competency discussion can easily get bogged down in semantics (Hagan et al., 2006), it is more effective to explain the concept used here by describing the criteria for observing and measuring its indicators than by defining it as a construct (Lahti, 1999). The next section will therefore describe how the concept can be measured and how it will be measured and defined in this study.

1.3.3 Measurement of Competence

The various ways to measure and identify competence can be categorized into either the rationalistic or the interpretative approach (Sandberg, 2000). The rationalistic approach is the dominant approach used in management and basically consists of job analysis. This approach can be subdivided into three main approaches: the worker-oriented or behavioural method, the work-oriented or functional method, and the multimethod-oriented or multidimensional method (Delamare Le Deist & Winterton, 2005; Sandberg, 2000). All these methods

view competence as an attribute-based phenomenon that professionals utilize in their work, but the methods differ in the way they identify competence.

The worker-oriented approach views competence as a set of attributes possessed by workers, typically represented as knowledge, skills, attitudes (KSAs) and personal traits required for effective work performance (Veres et al., 1990: 87). The emphasis here is on behavioural competence (metacognition and attitudes), or what these researchers call a competen*cy*, which is defined in terms of 'underlying characteristics of people' that are 'causally related to effective or superior performance in a job', applicable 'across situations', and 'enduring for a reasonably long period of time' (Boyatzis, 1982; Spencer & Spencer, 1993). Their methods focus on observing successful and effective job performers to determine how these individuals differ from less successful performers. However, the profiles resulting from this method are often too general, thereby losing the context-specificity of the competencies, and are therefore difficult to use in professional practice.

Consequently, another method has gained ground, which emphasizes job-related functional skills and underpinning knowledge: the work-oriented approach (Delamare Le Deist & Winterton, 2005). This method also views competence as a specific set of attributes, but takes the work or job, instead of the professional, as the point of departure. The emphasis is on functional competence (knowledge and skills) and the ability to demonstrate performance in accordance with pre-determined performance descriptors (ibid). Definitions of competence in this method include work expectations, input measures (knowledge and skills) and psychological attributes (Mansfield & Mitchell, 1996: 46). The measurement of competence focuses on identifying activities that are central for accomplishing specific work tasks and then translating those activities into personal attributes (Sandberg, 2000). In this way, the researchers are able to generate more concrete and detailed descriptions of what constitutes competence and, thus, largely overcome the problem of generating descriptions of competence that are too general (ibid). One basic criticism of the work-oriented approach is that a list of work activities does not sufficiently capture the underlying knowledge, skills and attitudes required to accomplish those activities efficiently (Delamare Le Deist & Winterton, 2005).

The multimethod-oriented approach attempts to avoid the criticisms raised with respect to the previous methods by combining them (Sandberg, 2000). Competence is again viewed as a specific set of attributes, but in a more holistic way, combining behavioural competence and functional competence (Delamare Le Deist & Winterton, 2005). The multimethod-oriented approach generally first identifies activities that are central for accomplishing specific tasks and then the attributes that are necessary to perform those tasks or activities (Sandberg, 2000).

A central concern regarding the rationalistic approach is that it identifies human qualities that are linked to performance in a job, but these qualities do not necessarily predict performance in a job (Sandberg, 2000). Performance is

not only dependent on competence, but also on the *action theory* a professional develops. An action theory of a professional can be seen as a (personally applicable) inter-related set of values, insights, beliefs and rules about what should be done in a particular situation and how (cf. Van der Krogt & Vermulst, 2000). The concept has its roots in the concept of 'theories of action' developed by Argyris and Schön (1974, 1978), who speak about *action strategies* to describe the moves and plans used by people to keep their 'governing values' within an acceptable range. Competencies are the basis for action theories, but action theories are also influenced by other factors such as the conception of work (Sandberg, 2000). When workers encounter their work, they view problem situations based on how they experience them and decide, consciously or unconsciously, how to behave and which competencies to apply. The rationalistic approach does not take the professional's 'lived experience of work', into account. These profiles rather predefine central prerequisites for performing particular tasks competently, but such descriptions demonstrate neither whether or when the workers use these attributes, nor how they use them in accomplishing their work (Sandberg, 2000:11). Therefore, the interpretative approach was developed, which views the worker and his or her work as inextricably related (ibid). According to the interpretative approach, attributes used in accomplishing work are situational and depend on people's ways of experiencing work. Adopting this approach, however, would result in a highly situation-dependent competence profile, which does not fit the central aim of this PhD thesis: developing a generic competence profile for professionals in open innovation teams.

A rationalistic approach was therefore used to identify open innovation competence. Within this approach, the multimethod-oriented approach was chosen since it combines the advantages of both the worker-oriented approach and work-oriented approach. Competence then is seen as the functional area, the general capability of a person to perform in an area of work; and a competency is a part of competence (Mulder, 2007). Open innovation competence is defined as integrated capabilities, consisting of clusters of knowledge, skills and attitudes, which are necessarily conditional for performance and for being able to function effectively in open innovation teams. Open innovation competencies are then part of competence, and are also defined as integrated capabilities, consisting of clusters of knowledge, skills and attitudes that are necessarily conditional to perform a *sub-task or activity in* open innovation teams. Figure 1.2 visualizes the distinction between competence and competency. To come back to the various dimensions of competence described in the previous section, this thesis views competence and competency at individual level, as the integration of KSAs, and as something that is applicable across open innovation contexts, learnable (to some extent), visible and linked to high performance. A competence profile can then be defined as the overview of the essential professional competencies, each consisting of various attributes such as knowledge, skills and attitudes, which will be further called

'competency elements', required for effective performance. The next section will describe how a competence profile for open innovation professionals was developed in this research, by specifying the research questions and how these questions will be investigated.

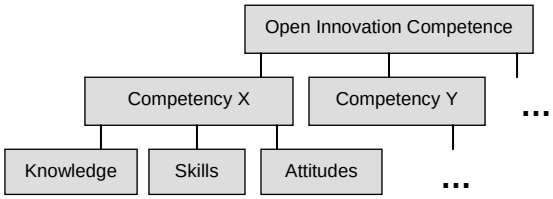

Figure 1.2: The distinction between competence and competency visualized

1.4 Research Questions and Design

Based on the previous section, the central research question in this PhD thesis can be formulated as follows:

> *Which competencies do professionals in an open innovation team need in order to contribute to its success?*

In line with the rationalistic multimethod-oriented approach, the first step in competence identification is to identify the main activities open innovation professionals need to perform. The first sub-question is therefore:

> *Sub-question a: What are the main activities professionals need to perform in open innovation teams?*

As a second step, competency elements needed to perform these activities should be identified. Accordingly, the second sub-question is:

> *Sub-question b: Which competency elements do professionals need in order to perform the main activities in open innovation teams?*

According to the rationalistic multimethod-oriented approach, the competency elements are clustered by main activity. There are, however, also other possible ways to cluster competency elements. The third sub-question is therefore:

> *Sub-question c: What is the optimal clustering of the identified competency elements in the competence profile?*

Not all competencies in the resulting profile need to be possessed by all open innovation professionals. The importance of the identified competencies might depend on factors such as team role or team composition. In order to reveal how generic the competence profile is, the next sub-question was formulated:

> *Sub-question d: Does the importance of the competencies in the competence profile vary across contexts, and if so, how?*

Despite a widespread consensus that human competencies play an important role in innovation processes and that they are highly related to performance in general, empirical evidence linking competencies to team success is still scarce. In order to investigate the relationship between the identified competencies and team success the fifth and last sub-question was formulated:

> *Sub-question e: Does the application of the competencies in the competence profile significantly contribute to team performance, and if so, how?*

Figure 1.3 shows how the research questions fit into the overall research framework.

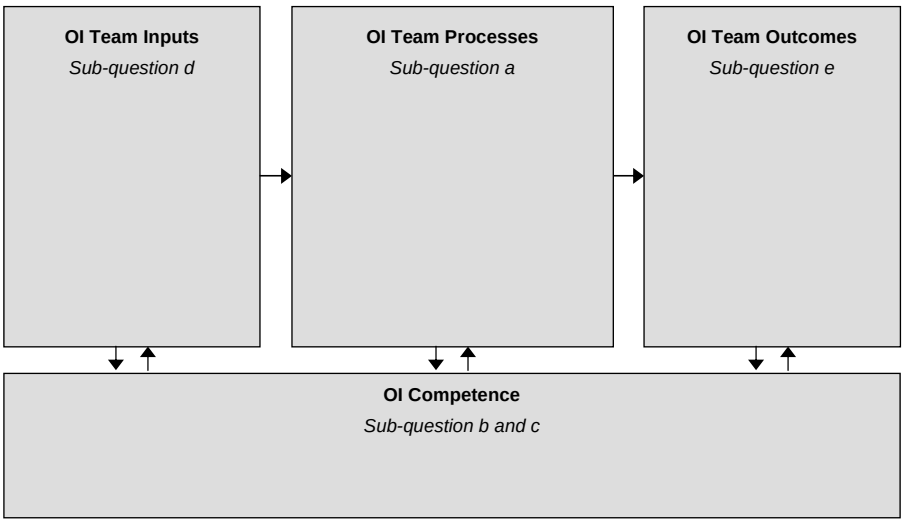

Figure 1.3: Input-Process-Outcome framework for open innovation (OI) teams with research questions

This design- and explanatory-oriented research was conducted in three separate stages or studies. A mixed-methods approach with multiple sources of evidence was used, combining various ways of identifying and assessing competence that differed from qualitative and quantitative, objective and self-report based data. The first study consisted of an inter-disciplinary literature study, combining literature in organizational, management, HR and educational studies. This study aimed at developing a competence profile for open innovation professionals, by identifying competency elements based on literature findings. This resulted in a preliminary competence profile.

The second study involved empirical, qualitative research, consisting of explorative interviews and focus group discussions. This study aimed at elaborating the preliminary competence profile, by identifying the activities and competency elements based on qualitative data. The preliminary competence profile was used as a framework to classify the empirical data and add information to the preliminary profile, which resulted in an elaborated competence profile. Qualitative research has been proven to be most valuable for competence identification (Mulder et al., 2005), since it can be used to explore and understand complex phenomena, and is therefore suitable in circumstances in which there are no elaborated theories.

The qualitative study had the disadvantage of reaching only a relatively small group of participants. Therefore, a third study was carried out that adopted a quantitative research method, involving a case study conducted by means of a survey and group interviews. This study aimed at validating the competence profile developed in the previous studies, by testing the relevance of the competency elements and the chosen clustering of the competency elements to a larger group of open innovation professionals. This study resulted in a validated competence profile that is potentially applicable for HR practices. The survey method has proven to be an adequate means of validating earlier findings (Krathwohl, 1998) and for ensuring that a qualitatively developed profile is shared by many (Mulder et al., 2005). Important advantages of this strategy are that it enables structured, standardized, controlled and quantitative data gathering, with specified accuracy. Disadvantages are, however, that it may be difficult for respondents to recall information or truthfully answer controversial questions. Apart from the rating biases, the translation fidelity of a questionnaire can be endangered by the fact that it relies on retrospective and self-reported data. Therefore, additional group interviews were employed in order to check the outcomes of the survey. The last study also included additional tests to check for variation, and to show the relationship between competence and team success. Table 1.1 summarizes the main goals and characteristics of the three studies. The table clearly shows that this research combines qualitative and quantitative research methods, objective and self-reported data in three separate studies, using multiple sources.

Table 1.1: Characteristics of the three separate studies, described by goal, research questions, variables, nature of the study, research strategy, sources, and final result

	Study 1	Study 2	Study 3
Goal	Developing a competence profile, by theoretical identification of activities and competency elements, resulting in a preliminary profile	Elaborating the preliminary profile, by empirical identification of activities and competency elements, resulting in an elaborated profile	Validating the elaborated profile, linking it to context and success factors, resulting in a validated profile and information about its generalizability and explanatory value
Sub-question	a and b	a and b	b, c, d and e
Variables	Competencies and -elements	Competencies and -elements	Competencies and -elements, input, process and outcome factors
Nature of the study	Literature study	Qualitative study	Quantitative and qualitative study
	Descriptive and explorative	Explorative	Testing and explanatory
Research strategy	Literature review	Explorative interviews and focus group discussions	Multiple case study including survey and group interviews
	Comparing and integrating previous research findings	Critical incidents technique	Factor, variance, and regression analysis
		Self-reported, objective and retrospective data	Self-reported and retrospective data
Sources	Organizational, management, HR, and educational studies	OI professionals and subject matter experts	OI professionals

1.5 Structure of the Book

The chapters to follow will describe in detail how the separate studies were carried out and the research outcomes. Each chapter addresses a certain study and sub-questions belonging to that study. Chapter 2 will discuss the results of the first study: the development of the competence profile through a literature study. It will also present the preliminary competence profile. It is more exhaustive with respect to the activities that need to be performed in open innovation teams, since literature on competency elements needed in order to perform these activities is still scarce. Chapter 3 will elaborate the preliminary profile with empirical data. The main focus is on the competency elements, to complement the literature findings. This results in an elaborated competence profile. Chapter 4 will deal with the validation of this elaborated competence profile. This will result in a validated competence profile with adjusted competencies. Chapter 5 will discuss the relationship between the validated competence profile and context, in order to investigate how generic the profile is or applicable across contexts. Chapter 6 will discuss the relationship between the newly derived competencies and team success, in order to determine the contribution of the profile to team success. The book will conclude with Chapter

7, which discusses the main findings of this research and their implications for science and practice. Figure 1.4 shows how each chapter fits in the overall research framework, accompanied by the kind of study and research question it addresses.

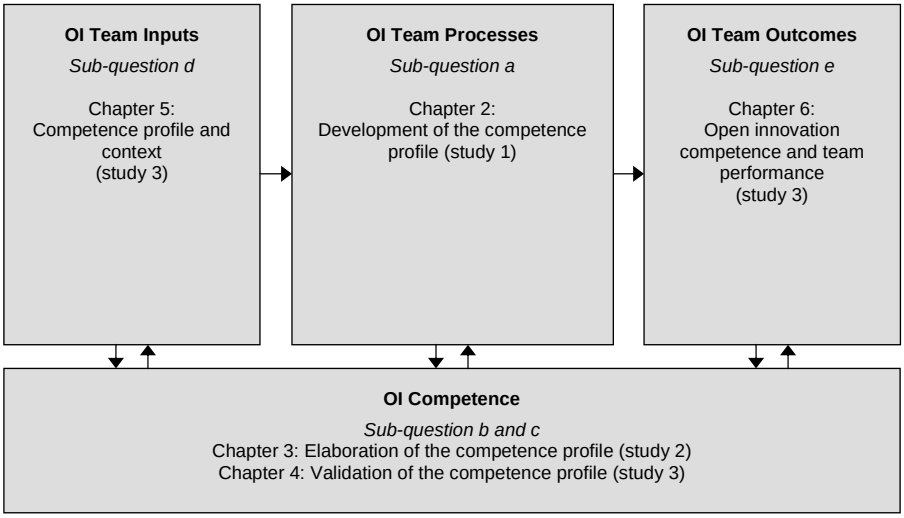

Figure 1.4: Input-Process-Outcome framework for open innovation (OI) teams with research questions and book chapters

Chapter 2
Development of the Competence Profile*

2.1 Introduction

This chapter reports the results of the first study, which aimed to identify the activities and competency elements through an inter-disciplinary literature review and develop a preliminary competence profile. The research questions this study addresses are:

> *Sub-question a: What are the main activities professionals need to perform in open innovation teams, according to literature?*
>
> *Sub-question b: Which competency elements do professionals need in order to perform the main activities in open innovation teams, according to literature?*

An extensive literature study was carried out combining literature on learning, (inter) organizational learning, (open) innovation management, business alliances and networks in organizational, management, HR, and educational studies. The next sections will report the outcomes. Section 2.2 explores the main activities open innovation professionals need to be able to perform in order to be considered 'competent' for operating in open innovation teams. These activities appear to be: managing the overall innovation process, managing the collaborative knowledge creation process and effectively dealing with the challenges caused by inter-organizational collaboration. Section 2.3 will explore the competency elements needed to perform these activities, which will result in a preliminary competence profile. Section 2.4 will discuss the findings and the chapter will end with a conclusion described in section 2.5. Figure 2.1 depicts the variables focussed upon in this chapter.

*This chapter is based on: Du Chatenier, E., Verstegen, J.A.A.M. Biemans, H.J.A., Mulder, M., & Omta, S.W.F. (in press). The challenges of collaborative knowledge creation in open innovation teams. *Human Resource Development Review*.

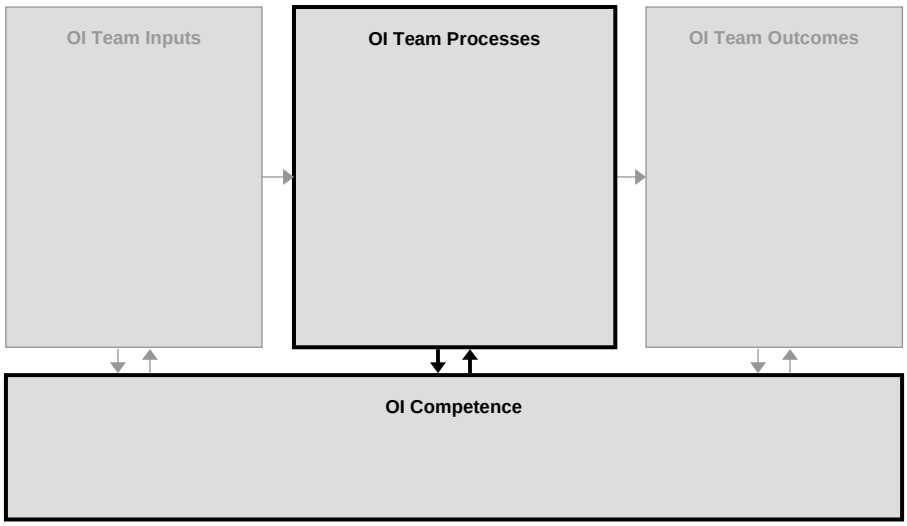

Figure 2.1: Input-Process-Outcome framework for open innovation (OI) teams with in bold the variables focussed upon in Chapter 2

2.2 Main Activities to Perform in Open Innovation Teams

2.2.1 The Overall Innovation Process

The first main activity in an open innovation team is managing the overall innovation process. The innovation process generally starts with an invention or an idea that is transformed into an innovation by combining different types of technologies, concepts, skills and means (Fagerberg, 2005). At a high level of abstraction, there are three stages that can be discerned (Tidd et al., 2001). First, professionals scan the environment and process relevant signals about opportunities for change. Second, professionals define the project by taking decisions about what the object of innovation will be and how the project should be carried out. Third, professionals develop the product and obtain the resources to implement the product successfully. In each of these phases innovation-process-specific activities are carried out (see for instance Cooper & Kleinschmidt, 1987), which should finally result in a clear and common goal or vision (Paton & McCalman, 2000), agreement on the means that the group should use to reach these goals (Knowles, 1990), well-considered and structured action plans (Kylen & Shani, 2002; Choo et al., 2007) and new ideas or prototypes. It is however very difficult to describe how individuals interact by describing innovation-process-specific activities, since all the actions exhibit a chaotic pattern, especially during the initial period of innovation development (Cheng & Van de Ven, 1996), and may differ in purpose, medium and frequency for different innovation projects (Kratzer et al., 2007). Nevertheless, although

the kind of activities and the desired outcomes may differ, the underlying process common to all these activities is the creation of new ideas or knowledge (Lee & Choi, 2003; Madhavan & Grover, 1998). This process is also referred to as collaborative knowledge creation or learning (Dosi et al., 1998; Kasl et al., 1997). The process of collaborative knowledge creation can thus be said to be the core process of all activities open innovation professionals undertake together, irrespective of the specific innovation context and specific activities. Therefore, the next main activity of open innovation professionals is to manage the collaborative knowledge creation process.

2.2.2 The Collaborative Knowledge Creation Process

There are many ideas about how knowledge flows and grows in groups (Harrison & Kessels, 2004). In order to find the most relevant models that describe the process of collaborative knowledge creation, scientific search engines, for example ISI Web of Knowledge[sm], were used with key words such as collaborative learning, knowledge creation, and team learning. Theories most cited in articles dealing with collaborative knowledge creation or learning in organizational, management, HR, and educational studies were selected. Collaborative knowledge creation is defined here as a specific type of learning, intentional in nature and directed towards delivering a product (knowledge, service or technology). Recently, some scholars developed the knowledge creation metaphor as a way to view learning and to explore how that process takes place (Paavola et al., 2004; Hakkarainen et al., 2004). The idea behind their metaphor is that participation in social activities benefits cognitive processes, and the metaphor strongly emphasizes the aspect of collaborative knowledge creation for developing shared objects of activity (Paavola et al., 2004). As such, the knowledge creation metaphor combines two other metaphors mentioned in the literature: the acquisition metaphor and the participation metaphor (Sfard, 1998). The acquisition metaphor views learning as a cognitive process. Knowledge is understood as a property of an individual mind, in which learning is a matter of construction, acquisition and outcomes, which are realized in the process of transfer (Paavola et al., 2004: p.557). The participation metaphor, by contrast, views learning as a social process. Learning is a matter of participation in practices and actions, where knowledge is acquired by social activities. The two metaphors complement rather than contradict each other and therefore the knowledge creation metaphor was developed. The models used to illustrate this metaphor are: the model of knowledge creation of Nonaka and Takeuchi, Engeström's model of expansive learning and Bereiter's model of knowledge building. In this study, nine models were identified as most relevant to describe the process of collaborative knowledge creation: the knowledge creation model of Nonaka and Takeuchi (1995), the information processing model of Huber (1991), the social learning cycle or the new knowledge flows of Boisot (1986; 1995), the 3-T Framework by Carlile (2004),

the model of work-based learning by Raelin (1997), which has similarities to the experiential learning cycle of Kolb (1984; 1995), Engeström's model of expansive learning (1999), the holistic theory of knowledge and learning by Yang (2003), Beers et al.'s (2005) model of collaborative knowledge construction, the model of knowledge building by Bereiter (2002; Bereiter & Scardamalia, 1993) and collaborative learning by Van Boxtel et al. (2000). The models embody different views on knowledge. Knowledge is for instance viewed as a commodity, a personal capability or as something that is embedded in action and context (Patriotta, 2003). These different views on knowledge are partly related to the aggregation level at which the collaborative knowledge creation process is described. At an organizational level, knowledge is often viewed as a commodity and at the group or individual level as something that is situated in a context, or a personal capability. Although the different models describe the collaborative knowledge creation process at different aggregation levels, a recent study on the Nonaka and Takeuchi model suggests that the models can be applied on different aggregation levels (Schulze & Hoegl, 2006). Table 2.1 compares the models with respect to their aggregation level, view on knowledge and different process stages they describe. Interestingly, four process stages re-appear in many of these models:

1. Externalizing and sharing: Professionals verbalize and share their (implicit) knowledge, information and needs with other professionals. This stage takes place at group level and results in distributed knowledge, often experienced as a chaotic situation.
2. Interpreting and analysing: Professionals absorb what they hear and interpret and analyse it by associating it with their own knowledge. When interpreting the words of others, one is always contextualizing, linking new information to one's own framework, a process that takes place at individual level and often results in different interpretations by different individuals, also referred to as decentralized knowledge.
3. Negotiating and revising: Professionals gather and order these different interpretations and build mutual understandings and meanings for which they sometimes need to revise their own way of thinking. They engage critically but constructively with each other's ideas (Mercer, 2000). This process at group level may result in shared knowledge, or a common communication language (Davenport & Prusak, 1998), shared meanings (Dougherty, 1992) and common ground (Beers et al., 2005) about concepts, ideas, roles, tasks and goals.
4. Combining and creating: Professionals combine different knowledge bases, accumulate and create new ideas. This process, taking place at individual level, results in co-created knowledge, including (depending on the innovation phase) new ideas for innovation, common goals and action plans, which will finally result in an implemented product, process or service.

Table 2.1: Different models of collaborative knowledge creation compared with respect to process stages, foci, levels and nature of knowledge

Model	Process stages						Focus on	Level	Knowledge
		Externalizing & Sharing	Interpreting & Analysing	Negotiating & Revising	Combining & Creating				
Organizational studies									
Knowledge creation (Nonaka and Takeuchi, 1995)	socializing	articulating externalizing			connecting combining	embody-ing, inter-nalizing	External processes, transforming knowledge	Organization Group	Commodity
Information processing (Huber, 1991)	acquiring knowledge	distributing information	interpreting information			organi-zational memory	External processes, transforming knowledge	Organization	Commodity
Social learning cycle (Boisot, 1986;1995)		knowledge diffusion	knowledge absorption	information scanning	problem solving		External processes, transforming knowledge	Organization	Commodity
3-T Framework (Carlile, 2004)		transferring	translating		transforming		Internal and external processes	Group	Personal capability
Work-based learning (Raelin, 1997; Kolb, 1984;1995)		experiencing	reflecting, processing	conceptuali-zing, genera-lizing	experiment-ting, applying		Internal and external processes	Group Individual	Situated in action context
HR studies									
Expansive learning cycle (Engeström, 1999)			reconceptua-lizing	transforming	creating		Activities	Group	Situated in action context
Holistic theory of knowledge and learning (Yang, 2003)	participa-tion, inter-pretation	conceptualizing	contextualiza-tion, systema-tization	validation, legitimization	transfor-mation	material-lization	Internal, external processes, transforming knowledge	Group Individual	Personal capability
Educational studies									
Collaborative knowledge construction (Beers et al., 2005)		externalizing	internalizing	negotiating	integrating		Internal processes, transforming knowledge	Group	Personal capability
Knowledge building (Bereiter, 2002)				asking, answering			Progressive discourse	Group	Commodity
Collaborative learning (Van Boxtel et al., 2000)		verbalization, understanding of concepts	reasoning with concepts	questioning answering, conflict elaboration	generation, comparison, evaluation		Internal processes	Group Individual	Personal capability

Figure 2.2 depicts the process of collaborative knowledge creation, based on the four stages derived earlier and the combination of the two metaphors in the knowledge creation metaphor. Although the figure suggests a sequential process between two persons, it may involve more people, and stages can be skipped or occur concurrently, which is common to processes that have to do with thinking and reflection (Dewey, 1933). Figure 2.2 shows that collaborative knowledge is created in a process in which two (or more) individuals switch between interactive stages and individual stages, and as a consequence results in different kinds of knowledge: knowledge exclusive to the individuals and knowledge common within the group. The model also combines different foci on the process: internal (within an individual) and external (between individuals), and the transformation of knowledge. However, it does not use the kind of knowledge transformation used by Nonaka and Takeuchi (1995), who suggest that knowledge is transformed from tacit into explicit knowledge. The concept of tacit knowledge was developed by Polanyi (1966), but the number of scientists in business management who use this concept as originally intended is limited (Tsoukas, 2003). Polanyi wrote about tacit knowing, a process, rather than tacit knowledge, which is a product. Tacit knowing is about things you know how to do without being able to express them, like keeping balance while cycling. The point Polanyi actually aimed to make was that knowledge is personally bound and cannot be managed. Ironically, it is knowledge managers who mainly use the term tacit knowledge. To avoid the controversies about this concept, this thesis will avoid this term as much as possible.

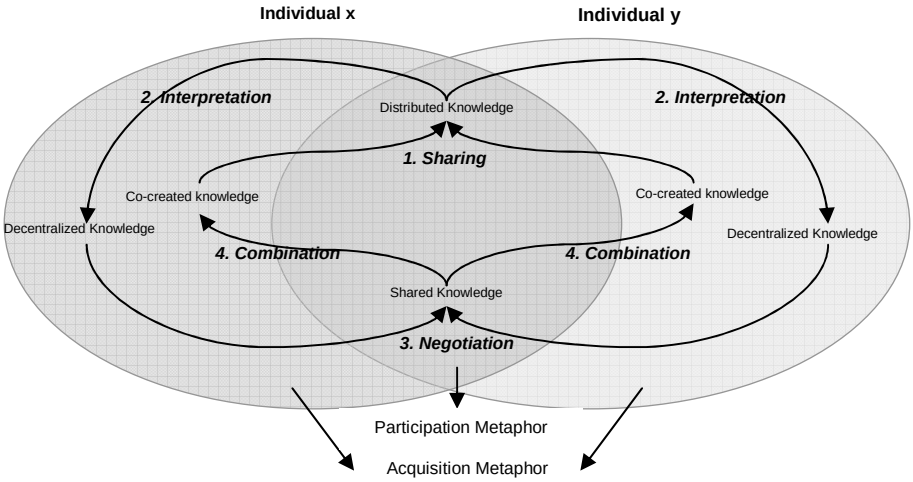

Figure 2.2: The knowledge creation metaphor visualized: the way individuals interact when creating new knowledge collaboratively

As mentioned in Chapter 1, the diversity of organizational backgrounds in open innovation teams might be a source of creativity in the collaborative knowledge creation process, but also a source of social and communicative dilemmas. The inter-organizational collaboration context causes many challenges that need to be managed by the open innovation professionals. The next section will focus on which specific challenges open innovation professionals face, by exploring how typical characteristics of open innovation teams may affect the collaborative knowledge creation stages as visualized in Figure 2.2 and which specific challenges they cause for open innovation professionals.

2.2.3 Challenges Caused by Inter-Organizational Collaboration

Numerous studies mention problems that may occur in open innovation teams such as leakage of information (Szulanski, 2000) and opportunistic learning behaviour (Larsson et al., 1998), but a clear overview of the challenges open innovation professionals face is lacking in organizational, management and HR studies. Organizational and management studies are mainly focused on success stories rather than the failures of relationships and networks (Ritter & Gemünden, 2003a). HR studies tend not to explore how topics such as power differences and political agendas cause problems for learning (Blackler & McDonald, 2000), thereby creating an 'overly romanticized view of collaboration' (Raeithel, 1996). In order to explore the typical characteristics of open innovation teams and how they influence the process of collaborative knowledge creation, a literature search was carried out using key words in scientific search engines and journals in organizational, management, HR, and educational studies, such as learning, (inter-) organizational learning, (open) innovation management, business alliances and networks. It appeared that various streams of literature use different labels for similar or identical concepts (see Appendix A). Whenever empirical studies were available, these were selected and analysed as follows. First, factors at team level that influence collaborative knowledge creation in general were identified. The elicited factors were categorized in a table by discipline and labelled. The diverse factors were clustered using the categories of Mathieu et al. (2008) and labelled as 'team emergent states', 'team composition inputs' and 'team-level inputs'. Team emergent states refer to the cognitive, motivational and affective states that may occur when team members start working together. Team composition inputs refer to the diversity of people assigned to the team and their background and characteristics. Team-level inputs refer to the opportunities given and conditions set by the parent organizations. Next, an additional literature search was carried out to explore the impact of these factors, how they are featured in open innovation teams, and how they influence collaborative knowledge creation in the specific open innovation context. This resulted in a list of challenges for professionals operating in open innovation teams. The following sections describe the findings, which are summarized in Table 2.2.

Table 2.2: Factors influencing collaborative knowledge creation and other factors resulting in challenges for open innovation teams

Categories	Factors	Impact on	Challenges
Team emergent states	Group efficacy	Sharing	1. Being a good partner, but preventing free-riding
	Social cohesion	Sharing Interpretation Negotiation	
	Learning climate	Sharing Interpretation Negotiation	2. Balancing openness and closure and building trust in a non-trusting environment
	Shared cognition	Sharing Interpretation Negotiation Combination Learning Climate	3. Balancing individual and alliance interests, creating common meanings, goals and work plans
	Power differences	Sharing Negotiation	4. Finding a balance between exerting influence and having no influence
Team composition inputs	Team diversity	Shared cognition Power differences Structural composition	
	Team stability	Negotiation Combination Level of uncertainty	5. Fostering optimal dynamics
	Hierarchy	Overall process Leadership	6. Finding a balance between being in control and having no control
	Leadership	Overall process	
	Structural composition	Combination Team Diversity Leadership	7. Deciding when to work together and when apart
	Functional composition	Overall Process	8. Coping with role overload
	Geographical proximity	Sharing	9. Efficiently and effectively organizing teamwork
	Learning history	Learning climate Shared cognition	10. Rapidly building good relationships
Team-level inputs	Autonomy	Resource availability	
	Resource availability	Overall process	11. Mobilizing commitment
	Level of uncertainty	Overall process Resource availability	12. Balancing short- and long-term goals, stability and risk
	Learning future	Overall process Level of uncertainty	13. Sustaining good relationships

1. Team Emergent States

Marks et al. (2001: 357) described emergent states as 'cognitive, motivational, and affective states of teams [that are] . . . dynamic in nature and vary as a function of team context, inputs, processes, and outcomes.' Team emergent states that will be discussed here are: group efficacy, social cohesion, learning climate, shared cognition and power differences.

Group efficacy. Group efficacy is a group's belief in its capability to perform its objectives, which can be a very powerful motivator in a team (Gibson, 1999). A high level of perceived collective efficacy is vital for successful and effective team learning performance (Van den Bossche et al., 2006). A concept underlying group efficacy is reciprocal commitment, which means that a team member is willing to help another team member because he or she may expect that the other team member will return the favour when needed. The concept of reciprocal commitment is derived from social exchange theories

and appears to be positively related to learning and knowledge transfer in strategic alliances (Muthusamy & White, 2005). It is also referred to as equity, defined as 'fair dealing', which does not require that inputs or outcomes are always divided equally between the parties (Ring & Van de Ven, 1994:93). However, in alliances one must be alert for free riders: members who enjoy the benefits of the collective good without contributing to its establishment and/or maintenance (Dyer & Nobeoka, 2000:348). This is also referred to as opportunistic behaviour, which means that an actor uses new ideas unfairly, or takes advantage of the openness of other actors in the network (Teece, 2002). In alliances, it appears to be difficult for partners to contribute human, technological or marketing resources equally. Not only in scale alliances, but also in link alliances (see p. 39 for definition) 'natural conflicts emerge over pricing, the timing of new product releases and who captures the greatest value at different phases of product generations' (Casadesus-Masanell & Yoffie, 2007:584). A major dilemma in alliances is that being a good partner can invite exploitation from partners attempting to maximize their individual appropriation of the joint learning, which undercuts the collective knowledge development (Larsson et al., 1998). Professionals operating in open innovation teams therefore have to find a way to be good partners, while at the same time preventing free riding. They have to motivate members to participate and openly share information, and at the same time prevent undesirable spillovers of strategic information to (potential) competitors (Dyer & Nobeoka, 2000).

Social cohesion. Social cohesion refers to the nature and quality of the emotional bonds of friendship such as liking, caring and closeness among group members (Van den Bossche et al., 2006:499). According to De Dreu (2007), a good relationship is crucial, since conflicts about goals and actions can be solved by collaborative problem solving, but conflicts at the level of relationships, about for example personal taste, political preferences, values or interpersonal style, are far more difficult to solve. The network literature also refers to relational embeddedness, or strong or weak ties (Granovetter, 1983). Organizational learning literature also mentions the concept of care. When organizational relationships are fostered through care, knowledge can be created and shared (Lee & Choi, 2003). Social cohesion is supposed to enhance knowledge transfer, although strong social cohesion may also lead to uncritical agreements within the team and consequently have a negative impact on problem solving (Janis, 1972). Team members of highly socially cohesive teams will focus more on maintaining relationships, tending to seek concurrence, instead of criticizing each others' ideas, which diminishes innovative performance (Sethi et al., 2002). Van den Bossche et al. (2006) found, however, no relationship between social cohesion and team learning behaviours, whereas learning climate was highly related to team learning behaviours.

Learning climate. The learning climate, including elements of psychological safety, team culture and atmosphere, refers to the qualities of an environment that facilitate learning (Knowles, 1990). An optimal learning climate exudes a

spirit of mutual respect for different opinions. There is lenience in judgement, empathy, collaboration rather than competition, access to help and courage; there are people eager to share what they know and feel rather than hold back; there is mutual trust (Knowles, 1990; Zarraga & Bonache, 2003), 'peace' and creative turmoil (Kessels, 2001). Psychological safety ensues from mutual respect and trust among team members (Edmondson, 1999). Trusting one another to be honest, capable and committed to joint aims can lead to, and is a necessary condition for, cooperative behaviour among individuals, groups or organizations, learning and knowledge transfer, experimenting, admitting mistakes, and questioning current team practices, and reducing the fear of taking risks (Dodgson, 1994; Edmonson, 1999; Hausler et al., 1994; Jones & George, 1998; Lee & Choi, 2003; Lundvall, 1988; Uzzi, 1997). Based on other studies, Inkpen & Pien (2006) argue that a high level of trust contributes to information sharing because the holders do not feel that they have to protect themselves against opportunistic behaviour. Too much trust, however, can diminish the innovativeness of a team, since the team members do not check each other's activities anymore (Hite, 2003; 2005). Trust is assumed to be difficult to develop and maintain in open innovation teams. In many new alliances, the partners are often suspicious of each other (Doz & Hamel, 1998), because the team is not governed by traditional hierarchical relationships (Ring, 1997). More permeable organization boundaries provide easier access to external knowledge, but also allow for more rapid dissemination of an organization's unique stock of knowledge outside its boundaries (Matusik & Hill, 1998). Alliance partners may relinquish their competitive position by loss or transfer of core competencies because of the sense of security pressures created through the strategic partnership. The possibility of skill depreciation and the creation of future competitors make professionals suspicious of one another and afraid to leak knowledge, which inhibits open knowledge sharing and honest feedback (Brown & Duguid 2002; Szulanski, 2000). Dodgson (1994), aware of the social problems of collaboration, argues that one of the most important aspects of inter-organizational networking is creating and sustaining trusting or personal relationships between the parties for ensuring effective exchange of knowledge and resources. Yet, a trusting relationship is also developed by sharing information, which makes development and maintenance of trust problematic (Ring, 1997). Professionals operating in open innovation teams, therefore, often encounter the dilemmas of dialogue versus withholding, or openness versus closure, when they want to form an alliance without revealing trade secrets (Khilji et al., 2006) and build trust in a non-trusting environment.

Shared cognition. Shared cognition, or conversely cognitive distance, describes the degree of similarity among actors concerning their representations, interpretations and systems of meaning or beliefs about the types of issues perceived to be important, how such issues are conceptualized, and alternative approaches for dealing with such issues (Cohen & Levinthal, 1990; Simsek et

al., 2003). In this thesis, distinctions are made between differences in conceptualizations, goals and working culture.

Differences in conceptualizations refer to the degree to which team members share the same understanding of certain concepts. Research shows that individuals' perspectives, visions and opinions influence their commitment and contribution to knowledge creation processes (Hofer & Pintrich, 2002). The differences in open innovation teams can be so big that team members no longer understand each other (Horwitz, 2005; Von Hippel, 1994) and stop sharing knowledge. Making different perspectives explicit may help to overcome this problem, but even then, an open reflective dialogue can be complicated by unawareness of the problem, and the fact that individuals find it difficult to view other interpretations of the problem situation and revise their perspectives (Brooks, 1994). In addition, cognitive or information overload can bog down the process, cancelling out the advantage of team diversity (Sethi et al., 2002).

Differences in goals, or conversely task cohesion, refers to the degree of shared commitment among team members to achieve a goal that requires the collective effort of the group (Van den Bossche et al., 2006: 499). Organizational diversity may cause team members from different companies to have similar or competitive aims (Hamel, 1991). Competing goals make balancing individual and alliance interests difficult. This threatens the negotiation stage, since in these situations searching and finding a common goal is almost impossible (Inkpen, 2000). It may cause projects to fail (Bessant et al., 2003), since common goals and common interests are key factors in effective knowledge creation (Senge, 1990). A concern in open innovation teams is therefore how the team members can use their relationships to their advantage, without restricting each other in the pursuit of their individual aspirations (Haakansson & Ford, 2002). Inkpen (2000) views this as the dilemma between competition and cooperation. Jap and Anderson (2003) conclude that (absolute) goal congruence is important only when high levels of opportunism exist among the partners.

Differences in working culture, or business culture, refers to different patterns of basic assumptions between professionals on how to develop solutions to everyday problems, how to take action, how to determine what information is relevant and when there is enough information, and how to know whether to act and what to do (Schein, 1985). Differences in the way of thinking and management methods among the members in open innovation teams can cause serious operational difficulties (Inkpen & Pien, 2006). Different working cultures cause misunderstandings and make it difficult to develop common work plans (Bessant et al., 2003). It may even prohibit collaborative knowledge creation, when the group decides to decompose and work in subgroups (Newell & Swan, 2000; Sethi et al., 2002).

To summarize, the organizational diversity in open innovation teams influences cognitive distance in conceptualizations, goals and work plans. This may cause conflicts that either inhibit or stimulate the sharing, interpretation,

negotiation, or combination stage, and the degree of trust among team members. It is thus a challenge for open innovation teams to balance individual and alliance interests in order to create common goals, meanings and work plans.

Power differences. Power can be seen as the medium of responsible collective action and can depend on factors such as status, position (Thomas-Hunt et al., 2003) or mastery (Blackler & McDonald, 2000). Power strongly influences the ability of people to construct the parameters of debate and the extent to which one's voice is heard (ibid). Learning theories state that interdependence between team members is necessary for achieving desired learning outcomes. Interdependence means, among other things, that participants perceive that they need each other to reach their goals (Johnson et al., 1998). Brooks (1994) found that the production of knowledge occurs either when there is no difference in power between team members or when these differences are controlled. The dispersion of power facilitates information exchange (Bolhuis & Simons, 2001). Muthusamy and White (2006) found the same result in strategic alliances, where mutual power or influence between partners was positively related to learning and knowledge transfer. The presence of dominant network members reduces the willingness of team members to exchange information and feelings of dependency inhibit knowledge sharing (Gulati, 1995). Although traditional hierarchical relationships are lacking in open innovation teams (Ring & Van de Ven, 1992) power differences do exist. Suppliers, for instance, are often more dependent on their buyers than buyers are on their suppliers because of the fear of harming or losing the buyer (Bessant et al., 2003). In addition, it appears that large organizations have lower degrees of dependence and are thus more difficult to influence (ibid). Although power differences have advantages and disadvantages, it is very likely that professionals operating in open innovation teams have to deal with issues such as dominance of a partner, the threat of ostracism and the loss of reputation, which may cause a loss of control or ownership, and negatively influence sharing of knowledge and negotiating in the knowledge creation process. These professionals are therefore challenged to find a good balance between influencing and being influenced (Haakansson & Ford, 2002).

2. Team Composition Inputs

Team composition inputs deal with competency elements of team members and the impact of the combination of such competency elements on processes, emergent states and outcomes (Matieu et al., 2008). The following sections describe the factors team diversity, team stability, hierarchy, leadership, structural composition, functional composition, geographical proximity and learning history.

Team diversity. This factor refers to the degree of demographic, job, expertise and organizational diversity present in the team (D'Abate et al., 2003). It is not yet clear how diversity impacts team output but Van Knippenberg and Schippers (2007) emphasize that multiple dimensions of diversity (social,

information/decision-making) have to be taken into account to evaluate this impact. Demographic diversity is also investigated as multicultural teams and job diversity as interdisciplinary teams (Lattuca et al., 2004) or group heterogeneity (Dillenbourg et al., 1996). The degree of organizational diversity is always high in open innovation, but the degree of job and demographic or cultural diversity may vary across open innovation teams. Studies on business alliances often distinguish between asymmetric and symmetric alliances and between scale and link alliances. In asymmetric alliances, the cooperating organizations differ in size, whereas in symmetric alliances they are about the same size. Scale alliances refer to partnerships in which resources are pooled for activities in the same stage(s) of the value chain (Kalaignanam et al., 2007), also referred to as partner resource similarity (Inkpen & Pien, 2006). Link alliances refer to partnerships in which resources are exchanged for activities performed at different stages of the value chain (Kalaignanam et al., 2007), also referred to as partner resource complementarity (Inkpen & Pien, 2006). Studies on business alliances show that link alliances lead to higher levels of learning between the partners than do scale alliances (Dussauge et al., 2000). Others have found the opposite, stating that groups consisting of potential competitors, i.e. sources of complementary technological or market know-how (scale alliances), were more successful than alliances of buyers and suppliers, i.e. sources of supplementary knowledge (link alliances) (Inkpen, 1996). According to these studies, the great variety in perspectives and partner characteristics actually reduces the creation and diffusion of innovative ideas (Newell & Swan, 2000), and thus the longevity and effectiveness of the collaboration (Parkhe, 1991; 1993). Similarly, some studies in innovation management state that heterogeneous teams with a broad range of skills and experiences promote creativity, innovation and problem solving (McCain, 1996), whereas others find that merely including people from a large number of functional areas does not improve the innovative capacity (Sethi et al., 2002). Homogeneous teams with similar basic knowledge would be likely to be more productive than heterogeneous teams because of mutual attraction of team members with similar characteristics (Horwitz, 2005:224). In educational studies, the effect of interdisciplinary learning on learning outcomes does not seem to be clear yet (Lattuca et al., 2004). Diversity could provide a variety of perspectives and ideas essential for creative combining, but while more ideas may come to the table, sharing information, interpreting, negotiating and combining may become more difficult since team diversity influences the shared cognition among the team members.

Team stability. Stability refers to the rate of entry and exit of members (Gilsing & Nooteboom, 2005). A stable group is expected to be more likely to create a lock-in effect, or ‘groupthink’, than a more flexible group. This implies the danger of developing certain habits and assumptions that make a team blind to new developments (Johannisson, 2000). Although working in teams potentially creates synergies resulting in team outputs that are superior to the collective outputs of individuals, the opposite may also occur (Hackman, 1990).

The danger of routinization with explicit and implicit rules of behaviour and rituals is present in business alliances (Haakansson & Snehota, 1995). This danger will, however, be small in open innovation teams, since the sole constant is the ongoing mix of contributors, tasks and tools, and the long-term pattern associated with it (Engeström et al., 1999). This avoids, on the one hand, the danger of groupthink, but on the other hand, increases the degree of uncertainty in the team, which will be discussed later on. In addition, part-time and temporary participation of team members could result in loss of organizational memory (Van de Ven & Polley, 1992). Therefore, it is necessary to foster a network that, on the one hand, prevents groupthink by allowing entry and exit of network members, but on the other hand remains quite stable with respect to its size in order to keep organizational memory in the network (Dhanaraj & Parkhe, 2006).

Hierarchy. This factor refers to the positions people take in the network and the division of power and the locus of decision making authority and control *within* an organizational entity (Hoang & Antoncic, 2003). A negative relation exists between a strong hierarchy and knowledge creation, since a strong hierarchy appears to inhibit a constant flow of communication and ideas (Lee & Choi, 2003). Groups with flat communication structures positively influence information exchange (Bolhuis & Simons, 2001). In terms of the theory of economic organization, inter-organizational alliances fall between the polar models of markets and hierarchies (Grant & Baden-Fuller, 2004), which means that they are not governed by market relations or formal contracts, ownership and hierarchical lines. The fact that these teams are not governed by traditional hierarchical relationships (Ring, 1997) should have a positive influence on the knowledge creation process. However, it also implies that nobody has the authority to issue commands and none of the members are obliged to obey, which makes influencing, controlling, leading or efficient coordination more complicated (Dhanaraj & Parkhe, 2006; West & Gallagher, 2006). It is thus a challenge for open innovation professionals to find a good balance between being in control and having no control (Haakansson & Ford, 2002).

Leadership. This factor is also called regulation, direction or distribution of responsibilities (Bolhuis & Simons, 2001; Knowles, 1990). It describes the way an innovation team is managed, coordinated or facilitated, which determines, to a large extent, the kind of innovation outcomes (Gieskes & Van der Heijden, 2004). Innovation management literature often stresses the importance of strong and pluralistic leadership in innovation projects that allows for a variety of competing perspectives (Fagerberg, 2005), whereas studies on (organizational) learning stress the importance of self-direction and mutual responsibilities for the success of learning teams (Knowles, 1990). Somech (2006) suggests that the way alliances should be managed depends on the functional heterogeneity, or job diversity, in the team. In a study of 136 primary care teams, Somech found that in teams with high functional heterogeneity, a participative leadership style (‘asking for ideas’) was positively associated with team reflection (which in turn

fostered team innovation). Only in teams with low functional heterogeneity is team reflection positively affected by directive leadership ('setting rules for behaviour'). According to Van Aken and Weggeman (2000), subtle leadership is needed in innovation teams because too little management may lead to the under-exploitation of potential and poor productivity. Too much management, however, may destroy informality and hence the creative and explorative potential of the team. Especially in open innovation teams, it appears difficult to find a good balance between controlling and coordinating (Khilji et al., 2006), since open innovation teams often lack a single overview or centre of control (Engeström et al., 1999). Control is dangerous, but also important (Haakansson & Ford, 2002). It is suggested that in the absence of hierarchical authority, i.e. 'loose coupling', subtle leadership becomes essential (Orton & Weick, 1990).

Structural composition. To describe the network structure, network literature refers to the size, density, structural holes and closure of the network, which influence the amount and quality of resources that one can access (Hoang & Antoncic, 2003; Simsek et al., 2003). The kind of network necessary for successful (open) innovation depends, however, on the complexity of the innovation goals (Gilsing & Nooteboom, 2005). Since the kinds of networks and innovation goals may vary across open innovation teams, it makes no sense to discuss what kinds of challenges structural composition would cause for open innovation teams in general. Innovation management literature refers to hierarchical decomposition (Leenders et al., 2007) or the split-up of the team into subgroups to describe the structure of a team. Highly diverse teams often tend to split up into subgroups because of the problems caused by diversity (Newell & Swan, 2000). The degrees of freedom in the resulting tasks are so low then that creativity is unlikely to happen at all (Enberg et al., 2006). There is also less communication between the team members. In the innovation management literature, successful performance is often associated with promoting direct and extensive communication between members from different functions. Enberg et al. (2006) state that the impact of communication or interaction between team members depends on the homogeneity of the group. In contexts such as project work where frequency of communication and homogeneity are high, work may be successfully undertaken without much communication or interaction between project members, even though substantial computational and epistemic complexity may prevail. Team members of an interdisciplinary team should have close and constant interaction and work together from start to finish (ibid), although this may also increase the possibility of conflicts emerging. Since the diversity in open innovation teams is typically high, they will likely split up into subgroups. This diminishes the possibility of conflicts, but also the team's probability of coming up with (innovative) new combinations. It is therefore a challenge for open innovation teams to decide when to split up into subgroups and when to collaborate collectively (despite the higher risk of conflict).

Functional composition. This factor refers to the roles that are present in the team. It is argued that a healthy balance between different roles is necessary for team success (Belbin, 1993). Belbin (1993) defines nine team roles that seem closely linked to how people behave naturally (the plant, the resource investigator, the coordinator, the shaper, the monitor, the evaluator, the team worker, the implementer, the completer/finisher, the specialist). Innovation literature stresses the importance of a dedicated accountable team leader, who is held accountable for the entire project from the very beginning to the end (Cooper, 1999). Zhang and Doll (2001) propose that an innovation team needs a 'heavyweight manager', someone in the organization who has political influence, who has access to the necessary resources, and who is championed by someone who is an enthusiastic salesperson for the new idea. Reid and De Brentani (2004) suggest that innovation teams need roles that involve championing, boundary spanning, gatekeeping and pattern recognition. No specific literature on roles in open innovation teams was found. However, the important causes for team failure suggested by Belbin (1993), for example competitive roles, absence of certain roles and conflicting team roles, may also pertain to open innovation teams. In addition, the team members may experience role overload, since they need to perform a certain role both in their own organization and in the open innovation team (Marrone et al., 2007).

Geographical proximity. Geographical proximity, also called physical proximity or conversely team dispersion (Hoegl et al., 2007) or distance (Bessant et al., 2003), describes how far team members work from each other. The physical distance influences the way team members have access to one another (Cross et al., 2001) and some studies state that high proximity positively influences the collaborative learning process (Bessant et al., 2003). The geographical proximity in open innovation teams is likely to be low since the team members typically work at different locations. This could make the network inefficient at knowledge sharing, since the speed and ease with which network members can find and access valuable knowledge within the network is slower and costs are higher (Dyer & Nobeoka, 2000). Low proximity should, however, not be regarded as an inconvenience to be overcome or avoided (Hoegl et al., 2007; Kirat & Lung, 1999). It may be an opportunity as these teams can reach higher levels of effectiveness and efficiency than co-located ones if they manage to achieve high levels of teamwork over distance (Hoegl et al., 2007). So, low proximity in open innovation teams could be an opportunity, but also a challenge for the team members to organize the sequence and content of collaborative knowledge creation processes more efficiently and effectively.

Learning history. Learning history has to do with the period of time that team members worked with each other before joining the team (Bolhuis & Simons, 2001). Prior related interaction between the partners has a positive impact on team performance as partners already know each other's business languages or business culture and have learned to trust each other (Zollo et al., 2002). In alliances, inter-partner trust will be increased if they have successfully

worked together in the past (Ring & Van de Ven, 1992). Yet, although companies may have a long-lasting relationship, this does not necessarily imply that the members in open innovation teams share a relationship over time. In many cases, members of open innovation teams do not know each other in advance and thus have no learning history. This threatens collaborative knowledge creation, since there may be different languages in the team and less trust. Since innovation teams in general need to get results as quickly as possible, open innovation professionals are challenged to build good relationships rapidly.

3. Team-Level Inputs

Team-level input factors refer to the opportunities given and conditions set by the parent organizations that could influence the collaborative knowledge creation process in open innovation teams: autonomy, resource availability, level of uncertainty, and learning future.

Autonomy. The degree of autonomy describes the kinds of power relationships that exist between the team and actors *outside* the team (Langfred, 2007) or the decision-making authority (Zellmer-Bruhn & Gibson, 2006). This indicates the degree to which the team is allowed to make its own decisions about the content and results of the innovation process. Team autonomy appears to be positively related to team learning (ibid). There are indications that most (innovation) teams in (large) organizations are not autonomous (Tjepkema, 2002). According to Cooper (1999), the innovation process is characterized, for example, by too many presentations to senior management, too many status reports, and generally too much deference and reporting to senior management, which inhibits the team's freedom to design their own process and ability to enter the market quickly and successfully. It was also found that in alliances, professionals are dependent on their management for obtaining funds, which stimulates them to present over-optimistic plans and triggers a cycle of impression management and uncritical, 'sugar-coated' administrative reviews (Van de Ven & Polley, 1992). However, it was also found that 'within limits close monitoring by senior management signals to team members and the rest of the organization that their project is important, which motivates team members and enhances the team's creativity' (Sethi et al., 2002:17). In addition, greater visibility at management level increases the team's access to organizational resources (ibid).

Resource availability. Resource availability refers to the degree to which team members have access to the necessary resources for performing their tasks successfully. Access to the required resources, whether they are economic, material, legal or intellectual, is needed for successful learning outcomes (Knowles, 1990). Limited financial resources and high costs are important failure factors for innovation projects (Garcia Martinez & Briz, 2000). In most situations, the organization is responsible for supplying enough financial support. There are indications that in an open innovation context the financial

and intellectual support of the parent organizations is often inadequate and inconsistent (Haakansson & Snehota, 1995). So, in brief, sufficient resource availability is not obvious for professionals operating in open innovation teams, because the parent organizations and/or the partners are not very eager to provide them. This negatively influences the success of the overall innovation project. To avoid this problem open innovation professionals face the challenge of mobilizing commitment to provide the necessary resources.

Level of uncertainty. Uncertainty is defined as 'the inability to assign probabilities to outcomes' (Zhang & Doll, 2001:97). Fundamental uncertainty is typical of innovation projects (Schumpeter, 1934) and the level of uncertainty is often high because of the non-linear or disorderly character of innovation processes, instability of the team, and lack of clarity in the information that is circulated (Zhang & Doll, 2001). In addition, long-term goals generate a higher level of uncertainty as they make the causal relationships between decisions and the corresponding results unclear and increase the time span of feedback about the results of decisions (ibid). Apart from these sources of uncertainty, open innovation team members also need to deal with uncertainties regarding the future of their relations, and uncertainty about whether they can trust each other (Ring & Van de Ven, 1994). In such an environment with high levels of uncertainty and at the same time high competitive pressures to 'discover new combinations', a creative turmoil may create the dynamics to leave traditional paths behind and come up with radical innovations (Kessels, 2001). Yet, empirical research shows that a high level of uncertainty (with respect to future costs and benefits) is also an important reason for the failure of many innovation projects (Garcia Martinez & Briz, 2000). Simpson et al. (2000) studied learning groups as complex systems and explained this paradox. According to these authors, learning implies coming to know what is as yet unknown. The outcome is uncertain, which stimulates positive or negative responses, such as explorative or defensive behaviour. It can therefore be a significant challenge for the actors to discover ways of working effectively with these limiting forces in the learning process as well as with its creative dynamics. It is also a challenge for professionals operating in open innovation teams to determine whether, and how, to continue a developmental effort in the absence of concrete performance information (Van de Ven & Polley, 1992), to strive for equilibrium in short- and long-term goals of innovation projects (Hermens, 2001) and to find a balance between stability and risk (Brooks, 1994).

Learning future. Learning future is the period of time participants will collaborate in an open innovation team. The relationship can be short term (less than six months) or long term (many months or even years) (Haakansson & Snehota, 1995). A long-term orientation is likely to empower the collective learning process (Larsson et al., 1998), but more empirical research is needed to discover exactly how and in which situations. Open innovation usually takes quite some time, suggesting that the teams have a long learning future and, thus, time to develop a good working relationship. However, alliance duration is often

uncertain (Kogut, 1991) and a long-term relationship also means that relations must be sustained. It is therefore a challenge for open innovation team members to sustain a good relationship.

2.3 Competency Elements Needed to Perform Main Activities

2.3.1 Identification Strategy

Simply putting a diverse group of individuals together appears not to be a guarantee for successful innovation (Newell et al., 2002) and some authors question the usefulness of diverse teams because of the dilemmas mentioned in section 2.2.3 (Newell & Swan, 2000). Others think that collaboration is in itself neither efficient nor inefficient, but works under certain conditions (Dillenbourg et al., 1996) and needs support (Horwitz, 2005). In this research, it is assumed that an open innovation team can benefit from the members' diverse organizational backgrounds, only if the team members possess the competency elements to perform the activities, including effectively dealing with the challenges. In order to identify the competency elements that open innovation professionals need in order to perform the main activities, literature on learning, (inter) organizational learning, (open) innovation management, and business alliances and networks, in organizational, management, HR, and educational studies were reviewed. From these data sources, a selection was made of previously compiled lists of the relevant competencies required to perform the main activities, including dealing with the challenges. The selection criteria for the competence lists were that they should match with the definition of competence mentioned in section 1.3.3, that they should closely fit the activity or challenge at hand, and that there should be empirical evidence indicating the relevance of the competency elements for the activity or challenge. The next section will describe which competency elements are necessary from a theoretical point of view, resulting in a preliminary competence profile.

2.3.2 Competency Elements to Perform Main Activities

The competence lists that matched the selection criteria best (Table 2.3) were the novelty generating competence described by Schweizer (2006) for the overall innovation process, and the learning competence described by Bolhuis and Simons (2001) for the collaborative knowledge creation process. One overarching competence list was identified that dealt with managing the inter-organizational collaboration process: the boundary spanner competence, described by Williams (2002). Several competence lists were found for dealing with the specific challenges caused by inter-organizational collaboration. Those

Table 2.3: Main activities and selected competence lists, accompanied by main competency elements to perform these activities included in each list

Main activities	Competence lists	Elements
Activities		
Overall innovation process	a) The novelty generation or creativity model (Schweizer, 2006)	• Novelty seeking; • Novelty finding; • Novelty producing; • Innovative performance
Collaborative knowledge creation process	b) Learning competence (Bolhuis & Simons, 2001)	• Learning knowledge (basic knowledge and perceptions); • Learning skills (social skills, reflective skills, meta cognitive skills); • Learning attitude (appreciation of learning domain, learning motivation, self confidence, daring to take risks)
Inter-organizational collaboration process	c) Competencies for boundary spanners (Williams, 2002)	• Building sustainable relationships; • Managing through influencing and negotiation, networking; • Managing complexity and interdependencies; • Managing roles, accountabilities and motivations
Challenges		
1. Being a good partner, but preventing free-riding 4. Finding a balance between exerting influence and having no influence 10. Rapidly building good relationships 13. Sustaining good relationships 11. Mobilizing commitment	d) Political skill (Ferris et al., 2005)	• Social astuteness; • Interpersonal influence; • Networking ability; • Apparent sincerity
6. Finding a balance between being in control and having no control	e) Skills of self-directed learning (Knowles, 1990)	• Engaging in divergent thinking; Accepting feedback; • Diagnosing learning needs; Formulating goals; • Identifying resources for accomplishing objectives; • Designing strategy plan; • Carrying it out; • Collecting evidence of accomplishments
7. Deciding when to work together and when apart 8. Coping with role overload 9. Efficiently and effectively organizing teamwork	f) Teamwork competence (Stevens & Campion, 1994; adapted by Miller, 2001)	• Conflict resolution; • Collaborative problem solving; communication; • Goal setting and performance; Planning and task coordination
12. Balancing short- and long-term goals, stability and risk 5. Fostering optimal dynamics	g) Coping with chaos tools (Eoyang, 1997)	• Managing butterfly effects; • Managing boundaries; • Transforming feedback; • Using fractals; • Using attractors; • Self organization; • Coupling
2. Balancing openness and closure and building trust in a non-trusting environment	h) Key components of trust (Tschannen-Moran & Hoy, 1998, 2000)	• Being benevolent; • Being reliable; • Being competent; • Being honest; • Being open
3. Balancing individual and alliance interests, creating common meanings, goals and work plans	i) Negotiating reality (Friedman & Antal, 2005)	• Openness (treats differences as important opportunities); • Active awareness of own perceptions; • Ability to engage with others to explore assumptions

that matched the selection criteria best were as follows. The political competence list developed by Ferris, et al. (2005) seemed to best fit the challenges related to low reciprocal commitment, power differences, no learning history, longer learning future and low resource availability, which respectively stimulate open innovation professionals to be a good partner, but prevent free-riding; find a balance between exerting influence and having no influence; rapidly build and sustain good relationships; and mobilize commitment. The self-directed learning competence described by Knowles (1990) was selected for dealing with the absence of traditional hierarchical lines, which challenge professionals to find a balance between being in control and having no control. The teamwork competence list developed by Stevens and Campion (1994, 1999; adapted by Miller, 2001) was selected for dealing with low proximity and structural team and functional team composition, which challenge professionals to respectively decide when to work together and when to work apart, cope with role overload, efficiently and effectively organize teamwork, and balance short- and long-term goals, stability and risk. The coping with chaos competence as described by Eoyang (1997) was selected for dealing with low team stability and high levels of uncertainty and for fostering optimal dynamics. The 'key components of trust' developed by Tschannen-Moran and Hoy (1998, 2000) were selected for dealing with low social cohesion and an unsafe learning climate, which make it necessary to balance openness and closure and build trust in a non-trusting environment. Finally, the negotiating competence of Friedman and Antal (2005) was selected for dealing with high diversity and cognitive distances, balancing individual and alliance interests, and creating common meanings, goals and work plans.

2.3.3 Preliminary Competence Profile

The competence lists mentioned in Table 2.3 were put into a framework consisting of two levels: the competence itself and its underlying elements. These were then clustered in four main categories: interpersonal management (for managing the inter-organizational collaboration process), project management (for managing the overall innovation process) and content management (for managing the process of collaborative knowledge creation). Some elements, which mainly had to do with self management, appeared to fit in all three clusters. A fourth cluster, self management, was therefore added to the framework, which can be viewed as a basis for managing all other activities. As a result, a preliminary competence profile for open innovation professionals was constructed consisting of 4 clusters, 13 competencies, and 34 underlying competency elements, based on the identified activities and selected competence lists (Table 2.4). It should be noted that the entire profile is based on a rationalistic multimethod-oriented approach, which means that the competency elements are clustered by activity. There are, however, various possible ways to classify and cluster competency elements. Other groupings can for instance be

Table 2.4: Preliminary open innovation competence profile, consisting of competencies and underlying competency elements for performing the main activities, including effectively dealing with the challenges (c), with reference to literature source

Competencies Is able to…	**Competency elements** The open innovation professional therefore…	**Reference**
Cluster 1: Self management		
Commit oneself	Appreciates the learning domain, has the motivation to learn.	b
Govern oneself (c8)	Has self confidence.	b, a
	Is aware of, and regulates, own thinking.	b, i
	Has perseverance.	a
	Manages tensions created by multiple accountabilities.	c
Cluster 2: Interpersonal management (dealing with challenges caused by inter-organizational collaboration)		
Show social astuteness (c1)	Understands social situations as well as interpersonal interactions. Is sensitive to the roles and responsibilities of all partners, aware of their collaborative motivations and expresses understanding and empathy.	d, c
Influence (c4,11)	Appropriately adapts, calibrates ones behaviour to each situation in order to elicit particular responses from others. Uses influencing skills (as opposed to instructing).	d, c
Socialize (c10,13)	Develops, maintains and uses effective networks. Is approachable, develops friendships easily and strong beneficial alliances and coalitions.	c, d, f
Build trust (c2)	Is honest: possesses high levels of integrity, authenticity, sincerity and genuineness. Can be counted on to represent situations fairly.	h, c
	Is open: shares information freely with others.	h, c
	Is competent: able to perform the tasks required by the position.	h
	Is benevolent: has the best interests of others at heart, protects their interests.	h, c
	Is reliable: ensures that the others can depend upon him/her to come through for them, acts consistently, follows through.	h
	Is assertive, extroverted.	a
Cluster 3: Project management (managing overall innovation process)		
Invent	Seeks novelties, *experiments*. Is sensitive to environment and market oriented. Manages ambiguous situations, takes risks.	b, c
	Picks up signals, sees opportunities, creates vision.	a
	Is pro-active.	a
Control and coordinate (c6,7,9)	Establishes specific, challenging, accepted team goals. Diagnoses, formulates learning objectives in performance outcomes.	f, e
	Coordinates and synchronizes activities, information, and tasks between team members. Designs a plan of strategies. Carries out the plan systematically and sequentially.	f, e
	Identifies human, material, and experiential resources for accomplishing various kinds of learning objectives. Identifies situations for participative group problem solving, using the proper degree of participation, and recognizes obstacles and corrective actions.	e, g
	Monitors, evaluates, and provides feedback on overall team and individual performance. Accepts feedback about his/her performance non-defensively. Collects evidence of accomplishments.	f, e, g
Cope with chaos (c5,12)	Has an overall picture of the project and influencing factors. Understands and manages complexity. Supports many things on his/her mind at the same time.	c, a, g
	Balances short- and long-term goals. Identifies problem.	g
	Deals with unexpected situations, is flexible with plans, deadlines, improvises. Is not too systematic, rigid.	a, g

Cluster 4: Content management (managing collaborative knowledge creation process)		
Externalize	Communicates clearly and understandably. Recognizes open and supportive communication methods.	c, f
Interpret	Has good reflective skills and applies analysis techniques.	b, c
	Possesses basic knowledge and perceptions of various technical/professional areas. Has experience working in partnerships.	b, c, a
	Listens actively: listens with a view to being influenced; is not closed.	b, c
Negotiate (c3)	Openness: treats differences as important opportunities.	i, c
	Is competent in techniques of lateral thinking or divergent thinking.	c, e
	Combines high advocacy (egocentrism) with high inquiry.	i, c, a
	Explores assumptions by knowing when and how to interrupt automatic functioning and brings theories of action into awareness.	i
	Recognizes types and sources of conflict, encourages desirable but discourages undesirable conflict.	f, c
Combine	Employs integrative (win-win) negotiation strategies rather than distributive (win-lose) strategies. Brokers solutions or outcomes.	f, c, a
	Thinks in ways that differ from established lines of thought.	

a) The novelty generation or creativity model (Schweizer, 2006)
b) Learning competence (Bolhuis & Simons, 2001)
c) Competencies for boundary spanners (Williams, 2002)
d) Political skill (Ferris, et al., 2005)
e) Skills of self-directed learning (Knowles, 1990)
f) Teamwork competence (Stevens & Campion, 1994; adapted by Miller, 2001)
g) Coping with chaos tools (Eoyang, 1997)
h) Key components of trust (Tschannen-Moran & Hoy, 1998, 2000)
i) Negotiating reality (Friedman & Antal, 2005)

achieved by focusing on domain (such as procedural and interpersonal competencies) (Woodruffe, 1993), team role (ibid); hard and soft (such as sensitivity and organization) competencies (ibid); threshold (basic competencies needed to undertake the job), and performance competencies (which differentiate between levels of performance) (Boyatzis, 1982, 2008). The competencies taken from the competence lists had sometimes been clustered in alternatives ways and did not always entirely fit the activities at hand. Therefore, they had to be split up into different competencies. Moreover, when the competency elements from the competence lists were put in the framework some overlap emerged. Redundant competency elements were therefore removed from some competencies in the profile. The movement of competency elements to other competencies and the removal of some competency elements, however, were not based on empirical data. The current clustering of the competency elements in the profile therefore needs to be treated with caution.

2.4 Discussion

Inter-organizational collaboration in open innovation teams can spark creativity, but many pitfalls, related to power differences and political agendas for example, make the process difficult and frustrating as well (Crossan & Inkpen, 1995). Given the importance of open innovation projects for organizations, it is crucial to define the competencies required for professionals working in open innovation teams, in order to enable companies to prepare their professionals optimally. The present chapter developed a preliminary competence profile consisting of the essential elements of open innovation competence that are needed for effective performance in open innovation teams (Table 2.4).

The profile was developed based on an inter-disciplinary literature study, combining literature on learning, (inter)organizational learning, (open) innovation management, and business alliances and networks in organizational, management, HR and educational studies. A rationalistic multimethod-oriented approach was adopted to develop the profile, which first entailed the identification of the main activities in open innovation teams, followed by identification of competency elements that are needed to perform these activities. Three main activities were identified: (1) managing the overall innovation process, (2) managing the collaborative knowledge creation processes, and (3) dealing with the specific challenges caused by inter-organizational collaboration. Analysis of the collaborative knowledge creation process led to a richer understanding of how collaborative knowledge creation actually takes place. It resulted in a knowledge creation model (Figure 2.2) that shows how individuals interact at the individual *and* group level, leading to different kinds of knowledge situated at different levels. In this respect, the model fills a gap in knowledge creation theories since the model clearly shows

how knowledge is created on an individual and group level, hereby integrating different views on knowledge.

Analysis of the team characteristics of open innovation teams and the way they can influence the open innovation and collaborative knowledge creation process and/or other factors resulted in a valuable overview of the challenges of working in open innovation teams (Table 2.2). The competency elements required to perform the main activities and the specific challenges were identified by selecting existing competence lists that were developed for similar activities. Combining the different strands of thought resulted in an extensive overview of the processes that play a role in open innovation teams, how they are interrelated, and what can be done at a personal level to optimize them. The different research disciplines appeared to complement each other surprisingly well. In educational studies, for instance, it was hard to find studies on power differences within the team, whereas this literature provides a wealth of knowledge on power differences outside the team, also referred to as autonomy. In organizational studies, the opposite was found. But obviously, more research is needed to test the validity of the findings.

The large number of interrelated factors in the literature challenges the robustness of these findings. For instance, team diversity may be seen as a positive aspect for an open innovation team, but this might be true only when there is a good learning climate. Furthermore, it is not clear whether this interaction between team diversity and learning climate holds for different types of open innovation teams, since the context may also play a role. In addition, there may be other moderating variables, which have not been considered yet. Moreover, many organizational studies use concepts at team level and individual level, but measure them at organizational level. The concept of cognitive distance, for instance, is defined in both educational and organizational studies as the difference in beliefs between individuals in order to measure the diversity in teams. In organizational studies, however, the cognitive distance is operationalized at organizational level by the different types of patents the organization possesses, for example, whereas in other disciplines attempts are made to measure the concept at an individual level. Furthermore, many researchers do not make a distinction between, for instance, team diversity and cognitive distance. They claim to measure cognitive distances by measuring team diversity. However, team diversity in itself does not necessarily imply that there are cognitive distances. It is simply not yet known what the impact of the different measurement methods is on the outcomes of the various studies and therefore one has to be careful when interpreting results and drawing conclusions on what challenges are relevant to explain the success or failure of open innovation teams. Further research should therefore include empirical studies to validate the challenges identified in the present study and the competency elements needed to deal with these challenges to see if all of these elements hold in practice.

2.5 Conclusion

This chapter has resulted in a preliminary competence profile developed based on an extensive literature study. For the study a rationalistic multimethod-oriented approach was adopted, which means that first the activities open innovation professionals should perform were analysed, followed by the identification of the competency elements that are necessary to perform these activities. Two questions guided this study: (1) What are the main activities professionals need to perform in open innovation teams, according to literature? and (2) Which competency elements do professionals need in order to perform the main activities in open innovation teams, according to literature? The activities identified consisted of managing the overall innovation process, managing the collaborative knowledge creation process, and dealing with the challenges caused by inter-organizational collaboration. Thirteen competencies were identified in relation to performing these activities. Figure 2.3 summarizes the outcomes graphically. The resulting preliminary competence profile (Table 2.4), gives a valuable overview of the activities that need to be performed in open innovation teams and the competency elements professionals need in order to perform these activities. More empirical evidence is needed to judge whether the identified challenges, and the competency elements needed to deal with these challenges hold true in practice. The next chapter will address this issue.

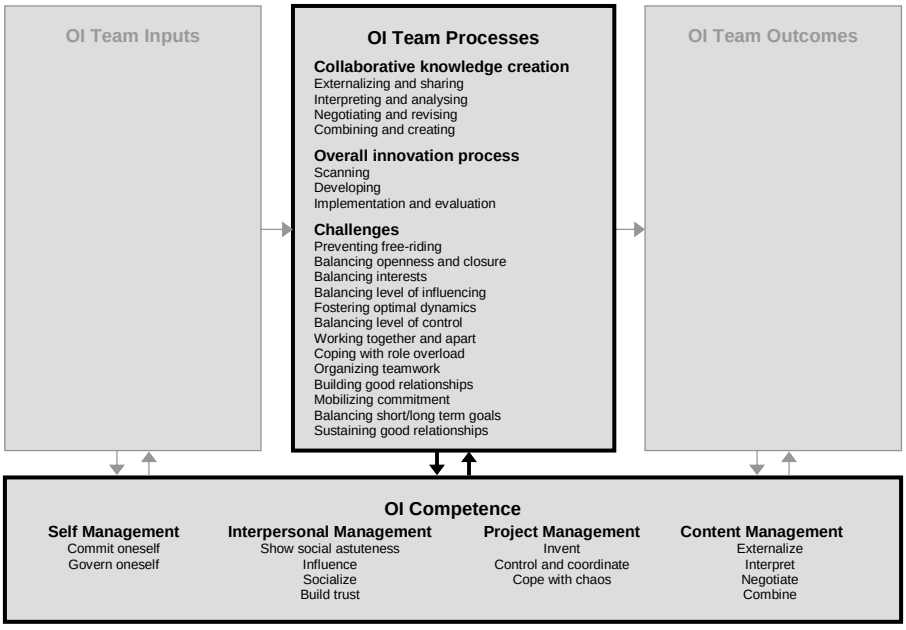

Figure 2.3: Input-Process-Outcome framework for open innovation (OI) teams with activities and competencies defined, based on the findings in Chapter 2

Chapter 3
Elaboration of the Competence Profile*

3.1 Introduction

In Chapter 2, the main activities in open innovation teams and the competency elements needed to perform these activities were identified via a literature study. As argued in the discussion section of the previous chapter, additional empirical evidence is required. This chapter reports the results of the second study that aimed at elaborating the preliminary competence profile by identifying the activities and competency elements empirically through a qualitative study. The focus will be on the challenges that are specific (but not necessarily unique) to open innovation. The research questions guiding this study were:

> *Sub-question a: What are the challenges professionals have to deal with in open innovation teams, according to qualitative empirical data?*
>
> *Sub-question b: Which competency elements do professionals need in order to deal with the challenges in open innovation teams, according to qualitative empirical data?*

The next sections will explain how this study was conducted, and what its results were. Section 3.2 will report how the competency elements were identified empirically. A qualitative study was conducted, consisting of explorative interviews and focus group discussions. The theoretical competence profile constructed in the previous chapter was used to code the data derived from the explorative interviews and focus group discussions. Section 3.3 will report the results followed by a discussion and conclusion in sections 3.4 and 3.5, respectively. Figure 3.1 depicts the focus of this chapter in the input-process-outcome framework.

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* This chapter is based on: Du Chatenier, E. Verstegen, J.A.A.M., Biemans, H.J.A., Mulder, M., & Omta, S.W.F. (in press). Identification of competencies for professionals in open innovation teams. *R&D Management*.

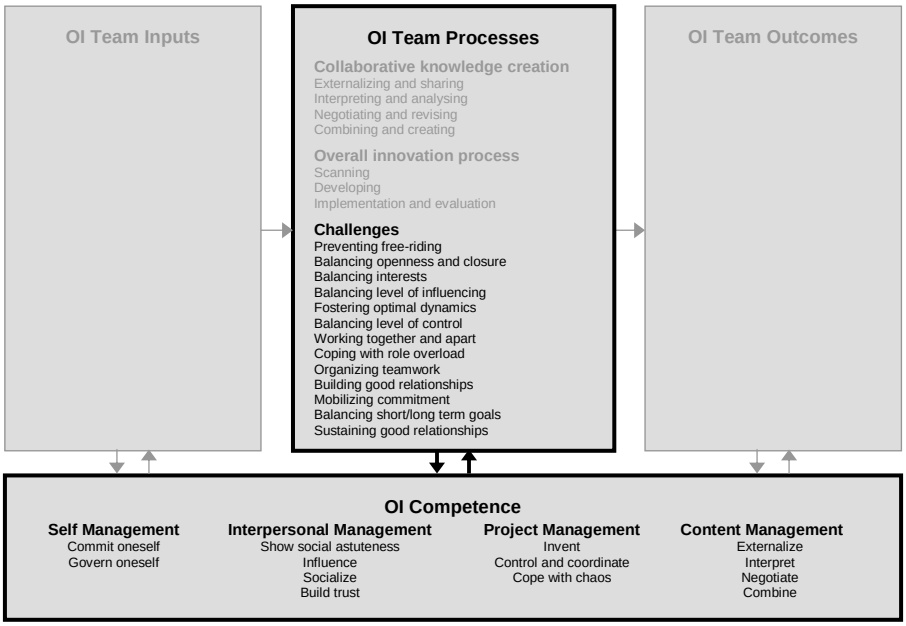


Figure 3.1: Input-Process-Outcome framework for open innovation (OI) teams with in bold the variables focussed upon in Chapter 3

3.2 Methods

Since no competence profiles based on empirical research have yet been developed in the domain of open innovation, qualitative methods were chosen to empirically identify required competency elements and elaborate on the preliminary open innovation competence profile. Two empirical sub-studies were conducted: explorative interviews and focus group discussions. Each of the sub-studies followed a different bottom-up approach.

3.2.1 Explorative Interviews

Seventeen explorative interviews were conducted (three by telephone, fourteen face-to-face) with professionals from different organizations and mediators who had been working in or with open innovation teams (N=20, see Table 3.1). In research with a specific problem statement, 15 to 25 interviews are considered sufficient to cover the possible variety in information (Baarda et al., 2001). A judgemental sample method was adopted to select participants who represent well-known organizations that initiated, participated in, and facilitated open innovation teams in Dutch agribusiness, a sector that is well known for its innovativeness. The main selection criterion was that they have experience

working in several open innovation teams with at least one external partner, through which new products, services or markets were co-developed. The kind of partner and the type of innovation goal were not selection criteria. In total, seventeen open innovation teams were selected, twelve of which were labelled as co-development teams with link alliances (i.e. with customers and/or suppliers), one as a team with a scale alliance (with a competitor), and four as teams with both link and scale alliances. Among these selected teams, for example, was one aimed at developing a glasshouse that not only consumes but also produces energy (involving various partners in Dutch horticulture), and one team with several supply-chain partners aimed at finding solutions to diminish losses in the organic pig supply chain.

The interviews took about one-and-a-half hours each and were semi-structured. They were conducted according to the critical incidents method, which is a key methodology in competence studies that emphasize the human qualities required to perform a particular job (Caird, 1992). The critical incident interview requires professionals to identify and describe the most critical situations they have encountered in their jobs and to specify the most important competency elements needed to respond to these critical incidents (Spencer & Spencer, 1993). Central questions in the interviews were: what was the open innovation team you participated in, what were the challenges/critical situations (typical for open innovation teams), and (how) did you deal with them? The interviewer conducted the interviews in an open and non-directive way. The empirical data were based on self-reporting and allowed for a wide variety of insights into the competency elements needed.

3.2.2 Focus Group Discussions

An alternative method to identify competencies is the use of ratings expressed by 'experts' in, for instance, focus group discussions (McClelland, 1998). Two focus group discussions were held to gain insight into the degree of consensus on competency elements required for operating in open innovation teams. The focus group discussions were organized with representatives of multiple groups that were involved in different aspects of open innovation (see Table 3.1). These groups were: HR and Open Innovation (OI) experts (mediators and consultants), scientists and professionals from different kinds of organizations. All of these 'representatives' were selected based on their experience with and knowledge related to open innovation. Two members of each of the above-mentioned subgroups were invited to participate in each focus group. The wide variety of participants was intended to guarantee a broad range of expertise and more reliable insights into the degree of consensus on the required open innovation competency elements. In practice, however, not every group was represented by two participants, as some had to cancel at the last moment. It also appeared that the selected HR professionals were not actually involved in open innovation processes but dealt with open innovation from a HR perspective.

The focus group discussions were structured similarly to the interviews: they were semi-structured using the critical incidents method. The central questions in the focus group discussions were: can you give an example of a typical open innovation team, what makes this team different from normal teamwork (with respect to challenges/critical incidents), which competency elements or personal qualities are needed by open innovation professionals, and how important are they? Examples given of open innovation teams were one set up to develop an environmentally friendly product label in collaboration with multinationals in the food sector and the government, and one set up to develop a marketing strategy for (high-quality, expensive) Dutch vegetables in collaboration with retailers and growers. The discussions were held in a Group Decision Room, using group decision software. This tool helped to gather and categorize all the answers and subsequently to rate the importance of each answer in an efficient way. For organizing the meeting, the guidelines of the Focus Group Kit by Morgan and Krueger (1997) were used. Each focus group discussion lasted about three hours.

Table 3.1: Goals, methods, subjects and numbers of participants per sub-study

Subjects	**Sub-study 1: Identifying challenges and competency elements**	**Sub-study 2: Identifying and converging challenges and competency elements**	
	Explorative interviews	Focus Group 1	Focus Group 2
OI Professionals			
Retailers	2 (2 interviews, 1 by phone)		
Processors	8 (7 interviews)	1	2
Producers	2 (2 interviews, 2 by phone)		
Knowledge institutes	1 (1 interview)		
Stakeholders	2 (2 interviews)		
HR Professionals			
OI Experts	5 (3 interviews)	2	2
HR Experts		2	2
OI Scientists		2	1
HR Scientists		2	1
Total N	20 (17 interviews, 3 by phone)	9	8

3.2.3 Data Analysis

The data derived from the explorative interviews and focus group discussions were interpreted and coded based on the competence profile derived from the literature study (see Chapter 2). Direct references to competency elements in the explorative interviews and focus group discussions were positioned in the framework next to the corresponding competencies. The quotes per competency element were counted and inserted in the framework as well. Only those competency elements the focus groups agreed upon as being important were used. Competency elements mentioned in the empirical studies but not yet included in the theoretical framework were added to the framework. In order to deal with issues of validity and reliability, Huberman and Miles (1998)

recommend the use of particular 'tactics' for testing or reconfirming conclusions. Creswell and Miller (2000) offer a menu of possible verification procedures, for use in qualitative research studies and recommend the use of at least two in any given study. In this study, two verification procedures were applied: the reports of both the explorative interviews and focus group discussions were sent to the participants for verification and the categorization of quotes in the framework was reviewed by and discussed with peer researchers.

3.3 Results

3.3.1 Challenges Mentioned

In both the explorative interviews and the focus group discussions various challenges were mentioned that were considered specific (but not necessarily unique) to open innovation teams (see Table 3.2). In contrast to the findings of the literature study, four out of thirteen possible challenges were not mentioned by the participants, namely challenges related to structural and functional team composition, learning history, learning future, and complex innovation goals. Challenges related to low proximity and low team stability were only mentioned in some interviews. Challenges related to low reciprocal commitment, power differences, and low resource availability were mentioned in all interviews and one of the focus groups. Challenges related to high diversity and cognitive distances, low social cohesion and unsafe learning climate, absence of traditional hierarchical lines and high level of uncertainty were mentioned in all interviews and both focus groups.

3.3.2 Competency Elements Mentioned

To a large extent, the competency elements mentioned in the interviews and focus group discussions that are required to deal with the challenges mentioned (see Table 3.2) were similar to those found in the literature (see Table 3.3). 23 out of the original 34 competency elements were mentioned during the explorative interviews and both focus group discussions. Nine competency elements were mentioned during the explorative interviews and one focus group discussion. One competency element was only mentioned during the explorative interviews ('manages tensions created by multiple accountabilities'). Only one competency element was not mentioned during the explorative interviews, nor in the focus group discussions ('explores assumptions').

Table 3.2: Team characteristics and related challenges mentioned in explorative interviews (N=20) and focus groups (N=2) in frequencies, illustrated by quotes

Challenge	Inter-views	Focus groups	Quotes
1. Low reciprocal commitment: Preventing free-riding	10	1	'There are too many parasites around.' 'Of course you want to give, but you don't know what you will get back. That makes you more cautious in giving'.
2. Lower level of social cohesion and unsafe learning climate: Balancing openness and closure	8	2	'Working together on a project with your buyer is complicated, as (s) he is in fact also your competitor.' 'Being open and honest is important. You scratch my back and I will scratch yours. On the other hand, everything you say can be held against you.'
3. High team diversity and cognitive distances: Balancing interests	6	2	'There are different working cultures. At the university for instance, they have time to look out of the window and just think things through, but I have to report to my boss every single minute on what I do.' 'In fact, the collaboration shouldn't be complex, but we make it complex because we participate in projects because of strategic and political reasons and not because of the project itself. In that case everybody is pursuing their own interests and not common interests.' 'You have different interests; everyone looks for the solution outside his or her own company.'
4. Power differences: Finding a balance between exerting in-fluence and having no influence	3	1	'It is difficult to give each other direct feedback, because you are quite dependent on your partner and do not want to lose him.' 'I cannot put pressure on the client, and I need to empathize much more to get things done.'
5. Team instability: Fostering optimal dynamics	1	0	'Team members came and went. At some point I didn't know anymore who was doing what, which led to many misunderstandings.'
6. No traditional hierarchical lines: Finding a balance between being in control and having no control	2	2	'When you collaborate inside the company there is already an existing structure of hierarchy, routines, etc. In this situation everything is 'open' again. For instance, who has the right to decide? This has to be fought out with the partner.' 'You don't have any direct responsibilities towards each other, which makes it difficult to call the partner to account concerning his or her conduct.'
7. Structural composition: Working together and apart	0	0	
8. Functional composition: Coping with role overload	0	0	
9. Low proximity: Organizing Teamwork	2	0	'You don't see each other every day, which makes it difficult, as you don't easily know what the other party is dealing with.'
10. No learning history: Building good relationships	0	0	
11. Low resource availability: Mobilizing commitment	4	1	'Getting commitment from higher management, so that they give me enough time and money is difficult because they do not see what I do.' 'I got time from the organization to work on this project, but when it comes to the crunch, they judge me on what has to be ready for tomorrow.'
12. High level of uncertainty: Balancing short/long-term goals	4	2	'The innovation process is not a linear process, it goes in many different directions, and you don't know what is going to happen.'
13. Longer learning future: Sustaining good relationships	0	0	

There were also additions to the competency elements derived from the literature, which are indicated in italics in Table 3.3. More specifically, the competency elements identified in the literature review and mentioned in the interviews and/or one or both focus groups per competency were:

1. Commit oneself: 'appreciates the learning domain and has the motivation to learn'.
2. Govern oneself: 'has self-confidence'. The competency elements 'is aware of and regulates own thinking' and 'has perseverance' were not mentioned by one focus group, and 'manages tensions created by multiple accountabilities' was only mentioned in one interview.
3. Show social astuteness: 'understands social situations'.
4. Influence: 'influencing skills' and 'assertiveness'.
5. Socialize: 'develops, maintains, uses effective networks'.
6. Build trust: 'is honest', 'is open', 'is competent', 'is benevolent'. The competency element 'is reliable' was not mentioned by one focus group.
7. Invent: 'seeks novelties', 'picks up signals'. The competency element 'is pro-active' was not mentioned by one focus group.
8. Control and coordinate: 'coordinates and synchronizes', 'identifies resources'. The competency elements 'sets goals' and 'monitors' were not mentioned by one focus group.
9. Cope with chaos: 'has an overall picture' and 'is flexible and improvises'. The competency element 'balances short- and long-term goals' was not mentioned by one focus group.
10. Externalize: 'communicates clearly'.
11. Interpret: 'has a certain knowledge base' and 'listens actively'. The competency element 'has good reflective skills' was not mentioned by one focus group.
12. Negotiate: 'sees differences as opportunities', 'is competent in techniques of lateral thinking', and 'combines high inquiry with high advocacy'. The competency element 'recognizes and handles conflict' was not mentioned by one focus group, and 'explores assumptions' was not mentioned at all.
13. Combine: 'creates a win-win situation'.

Some competency elements mentioned in the interviews and focus group discussions seem to contradict each other. For instance, on the one hand participants said it was important to use some degree of diplomacy to express things correctly; on the other hand, they mentioned that it is necessary to be straightforward and sometimes even rude. Likewise, it was said that team members have to share their knowledge even if they are not sure, but it was also mentioned that it is necessary to 'share within boundaries'. Also, some participants said that team members sometimes have to put their own goals aside, whereas others said that individual team members should not accept the goals of others and must be able to 'agree to disagree' on certain points. It is necessary to be open, but also have a clear vision of where one wants to go.

Table 3.3: Elaborated open innovation competence profile, consisting of competencies and underlying competency elements for performing the main activities, including effectively dealing with the challenges (c), mentioned in the Interviews (I) and focus groups (F) (in frequencies). Competency elements mentioned in the empirical studies but not identified in the literature are indicated in italics.

Competencies Is able to…	**Competency elements** The open innovation professional therefore…	**I**	**F**
Self management			
Commit oneself	Appreciates the learning domain, has the motivation to learn, *has a sense of urgency, and wants to learn from others.*	7	2
Govern oneself (c8)	Has self confidence. *Knows what his/ her qualities are, does not take the position of the underdog.*	1	2
	Is aware of, and regulates, own thinking *and feeling.*	1	1
	Has perseverance, *keeps on thinking positively, having end-goal in mind.*	7	1
	Manages tensions created by multiple accountabilities, *tasks and roles.*	1	0
Interpersonal management			
Show social astuteness (c1)	Understands social situations as well as interpersonal interactions. Is sensitive to the roles and responsibilities of all partners, aware of their collaborative motivations and expresses understanding and empathy. *Knows how to play the political game.*	9	2
Influence (c4,11)	Appropriately adapts, calibrates ones behaviour to each situation in order to elicit particular responses from others. Uses influencing skills (as opposed to instructing): *position, coalition, stimulation, and knows who to inform and when.*	7	2
Socialize (c10,13)	Develops, maintains and uses effective networks. Is approachable, develops friendships easily and strong beneficial alliances and coalitions. *Develops a team spirit.*	8	2
Build trust (c2)	Is honest: possesses high levels of integrity, authenticity, sincerity and genuineness. Can be counted on to represent situations fairly.	2	2
	Is open: shares information freely with others, *even when not sure. Recognizes the boundaries to sharing, and is aware of the value of knowledge.*	6	2
	Is competent: able to perform the tasks required by the position. *Is professional, takes a role in the group, works independently and is clear about his or her own role.*	3	2
	Is benevolent: has the best interests of others at heart, protects their interests, *shares successes, allows people to make mistakes. Trusts the other party.*	3	2
	Is reliable: ensures that the others can depend upon him/her to come through for them, acts consistently, follows through.	5	1
	Is assertive, extroverted. *Communicates own perceptions and feelings (in a diplomatic way). Is straightforward.*	6	2
Project management			
Invent	Seeks novelties, *experiments*. Is sensitive to environment and market oriented. Manages ambiguous situations, takes risks, *is result oriented, pragmatic.*	3	2
	Picks up signals, sees opportunities, creates vision, *has intuition for innovation*.	3	2
	Is pro-active. *Comes up with ideas him/herself and takes initiatives.*	3	1
Control and coordinate (c6,7,9)	Establishes specific, challenging, accepted team goals. Diagnoses, formulates learning objectives in performance outcomes (*but not too quickly).*	6	1
	Coordinates and synchronizes activities, information, and tasks between team members. Designs a plan of strategies. Carries out the plan systematically and sequentially. *Feels responsible for the team and acts as such.*	6	2
	Identifies human, material, and experiential resources for accomplishing various kinds of learning objectives. *Organizes complementarities.* Identifies situations for participative group problem solving, using the proper degree of participation, and recognizes obstacles and corrective actions.	7	2

	Monitors, evaluates, and provides feedback on overall team and individual performance. Accepts feedback about his/her performance non-defensively. Collects evidence of accomplishments. *Asks many critical questions.*	6	1
Cope with chaos (c5,12)	Has an overall picture of the project and influencing factors. Understands and manages complexity. Supports many things on his/her mind at the same time.	1	2
	Balances short- and long-term goals. Identifies problem. *Discerns sub from main issues.*	2	1
	Deals with unexpected situations, is flexible with plans, deadlines, improvises. Is not too systematic, rigid. *Deals with a flexible team composition.*	6	2
Content management			
Externalize	Communicates clearly and understandably. Recognizes open and supportive communication methods.	4	2
Interpret	Has good reflective skills and applies analysis techniques. *Is critical, but constructive.*	4	1
	Possesses basic knowledge and perceptions of various technical/professional areas *and business languages*. Has experience working in partnerships.	3	2
	Listens actively: listens with a view to being influenced; is not closed. *Is curious.*	8	2
Negotiate (c3)	Openness: treats differences as important opportunities. *Respects, values and appreciates people and their ideas.*	2	2
	Is competent in techniques of lateral thinking or divergent thinking.	3	2
	Combines high advocacy (egocentrism) with high inquiry. *Is aware that he or she represents an organization; refuses to accept less.*	6	2
	Explores assumptions by knowing when and how to interrupt automatic functioning and brings theories of action into awareness.	0	0
	Recognizes types and sources of conflict, encourages desirable but discourages undesirable conflict.	5	1
Combine	Employs integrative (win-win) negotiation strategies rather than distributive (win-lose) strategies. Brokers solutions or outcomes.	12	2
	Thinks in ways that differ from established lines of thought. *Agrees to disagree (lose-lose strategy). Considers common goal as most important. Adapts without violating own ideas.*		

Similarly, one has to build on the ideas of others, but also be critical about these ideas. Apparently, there is not one single road to optimally deal with some challenges.

The top three most frequently mentioned competency elements are related to being able to (1) combine: 'creates a win-win situation' (2) show social astuteness: 'understands social situations' and (3) socialize: 'develops, maintains, uses effective networks', and (4) interpret: 'listens actively'.

The top three least frequently mentioned competency elements are related to being able to (1) negotiate: 'explores assumptions' and (2) govern oneself: 'manages tensions created by multiple accountabilities' and (3) 'is aware of and regulates own thinking'.

3.3.3 Elaborated Competence Profile

Table 3.3 shows the adapted and elaborated competence profile. It shows how often each competency element was mentioned during the interviews and focus group discussions. Competency elements mentioned in the empirical studies and not identified in the literature are indicated in italics.

3.4 Discussion

Given that the preliminary competence profile based on the literature study (see Chapter 2) needed to be supported by empirical evidence, the present chapter explored the challenges of open innovation and competency elements professionals need in order to perform well in open innovation teams through a qualitative empirical study, resulting in the elaborated competence profile presented in Table 3.3. Participants were asked to mention critical incidents or challenging situations that are specific (but not necessarily unique) to an open innovation context, and describe how they dealt with those critical incidents. The advantage of the methods used is that the competency elements were identified by the participating professionals themselves and by other innovation experts. The critical incidents technique seems to be a good method to bring valuable knowledge forward; but some information still remained vague. It was therefore also necessary to ask for concrete examples and explicit details about who, what, when, and where, in order to bring more background information to the table.

Challenges that were mentioned as being specific to an open innovation context included low reciprocal commitment, low social cohesion and unsafe learning climate, high diversity and cognitive distances, high level of uncertainty, low resource availability, absence of traditional hierarchical lines, and power differences. For instance, to build trust, open innovation professionals need to share all necessary information, but often that is not

possible, for instance for confidentiality reasons. To create a safe learning climate it is necessary to tolerate mistakes, but often this is not possible because it costs too much money. The challenges found in literature not mentioned during the interviews and focus groups had to do with structural and functional team composition, learning history and learning future. These challenges might not be as specific to an open innovation context. Alternatively, these are challenges at a higher abstraction level. Nevertheless, for all competency elements identified from the literature (except for one), empirical support was found illustrating how open innovation professionals deal with their challenges. The three least frequently mentioned competency elements concerned higher cognitive capabilities. The fact that they were not mentioned frequently does not necessarily mean that they are less important for open innovation professionals. Coming up with these competency elements usually takes deeper and longer reflection than can be reached in a single interview or focus group discussion. The competency element 'explores assumptions' can be removed from the profile, since no empirical evidence was found for it.

Some competency elements were added because of this empirical study. These nuanced the competency elements derived from literature, but led to contradictions or paradoxes as well. For instance, one has to adapt one's behaviour to the external partner, but not one's own ideas. One has to protect one's own interests, but let them go at the right time as well. One has to be open to other ideas, but in the end strive for one's own vision. One has to share knowledge in order to build trust, but treat knowledge confidentially as well. One has to secure one's own ideas and at the same time negotiate, combining different ideas. One has to work in an organized way, but at the same time be flexible. This fits the idea of 'paradoxical perspective' of Denison et al. (1995), which implies that effective behaviour is formed by the capacity to recognize and react to paradox, contradiction and complexity in the environment.

The competency elements that seem most important for most open innovation professionals concern brokering solutions and being socially competent. However, the challenges mentioned varied among different kinds of respondents, and there is a great variety of answers in the interviews and (seemingly) contradictory competency elements. The variety of answers might be a result of the specific backgrounds of the respondents and their innovation contexts. The respondents participated in different open innovation teams, which varied in alliance type, the way they were financed, initiated, and facilitated, and in innovation goals. Especially the alliance type could influence the competencies and competency elements needed (see Chapter 5 for a further discussion of this topic). A relevant question therefore is whether the competency elements that were identified are relevant for all types of open innovation professionals or whether open innovation competence contains multiple opposing behaviours simultaneously. On the other hand, in accordance with the paradoxical perspective, the many challenges in open innovation teams might require professionals to show (seemingly) opposing behaviours at

different times. The respondent group in this study was too small to investigate this issue in depth, so more empirical evidence on the profile needs to be gathered.

Moreover, this study did not focus on the clustering of the competency elements. The preliminary competence profile developed in the previous chapter was taken as a framework to code and cluster the empirical data. As mentioned in section 2.3.3, however, the clustering of the competency elements is disputable. Some findings in this study possibly indicate that the current clustering of the competency elements is not adequate. For instance, the challenges related to learning history and future, and structural and functional team composition were not mentioned themselves, but all competency elements associated with these challenges were mentioned in the context of other challenges. This could indicate that the competency elements needed to deal with these challenges were also needed to deal with other challenges, which implies that the categories have fuzzy borders and the clustering is not yet adequate. Also, the procedure used to categorize the quotes is susceptible to interpretation, which endangers an adequate clustering of the competency elements. It is important to have valid competency clusters, since this would enable an appropriate analysis of which competencies are of importance. Further research should therefore focus on an adequate clustering of the competency elements. More respondents are required to obtain sufficient empirical data and to use more quantitative methods for clustering the competency elements.

3.5 Conclusion

To conclude, this empirical study has resulted in an elaborated competence profile for open innovation professionals, which adds a new perspective to the field of open innovation management. The present study explored the competency elements professionals need to deal with challenges that are specific (but not necessarily unique) to open innovation teams. Two research questions guided this chapter: (1) What are the challenges professionals have to deal with in open innovation teams, according to qualitative empirical data? and (2) Which competency elements do professionals need in order to deal with the challenges in open innovation teams, according to qualitative empirical data? Explorative interviews and focus group discussions were conducted, resulting in a list of challenges that are specific to open innovation teams and an elaborated competence profile (see Table 3.3). Figure 3.2 summarizes the outcomes of this study graphically. The framework gives a valuable overview of the competency elements that might be necessary for open innovation professionals, but since the analysis of the empirical data was interpretative, more research is needed to validate the robustness of the findings and the way the competency elements are clustered. The next chapter will address this issue.

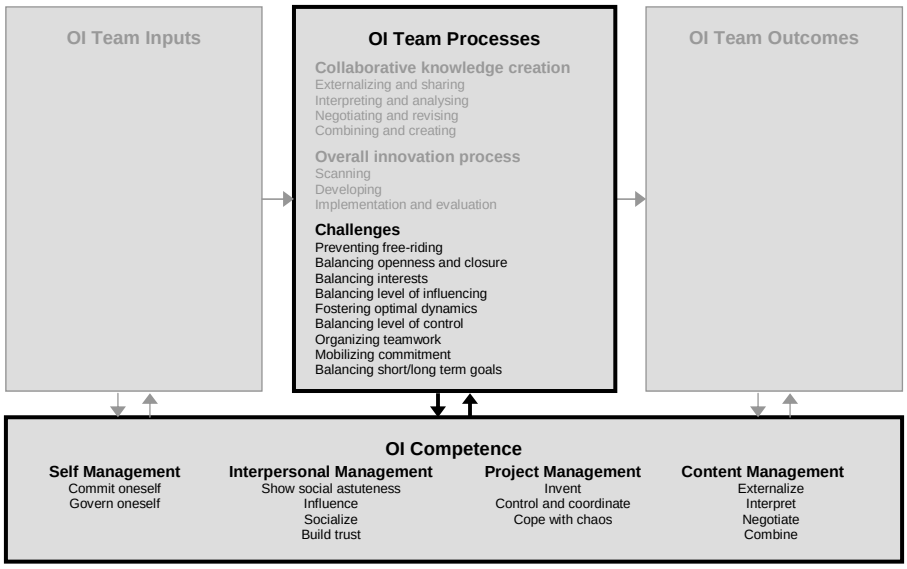


Figure 3.2: Input-Process-Outcome framework for open innovation (OI) teams with identified challenges and competencies, based on the findings in Chapter 3

Chapter 4
Validation of the Competence Profile

4.1 Introduction

The previous studies described in Chapters 2 and 3 resulted in a valuable overview of activities performed and competency elements needed by open innovation teams, which were clustered in a competence profile. However, the constructed profile is based on relatively little empirical evidence, and its validity is therefore disputable. This chapter therefore aims at validating the profile that was developed, using the quantitative approach of asking a larger group of open innovation professionals how often they used the competency elements identified, and how important these competency elements were for their role in an open innovation team. Moreover, it appeared that the manner of clustering the competency elements into competencies presented in the earlier chapters is debatable (see section 2.3.3 and 3.4). So, this chapter also investigates an optimal clustering of the competency elements. The research questions this chapter addresses are the sub-questions b and c below. Sub-question b addresses the relevance of the identified competency elements, which is defined as the combination of importance and frequency of use of the competency elements.

> *Sub-question b: How relevant are the competency elements identified in the previous two studies for a larger group of open innovation professionals?*
>
> *Sub-question c: What is the optimal clustering of the identified competency elements in the competence profile?*

Section 4.2 will describe the methods used to investigate these research questions. Section 4.3 will elaborate on the results. Section 4.4 will discuss the results and section 4.5 summarizes the chapter. Figure 4.1 depicts the focus of this chapter in the input-process-outcome framework.

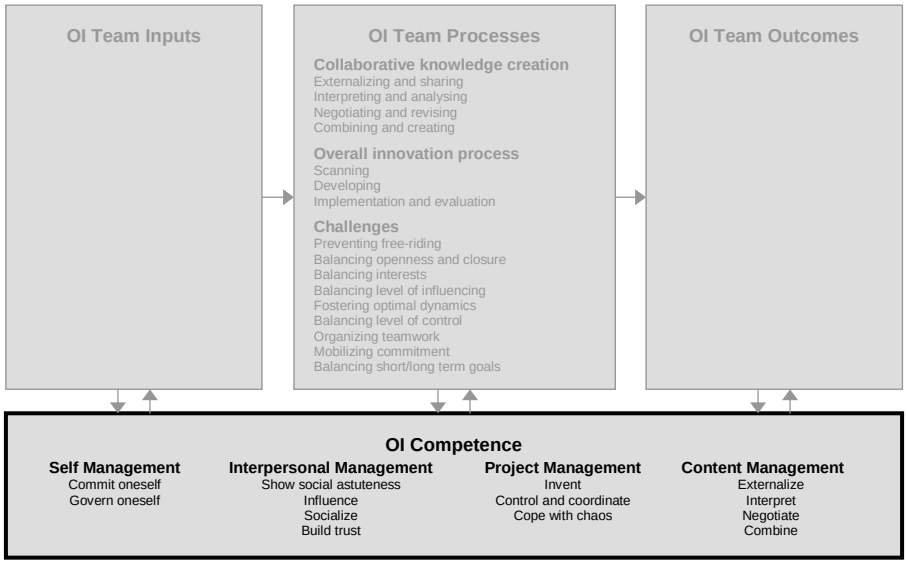


Figure 4.1: Input-Process-Outcome framework for open innovation (OI) teams with in bold the variables focussed upon in Chapter 4

4.2 Methods

4.2.1 Data

A cross-sectional web-based survey approach was adopted to measure how often the earlier identified competency elements are applied and how important they are perceived to be by a larger group of open innovation professionals. The survey method has proven to be an adequate means of validating earlier findings (see section 1.4). A major advantage of online or web-based questionnaires is that the data are automatically transferred to a database, which avoids mistakes in data processing (Thomas, 2004). In survey research, the emphasis is on adequate sampling and representation of the target population (Krathwohl, 1998); in this case the population of open innovation professionals. Since the population of open innovation professionals is not registered, the following steps were taken to select the professionals. First, it was decided to focus on organizations which are thought to be innovation leaders in their fields or so-called prospector companies, assuming that the chance of finding open innovation teams would thus be high (Fortuin et al., 2007). Prospectors differentiate themselves from their competitors, by using their ability to develop innovative technologies and products and being 'first-to-the-market' with a new product or service (Miles et al., 1978). The ten largest Dutch companies in the agrifood sector, including for instance Unilever and Heineken (Ministry of Agriculture, Nature and Food Quality, 2006), were approached, and four

companies expressed a willingness to cooperate. Three of these companies had to withdraw at a later stage because of internal reorganizations, which made talking about competencies a sensitive issue. Since this reduced the number of available cases too drastically, an additional group of organizations, also known to be prospectors, was approached. Through Wageningen University's network, one extra multinational chemical company, one more company in the agrifood sector and one consultancy firm in the public sector were approached. In each organization, one contact person who had a good overview of open innovation processes taking place in the organization was asked to select complex open innovation teams that (a) dealt with radical innovation, (b) had completed the innovation process (in order to enable an optimal judgment of which competency elements were needed), and (c) included real co-development partnerships, according to the definition of open innovation teams. This resulted in fifteen open innovation teams. 118 open innovation professionals who took part in these teams were asked to complete an online questionnaire. A modified version of Dillman's (2007) Tailored Design Method (TDM) was used in this study. In other survey studies, TDM has proven to be useful for maximizing response rates (De Rada, 2001). The procedure consisted of a notification message from the project leader, an introduction letter with the link to the questionnaire from the researcher and up to two reminders to non-respondents. Because competencies may be considered a private matter, participants were informed that their data would be kept strictly confidential.

After the survey, group interviews were held with two teams to evaluate the accuracy of the response, to check whether the questions were understood as intended and whether the answers were interpreted in the right way. The two open innovation teams selected for the group interviews differed with respect to country and organization, but they were both in the industrial sector. The main selection criteria were that the teams showed a high response rate (> 67%) to the questionnaire and that it would be possible to organize a group meeting with the team members. For one team three of the five respondents could come together and for the other team five out of ten. During the group interviews, a document was distributed showing the team mean scores and standard deviations on the competencies, followed by team mean scores and standard deviations for each competency element. This approach did not affect the anonymity of the respondents, because only team scores were discussed. For each competency element, the team members in the group were asked: Is the result recognizable; is it true that this competency element was (or was not) important or frequently used in the project? If the participants in the group interviews felt that the result was counter-intuitive, they were asked to indicate what they believed it should have been and what the reason could be that the survey results deviated from the actual practice. Finally, possible gaps in the survey were discussed. The interviews took place in the organizations, lasted about three hours, and were recorded on tape and transcribed.

4.2.2 Measures

The items used to measure the competency elements were derived directly from the competence profile as presented in Table 3.3. For each competency element that was identified in the literature study and that was confirmed by the qualitative study, an item was constructed. No items were included for competency elements that were mentioned in only one study (thus only during the interviews or only in the focus groups), were too detailed or were not specific to open innovation teams (i.e. were also applicable to normal project management, see Table 4.1). The remaining competency elements were translated into statements (referred to here as items) that were thought to capture the meaning of each competency element. In total 47 items were constructed (see Table 4.2) in accordance with the following criteria: they had to be simple and clear, well written, free of jargon, unambiguous, have appropriate emphasis and be free of biased words or phrases (Spector, 1992). Some items were derived from other instruments; this is indicated with a footnote in the table.

Respondents were asked the following questions: 'Looking back on the collaboration process… To what extent did this statement apply to you? How important was this for your role in the project?' Five-point rating scales were used to measure the competency elements' frequency of use (1: never; 2: seldom; 3: sometimes; 4: often; 5: always) and importance (1: very unimportant; 2: unimportant; 3: neutral; 4: important; 5: very important). The items were clustered per competency cluster, which was communicated to the respondents through the page headers 'Self Management', 'Interpersonal Management', 'Project Management', or 'Content Management'. Apart from the competency elements, respondents were also asked to mention their age, gender, job or function in organization, name and location of organization they work for, name of the project they completed the questionnaire for, and work experience with innovation (and specifically with open innovation).

Table 4.1: Competency elements not used for the survey, with reason for non-inclusion

Competencies	Competency elements	Not included, because…
Self Management		
Commit oneself	Appreciates the learning domain.	normal project management
Interpersonal Management		
Influence	Influences by using position, coalition, stimulation.	too detailed
Build trust	Benevolent trust: Shares successes.	only mentioned in one study
Project Management		
Control and coordinate	Designs a plan of strategies. Carries out the plan systematically and sequentially. Feels responsible for the team and acts as such.	normal project management
	Provides feedback on overall team and individual performance Accepts feedback about his/her performance non-defensively.	normal project management
Content Management		
Interpret	Is constructive.	only mentioned in one study
Combine	Agrees to disagree (lose-lose).	only mentioned in one study

Table 4.2: Overview of the survey items by competency, based on the profile presented in Table 3.3

Competencies and Items	
Self Management	
Commit oneself	a1 I had a sense of urgency to work on the project and make it a success
	a2 I personally felt the need to learn from others outside my own department/organization
Govern oneself	b3 I had confidence in my own qualities
	b4 I knew what kind of qualities I could and could not bring to the team
	b5 My feelings about situations/team members did not negatively affect my performance
	b6 While doing activities for the project I managed to focus, despite other tasks and responsibilities I had outside the project
	b7 I looked for opportunities in every situation, even when set backs occurred
Interpersonal Management	
Show social astuteness	c8 I understood that other members had other roles and responsibilities and therefore had other drives and motivations
	c9 I knew when and how to inform certain people for strategic reasons
Influence	d10 I was able to use influencing skills to get others to do things the way I wanted to
	d11 I knew how to play political games
	d12 I recognized problems and conflicts and dealt with them openly
Socialize	e13 I created a team spirit (one for all, all for one)
Build trust	f14 I kept information that could harm the team or particular team members confidential
	f15 I shared all the necessary knowledge to ensure the success of the team
	f16 I did not share confidential company information although it was asked for in the project
	f17 I had enough authority inside and outside the organization to get things done
	f18 I consciously took my own role in the group and worked independently
	f19 When making decisions about the project, I took the consequences for others into account*
	f20 I allowed the team members (including myself) to make mistakes
	f21 I trusted the personal qualities of the other team members
	f22 I did what I said I would do
Project Management	
Invent	g23 I tried out or experimented with new things
	g24 I picked up signals, identified and created chances and possibilities
	g25 I had a clear vision of what I wanted to obtain with the project
	g26 I initiated activities and took care that things got done
Control and coordinate	h27 I made decisions and set priorities and goals
	h28 I had enough communication with my team members to do my work efficiently and in an effective way†
	h29 I knew when and how to involve people with certain professional backgrounds
	h30 I made the results of my own work and teamwork visible, e.g. by documenting them
Cope with chaos	i31 I kept an overall view of the innovation process
	i32 I found a good balance between long term and short term goals
	i33 I was able to deal with chaotic, uncertain, and unexpected situations
Content Management	
Externalize	j34 I got my messages across very clearly
Interpret	k35 I was good at analysing information, linking together different points of view and drawing conclusions
	k36 I criticized ideas, statements, and/or opinions of others
	k37 I knew the (organizational) cultures of the other team members and spoke their languages
	k38 I was good at my job and possessed relevant knowledge
	k39 I was curious to know what the other team members thought and had to say
Negotiate	l40 I recognized and appreciated the ideas of others even when they looked very odd to me
	l41 I was able to see the same problem from many different perspectives
	l42 I found out why people thought what they thought, by e.g. raising the right questions
	l43 I pushed my own ideas forward, not adopting the ideas of others
	l44 I detected misunderstandings between different team members and made them explicit
	l45 I did not avoid conflicts, but used them as learning opportunities
Combine	m46 In striving for agreement I was able to combine conflicting ideas into win-win situations
	m47 I abandoned my own ideas, estimating the success of the team as more important than my own

* Muthusamy and White (2006)
† Fortuin et al. (2007)

Three peer researchers in HRD and management studies reviewed the survey items to judge whether the items measured the competency elements well enough or matched the competency elements as described in the profile. The questionnaire was also checked by pre-testing it on another peer researcher, one expert on developing questionnaires and three contact persons at the organizations involved in the research. They were asked whether the layout of the questionnaire was adequate and, more importantly, whether the survey items had the right content, scale, and response mode and were not ambiguous or confusing. This face validity check did not lead to major changes. The items were found to be adequate and there were only some comments about language use, which led to minor revisions.

4.2.3 Data Analysis

The data were analysed in four steps. First, to detect any non-respondent bias, the group of professionals who responded to the survey was compared to the group of professionals who were approached but did not respond. The respondents' profiles were also analysed with respect to sector, size of the organization, country, job, gender, age, and work experience with innovation. These variables were described by frequencies and percentages to get insight into the composition of the actual respondent group. The jobs of the respondents were categorized into four main categories: overall (project) management, product development and technology, quality assurance or production management, and marketing or account management (see Appendix B). Second, frequency tables were used to get an indication of the frequency of use and importance of the competency elements. Third, in order to test for a matrix effect, i.e. to see whether respondents rate a particular item the same on two different scales, the correlation between the two scores was calculated. In addition, remarks made during the group interviews about unrecognizable item scores were analysed. Fourth, an exploratory factor analysis was conducted. Since there was relatively little theoretical and empirical basis to make strong assumptions about how many common factors exist, this approach was more applicable than confirmatory factor analysis (Fabrigar et al., 1999). The common factor model (Principle Axis Factoring) was used as extraction model, in order to understand the latent structure of the set of competency elements (Conway & Huffcutt, 2003). Oblique rotation (Oblimin, structure matrix) was used since there is a substantial theoretical and empirical basis for expecting constructs about human behaviour to be correlated with one another (Costello & Osborne, 2005; Fabrigar et al., 1999). Oblique rotations provide accurate and realistic representations of how constructs are likely to be related to one another, whereas orthogonal rotations are often unwarranted and can yield misleading results (Fabrigar et al., 1999). This strategy was adopted for both the scores related to frequency of use and importance. The two resulting factor solutions were compared to identify common factors, since items that belong to the same

construct should be clustered together regardless of the kind of scale used (Spector, 1992). Once these factors were identified, an internal consistency reliability analysis was conducted to find out if the scale underlying an identified factor reliably measured a dimension. Cronbach's α was calculated for all scales, taking .60 as the lower limit that is acceptable for exploratory research (Hair et al., 1998), although values of .50 do not seriously attenuate validity coefficients (Schmitt, 1996). As a final check, separate factor analyses were conducted for each newly derived construct to determine if the construct really contained one single underlying dimension. Finally, the competence profile was adjusted according to the results of the factor and the internal consistency analyses.

4.3 Results

4.3.1 Respondent Group Description

Of the 118 open innovation professionals approached, 73 completed the questionnaire, which gives a response rate of 62% (see Table 4.3). For confidentiality or practical reasons, it was not possible to approach every member of each team. In some cases, one or two professionals had already left the organization. A more significant problem was that in five cases the researcher had to agree not to contact the team's external partners (which is, perhaps, a clear example of the communication dilemmas in inter-organizational collaboration). As a result, for six of the fifteen teams approached, the voice of external partners was missing.

The open innovation professionals who responded to the questionnaire came from 22 different organizations, varying in sector and size, although industrial and multinational companies were dominant (Table 4.4). The companies were mainly situated in the Netherlands (63.0%) and Spain (24.7%).

Most respondents were product developers or product managers (39.7%), marketing or account managers (27.4%) or overall (project) managers (26.0%). A few respondents worked in the field of quality assurance or production management (6.9%). About two thirds were male (68.5%) and one third female (31.5%), with an average age of 42 (*SD* 9.4). On average, the respondents had nine years of work experience with innovation projects and six years with open innovation projects.

Table 4.3: Per team, initiating organization, response rate, the type(s) of team members who were not asked to participate, the type of team members who did not respond, and the resulting gaps in the responses (internal or external partners, or a mix of them)

	Project initiated by…	No. approached	No. that responded	Response rate	Type of team members not approached	No response from…	Resulting gap in responses
Team 1	Company A	20	14	70%	n/a	n/a	n/a
Team 2	Company A	16	13	81%	n/a	n/a	n/a
Team 3	Company A	12	7	58%	n/a	External	External
Team 4	Company A	10	6	60%	External partners	Internal	External
Team 5	Company A	13	6	46%	n/a	Internal	n/a
Team 6	Company A	5	3	60%	n/a	n/a	n/a
Team 7	Company B	5	5	100%	External partners	n/a	External
Team 8	Company B	3	2	67%	External partners	n/a	External
Team 9	Company C	3	3	100%	External partners	n/a	External
Team 10	Company C	1	1	100%	External and internal partners	n/a	Mixed
Team 11	Institution I	6	4	67%	n/a	n/a	n/a
Team 12	Institution I	5	2	40%	n/a	n/a	n/a
Team 13	Institution I	5	2	40%	n/a	n/a	n/a
Team 14	Consultancy I	9	4	44%	n/a	n/a	n/a
Team 15	Consultancy I	5	1	20%	n/a	n/a	n/a
Total		118	73	62%	External partners	Mixed	External

Table 4.4: Composition of the respondent group, by sector, size of the organization, country, job, gender, age, and experience with innovation and open innovation

Variable		N	Percent
Sector	Industry	60	82
	Agriculture	2	3
	Services	5	6
	Wholesale and retail	4	6
	Public	2	3
Size of the organization	Very large (>1000 employees)	64	87.8
	Large (250-1000 employees)	2	2.7
	SME (<250 employees)	7	9.6
Country	Germany	2	2.7
	Spain	18	24.7
	England	6	8.2
	The Netherlands	46	63.0
	Poland	1	1.4
Job	Product development & technology	29	39.7
	Marketing/Account management	20	27.4
	Overall (project) management	19	26.0
	Quality assurance /Production management	5	6.9
Gender	Male	50	68.5
	Female	23	31.5
Age	<25 years	1	1.4
	25-34	14	19.1
	35-44	31	42.5
	45-54	16	21.9
	>54	11	15.1
Experience with innovation	<5 years	24	32.9
	5-10	27	37.0
	>10	22	30.1
Experience with open innovation	<5 years	34	46.6
	5-10	30	41.1
	>10	9	12.3

4.3.2 Relevance of the Competency elements

Table 4.5 shows the percentages of respondents who rated the importance and frequency of use on each item as > 3. The percentage of respondents who rated the items as important or very important ranges from 36.9% to 94.6%. Only three items were rated by less than 50% of the respondents as being important or very important. This means that 44 items, by far the majority, were considered to be important by more than 50% of the respondents. The percentage of respondents who rated the frequency of use of the items as often to always ranges from 13.7% to 95.9%. Only nine items were said to be used often to always by less than 50% of the respondents. This means that 38 items, also by far the majority, were used often to always by more than 50% of the respondents. The nine items that were applied often to always by less than 50% of the respondents are the same as those with the lowest average scores, with one exception (f20 'I allowed the team members (including myself) to make mistakes'). The average scores for importance of the separate survey items range from 3.07 to 4.37. The average scores for frequency range from 2.49 to 4.49, which is a larger range compared to the scores for importance. With regard to importance, 26 items have an average score between 3.0 and 4.0 and 21 items an average ≥ 4.0. With regard to frequency of use, 2 items have an average score ≤ 3.0, 24 items between 3.0 and 4.0 and 21 items ≥ 4.0.

The standard deviations of importance scores range from 0.59 to 1.27. The standard deviations of frequency of use scores range from 0.54 to 1.45, which is again a larger range compared to the range for importance. With regard to importance, 30 items have a standard deviation ≤ 0.80, which means that for a bit more than half of the items the scores are fairly clustered around the mean and there is not a great diversity in the answers. Items with a high standard deviation also have the lowest mean scores, which means that these items were far more important for some respondents than for others. With regard to frequency of use scores, 27 items have a standard deviation ≤ .80, which means that for a bit more than half of the items the scores are fairly clustered around the mean and there is not a great diversity in the answers. Here, items with a high standard deviation also generally have the lowest mean scores, which means that these items with low mean scores are not frequently used by some, but are frequently used by others.

The scores for importance and frequency of use were compared in order to derive the relevance of the competency elements. Twenty items were considered to be important or very important and were used often to always by more than 75% of the respondents. These items received a five star relevance. Two items were considered to be important or very important by more than 75% of the respondents, but were used often to always by 50-75% of the respondents. These items received a four star relevance. Three items were considered to be important or very important by 50-75% of the respondents and were applied often to always by more than 75% of the respondents, and received three stars.

Table 4.5: Importance, frequency of use, and relevance of the items, sorted on relevance, and the correlation between the two answer options

Item		Importance			Frequency of use			Relevance*	Correlation†
		>3	*M*	*SD*	>3	*M*	*SD*		*r*
f15	Sharing all knowledge	94.6	4.34	.59	93.2	4.49	.63	*****	.703**
h28	Communicating enough	91.8	4.37	.64	82.2	4.22	.77	*****	.572**
h29	Involving others	90.4	4.25	.62	84.9	4.11	.64	*****	.530**
g25	Having a vision	89.0	4.34	.67	89.1	4.40	.72	*****	.633**
j34	Getting message across	89.0	4.27	.69	76.7	3.95	.69	*****	.647**
f22	Being reliable	87.7	4.34	.69	95.9	4.43	.58	*****	.397**
k38	Being good at one's job	86.3	4.18	.65	89.0	4.07	.54	*****	.560**
k35	Being good at analysing	86.3	4.16	.65	82.2	4.04	.68	*****	.557**
l31	Keeping overview	85.0	4.12	.82	83.6	4.08	.72	*****	.478**
a1	Having sense of urgency	84.9	4.33	.73	94.5	4.45	.60	*****	.607**
b7	Having a positive attitude	84.9	4.11	.64	78.1	4.10	.77	*****	.519**
g26	Initiating activities	83.6	4.15	.72	84.9	4.15	.70	*****	.560**
c9	Informing strategically	83.6	4.12	.67	78.1	4.04	.70	*****	.559**
d12	Recognizing conflicts	83.5	4.19	.70	80.8	4.11	.74	*****	.497**
h27	Setting goals	83.5	4.15	.76	79.5	4.07	.69	*****	.693**
b3	Having self confidence	80.8	4.15	.72	89.0	4.25	.64	*****	.310**
i33	Dealing with chaos	80.8	4.27	.77	84.9	4.07	.65	*****	.516**
l41	Being conceptual flexible	79.5	3.95	.60	78.1	3.92	.72	*****	.407**
f21	Trusting others	78.1	4.11	.81	75.4	4.03	.87	*****	.412**
b6	Being able to focus	76.7	4.03	.80	76.7	3.97	.85	*****	.615**
f17	Having authority	79.4	4.11	.72	60.3	3.78	.87	****	.395**
k39	Being curious	78.1	4.01	.81	72.6	3.92	.92	****	.560**
b4	Having self knowledge	74.0	3.90	.75	79.5	4.06	.72	***	.522**
c8	Understanding others	68.5	3.92	.85	82.2	4.10	.95	***	.549**
f19	Thinking of others	68.5	3.88	.78	79.5	4.04	.68	***	.589**
l44	Detecting fallacies	73.9	3.95	.69	50.6	3.56	.90	**	.525**
l42	Raising questions	72.6	3.80	.71	60.2	3.66	.63	**	.434**
b5	Being emotionally stable	71.2	3.93	.84	67.1	3.80	1.19	**	.208
k37	Knowing other cultures	69.9	3.84	.69	68.5	3.85	.76	**	.325**
e13	Creating team spirit	69.9	3.97	.80	61.7	3.84	.94	**	.621**
a2	Having need to learn	68.5	3.96	.87	72.6	4.00	1.02	**	.666**
h30	Making results visible	68.5	3.90	.84	64.4	3.81	.88	**	.619**
l45	Using conflicts	68.5	3.80	.75	56.2	3.59	.76	**	.486**
l40	Recognizing other ideas	67.1	3.85	.74	68.5	3.84	.71	**	.297*
i32	Balancing goals	65.8	3.74	.82	67.1	3.66	.75	**	.624**
g24	Picking up signals	65.8	3.73	.73	56.1	3.58	.73	**	.721**
f18	Fulfilling specific role	57.6	3.64	.99	61.6	3.59	1.05	**	.324**
d10	Using influencing skills	57.5	3.67	.77	53.4	3.49	.82	**	.595**
m46	Creating win-win	72.6	3.84	.75	46.5	3.47	.73	*	.629**
k36	Criticizing other ideas	61.6	3.55	.91	45.2	3.38	.97	*	.529**
g23	Experimenting	58.9	3.71	.87	49.4	3.45	.91	*	.652**
f20	Allowing mistakes	57.6	3.71	.86	46.5	3.53	.90	*	.454**
m4	Abandoning own ideas	53.5	3.56	.82	42.5	3.34	.92	*	.501**
f14	Withholding damaging info	52.0	3.64	.98	39.7	3.14	1.33	*	.606**
d11	Playing political games	45.2	3.43	.91	34.3	3.15	.91		.475**
f16	Not sharing information	42.5	3.25	1.27	24.7	2.49	1.45		.378**
l43	Pushing ideas forward	36.9	3.07	.98	13.7	2.56	.90		.304**

* ***** = Importance 75-100% >3 & Frequency 75-100% >3
**** = Importance 75-100% >3 & Frequency 50-75% >3
*** = Importance 50-75% >3 & Frequency 75-100% >3
** = Importance 50-75% >3 & Frequency 50-75% >3
* = Importance 50-75% >3 & Frequency 25-50% >3

† ** Correlation is significant at the .01 level (2-tailed); * Correlation is significant at the .05 level (2-tailed)

Thirteen items were considered to be important or very important and were applied often to always by 50-75% of the respondents. These items received a two star relevance. Six items were considered to be important or very important by 50-75% of the respondents, but were applied often to always by less than 50%. These items received a one star relevance. Three items were considered to be important or very important and were applied often to always by less than 50% of the respondents. These items received no star. They were not removed from further analysis, however, since more than one third of the respondents had rated them as important or very important. Table 4.5 also shows the correlation between the two answer options (frequency of use and importance), which will be elaborated in the next section.

4.3.3 Accuracy of the Questionnaire

For all items, except one (b5 'being emotionally stable'), the correlation between the rated importance and the rated frequency of use is significant ($p < .05$). The correlation for most items is however far from perfect; only two items have a correlation > .70. In one group interview, it was explicitly asked whether the matrix effect could have played a role, but this was denied. Some participants had difficulty understanding (or perhaps did not want to respond openly to) four items:

- f18 I consciously took my own role in the group and worked independently ('We are not independent, that is selfish thinking');
- f20 I allowed the team members (including myself) to make mistakes ('What do you mean by 'I allowed'?');
- f14 I kept information that could harm the team or particular team members confidential ('What do you mean by confidential?');
- d11 I knew how to play political games ('How do you define a political game?').

It strikes that all these items are situated in the lowest segment of relevance. Based on the outcomes it was decided to only remove item f18 from further analysis. This item was misunderstood by most respondents who took part in the group interviews, whereas the other items were misunderstood by only one respondent. When asked whether there were any other competencies or competency elements that were of importance, the participants in the group interviews could not name any. Some in one group, however, did mention that they would label the competencies differently, for example, entrepreneurship, creativity, decisiveness, flexibility, goal orientation, persuasion, collaboration, involvement, organizational capability, communication, and analytical capabilities. They also thought that self management should contain more items than it does now and stressed the importance of being able to take risks, being focused on your goal, and being capable of finding ways to get there. These items will be further discussed in section 7.2.4.

4.3.4 Clustering of the Competency Elements

Exploratory factor analysis was conducted to cluster the survey items into a limited number of factors. Preliminary analysis of the data for both frequency of use and importance indicated that there were neither missing data nor extreme values that could disturb the factor analysis. Multiple factor analyses were conducted with and without (combinations of) the items that were mis-understood (or not easily answered) (see the previous section). It appeared that these items did not disturb the factor solution. However, there was one other item (f16 'Not sharing information') that loaded on different factors depending on the items that were removed or added to the analysis. It was therefore decided to exclude this item from further analysis. Factor analyses on the remaining 45 items showed the following.

Scanning the significance levels of the correlation matrix for both frequency of use and importance it appeared that many items significantly correlated with each other. All correlation coefficients were < .60, with two exceptions in the importance correlation matrix, which were < .70. Bartlett's Test of Sphericity showed for both situations a *p*-value of .00 and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .62 for frequency of use and .74 for importance. These measures are above the threshold value of .50 meaning that the partial correlations between the items are sufficiently low to conduct a factor analysis.

A combination of techniques was used to decide how many factors to retain: a priori theory, Kaiser's (1956) 'eigenvalues greater than one' rule, parallel analysis, the scree test, and retaining the number of factors that gives a high proportion of variance accounted for or that gives the most interpretable solution (Conway & Huffcutt, 2003). Based on a priori theory, thirteen factors should be expected. The initial factor solution for frequency of use extracted fourteen factors with an eigenvalue greater than 1.0. The initial factor solution for importance extracted thirteen factors with an eigenvalue greater than 1.0. Horn's parallel procedure (Horn, 1965) showed no cut off point before sixteen factors, which suggests that the fourteen and thirteen factors selected based on eigenvalue > 1.0 essentially explain more than just random variance. So, both a priori theory, the eigenvalues greater than one rule, as well as Horn's procedure supported the choice to retain thirteen to fourteen factors. The scree plot indicated three and two factors to be retained for frequency of use and importance respectively. From nine and eight factors, more than 60% of total variance was explained for respectively frequency of use and importance. Based on these outcomes the data was run six times, setting the number of factors extracted at nine to fourteen for frequency of use and eight to thirteen for importance. After rotation, the factor loading matrices were compared and the most easily interpretable and meaningful solutions were chosen as best fitting the data. This appeared to be the fourteen-factor solution for frequency of use (74% total variance explained), and the thirteen-factor solution for importance (76% total variance explained). The factor loading matrices and the interfactor

correlation matrices for frequency of use and the structure loadings for importance are presented in Appendices C and D respectively.

The factor-loading matrix for frequency of use had the best simple structure (Thurstone, 1947): each factor had a subset of variables with item loadings above .30, and the rest with low loadings, and there were fewer item cross loadings (Costello & Osborne, 2005). This could indicate that respondents were more specific in indicating how often they made use of a certain competency element than how important it was for their role in the project, or that underlying dimensions are less correlated. As such, the factor loading matrix for frequency of use was more useful as a starting point to interpret the data and was therefore used as point of departure in comparing the two matrices. Through comparing the two factor solutions, the following common factors were derived: 'compete', 'explore', 'communicate clearly', 'involve', 'monitor', 'handle conflicts', 'create learning climate', 'undertake', 'prevail', 'combine', 'influence', 'decide' and 'analyse' (see Appendices C and D). These will be discussed more in the next section. The interfactor correlation matrix indicated that all correlations are below .30 and most of them below .20, which is relatively low.

For each factor, an internal consistency analysis was conducted. In addition, separate factor analyses were conducted for items that were assigned to a particular factor. Based on these results it was decided to which factor the 'double booked' items had to be assigned. If the removal of a certain item decreased the reliability for both factors, the item was assigned to a certain factor based on content reasons. Table 4.6 shows the outcome of the reliability analysis of the different factors, including Cronbach's α, and the number of underlying dimensions when doing a factor analysis on the single factors and the lowest factor loading. Almost all Cronbach's αs were above the minimum criterion of .60 for reliable scales, except for the frequency of use scores on 'handle conflicts', 'create learning climate', and 'combine'. Although α for these constructs is poor, it was not seen as a serious problem, since it is > .50, which does not seriously attenuate validity coefficients (Schmitt, 1996).

Table 4.6: Number of included items per factor, Cronbach's α for each factor, and lowest factor loading in each separate factor analysis

Factor	No. items	α Frequency factor	α Importance factor	Lowest loading frequency	Lowest loading importance
Compete	2	.721	.695	.751	.730
Explore	7	.817	.831	.574	.443
Communicate clearly	4	.711	.791	.562	.610
Involve	2	.685	.601	.723	.656
Monitor	3	.675	.673	.507	.611
Handle conflicts	3	.518	.632	.329	.465
Create learning climate	4	.537	.693	.403	.500
Undertake	5	.680	.746	.504	.508
Prevail	3	.711	.706	.629	.594
Combine	2	.564	.641	.634	.687
Influence	2	.694	.607	.730	.664
Decide mindfully	4	.685	.676	.520	.442
Analyse	4	.627	.721	.512	.444

When conducting separate factor analyses with the newly derived constructs, based on eigenvalues greater than 1.0, they all appeared to consist of one underlying dimension, except for the frequency of use scores for 'undertake'. However, the items could not be assigned to other factors, and removal of any items would diminish Cronbach's α. It was therefore decided to use this construct as one single factor.

4.3.5 Validated Competence Profile

Table 4.7 compares the former profile structure with the newly proposed profile structure, based on the outcome of the exploratory factor and reliability analyses. The table may also serve as a short description of the content of the competencies. Comparing the two profiles shows that the overall structure in four main clusters can be retained. Many items moved, however, to other clusters and competencies, through which different competencies emerged and new names for the competencies had to be developed. The cluster 'self management' totally changed. The competencies 'commit oneself' and 'govern oneself' became embedded in other competencies, and were replaced by the competencies 'take on' and 'prevail'. It is interesting to note that items related to governing oneself are highly related to actually doing things. It is also striking that items that have to do with superior behaviour came together in one cluster, which was called 'prevail'.

The cluster 'interpersonal management' changed from the competencies 'show social astuteness', 'influence', 'socialize', and 'build trust' into 'involve', 'influence', and 'create learning climate'. The competency 'involve' deals with involving people with different backgrounds and involving key persons by strategically informing them. The competency 'influence' remained intact, although the item 'recognizing conflicts' was moved to the competency 'handle conflicts'. Many items of the competency 'build trust' were removed to other competencies. Some of these items and the items for 'socialize' came together in the newly derived competency 'create learning climate'. This clustering of items was named as such since the items fit the concepts that are mentioned in HRD studies about a good learning climate, which consists of safety (allowing mistakes), trust (keeping information that can harm others confidential), cohesiveness (creating a team spirit), and creative turmoil (dealing with chaos) (see section 2.2.3).

The cluster 'project management' changed from 'invent', 'control and coordinate' and 'cope with chaos' into 'explore', 'monitor' and 'decide mindfully'. In the competency 'invent', entrepreneurial items ('having a vision' and 'initiating activities') were replaced by exploring items and items that had to do with openness, which together form the new competency 'explore'. It is interesting that the item 'balancing goals' belongs to this competency, since it was mentioned during the explorative interviews that this was an important skill

Table 4.7: Former profile structure compared to the newly proposed profile structure of competency items (c=challenge)[*]

Former profile structure		Newly proposed profile structure	
Competencies	Items	Items	Competence
Self Management			
Commit oneself	a1 Having sense of urgency a2 Having need to learn	l31 Keeping overview b3 Having self confidence f17 Having authority	Prevail (c5)
Govern oneself (c8)	b3 Having self confidence b4 Having self knowledge b5 Being emotionally stable b6 Being able to focus b7 Having a positive attitude	b5 Being emotionally stable b6 Being able to focus b7 Having a positive attitude f22 Being reliable g26 Initiating activities	Take on (c8)
Interpersonal Management			
Show social astuteness c1	c8 Understanding others c9 Informing strategically	h29 Involving others c9 Informing strategically	Involve (c1)
Influence (c4, 11)	d10 Using influencing skills d11 Playing political games d12 Recognizing conflicts	d10 Using influencing skills d11 Playing political games	Influence (c4, 11)
Socialize (c10, 13)	e13 Creating team spirit	f20 Allowing mistakes f14 Withholding damaging info e13 Creating team spirit i33 Dealing with chaos	Create learning climate (c2, 10, 13)
Build trust (c2)	f14 Withholding damaging info f15 Sharing all knowledge f16 Not sharing information f17 Having authority f18 Fulfilling specific role f19 Thinking of others f20 Allowing mistakes f21 Trusting others f22 Being reliable		
Project Management			
Invent	g23 Experimenting g24 Picking up signals g25 Having a vision g26 Initiating activities	g23 Experimenting k39 Being curious l42 Raising questions l44 Detecting fallacies l45 Using conflicts g24 Picking up signals i32 Balancing goals	Explore (c12)
Control and coordinate (c6, 7, 9)	h27 Setting goals h28 Communicating enough h29 Involving others h30 Making results visible	h28 Communicating enough h30 Making results visible f21 Trusting others	Monitor (c6, 9)
Cope with chaos (c5, 12)	l31 Keeping overview i32 Balancing goals i33 Dealing with chaos	b4 Having self knowledge k38 Being good at one's job h27 Setting goals f19 Thinking of others	Decide mindfully (c7)
Content Management			
Externalize	j34 Getting message across	g25 Having a vision a1 Having sense of urgency f15 Sharing all knowledge j34 Getting message across	Communicate clearly
Interpret	k35 Being good at analysing k36 Criticizing other ideas k37 Knowing other cultures k38 Being good at one's job k39 Being curious	a2 Having need to learn c8 Understanding others k35 Being good at analysing l41 Being conceptual flexible	Analyse
Negotiate (c3)	l40 Recognizing other ideas l41 Being conceptual flexible l42 Raising questions l43 Pushing ideas forward l44 Detecting fallacies l45 Using conflicts	l40 Recognizing other ideas k37 Knowing other cultures d12 Recognizing conflicts	Handle conflicts (c3)
Combine	m46 Creating win-win m47 Abandoning own ideas	m46 Creating win-win m47 Abandoning own ideas	Combine
		k36 Criticizing other ideas l43 Pushing ideas forward	Compete

[*] For a detailed overview of the challenges see section 2.2.3.

for innovative behaviour (see section 3.3.2). The items ‘setting goals’ and ‘involving others’ were removed from the competency ‘control and coordinate’ and were replaced by ‘trusting others’. Apparently, trusting others is related to good monitoring behaviour. ‘Cope with chaos’ did not appear to be an appropriate competency at all and was replaced by the competency ‘decide mindfully’. An interesting point about this competency is that the items ‘having self knowledge’, ‘being good at one’s job’, and ‘thinking of others’ are highly related to each other and to setting goals.

The overall structure of the cluster ‘content management’ stayed mainly the same. The competency ‘externalize’ was changed into the competency ‘communicate clearly’. An interesting change to this competency is that it was expanded to include the items ‘sharing all knowledge’, ‘having a vision’, and ‘having sense of urgency’. The competency ‘interpret’ was replaced by the competency ‘analyse’, which was expanded to include items about open behaviour such as ‘having need to learn’. The competency ‘negotiate’ was totally changed and replaced by a competency that deals with empathizing behaviour and solving conflicts, which was consequently called ‘handle conflicts’. The competency ‘combine’ remained intact. An extra competency was added, ‘compete’, which consists of opportunistic behaviours from the former competencies ‘interpret’ and ‘negotiate’.

The newly derived competencies correspond at least as well to the challenges the original competencies were developed for. For instance, through the addition of ‘trusting others’ the competency ‘monitor’ corresponds even better to the challenge ‘finding a balance between being in control and having no control’ and the challenges caused by low proximity. The former competency ‘cope with chaos’ was entirely split up and the items belonging to this competency were placed in the competencies ‘prevail’, ‘create learning climate’ and ‘explore’. The challenges associated with the competency ‘cope with chaos’, namely ‘fostering optimal dynamics’, and ‘balancing short- and long-term goals’ could also correspond respectively to 'prevail’, and ‘explore’. The competency ‘decide mindfully’ now corresponds better to the challenge: ‘deciding when to work together and when apart’.

Table 4.8 proposes the new profile. The items were replaced by the competency elements they were based on. The competencies ‘take on’ and ‘prevail’ were moved to the cluster ‘project management’, since they are not entirely about managing oneself, but also about managing the project. The competencies ‘explore’ and ‘handle conflicts’ were moved from ‘project management’ to ‘content management’ and from ‘content management’ to ‘interpersonal management’ respectively, since they fit these clusters better. It should be noted that the competency elements: ‘Recognizes the boundaries to sharing and is aware of the value of knowledge’ and ‘Is professional, takes a role in the group, works independently and is clear about his or her own role’ were not included in the revised competence profile, since these items were not taken into account in the analysis.

4.4 Discussion

The present chapter validated the competence profile developed in the previous two chapters by testing the profile by means of a survey sent to a wide range of open innovation professionals. The majority of the respondents rated almost all competency elements highly on frequency of use and importance. Items related to competitive behaviour and influencing behaviour were shown to be the least relevant, but they were nevertheless included in the profile because a significant number of the respondents (about one-third) considered them to be of importance. With such self-reported data, a self-perception or self-rating bias is possible and there is an inherent danger that people will rate everything as important. A fundamental issue when using self-report measures, therefore, is the truthfulness of what people report, especially when the information is personal and sensitive and when the validity of the information depends on the respondents' memory of some past event (Schacter, 1999). There is in this case, however, considerable evidence that the scores on the questionnaire can be taken seriously, because analysis of the accuracy of the questionnaire showed that the chance of a significant rating bias is low. Most importantly, the group interviews used to evaluate the adequacy of the answers showed that almost all outcomes were recognizable and reflected reality. A few exceptions were noted, and these items mainly dealt with non-cooperative or competitive behaviour. In addition, it seems that the questionnaire covered all the competency elements that open innovation professionals need, since no other or new competency elements were brought forward in the group interviews. These outcomes suggest that the preoperational explication of the constructs is adequate, that all competency elements were validated, and that they thus belong in the profile for open innovation professionals. The high scores, together with the positive outcomes on the accuracy analysis of the questionnaire, give a strong indication that the competency elements can be regarded as valid for further study.

Although the competency elements can be regarded as valid, factor analysis on the competency elements showed that the chosen categorization of the competency elements was not valid and had to change in the profile. This finding is not surprising, since the preliminary profile was mainly constructed based on separate literature findings and was not validated by empirical findings (see also the discussion in 2.3.3 and 3.4). Two different factor analyses were conducted, one on the scores for frequency and one on the scores for importance. The two analyses gave different, yet comparable results, in the sense that the same factors could be discerned. The fact that the two solutions differ to some extent might be because the respondents were able to more specifically indicate how often they used a certain competency element than how important it was for their role in the team. This observation fits the argument of Tversky and Kahneman (1973), who suggest that in general respondents are able to rate something objectively (frequency of use), but that it is more difficult for them to rate items on probability (importance). Based on the

Table 4.8: Validated open innovation competence profile, consisting of competencies and underlying competency elements for performing the main activities, including effectively dealing with the challenges (c), based on the validation study

Competencies	**Competency elements**
Is able to…	The open innovation professional therefore…
Interpersonal management	
Involve	Identifies human, material, and experiential resources for accomplishing various kinds of learning objectives. Organizes complementarities. Identifies situations for participative group problem solving, using the proper degree of participation, and recognizes obstacles and corrective actions. Knows who to inform and when.*
Influence	Appropriately adapts, calibrates ones behaviour to each situation in order to elicit particular responses from others. Uses influencing skills (as opposed to instructing): position, coalition, stimulation. Knows how to play the political game.
Handle conflicts	Openness: treats differences as important opportunities. Respects, values and appreciates people and their ideas. Possesses basic knowledge and perceptions of various technical/professional areas and business languages. Has experience working in partnerships. Is assertive, extroverted. Communicates own perceptions and feelings (in a diplomatic way). Is straightforward.
Create learning climate	Shares successes, allows people to make mistakes. Is honest: possesses high levels of integrity, authenticity, sincerity and genuineness. Can be counted on to represent situations fairly. Develops, maintains and uses effective networks. Is approachable, develops friendships easily and strong beneficial alliances and coalitions. Develops a team spirit. Deals with unexpected situations, is flexible with plans, deadlines, improvises. Is not too systematic, rigid. Deals with a flexible team composition.
Project management	
Take on	Is aware of, and regulates, own thinking and feeling. Manages tensions created by multiple accountabilities, tasks and roles. Has perseverance, keeps on thinking positively, having end-goal in mind. Is reliable: ensures that the others can depend upon him/her to come through for them, acts consistently, follows through. Is pro-active. Comes up with ideas him/herself and takes initiatives.
Prevail	Has an overall picture of the project and influencing factors. Understands and manages complexity. Supports many things on his/her mind at the same time. Has self confidence. Is competent: able to perform the tasks required by his or her position.†
Monitor	Coordinates and synchronizes activities, information, and tasks between team members. Designs a plan of strategies. Carries out the plan systematically and sequentially. Feels responsible for the team and acts as such. Monitors, evaluates, and provides feedback on overall team and individual performance. Accepts feedback about his/her performance non-defensively. Collects evidence of accomplishments. Asks many critical questions. Trusts the other party.

* Item specifically addressed informing for *strategic reasons*
† Item specifically addressed having enough *authority* to get things done.

Decide mindfully	Knows what his/ her qualities are, does not take the position of the underdog. Possesses basic knowledge and perceptions.* Establishes specific, challenging, accepted team goals. Diagnoses, formulates learning objectives in performance outcomes (but not too quickly). Is benevolent: has the best interests of others at heart.
Content management	
Communicate clearly	Creates a vision. Appreciates the learning domain and has the motivation to learn, has a sense of urgency. Is open: shares information freely with others, even when (s)he is not sure. Communicates clearly and understandably. Recognizes open and supportive communication methods.
Analyse	Wants to learn from others. Understands social situations as well as interpersonal interactions. Is sensitive to the roles and responsibilities of all partners, aware of their collaborative motivations and expresses understanding and empathy. Has good reflective skills and applies techniques of analysis. Is competent in techniques of lateral thinking or divergent thinking.
Explore	Seeks novelties, experiments. Is sensitive to environment and market oriented. Manages ambiguous situations, takes risks, is result oriented, pragmatic. Listens actively: listens with a view to being influenced; is not closed. Is curious. Combines high advocacy (egocentrism) with high inquiry.† Recognizes types and sources of conflict, encourages desirable conflict but discourages undesirable conflict. Picks up signals, sees opportunities, has intuition for innovation. Balances short- and long-term goals. Identifies problem. Discerns sub from main issues.
Combine	Employs integrative (win-win) negotiation strategies rather than distributive (win-lose) strategies. Brokers solutions or outcomes. Thinks in ways that differ from established lines of thought. Agrees to disagree (lose-lose strategy). Considers common goal as most important. Adapts without violating own ideas.
Compete	Is critical (but constructive). Is aware that he or she represents an organization; refuses to accept less.‡

* Item specifically addressed being good at one's *own job*.
† Item specifically addressed finding out what people thought by e.g. by raising questions.
‡ Item specifically addressed pushing own ideas through.

factor and reliability analysis many items were moved to other constructs, and a new clustering of competency elements into competencies was proposed.

The overall profile structure could stay intact, but the cluster 'self management' had to be incorporated into other clusters. Apparently, competency elements that belong to self management are not competency elements that can be isolated, but are elements of the other competencies. For instance, items on self government and active behaviour came together. The most interesting change in the cluster 'inter-personal management' was that the competency 'build trust' had to be replaced with the competency 'create learning climate'. Apparently, building trust is not a competency in itself, but is incorporated in other competencies. Moreover, the competency 'handle conflicts' was added to the cluster that corresponds to the challenge 'coping with team diversity'. Although many items from 'build trust' moved to the cluster 'project management', the main content of the cluster 'interpersonal management' stayed the same. An interesting change in the cluster 'project management' is that 'cope with chaos' was replaced by the competencies 'prevail' and 'decide mindfully', and 'invent' was replaced by the competency 'take on'. It is interesting to note that some project management competencies were expanded to include items having to do with trust. For good monitoring behaviour, for instance, trusting the qualities of others is necessary. Moreover, for setting goals one has to take the consequences for others into account. The cluster 'content management' is still in accordance with the competencies that are necessary for the four stages of the collaborative knowledge creation model. Most interestingly, it appeared that in order to get a message across clearly, one has to have a sense of urgency and a clear vision. In other words, externalizing is not only about the techniques of communicating clearly, but also about having something valuable to tell. The competency 'interpret' was expanded to include behaviours that deal with openness. Apparently, to interpret and analyse information correctly, one needs an open attitude. Finally, this cluster got an extra competency: 'compete'. It seems there are two options at the end of the collaborative knowledge creation process: either to combine different insights or push one's own ideas forward.

To summarize, in comparing the elaborated profile with the validated, the overall structure of the profile did not change, and although many competency elements moved to other competencies, the meaning of most competencies stayed the same. This means that they still correspond to the challenges the original competencies were designed for. Consequently, the clustering of the competency elements is still consistent with the rationalistic approach. This confirms that the competency elements required to deal with the challenges are valid, but also that the doubts about the way they were clustered theoretically and empirically were sound (section 2.3.3 and 3.4). It is worth noting that some of the suggestions for different labels made during the group interviews could indeed be assigned to the newly derived competencies (e.g., decisiveness, goal oriented, communication, and analytical capabilities). Hence, the newly derived

competencies are probably better constructs to deal with the challenges and activities at hand.

The elaborated competence profile can be regarded as relatively valid, since, in spite of the relatively small sample size for the number of variables, the reliability of the acceptable is adequate and most factor loadings were above Stevens's absolute value of .40 (Stevens, 2002). Moreover, it appeared to be possible to discover theoretical constructs per factor, with generally acceptable Cronbach's αs. The items that were marked as possibly confusing or that could be difficult to answer honestly came together in the same factors: 'creating a safe learning climate', and 'competing'. This could mean that variations in these answers are merely based on the social desirability of certain answers rather than on importance or frequency. Moreover, there were some items that could not be included in the analysis, but could be of importance to some factors. So more research has to be undertaken to define how valid these factors are. Although the statistical reliability of the studies can be improved, by using a larger sample for example, the profile is sufficiently valid for continuing further analysis. It is at least valid for the population of open innovation professionals approached, since there was a high response rate compared to previous survey research in academic studies (Baruch, 1999) and the respondent analysis showed a varied group regarding age, job, gender, experience, organizational background and country. However, the industrial sector, multinationals, and the Dutch and Spanish nationality are overrepresented and most respondents represented companies that initiated the open innovation projects in question. This could mean that the results are mainly applicable to Dutch and Spanish open innovation professionals working in multinational companies that initiate open innovation projects. Thus, the results should be applied with caution and further analysis should focus on the context-dependency of the newly derived competency clusters. Furthermore, quite a few competencies are mentioned and the intention is not to further the 'superman syndrome' among open innovation professionals. It might be sufficient if one person in a team knows how to create a learning climate and another knows how to monitor it. Thus, the specific set of competencies a person needs may depend on his or her team role. Further research should therefore address how the set of competencies depends on team roles and context.

4.5 Conclusion

The aim of this chapter was to validate the competence profile developed in the previous chapters. Two questions guided this chapter: (1) How relevant are the competency elements identified in the previous two studies for a larger group of open innovation professionals? (2) What is the optimal clustering of the identified competency elements in the competence profile? A survey among open innovation professionals and group interviews gave insight into how often

the competency elements were being applied and how important they were in an open innovation team. All competency elements were shown to be highly relevant, except for competency elements that dealt with competitive behaviour. Opinions about the relevance of competitive behaviour varied relatively widely, so all competency elements were retained in the profile. Factor analysis on the data resulted in a new clustering of the competency elements and a validated competence profile. Figure 4.2 summarizes the outcomes graphically. Further research should indicate how the importance of these newly derived competencies depends on contextual factors, such as team composition, team role and other project characteristics. The next chapter will address this issue.

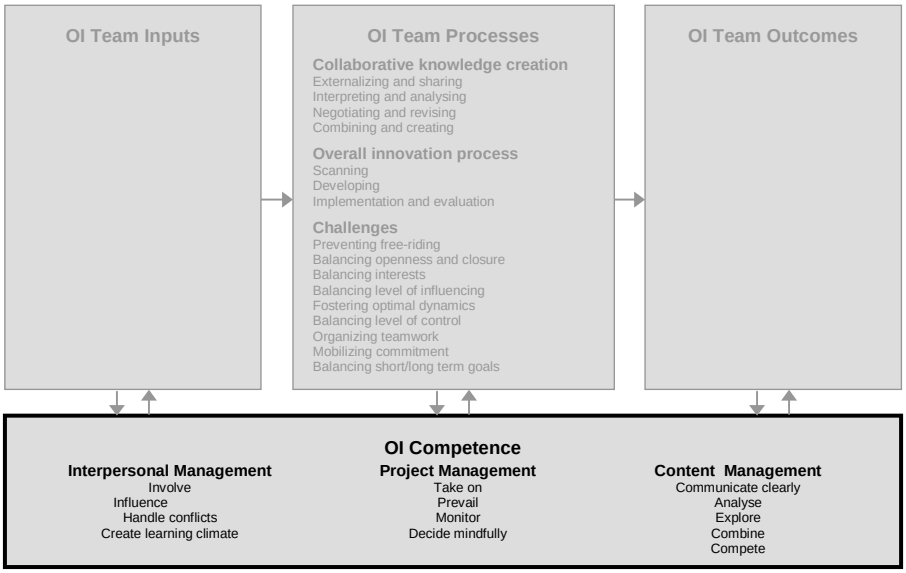


Figure 4.2: Input-Process-Outcome framework for open innovation (OI) teams with identified competencies, based on the findings in Chapter 4

Chapter 5
Competence Profile and Context Variation

5.1 Introduction

Although the previous chapter revealed that most competency elements were relevant to most open innovation professionals, the data also showed that some competencies were of more importance to some than to others. The composition of the competence profile may therefore vary because of contextual differences. A relevant question therefore is whether the identified competencies are commonly needed for open innovation professionals or if their importance depends on the open innovation context. If they are commonly needed, it could be said that the profile is generic and applicable across open innovation contexts. If the required competencies depend on the context, then this knowledge can be used for team composition and project management. The central research question this chapter addresses is:

> *Sub-question d: Does the perceived importance of the competencies in the competence profile vary across contexts, and if so, how?*

The context is the whole setting in which an open innovation team operates. More specifically, 'context can be defined as situational opportunities and constraints that affect the occurrence and meaning of organizational behaviour as well as functional relationships between variables' (Johns, 2006: 386). Section 2.2.3 defined a range of factors that may characterize specific open innovation team contexts and affect the importance of certain competencies. Although all of them are relevant, there is one factor that sets different kinds of open innovation teams apart: the organizational diversity in the team. The organizational diversity, which can also be interpreted as the inter-organizational context, the network or alliance characteristics, is an important and distinctive feature of open innovation projects (Dittrich, 2007; Faems, et al., 2005; Vanhaverbeke, 2006). The alliances involved in an open innovation team can vary in the three dimensions symmetry, link or scale, and national or international character (see section 2.2.3). The configuration of these dimensions in a specific alliance type was taken as the main context variable at team level in this study.

At the individual level, the functional role or task in the project of the open innovation professional was taken as the context variable. Team theory states that effective teams need a set of competencies, but not all competencies need to be held by each individual team member. Thus, the competencies an open innovation professional needs might be highly dependent on his or her role or task. Belbin (2003) distinguishes between team roles and functional roles. Team role refers to a tendency to behave, contribute and interrelate with others at work in certain distinctive ways (Belbin, 2003: 24). Functional role refers to the job demands that a person has been engaged to meet by supplying the requisite technical skills and operational knowledge (ibid). As already stated in section 2.2.3 it is suggested that team roles necessary in innovation teams are: championing, boundary spanning, gatekeeping and pattern recognition (Reid & De Brentani, 2004). However, the body of research about team roles in innovation teams is still in the explorative phase. Moreover, team role includes personality characteristics, which is a highly complicated and contested area of study, because of its subjectivity and arbitrariness (Williams, 2002). It was therefore decided to focus on functional roles, also described as project tasks, which can for instance include market research or product design (Cooper, 1999; Von Hippel, 1990). Section 5.2 will report how the study was set up and how the context variables were measured. Section 5.3 will report the outcomes, sections 5.4 and 5.5 discuss the results and conclude the chapter, respectively. Figure 5.1 depicts the focus of this chapter in the input-process-outcome framework.

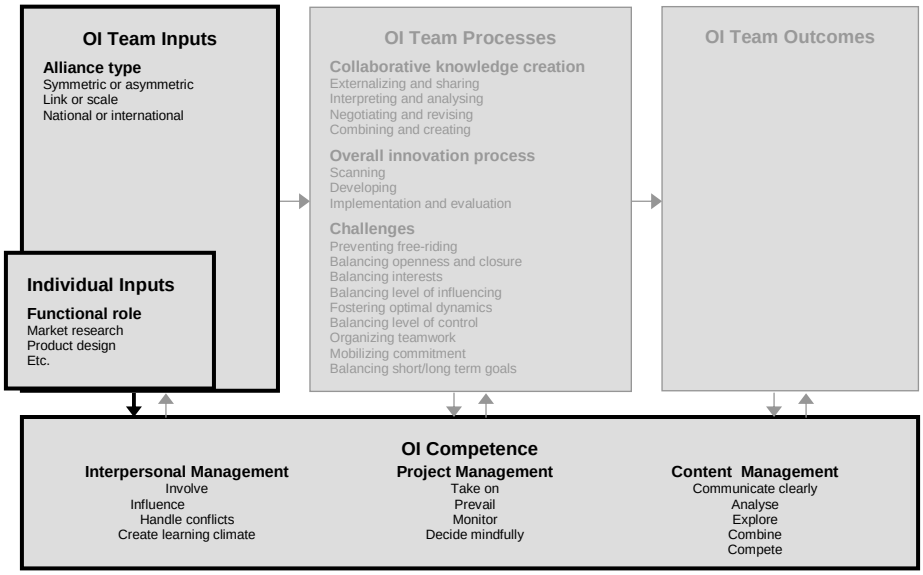


Figure 5.1: Input-Process-Outcome framework for open innovation (OI) teams with in bold the variables focussed upon in Chapter 5

5.2 Methods

5.2.1 Data

The research question was investigated using the same data set described in the previous chapter (see section 4.2). The online questionnaires that were sent to team members of the selected open innovation teams contained a separate set of questions about context variables. The next sections will describe which variables were included, how they were measured by the online questionnaires and how the data were analysed.

5.2.2 Measures

Dependent variables
The dependent variables are the newly derived competencies, based on the factor analysis in the previous chapter. These competencies include being able to 'involve', 'influence', 'handle conflicts', 'create a learning climate', 'take on', 'prevail', 'monitor', 'decide mindfully', 'communicate clearly', 'analyse', 'explore', 'combine' and 'compete'. For each respondent, a score on each competency was derived by calculating the mean of the items that belong to that competency. In this study, only scores on the level of importance of the competencies were used. These scores give more adequate information on the question of how generic the profile is, since scores on actual frequency of use depend not only on contextual factors but also on the skill level or personal mastery of the open innovation professional. How the competencies and competency elements were measured is discussed in detail in sections 4.2.2 and 4.3.5.

Independent variable
As explained, the alliance type is the main context variable at team level in this study. There are three dimensions in which alliances can differ: cultural diversity, which is represented by national or international alliances; functional diversity, which includes link or scale alliances; and organizational diversity, which is represented by symmetric or asymmetric alliances (see section 2.2.3). Scale alliances refer to partnerships in which resources are pooled for activities in the same stage(s) of the value chain (Dussauge et al., 2004; Kalaignanam et al., 2007); this is also referred to as partner resource similarity (Inkpen & Pien, 2006). Link alliances refer to partnerships in which resources are exchanged for activities performed at different stages of the value chain (Dussauge et al., 2004; Kalaignanam et al., 2007); this is also referred to as partner resource complementarity (Inkpen & Pien, 2006). In asymmetric alliances, the cooperating organizations differ in size and reputation, whereas in symmetric alliances they are about the same size and reputation (Chen & Chen, 2002). The

alliance type of the particular open innovation team was measured through information given by the project leaders via email messages or phone calls. The project leader was asked whether the team could be characterized as being made up of symmetric or asymmetric alliances, link or scale alliances, and whether all of the team members were situated in the same country or various countries. Each team was described according to these three dimensions of diversity and the following combinations appeared to be represented by the data:

1. Symmetric, Link, and International alliances (SymLinkInt);
2. Symmetric, Scale, and International alliances (SymScaleInt);
3. Asymmetric, Link, and National alliances (AsymLinkNat);
4. Asymmetric, Link, and International alliances (AsymLinkInt);
5. Mix of symmetric and asymmetric alliances, Link, and International alliances (MixLinkInt);
6. Mix of symmetric and asymmetric, Mix of link and scale, and International alliances (MixMixInt).

At the individual level, the functional role or task in the project of the open innovation professional was measured. The respondents were asked with an open question in the online questionnaire: 'What was your main task in the project?' Their answers (listed in Appendix E) were categorized as:

1. Project management, containing tasks related to project management, business control and external relations management. This group is, however, mainly represented by professionals who deal with project management;
2. Product development, containing tasks related to the development of new products;
3. Process control and operations, consisting of tasks related to process management and quality control.

Control variables

Several control variables were measured at different aggregation levels. Variables at individual level that might influence the perception of importance of certain competencies are: age, gender and work experience with (open and closed) innovation projects. The respondents were asked to provide this information in response to the following questions and requests in the online questionnaire: What is your age? Please indicate your gender. What was your level of experience at the start of the project: … years with innovation projects … years with open innovation projects (innovation projects involving professionals from other companies). At which organization, department and main location do you work?

At team level, team emergent states were measured, which refer to the cognitive, motivational and affective states that may occur when team members start working together. Marks and colleagues (2001: 357) described emergent states as 'cognitive, motivational, and affective states of teams [that are] … dynamic in nature and vary as a function of team context, inputs, processes, and

outcomes.' Since most team factors are thought to have an impact on processes via team emergent states, it was chosen to focus on team emergent states, more specifically: 'group efficacy', 'social cohesion', 'learning climate', 'power differences' and 'shared cognition' (see section 2.2.3). In this study, 'social cohesion' and 'learning climate' were taken together, since both were considered as related to a similar affective state: the emergent state 'team climate'. Fourteen items were developed to measure 'shared cognition', 'team climate', 'group efficacy' and 'power differences'. Table 5.1 shows the items measured per cluster, and their sources. Respondents were asked to indicate to what extent the items applied to their particular open innovation project team by using a 5-point rating scale ranging from 1: very unimportant; 2: unimportant; 3: neutral; 4: important; to 5: very important. They could also choose the option 0: don't know/not applicable. Tests for reliability of the items related to the four original constructs were evaluated using Cronbach's α with .60 as the lower limit. Items 8 and 11 were negatively stated, so these item scores were recoded. Cronbach's α for 'group efficacy' was .51; for 'team climate' .79; for 'power differences' .57, and for 'shared cognition' .87.

Table 5.1: Factors and corresponding items resulting from factor analysis of open innovation professionals' perception of group efficacy, team climate, power differences and shared cognition

Item*	Factor			
	1	2	3	4
Group efficacy				
1. The team members' level of commitment to the task was high				.628
2. We and the other partner involved equally committed resources to the project	.519			.330
3. The team members believed in the success of the project			.481	
Team climate (α=.84)				
4. I felt comfortable contacting other members when needed, regardless of rank, position or organization		**.838**		
5. The team members were fair in business dealings with each other		**.677**		
6. The team conducted open and lively conversations and/or discussions		**.653**		
7. The team members personally liked each other	.564	**.502**		
8. If you made a mistake in this team, it was often held against you				
Power differences (α=.72)				
9. The team was adequately managed (coordinated and controlled)		.321	**.640**	
10. All team members had an equal say in the project	.321		**.578**	
11. Some team members had the ability to influence other team members to change their decisions regarding the innovation project				
Shared cognition (α=.87)				
12. The team members shared the same culture in terms of work habits, attitude and behaviour	**.795**		.412	
13. The team members shared the same goals	**.670**		.414	
14. The team members shared the same perceptions and understandings	**.665**	.325	.396	

*Items used for further analysis in bold.
Sources per item: 1, 3, 7, 8: Van den Bossche et al. (2006); 2, 10, 11: Muthusamy & White (2005, 2006); 4: Jansen et al. (2006); 5: Mayer and Davis (1999); 6: Kreijns et al. (2004); 9, 12, 13, 14 section 2.2.3
Method: Principal Axis Factoring with Varimax rotation (extracting 4 factors). Loadings below .30 are not included.

In addition, an exploratory factor analysis (Principal Axis Factoring with Varimax rotation) was conducted on the 73 questionnaires, whereby the number of factors extracted was set at four. Items 8 and 11 appeared to belong to another separate underlying dimension, and these were therefore removed from further analysis. A second factor analysis without these items showed that the items of 'group efficacy' were all grouped under other dimensions (see Table 5.1). Reliability analysis showed, however, that adding these items to those different constructs lowered the reliability of the constructs. It was therefore decided to remove the construct 'group efficacy' from further analysis, since there was only one item left to measure this construct and 'with a single measure of each variable, one can remain blissfully unaware of the possibility of measurement error' (Blalock, 1970:111). For each respondent, mean scores on 'team climate', 'power differences' and 'shared cognition' were calculated.

At the organizational level the size of the organization (SME < 250 employees, large 250-1000 employees, very large > 1000 employees), country of main location and sector were measured based on the information given by the project leader. In addition, it was asked if the innovation project dealt with a product, process, service, or market innovation.

5.2.3 Data Analysis

First, means, standard deviations and percentages were computed for control variables at organizational and team level per alliance type and these scores were analysed to determine whether there are any other variables on which the alliance types differ. The same was done for control variables at individual level per functional role. Variables that appeared not to vary to a high extent across alliance types and functional roles were not included in further data analysis. These variables appeared to be innovation goal, size of the organization, sector, and country of the organization's location. In addition, means and standard deviations of the scores on the competencies were compared and analysed.

Second, the relation between the competence profile and context variation at team level was analysed. A one-way ANOVA analysis was employed to compare within-alliance type variance to between-alliance type variance per competency. In addition, a Kruskal-Wallis one-way analysis of variance by ranks was conducted for testing equality of population medians among groups per competency. The results of the Kruskal-Wallis test were identical to those of the one-way ANOVA analysis; thus, only the last are reported. Moreover, multiple regression analyses were conducted to assess the relationship between competencies, alliance type and control variables at team level (team emergent states). Five dummies were developed for the alliance types, with SymLinkInt as reference group, since this group contained the largest number of respondents. Dummies for the separate alliance type dimensions were also included to control for any overall effect of a single dimension. These dummies were: Asymmetric

versus Symmetric Alliances, Mix versus Symmetric (organizational diversity), Scale versus Link, Mix versus Link (functional diversity), and National versus International Alliances (cultural diversity). These dummies showed, however, high collinearity relationships with the alliance type dummies ($r > .07$) and were therefore not included in further analysis. Further analysis included a stepwise regression method, since stepwise methods are more adequate for explorative analysis (Menard, 1995). From the stepwise method the backward method was used, which begins with a full or saturated model including all the explanatory variables and then eliminates variables with non-significant effects (effects at a lower than 90 percent confidence level). The chance that a categorical variable with more than two categories is wrongly indicated as non-significant in backward regression is lower compared with the forward elimination method (Cohen, 1991). Nevertheless, forward regression analyses were conducted as well to further test the stability of the results. The forward method yielded essentially the same results as the backward method. The difference worth mentioning was that systematically fewer predictors, mainly dummies, were included in the end result with the forward procedure. In particular, it did not report the variables that were significant at a .10 level in the backward regression analysis. Thus, since the outcomes of the backward regression analyses contained more information, only these results are reported. All regression analyses were conducted with intercepts included.

Third, and lastly, a strategy was employed for analysing the relation between the competence profile and context variation at individual level. A one-way ANOVA analysis was employed to compare 'within functional role variance' to 'between functional role variance' per competency. Kruskal-Wallis tests led to the same model and are therefore not reported. Multiple regression analyses were conducted to assess the relationship between competencies, functional role and control variables at individual level (age, gender, experience with innovation and open innovation). Two dummies were developed for functional role, with Product development as reference group, again because this group contained the largest number of respondents. Again, the forward and backward procedure yielded similar results and only the end result of the backward regression is reported.

5.3 Results

5.3.1 Descriptives

Table 5.2 describes per alliance type the number of projects, number of respondents, and the control variables at organizational and team level. Most alliance types dealt with product innovation, with respondents coming mainly from large companies in the industrial sector. The exception to this rule is the alliance type AsymLinkNat, which contained one process innovation project,

many SMEs, and companies in different sectors. Most teams included Dutch respondents, except for those categorized as SymLinkInt and MixLinkInt. All alliance types had average scores of around 4.0 for 'team climate', and 3.5 for 'shared cognition' and 'power differences', which means that they were considered as good as or better than neutral respectively. The MixMixInt teams scored lower, however, on 'team climate', 'shared cognition' and 'power differences', but also had the highest standard deviations.

Table 5.2: Descriptives of control variables at organizational level and team level per alliance type, including number of teams and response rate*

	SymLink-Int*	SymScale-Int	AsymLink-Nat	AsymLink-Int	MixLink-Int	MixMix-Int	Total
No. teams (N)	2 (21)	1 (6)	5 (13)	3 (10)	2 (14)	2 (9)	15 (73)
Innovation goal	All product	All product	All product	2 product, 1 process	All product	All product	All product
Organization's size							
SME			53.8%				9.6%
Large				10.0%	7.1%		2.7%
Very large	100.0%	100.0%	46.2%	90.0%	92.9%	100.0%	87.7%
Sector							
Industry	100.0%	100.0%	.0%	100.0%	100.0%	100.0%	82.2%
Agriculture	.0%	.0%	15.4%	.0%	.0%	.0%	2.7%
Services	.0%	.0%	38.5%	.0%	.0%	.0%	6.8%
Retail	.0%	.0%	30.8%	.0%	.0%	.0%	5.5%
Public	.0%	.0%	15.4%	.0%	.0%	.0%	2.7%
Country							
DE	.0%	16.7%	.0%	10.0%	.0%	.0%	2.7%
ES	52.4%	.0%	.0%	.0%	42.9%	11.1%	24.7%
GB	19.0%	.0%	.0%	.0%	7.1%	11.1%	8.2%
NL	23.8%	83.3%	100.0%	90.0%	50.0%	77.8%	63.0%
PL	4.8%	.0%	.0%	.0%	.0%	.0%	1.4%
Team emergent state (M, SD)							
Team climate	3.93 (.64)	4.29 (.37)	4.08 (.58)	3.91 (.45)	3.92 (.69)	3.75 (1.00)	3.96 (.65)
Power differences	3.88 (.76)	3.67 (.75)	3.62 (.82)	3.60 (.66)	3.31 (.83)	2.78 (1.20)	3.53 (.88)
Shared cognition	3.40 (.98)	3.39 (.68)	3.85 (.74)	3.63 (.84)	3.82 (.83)	2.93 (.85)	3.53 (.88)

Table 5.3 describes per functional role the control variables at individual level. It is worth noting that the Process control group is smaller than the other groups and that it is made up mostly of men, its members are on average older than the respondents in the other groups and they have more work experience with innovation.

* SymLinkInt = Symmetric, Link, and International alliances;
SymScaleInt = Symmetric, Scale, and International alliances;
AsymLinkNat = Asymmetric, Link, and National alliances;
AsymLinkInt = Asymmetric, Link, and International alliances;
MixLinkInt = Mix of symmetric and asymmetric alliances, Link, and International alliances;
MixMixInt = Mix of symmetric and asymmetric, Mix of link and scale, and International alliances.

Table 5.3: Descriptives of control variables at individual level per functional role (mean and standard deviations)

	Project management	Product development	Process control	Total
Number of respondents	29	31	13	73
Age	41.10 (7.17)	39.39 (8.67)	50.00 (11.30)	41.96 (9.35)
Innovation experience (yrs)	9.31 (6.97)	7.37 (6.44)	13.92 (10.63)	9.31 (7.77)
Open innovation experience (yrs)	5.10 (4.67)	5.23 (5.11)	8.69 (9.10)	5.80 (5.91)
Gender ♂	55.2%	71.0%	92.3%	68.5%
♀	44.8%	29.0%	7.7%	31.5%

The descriptives of the competencies showed that 'communicate clearly' had the highest mean and a low standard deviation, followed closely by 'involve', 'prevail', 'monitor', 'take on', 'decide mindfully', and 'analyse' (scores ≥ 4.00), see Table 5.4. The competencies 'handle conflicts', 'create learning climate' and 'explore' scored moderately scored compared to the other competencies ($3.70 <$ scores < 4.00). The competencies 'combine', 'influence' and 'compete' received the lowest mean scores on importance (scores ≤ 3.70). These three competencies also had the highest standard deviation, which could indicate that these competencies were more context-specific. All the other competencies had low standard deviations ($< .65$), which might suggest that these are less context-specific. The following sections will explore how the competencies vary across different alliance types and functional roles.

Table 5.4: Mean and standard deviation for importance scores on competencies ordered by mean values (N=73)

	M	*SD*
Communicate clearly	4.33	.53
Involve	4.19	.54
Prevail	4.13	.60
Monitor	4.13	.60
Take on	4.11	.52
Decide mindfully	4.03	.53
Analyse	4.00	.55
Handle conflicts	3.96	.54
Create learning climate	3.90	.62
Explore	3.82	.54
Combine	3.70	.67
Influence	3.55	.71
Compete	3.31	.83

5.3.2 Context Variation at Team Level

Analysis of variance was used to test for differences in importance scores of the competencies among six alliance types. According to the test, the importance of the competencies does not differ significantly ($p < .05$) across alliance types (see Table 5.5). At $p < .10$ level, however, the effect of alliance type was significant,

F (5, 67) = 2.26, p = .058, but Bonferroni post-hoc comparisons of the six groups indicated no significant differences ($p < .10$).

Table 5.5: One-way ANOVA analysis results described by means and standard deviations per alliance type, *F*, and significance level per competency (N=73)

	SymLinkInt		**SymScaleInt**		**AsymLinkNat**		**AsymLinkInt**		**MixLinkInt**		**MixMixInt**		*F* (5, 67)	*p*
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Involve	4.14	.64	4.08	.37	4.12	.62	4.30	.42	4.29	.58	4.17	.43	.28	.92
Influence	3.43	.83	3.42	1.36	3.42	.45	3.50	.67	3.89	.53	3.61	.42	.91	.48
Handle conflicts	4.05	.53	3.78	.27	3.97	.60	3.73	.64	4.11	.60	3.85	.34	.92	.48
Create learning climate	3.71	.74	4.25	.45	4.10	.67	3.75	.53	4.04	.60	3.78	.20	1.39	.24
Take on	4.11	.48	4.23	.61	3.83	.66	4.08	.42	4.21	.52	4.31	.39	1.22	.31
Prevail	4.14	.43	3.94	1.06	3.95	.62	4.03	.64	4.21	.65	4.44	.33	.96	.45
Monitor	4.19	.68	4.17	.51	4.05	.59	4.00	.50	4.21	.67	4.15	.56	.20	.96
Decide mindfully	4.21	.47	3.75	.65	3.85	.59	3.93	.36	4.07	.57	4.08	.50	1.32	.27
Communi-cate clearly	4.51	.47	4.08	.34	4.06	.65	4.13	.36	4.48	.61	4.44	.37	2.26	.06
Analyse	4.08	.60	4.00	.45	3.94	.67	3.75	.47	4.18	.56	3.94	.39	.76	.58
Explore	3.98	.49	3.71	.31	3.91	.59	3.51	.51	3.85	.70	3.67	.37	1.30	.28
Combine	3.76	.57	3.42	.97	3.96	.63	3.40	.74	3.71	.70	3.67	.61	1.06	.39
Compete	3.36	.98	3.00	.45	3.12	.77	3.40	.65	3.43	1.05	3.39	.60	.41	.84

The analysis of variance was followed by multiple regression analyses to evaluate the impact of alliance type on the competencies, controlled for team emergent states. First, the degree of association between the dependent and independent variables was verified (Table 5.6). The correlation between the independent variables did not give concern for multicollinearity in the data, because all correlations are below < .062[*]. It should be noted that MixMixInt is significantly negatively correlated with 'shared cognition' and 'power differences', which confirms the previous notion that teams in this alliance type score lower on these team emergent states.

The one-way analysis of variance showed no significant differences between *separate* alliance types, but the regression analysis showed that there are differences between a single alliance type and other alliance types as a group. As shown in Table 5.7, the results from the multiple regression analyses indicate that AsymLinkNat was a significant negative predictor of 'take on' and 'communicate clearly' ($p < .05$). Moreover, it was found that both AsymLinkInt and SymScaleInt were significantly negatively linked to 'communicate clearly'; SymScaleInt was also significantly negatively linked to 'decide mindfully'; and MixMixInt was significantly positively linked to 'prevail'.

[*] Collinearity diagnostics suggested that multicollinearity was not a problem in the data (Tolerances > .20; largest VIFs < 10; average VIF not substantially > 1.0 (Bowerman & O'Connell, 1990)).

Table 5.6: Pearson Correlations for competencies, alliance type, and team emergent states (N= 72)

Variable*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Involve	1																				
2. Influence	.416**	1																			
3. Handle conflicts	.628**	.343**	1																		
4. Create learning climate	.465**	.414**	.546**	1																	
5. Take on	.621**	.590**	.587**	.521**	1																
6. Prevail	.539**	.551**	.525**	.359**	.669**	1															
7. Monitor	.492**	.187	.518**	.525**	.598**	.448**	1														
8. Decide mindfully	.561**	.461**	.598**	.403**	.704**	.583**	.589**	1													
9. Communicate clearly	.616**	.387**	.685**	.468**	.652**	.696**	.603**	.696**	1												
10. Analyse	.602**	.317**	.702**	.503**	.602**	.456**	.581**	.544**	.552**	1											
11. Explore	.459**	.233*	.638**	.426**	.448**	.328**	.430**	.422**	.466**	.629**	1										
12. Combine	.355**	.329**	.491**	.498**	.455**	.311**	.266*	.473**	.314**	.465**	.546**	1									
13. Compete	.065	.057	.133	.040	.195*	.163	.145	.248*	.222*	.313**	.189	.276**	1								
14. Team climate	.394**	.196*	.364**	.417**	.490**	.303**	.393**	.305**	.441**	.342**	.333**	.366**	.122	1							
15. Power differences	.240*	.039	.359**	.196*	.207*	.186	.228*	.225*	.289**	.233*	.270*	.331**	.031	.574**	1						
16. Shared cognition	.216*	.018	.247*	.285**	.166	.245*	.283**	.126	.315**	.152	.151	.154	.030	.583**	.619**	1					
17. SymScaleInt†	-.056	-.055	-.101	.171	.070	-.093	.020	-.159	-.140	.002	-.058	-.127	-.112	.156	.046	-.048	1				
18. AsymLinkNat	-.060	-.082	.013	.149	-.253*	-.141	-.060	-.162	-.241*	-.046	.081	.184	-.109	.086	.043	.172	-.139	1			
19. AsymLinkInt	.085	-.027	-.168	-.098	-.025	-.063	-.086	-.078	-.155	-.179	-.225*	-.179	.044	-.032	.030	.049	-.119	-.185	1		
20. MixLinkInt	.091	.237*	.146	.107	.096	.071	.071	.041	.143	.161	.026	.011	.071	-.027	-.122	.158	-.146	-.227*	-.194*	1	
21. MixMixInt	-.013	.033	-.075	-.075	.144	.200*	.013	.040	.083	-.036	-.105	-.018	.037	-.123	-.328 **	-.261*	-.112	-.175	-.149	-.183	1

* * p < .05, **p < .01.
† Reference group for alliance type is SymLinkInt

Table 5.7: Significant predictors per competency, described by R^2, p, b, and SE b (N=72)

Competencies* Predictor†	R^2	p	b[a]	SE b
Involve	**.155**	**.001**		
Team climate			.327**	.091
Influence	**.077**	**.064**		
Team climate			*.217*	.124
MixMixInt			*.351*	.208
Handle conflicts	**.133**	**.002**		
Team climate			.297**	.091
Create learning climate	**.174**	**.000**		
Team climate			.391***	.102
Take on	**.354**	**.000**		
Team climate			.424***	.078
AsymLinkNat			-.348*	.132
MixMixInt [b]			*.271*	.154
Prevail	**.154**	**.003**		
Team climate			.305**	.102
MixMixInt [b]			.449*	.198
Monitor	**.155**	**.001**		
Team climate			.358**	.100
Decide mindfully				
Team Climate	**.182**	**.003**	.287**	.089
SymScaleInt			-.449*	.208
AsymLinkNat			*-.292*	.148
Communicate clearly	**.388**	**.000**		
Team climate			.414***	.079
SymScaleInt			-.560**	.187
AsymLinkNat			-.497***	.134
AsymLinkInt			-.360*	.148
Analyse	**.117**	**.003**		
Team climate			.287**	.094
Explore	**.155**	**.003**		
Team climate			.266**	.090
AsymLinkInt			*-.318*	.168
Combine	**.201**	**.002**		
Team climate			.398**	.111
SymScaleInt			*-.485*	.261
AsymLinkInt			*-.349*	.206
Compete	**.000**	**.**		

This indicates that the competency ‘take on’ is less important in AsymLinkNat alliances than in the other alliance types; ‘communicate clearly’ is more important in SymLinkInt, MixLinkInt and MixMixInt alliances; ‘decide mindfully’ is less important in SymScaleInt alliances; and ‘prevail’ is more important in MixMixInt alliances than in the other alliance types. It should be noted that the majority of the competencies, that is ‘involve’, ‘influence’, ‘handle conflicts’, ‘create learning climate’, ‘monitor’, ‘analyse’, ‘explore’, ‘combine’ and ’compete’, are not significantly linked to alliance type. However,

* * p < .05, **p < .01, ***p < .001; b in italics are significant at p < .1
† Reference group for alliance type is SymLinkInt

'team climate' was significantly positively linked to most of these competencies, except to 'influence' and 'compete'. It should also be noted that in the framework of this multiple regression analysis the variables 'shared cognition' and 'power differences' did not have any impact on the perceived importance of the competencies.

For eleven competencies, the total explained variance is > 10%. In order to determine how much variance is explained by alliance type, an additional regression analysis (backward method) was conducted per competency with only the alliance type dummies included. It appeared that the total explained variance by alliance for the competencies 'take on', 'prevail' and 'communicate clearly' was only 6%, 4% and 14% respectively. It is striking that 'decide mindfully' was no longer related to any alliance type. Because this relationship is unstable, it was left out of further analysis of the data.

5.3.3 Context Variation at Individual Level

An analysis of variance showed that the effect of functional role was significant for 'involve', 'influence', 'create learning climate', 'prevail' and 'monitor' (Table 5.8). Bonferroni post-hoc comparisons of the three groups indicate that the group Project management gave significantly higher importance ratings than the Product development group for 'involve' (p = .04) and 'influence' (p = .03). Moreover, the Project management group gave significantly higher importance ratings than the Process control group for 'create learning climate' (p = .003), 'prevail' (p = .02) and 'monitor' (p = .03). Comparisons between the Product development group and the Process control group were not statistically significant at $p < .05$.

Table 5.8: One-way ANOVA analysis results described by means and standard deviations per functional role, *F*, and significance level per competency (N=73)

	Project management		**Product development**		**Process control**			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F* (2, 70)	*p*
Involve	4.38	.59	4.03	.48	4.12	.51	3.40	.04
Influence	3.79	.69	3.32	.71	3.54	.63	3.49	.04
Handle conflicts	4.02	.59	3.98	.50	3.77	.51	1.03	.36
Create learning climate	4.12	.59	3.88	.53	3.46	.67	5.87	.00
Take on	4.24	.60	3.99	.46	4.12	.44	1.63	.20
Prevail	4.36	.56	4.04	.54	3.82	.66	4.57	.01
Monitor	4.31	.57	4.10	.59	3.80	.54	3.70	.03
Decide mindfully	4.15	.53	3.94	.52	3.98	.51	1.29	.28
Communicate clearly	4.46	.48	4.29	.55	4.14	.54	1.87	.16
Analyse	4.12	.61	3.91	.52	3.92	.50	1.22	.30
Explore	3.88	.55	3.80	.57	3.73	.48	.37	.69
Combine	3.72	.68	3.68	.71	3.69	.60	.04	.97
Compete	3.33	.69	3.26	.94	3.39	.89	.12	.89

Multiple regression analyses were conducted to evaluate the impact of functional role on the competencies, controlled for variables at the individual level. First, the degree of association between the dependent and independent variables was verified, see Table 5.9. Age showed a positive correlation with experience with open and closed innovation, gender, and Process control, followed closely by experience with closed innovation. However, the correlations are below .60, and most even below .50, which means that there is no need for concern for multicollinearity in the data (Nunnally & Bernstein, 1994)[*]. Consequently, there is no need to exclude certain independent variables from further analysis.

As shown in Table 5.10, the results from the multiple regression analyses showed essentially the same results as the analysis of variance. Project management was significantly positively linked to 'involve', 'influence' and 'prevail' ($p < .05$). This indicates that these competencies are considered to be of more importance by professionals with project management tasks than by professionals with product development or process control tasks. According to the analysis of variance the first two ('involve', 'influence') are particularly less important to the Product development group and the latter ('prevail') to the Process control group. Moreover, the results showed that Process control was significantly negatively linked to 'create learning climate' and 'monitor' ($p < .05$). This indicates that these competencies are considered to be of less importance by professionals with process control tasks, according to the analysis of variance, especially compared to their importance among professionals with project management tasks.

It should be noted that in the framework of this analysis the competencies 'handle conflicts', 'take on', 'decide', 'communicate clearly', 'analyse', 'explore', 'combine' and 'compete' were not significantly linked to functional role ($p < .05$). Moreover, no significant effects were found for the control variables age, experience with open or closed innovation and gender, with one exception: gender was significantly negatively linked to 'combine' ($p < .05$). It is interesting, however, that the total explained variance of all competencies by these variables is low: below 11%.

[*] Collinearity diagnostics suggested that multicollinearity was not a problem in the data (Tolerances > .20; largest VIFs < 10; average VIF not substantially > 1.0 (Bowerman & O'Connell, 1990)).

Table 5.9: Pearson correlations for competencies, alliance type, and control variables at individual level (N= 73)

Variable*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Involve	1																		
2. Influence	.416**	1																	
3. Handle conflicts	.628**	.343**	1																
4. Create learning climate	.465**	.414**	.546**	1															
5. Take on	.621**	.590**	.587**	.521**	1														
6. Prevail	.539**	.551**	.525**	.359**	.669**	1													
7. Monitor	.492**	.187	.518**	.525**	.598**	.448**	1												
8. Decide mindfully	.561**	.461**	.598**	.403**	.704**	.583**	.589**	1											
9. Communicate clearly	.616**	.387**	.685**	.468**	.652**	.696**	.603**	.696**	1										
10. Analyse	.602**	.317**	.702**	.503**	.602**	.456**	.581**	.544**	.552**	1									
11. Explore	.459**	.233*	.638**	.426**	.448**	.328**	.430**	.422**	.466**	.629**	1								
12. Combine	.355**	.329**	.491**	.498**	.455**	.311**	.266*	.473**	.314**	.465**	.546**	1							
13. Compete	.065	.057	.133	.040	.195*	.163	.145	.248*	.222*	.313**	.189	.276**	1						
14. Age	-.113	-.076	-.083	-.084	-.069	-.109	-.104	.055	-.036	.021	.038	.069	.099	1					
15. Experience innovation	.047	-.002	.016	-.082	.105	-.036	-.060	.078	.103	.080	.101	.037	.074	.588**	1				
16. Experience open innovation	.118	.109	.138	-.074	.078	.008	-.038	.196*	.150	.048	.120	.094	.010	.487**	.575**	1			
17. Gender	.123	.079	.015	.122	.183	.152	.203*	.007	.067	-.076	-.029	-.247*	-.183	-.461**	-.352**	-.375**	1		
18. Project management	.292**	.281**	.097	.292**	.191	.313**	.251*	.186	.199*	.183	.089	.031	.019	-.075	.000	-.096	.233*	1	
19. Process control	-.060	-.006	-.165	-.334**	.010	-.241*	-.262*	-.042	-.173	-.062	-.080	-.004	.043	.403**	.278**	.230*	-.239*	-.378**	1

* * p < .05, **p < .01
Reference group for functional role is Product development

Table 5.10: Significant predictors per competency, described by R^2, p, b, and SE b (N=73)

Competencies[*] Predictor[†]	R^2	p	b[a]	SE b
Involve	**.086**	**.012**		
Project management			.322*	.125
Influence	**.079**	**.016**		
Project management			.407*	.165
Handle conflicts	**.000**	**.**		
Create learning climate	**.112**	**.004**		
Process control			-.534**	.179
Take on	**.000**	**.**		
Prevail	**.098**	**.007**		
Project management			.379**	.137
Monitor	**.069**	**.025**		
Process control			-.405*	.177
Decide mindfully	**.081**	**.053**		
Experience open innovation			*.019*	.010
Project management			*.220*	.123
Communicate clearly	**.040**	**.092**		
Project management			*.213*	.124
Analyse	**.000**	**.**		
Explore	**.000**	**.**		
Combine	**.061**	**.035**		
Gender			-.353*	.165
Compete	**.000**	**.**		

5.4 Discussion

First of all, it should be noted that any generalizations based on this study must be used cautiously, since most respondents came from very large companies in the industrial sector in the Netherlands, and in many cases the response of external partners is missing (see section 4.3.1). Moreover, the sample size may seem small compared to the number of variables used in the multiple regression analyses. This reduces the power of the test, which means that some existing relationships may not have been detected. For instance, at the .10 level of significance a relationship was found between work experience with open innovation and the competency 'deciding mindfully'. It may well be that this relationship becomes significant at a .05 significance level, when a larger sample is used. Moreover, the groups were of unequal size, which can suppress significant relationships of smaller groups with the dependent variable. Nevertheless, a significant relationship was found for the smallest group with symmetric, scale and international alliances (n=6), which indicates that group size did not necessarily have an influence on the data and that the data is suitable for further analysis.

[*] * p < .05, **p < .01, ***p < .001; b in italic are significant at p < .1
[†] Reference group is Product development

The data showed that the standard deviations for almost all competencies are low, which suggests that they are rather generic across respondents. The descriptives show that competencies which deal with relatively 'normal' project management behaviour ('communicate clearly', 'involve', 'prevail', 'monitor' and 'take on') are generally perceived as most important. Competencies that seem more specific for open innovation ('combine', 'influence' and 'compete') seem on average to be regarded as less important, but the opinions about their importance vary to a larger extent, compared to the more usual project management behaviours. These competencies could therefore be more context-specific. Significant relationships with context variables were found for the competencies with the lowest standard deviations. The competencies 'take on', 'prevail' and 'communicate clearly' were influenced by alliance type. 'Prevail', which included among other factors having enough authority to get things done, was more important in the most complex form of open innovation, with international, both symmetric and asymmetric, link and scale alliances. The teams in this alliance type showed a significantly lower on shared cognition and power differences, which together probably makes prevailing behaviour more important. 'Communicate clearly' was more important in mixed alliances, but also in the alliance type with scale, link and international alliances. The last alliance type included more professionals who were non-Dutch, and diverse in that sense, which could make this competency more important. 'Take on' was less important in the alliance type with national alliances, which could indicate that it is more important to 'take on' in international alliances. It seems that the more diverse an alliance type is the more important taking on, prevailing and communicating clearly becomes.

Analysis of context variation at the individual level showed that professionals with project management tasks consider 'involve' and 'influence' to be of more importance than do professionals with product development tasks. Moreover, they perceived 'prevail', 'create learning climate' and 'monitor' to be more important for their role than professionals who deal with process control. It seems therefore that the functional role project management requires more competencies than the other functional roles. Compared to context variation at team level, it is striking that the competencies that seem to vary across contexts mainly deal with interpersonal and project management, and not with content management (compare Table 4.8 and 5.5). This part of the profile seems to be most robust and context independent. However, although some significant relationships were found, the low total amount of explained variance by the context factors possibly indicates that their impact is not substantial. This would give support to the idea that the profile does not vary to a large extent across contexts. There are two issues to consider with respect to this finding.

An argument against is the idea that the context variables could possibly not have been measured well. For instance, the functional roles constructed were dependent on the data given by the respondents, which was very limited. More information about their tasks could have resulted in another more nuanced

classification of functional roles. Moreover, despite the good response to the questionnaire, there is a certain group missing: the external partners. It is possible that they had another functional role that fit other competencies. Further research should therefore indicate what kinds of functional roles and team roles in open innovation teams can be discerned. Section 7.3.2 will elaborate more on this issue. Moreover, there are some other contextual factors that could play a role. For instance, there was a significant negative relationship found between the alliance type that consisted of asymmetric, link and national alliances and 'take on'. 'Take on' consisted among other factors of being emotionally stable, able to focus and initiate activities, and it fits the challenge 'coping with role overload'. The teams covered by asymmetric, link and national alliances consisted of a large number of SMEs that were not situated in the industrial sector. Could it be that in very large organizations in the industrial sector it is more important to be able to 'take on'? Future research has to investigate this issue in more depth.

An argument in favour of the suggestion that the profile is generic is that the results indicate that 'team climate', a general feature not specific to specific kinds of teams, has by far a greater and positive impact on the importance of most of the competencies than the other variables. The other team emergent states 'shared cognition' and 'power differences' were positively correlated with 'team climate', so it cannot be stated that these emergent states are of no influence on the importance of the competencies. 'Team climate' was just the strongest and had the most positive influence on almost all competencies. So, it is not context-specific factors that influence the importance of the competencies, but factors that are known to be mediating factors for teams in general. A possible explanation is that if the team climate is good, professionals will feel more motivated or be more enabled to apply certain competencies, through which they become more important for their functional role. Interestingly, this is not the case for opportunistic competencies: 'compete' and 'influence'. Therefore, a good team climate does evoke all kinds of behaviours, apart from opportunistic behaviour. This fits the observation of Lee & Choi (2003), who found that it is not the competency itself (they focused on T-shaped skills[*]) that leads to successful knowledge creation, but the environment that determines how well these skills are used. They state that without an environment in which T-shaped skills flourish, people with T-shaped skills will not attempt to create new knowledge. The data in this chapter indicate that the same applies to open innovation competencies. On the other hand, this environment is also partly constructed by the use or non-use of certain competencies by the professionals. So, is it the environment, in this case a good team climate (and probably also a low shared cognition and small power differences) that enable professionals to make full use of their competencies; or it is the application of certain

[*] Professionals with T-shaped skills not only have a deep knowledge of a discipline, but also know how their disciple interacts with others (Lee & Choi, 2003).

competencies that creates a good team climate? More generally, if team emergent states, such as team climate, determine the use of certain competencies, what is the contribution of these competencies to team performance? Are the competencies crucial to the success of open innovation teams or do team emergent states lead to team performance? Another explanation for this relationship could lie in the cause-effect issue. Professionals who estimate the competencies as highly important, apply these more often (there is a correlation between importance and frequency of use, see section 4.3.2), and create as such a better team climate. To shed light on these issues, it is important to conduct further analyses on the relationship between application of the competencies and their effect on team performance.

5.5 Conclusion

The aim of this chapter was to test whether the developed profile in the previous studies was generic and suitable for use across different contexts, especially alliance type of the open innovation team and functional role of the professional. The research question guiding this chapter was: Does the perceived importance of the competencies in the competence profile vary across contexts and if so, how? A survey among open innovation professionals measured the competencies and context variables at team and individual level. Multiple regression analyses on the data showed that the importance of some competencies varied slightly on alliance type and functional role. In more complex forms of alliances, it was more important to 'take on', 'prevail' and 'communicate clearly'. Moreover, it appeared that professionals in charge of project management perceived more competencies as important for their role in the project, compared to professionals in charge of product development or process control. Specifically, they perceived the competencies 'involve', 'influence', 'prevail', 'create learning climate' and 'monitor' as more important for their role in the project. The variations in the profile due to contextual differences seem to mainly concern interpersonal and project management competencies. Content management competencies seem rather robust and context independent. However, there are indications that the whole profile is rather robust, since although the importance of the above-mentioned competencies varies across contexts, the variations on importance are small. Moreover, the specific context factors did not explain much of the variance in the data. Based on the findings in this study it can therefore be stated that there is insufficient evidence to claim that specific competence profiles have to be developed per context. Figure 5.2 summarizes the findings in this chapter graphically. However, general context factors, more specifically team climate, appeared to have a substantial overall positive effect on the competencies, except on opportunistic behaviour. This could indicate that team emergent states determine whether competencies are being applied or not. The question thus

emerges of whether team performance is determined by team emergent states or by the application of certain competencies. Apart from investigating in more depth which specific context factor could influence the importance of the competencies, further research should investigate the contribution of competencies to team performance. The next chapter will explore this issue in more detail.

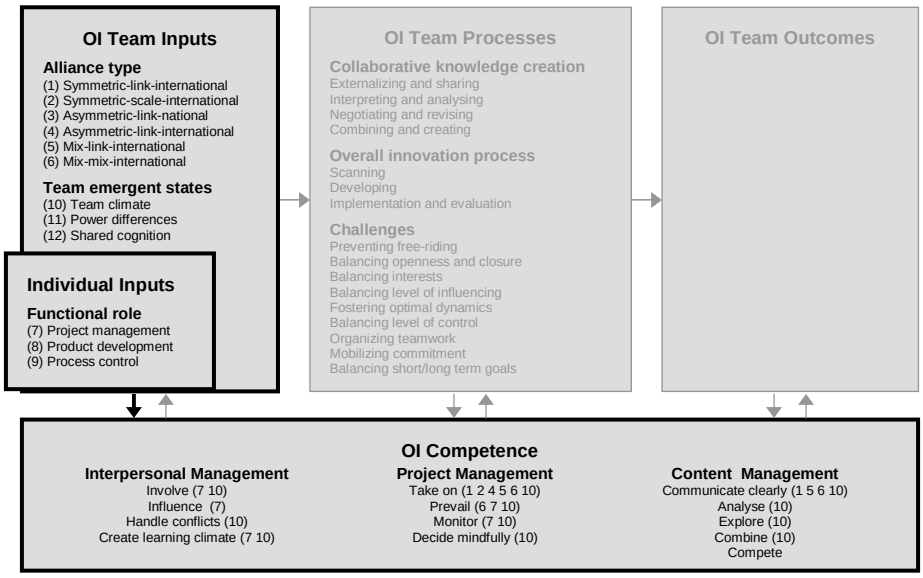


Figure 5.2: Input-Process-Outcome framework for open innovation (OI) teams with factors that influence the importance of the competencies, based on the findings in Chapter 5 (positive relationships are shown by numbers between brackets)

Chapter 6
Open Innovation Competence and Team performance

6.1 Introduction

This whole body of research is built on the assumption that individual competence has an impact on team performance or success. The previous chapter, however, questions this by suggesting that it is rather the environment, or team climate, that determines how the competencies are being used and, as such, determines team performance to a larger extent. Up till now, no studies have empirically and conclusively examined the relationship between competencies and team performance. This chapter therefore examines the contribution of the different competencies to team performance. The question guiding this chapter is:

> *Sub-question e: Does the reported application of the competencies in the competence profile significantly contribute to team performance, and if so, how?*

This study defines team performance by the success of team processes and direct team outcomes. Section 2.2 explained that the team processes consist of the overall innovation process, the collaborative knowledge creation process, and challenges caused by inter-organizational collaboration. Since the challenges influence team outcomes through the other processes, only the first two processes will be taken into account. These processes should eventually lead to common ground, common goals, action plans, new ideas for innovation and an implemented product (see section 2.2.2). Figure 6.1 depicts the focus of this chapter in the input-process-outcome framework. Section 6.2 will describe in more detail the methods used to investigate this research question. Section 6.3 will report the results. Section 6.4 will discuss the results and section 6.5 concludes the chapter.

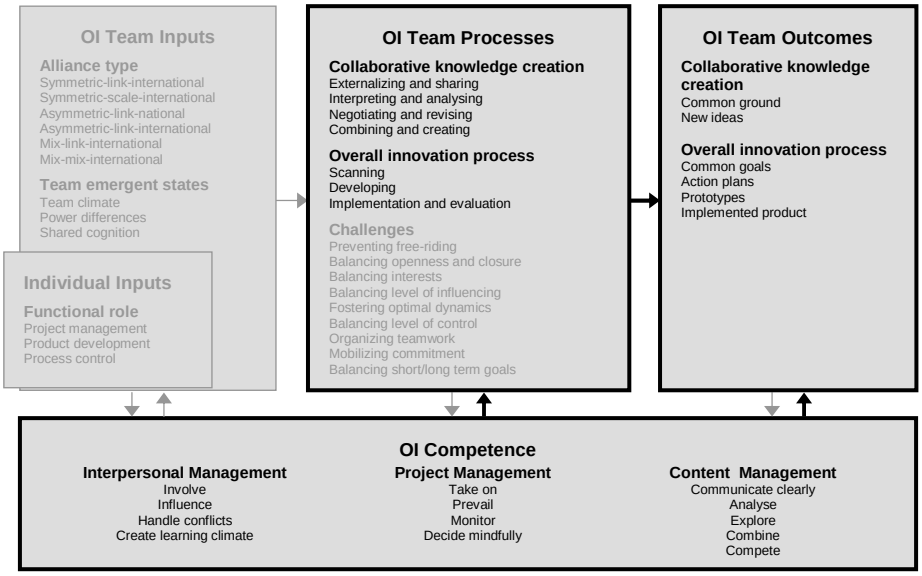


Figure 6.1: Input-Process-Outcome framework for open innovation (OI) teams with in bold the variables focussed upon in Chapter 6

6.2 Methods

6.2.1 Data

To answer the research question the same data set as described in the previous two chapters was used (see for more details section 4.2.1). The online questionnaire that was sent to team members of the selected open innovation teams contained, apart from questions on the competencies, an additional part about team processes and team outcomes. The next sections will describe how the variables were measured by the online questionnaire and how the data were analysed.

6.2.2 Measures

Dependent variables

The items to measure team performance were directly derived from the theoretical framework explained in sections 2.2.1 and 2.2.2. Six items were constructed to measure the overall innovation process and its outcomes: 'overall process', 'creating common goals', 'designing an action plan', 'constructing prototypes', 'evaluation', and 'implementation' (items 1-6 in Table 6.1). Another six items were constructed to measure the success of the collaborative knowledge creation process and its outcomes: 'sharing information', 'listening

to each other', 'handling conflicts', 'elaborating on each other's ideas', 'creating common ground' and 'developing new ideas' (items 7-12 in Table 6.1). For each item, respondents were asked the following question: 'How successful was the collaboration process, with respect to...' Respondents had to answer using a 5-point rating scale ranging from 1: very unsuccessful; 2: unsuccessful; 3: neutral; 4: successful; to 5: very successful. Respondents could also select the option 0: don't know/not applicable.

Factor analysis (Principal Axis Factoring, with Varimax rotation, extracting factors with eigenvalues over 1.0) on the questionnaire data of the 73 respondents revealed two scales that were quite close to the original two constructs: overall innovation process and collaborative knowledge creation process. However, the items 8 'listening to each other' and 9 'handling conflicts', which were constructed for the collaborative knowledge creation process, better fit the overall innovation process, and item 4 'constructing prototypes', which was constructed for the overall innovation process, better fit the collaborative knowledge creation process. Since the resulting factors did not entirely fit the constructs overall innovation process and collaborative knowledge creation process anymore, they were labelled as general innovation processes and specific creation processes respectively, which better fit the content of the newly derived factors. Reliability analysis on the resulting two factors showed a Cronbach's α of .89 for the construct general innovation processes and .83 for the construct specific creation processes. Table 6.1 reports the factors, their items and factor loadings. Mean scores on general innovation processes and specific creation processes were computed for all respondents.

Table 6.1: Factors and corresponding items resulting from factor analysis of open innovation professionals' perceptions of team performance

Items*	Factors†	
	1	2
General innovation processes (α=.89)		
1. The overall collaboration process	**.798**	
6. Implementation of the object of innovation	**.722**	
8. Listening carefully to each other	**.702**	.418
2. Creating common goals, a common understanding of the task to handle	**.616**	.328
5. Formal and informal evaluation moments, e.g. feedback by team members and evaluation meetings	**.612**	.312
9. Handling differences of opinions or conflicts	**.608**	.460
3. Designing an action plan, a common understanding of how to deal with the task	**.551**	
Specific creation processes (α=.83)		
12. Developing new ideas for innovation or improvements		**.808**
11. Creating common ground, same meanings and interpretations	.371	**.681**
7. Sharing relevant knowledge, information and expectations	.460	**.590**
10. Elaborating on, complementing each other's information and ideas	.566	**.561**
4. Constructing prototypes		**.430**

* Items are quoted from the survey.
† Principal Axis Factoring, with Varimax rotation. Loadings lower than .30 are not included in the table.

Independent variable
The independent variables were the newly defined competencies based on the factor analysis reported in Chapter 4: 'involve', 'influence', 'handle conflicts', 'create learning climate', 'take on', 'prevail', 'monitor', 'decide mindfully', 'communicate clearly', 'analyse', 'explore', 'combine' and 'compete'. Mean scores for frequency of use were computed for each competency. Only scores with respect to the frequency of use were used, since these scores provided the most information about the competencies as actually used in the open innovation teams. Since talking about personal competencies in this research context is a sensitive issue (see 1.4/7), the respondents were not asked to rate their own skill level. These kinds of scales are more likely to be more subject to the problem of self-rating bias and social desirability, due to political distortions, such as personal agendas (cf. Curtis et al., 2005), or unawareness of one's own performance (Ehrlinger et al., 2008). For more details about the items underlying each competency and the measurement method, see section 4.3.5.

Control variables
The relationship between the frequency of use of competencies and team performance was controlled for team emergent states. Team emergent states are thought to directly influence the innovation process and its outcomes (Mathieu et al., 2008), which are in turn influenced by team level input and composition variables (see section 2.2.3). The team emergent states included in this study were 'team climate', 'power differences' and 'shared cognition'. Apart from team emergent states, the analysis was controlled for alliance type of the particular open innovation team. For the measurement of these constructs, the reader is referred to section 5.2.2.

6.2.3 Data Analysis

First, means and standard deviations of the competency scores were analysed, followed by a hierarchical multiple regression analysis. This method was chosen because it gives the opportunity to estimate how much variance is explained by the predictor variables compared to the control variables, and whether the contribution of these predictors is significant. Two regression models were calculated: one regression model to explore the relationship between the frequency of use of the competencies and the success of general innovation processes, and one for the relationship between the frequency of use of the competencies and the success of specific creation processes. The control variable alliance type was entered in a first step, team emergent states were entered in a second step, and the competencies in a third step. This way, it could be determined if the alliance type had an effect on the data, how much of the total explained variance was accounted for by team emergent states, and how much extra variance is accounted for by the competencies, compared to alliance type and team emergent states. All regression analyses were conducted with

intercepts included. The chosen strategy however entailed that the ratio between number of predictors and respondents is disputable. The stability of the results was therefore tested by employing backward and forward regression as an alternative to the hierarchical regression with the enter method. In addition, the results of the regression analyses were compared with the correlations between the dependent and independent variables.

6.3 Results

6.3.1 Descriptives and Simple Correlations

Descriptives of the competencies show that 'communicate clearly' has the highest mean, a low standard deviation and is followed closely by 'take on', 'involve', 'decide mindfully', 'prevail', 'monitor' and 'analyse' (scores ≥ 4.00) (see Table 6.2). The competencies 'handle conflicts', 'create learning climate' and 'explore' are moderately scored ($3.60 < \text{scores} < 4.00$) compared to the competencies mentioned above, although average scores above 3.50 are still considered as being important. The competencies 'combine', 'influence', and 'compete' received the lowest mean scores on frequency of use (scores ≤ 3.40). In fact, the competency 'compete' is the only competency that has a low average score. These three competencies have however the highest standard deviation. All the other competencies have low standard deviations (< 0.65).

For a description of the alliance type variables, the reader is referred to section 5.3.1. This section also describes the team emergent states variables: 'team climate' ($M = 3.96$; $SD = .65$), 'power differences' ($M = 3.53$; $SD = .88$) and 'shared cognition' ($M = 3.53$; $SD = .88$). The means and standard deviations of general innovation processes and specific creation processes are 3.59 ($SD = .70$) and 3.66 ($SD = .70$) respectively.

Table 6.2: Means and standard deviations for frequency of use scores on competencies ordered by mean values (N=73)

	M	*SD*
Communicate clearly	4.32	.48
Take on	4.09	.56
Involve	4.08	.58
Decide mindfully	4.06	.47
Prevail	4.04	.60
Monitor	4.02	.65
Analyse	4.01	.59
Handle conflicts	3.93	.52
Create learning climate	3.64	.64
Explore	3.63	.56
Combine	3.40	.69
Influence	3.32	.76
Compete	2.97	.83

Before conducting the multiple regression analysis the degree of association between the dependent and independent variables was verified (see Table 6.3). Many competencies appeared to be significantly correlated to each other. 'Monitor' showed a significant relationship with eleven other competencies: 'take on', 'communicate clearly' and 'combine' with ten; 'involve', 'handle conflicts', 'prevail', 'decide mindfully' and 'explore' with nine; 'create learning climate' with eight; 'analyse' with seven; 'compete' with three, and 'influence' with two. All correlations were however < .52. The team emergent states showed the greatest collinearity, but the correlation coefficients were < 0.62, which is smaller than .80 (Nunnally & Bernstein, 1994). Moreover, collinearity diagnostics derived from the regression analyses later on suggested that multicollinearity was not a problem in the data (Tolerances > .20; largest VIFs < 10; average VIF not substantially > 1.0 (Bowerman & O'Connell, 1990)). It was therefore decided not to remove any variables from the analysis.

Comparing the relationships of the independent variables with the success of general innovation processes and specific creation processes, it is striking that the alliance type MixMixInt is significantly negatively related to both of them and the alliance type AsymLinkNat is positively related to specific creation processes. Moreover, all team emergent states are significantly positively related to general innovation processes and specific creation processes. Nine competencies are significantly related to the success of general innovation processes and eight to the success of specific creation processes.

Both 'compete' and 'influence' are the only competencies that are negatively related to the two dependent variables. The negative relationship between 'compete' and general innovation processes is significant. The competencies significantly positively related to the success of general innovation processes are (from strong to weak relationship): 'monitor', 'prevail', 'communicate clearly', 'decide mindfully', 'create learning climate', 'involve', 'handle conflicts' and 'combine'. The competencies significantly positively related to the success of specific creation processes are (from strong to weak relationship): 'monitor', 'communicate clearly', 'prevail', 'create learning climate', 'combine', 'decide mindfully', 'explore' and 'analyse'. It is striking that more content management competencies are significantly related to the success of specific creation processes and more interpersonal management competencies are related to the success of general innovation processes. It should be noted that the competencies 'influence' and 'take on' did not show any significant relationships with the team performance variables.

Table 6.3: Pearson correlations for dependent variables, control variables, and competencies (N= 72)

Variable*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. General processes	1																						
2. Specific processes	.732**	1																					
3. SymScaleInt	-.022	-.010	1																				
4. AsymLinkNat	.126	.239*	-.142	1																			
5. AsymLinkInt	.120	.036	-.121	-.189	1																		
6. MixLinkInt	-.048	-.057	-.142	-.220*	-.189	1																	
7. MixMixInt	-.403**	-.270*	-.114	-.177	-.152	-.177	1																
8. Team climate	.620**	.595**	.156	.086	-.032	-.027	-.123	1															
9. Power differences	.694**	.507**	.046	.043	.030	-.122	-.328**	.574**	1														
10. Shared cognition	.690**	.596**	-.048	.172	.049	.158	-.261*	.583**	.619**	1													
11. Involve	.232*	.160	-.033	-.146	-.044	.138	-.115	.168	.268*	.185	1												
12. Influence	-.064	-.110	.152	-.044	.028	.006	.047	.119	.082	-.055	.114	1											
13. Handle conflicts	.215*	.194	-.148	-.136	-.145	.148	-.021	.243*	.158	.319**	.225*	.017	1										
14. Create learning climate	.296**	.374**	.143	.300**	-.130	-.051	-.179	.356**	.302**	.364**	.141	.183	.218*	1									
15. Take on	.188	.185	.032	-.236*	-.099	.226*	-.113	.272*	.105	.144	.363**	.260*	.332**	.219*	1								
16. Prevail	.375**	.376**	-.040	.043	-.107	.064	-.278**	.377**	.379**	.296**	.425**	.173	.364**	.223*	.517**	1							
17. Monitor	.567**	.552**	.050	-.060	-.107	-.116	.019	.491**	.426**	.418**	.353**	-.102	.455**	.309**	.223*	.320**	1						
18. Decide mindfully	.320**	.261*	.052	-.222*	.004	.013	-.128	.282**	.251*	.189	.359**	.151	.391**	.194	.463**	.506**	.449**	1					
19. Communicate clearly	.326**	.383**	-.066	-.175	-.179	.147	.061	.436**	.396**	.395**	.426**	-.019	.380**	.207*	.371**	.451**	.427**	.375**	1				
20. Analyse	.091	.217*	.175	-.031	-.227*	-.016	.018	.274**	.294**	.085	.343**	.037	.115	.232*	.183	.185	.485**	.304**	.462**	1			
21. Explore	.176	.224*	.072	.149	-.181	-.180	-.107	.178	.213*	.123	.266*	-.010	.281**	.202*	.243*	.222*	.280**	.193	.227*	.482**	1		
22. Combine	.204*	.285**	-.173	.219*	-.231*	.165	-.123	.158	.259*	.188	.267*	.137	.286**	.307**	.277**	.257*	.229*	.273*	.232*	.409**	.414**	1	
23. Compete	-.278**	-.184	.117	-.104	.105	-.013	.027	-.066	-.139	-.062	-.116	.397**	-.191	-.121	.126	-.097	-.256*	-.275**	-.194	-.149	-.018	-.105	1

* * p < .05, **p < .01
Reference group for alliance type is SymLinkInt

6.3.2 Success of General Innovation Processes

As shown in Table 6.4 the results from the multiple regression analysis indicated that the competencies as a set had a significant contribution to the success of general innovation processes. The competency 'monitor' is significantly positively linked to general innovation processes, and the competencies 'compete', 'handle conflicts' and 'analyse' are significantly negatively linked. The variables together explain around 82% of the variance of general innovation

Table 6.4: Regression model for general innovation processes, described by (change in) explained variance, (change in) significance, b, and SE b (N=72)[*†]

	R^2	ΔR^2	ps	*p*	b	SE b
Step 1	*.186*	*.186*	*.016*	*.016*		
SymScaleInt					-.211	.300
AsymLinkNat					.024	.228
AsymLinkInt					.044	.249
MixLinkInt					-.231	.228
MixMixInt					-.893**	.258
Step 2	*.673*	*.488*	*.000*	*.000*		
SymScaleInt					-.275	.200
AsymLinkNat					-.094	.158
AsymLinkInt					.036	.166
MixLinkInt					-.241	.166
MixMixInt					-.510**	.184
Team climate					.290**	.104
Power differences					.183*	.087
Shared cognition					.274**	.086
Step 3	*.822*	*.149*	*.001*	*.000*		
SymScaleInt					-.112	.186
AsymLinkNat					-.057	.170
AsymLinkInt					.099	.150
MixLinkInt					-.106	.159
MixMixInt					-.547**	.171
Team climate					.200*	.096
Power differences					*.148*	.084
Shared cognition					.228*	.085
Involve					-.045	.091
Influence					.083	.075
Handle conflicts					-.314**	.114
Create learning climate					-.091	.085
Take on					.110	.109
Prevail					-.030	.105
Monitor					.493***	.104
Decide mindfully					-.049	.132
Communicate clearly					.092	.134
Analyse					-.408**	.113
Explore					.140	.105
Combine					.092	.086
Compete					-.213**	.069

[*] The additional backward and forward regressions yielded essentially the same results compared to each other and to the hierarchical enter method. The major difference worth mentioning is that the outcomes of both backward and forward regression included one extra significant team emergent state in the end result (shared cognition $p < .01$), compared to the hierarchical enter procedure.

[†] * $p < .05$, ** $p < .01$, *** $p < .001$; b in italic are significant at $p < .1$;

Reference group for alliance type is SymLinkInt.

processes[*]. Team emergent states significantly account for around 49% of the total explained variance and the competencies as a set significantly explain about 15% extra variance of the success of general innovation processes. Interesting to note is that the competencies take over the significant effect of some of the team emergent states. More specifically, 'team climate', 'power differences' and 'shared cognition' are significant positive predictors of the success of general innovation processes, but this significance disappears for 'power differences' when the competencies are added to the model ($p < .05$ in the second step and $p > .05$ in the third step). This suggests that the competencies are stronger predictors of the success of the general innovation processes than the team emergent state power differences[†]. It should be noted that the alliance type MixMixInt was negatively linked to the success of general innovation processes, which confirms the negative relationship in the correlation matrix.

The negative relationships of 'handle conflicts' and 'analyse' could indicate that there are suppressor variables in the data, because both competencies showed a positive relationship with general innovation processes in the correlation table. Although not significant, the same holds for 'involve', 'influence', 'create learning climate', 'prevail' and 'decide mindfully'. A suppressor variable suppresses variance that is irrelevant to prediction of the dependent variable, and is thus not defined by its own regression weight, but by its enhancement of the effects of other variables in the set of independent variables (Tabachnick & Fidell, 2001). To identify the suppressor variable the strategy proposed by Tabachnick and Fidell (2001) was followed. First, congruent independent variables were sought: those which had a correlation consistent in size and direction with the regression coefficients ('take on', 'monitor', 'explore', 'combine', 'compete', 'communicate clearly', team emergent states and alliance type). These variables were systematically left out of the regression model and changes in the regression coefficients were examined. It appeared that when 'monitor', 'team climate' and 'shared cognition' were left out of the model the regression coefficient of 'handle conflicts' became positive. A positive change in the regression coefficient of 'analyse' only came when 'monitor', the team emergent states, 'take on', 'explore', 'combine', 'communicate clearly', 'involve', 'create learning climate' and 'decide mindfully' were removed from the model. Clearly, we cannot speak of a suppressor variable anymore, but rather of a suppression situation: the situation in which the suppressor and the variables that are suppressed include more than one predictor (Tzelgov & Henik, 1991). Section 6.4 will discuss this

[*] Since the explained variance is very high, this could indicate common method bias. A factor analysis was therefore conducted on all the 21 independent variables, as Podsakoff et al. (2003) suggest. Seven factors were indicated, which suggests that common method bias is not a problem in this data.

[†] This finding is supported by the fact that when the competencies were added to the model in a second step and the team emergent states in the third, the competencies accounted for much more variance than the team emergent states ($R^2 = .19$ for Step 1: $\Delta R^2 = .49$ for Step 2 (ps < .00): $\Delta R^2 = .15$ for Step 3 (ps < .00)).

issue in more depth. When the competency 'monitor' was removed from the regression model, the significant relationship of 'handle conflicts' and 'analyse' disappeared, but apart from that, the model stayed essentially the same.

6.3.3 Success of Specific Creation Processes

As shown in Table 6.5 the results from the multiple regression analysis indicate that the competencies as a set do not have a significant contribution to the success of specific creation processes.

Table 6.5: Regression model for specific creation processes, described by (change in) explained variance, (change in) significance, b, and SE b (N=72)[*†]

	R^2	ΔR^2	ps	*p*	b	SE b
Step 1	*.115*	*.115*	*.143*	*.143*		
SymScaleInt					-.046	.313
AsymLinkNat					.329	.239
AsymLinkInt					.039	.260
MixLinkInt					-.106	.239
MixMixInt					*-.516*	.270
Step 2	*.496*	*.381*	*.000*	*.000*		
SymScaleInt					-.183	.249
AsymLinkNat					.165	.197
AsymLinkInt					-.004	.207
MixLinkInt					-.193	.207
MixMixInt					-.294	.229
Team climate					.398**	.130
Power differences					.030	.109
Shared cognition					.251*	.107
Step 3	*.642*	*.146*	*.126*	*.000*		
SymScaleInt					.007	.265
AsymLinkNat					.181	.242
AsymLinkInt					.220	.214
MixLinkInt					-.053	.226
MixMixInt					-.302	.244
Team climate					*.241*	.136
Power differences					-.044	.120
Shared cognition					.158	.120
Involve					-.153	.129
Influence					-.070	.107
Handle conflicts					*-.309*	.162
Create learning climate					.051	.121
Take on					.025	.156
Prevail					.130	.149
Monitor					.468**	.147
Decide mindfully					-.061	.187
Communicate clearly					.286	.190
Analyse					-.218	.161
Explore					.083	.150
Combine					.194	.122
Compete					-.039	.098

[*] The additional backward and forward regressions yielded essentially the same results compared to each other. Compared to the hierarchical enter procedure, both procedures included three extra significant variables in the end result (AsymLinkNat p < .05; Team climate p < .05; Shared cognition p < .05).
[†] * p < .05, **p < .01, ***p < .001; b in italic are significant at p < .1;
Reference group for alliance type is SymLinkInt

Nevertheless, the entire model for specific creation processes is significant and there is only one competency, 'monitor' that is significant. The variables together explain around 64% of the success of specific creation processes, which is lower than the total explained variance of general innovation processes. Team emergent states significantly account for around 38% of the total explained variance and the competencies as a set significantly explain about 15% extra variance of the success of specific creation processes, but not significantly. However, the competencies take over the significant effect of the team emergent states. 'Team climate' and 'shared cognition' are significantly positively related to the success of the specific creation processes, but both significant values disappear when the competencies are added. This could indicate that the competencies have a stronger relationship with the success of specific creation processes than 'team climate' and 'shared cognition'[*]. It should be noted that the control variable alliance type was not significantly related to the success of specific creation processes. Interesting to note is that when the competency 'monitor' was removed from the model, three other variables became significant positive predictors: 'team climate' (p = .005), 'shared cognition' (p = .000), and the competency 'combine' (p = .042).

6.4 Discussion

The findings in this study challenge the view of Lee and Choi (2003) that it is the environment that determines team performance. Hierarchical multiple regression analysis showed that the competencies as a set significantly contribute to the success of general innovation processes, but not to the success of specific creation processes. However, both models indicate that the competency 'monitor' is significantly positively related to team performance. This competency appeared to have a stronger predictive value than 'power differences' for the success of general innovation processes, and than 'team climate' and 'shared cognition' for the success specific creation processes. It seems that monitoring behaviour, which consists of communicating enough to do one's job, making results visible, and trusting others, is a strong predictor of open innovation team performance in general. Competing behaviour was significantly negatively related to the success of general innovation processes, and was not frequently used by most respondents, which questions the value of this competency to the competence profile. Interestingly, the results showed that 'shared cognition' has a positive relationship with both the success of general innovation processes and specific creation processes, which suggests that diversity is not positively related to team performance. This finding corresponds

[*] This finding is supported by the fact that when the competencies were added to the model in a second step and the team emergent states in a third step, the team emergent states did not significantly contribute to the model (R^2 = .11 for Step 1: ΔR^2 = .59 for Step 2 (ps < .00): ΔR^2 = .06 for Step 3 (ps > .05)).

with the notion in section 1.2.2 that diversity does not necessarily lead to positive outcomes. According to this study, the more team members share the same culture, goals and perceptions, the more successful they perceive team performance to be. Moreover, it appeared that the most complex alliance type that consisted of a mix of symmetric and asymmetric, link and scale, and international alliances, was negatively related to the success of general innovation processes. These findings confirm the earlier suggestion in this thesis that complexity in alliances has a down side and may have a negative effect on overall team performance (see section 1.2.2). It should be noted that the multiple regression models in this study contain many predictors in relation to the number of respondents, which reduces the statistical power of the test and thus the likelihood of finding significant predictors. Simple correlations showed much more significant relationships between competencies and team performance, which could possibly become significant in the regression model when a bigger respondent group is involved. Other possible explanations for insignificant relationships are as follows.

1. Context dependency of the competencies. This study did not examine possible interactions between context variables and competencies. Adding interaction variables would have resulted in a saturated model that does not allow any testing of effects. Consequently, the results of the multiple regression analysis indicate competencies that are related to team performance *in general*, independent of for instance team or functional roles. It is likely that monitoring behaviour should be applied by all open innovation professionals to enhance team performance, whereas the other competencies are more role dependent. If the interaction between an individual's role and competency had been taken into account in the data-analysis, it is possible that more significant relationships would have been found. The previous chapter indicated that some competencies are dependent on functional role, which stresses the importance of investigating this issue in more depth.

2. Measurement of performance. The level of performance was rated on a scale that measured frequency of use. The advantage of such a scale is that it more objectively identifies the actual performance, compared to scales about skill level (see section 6.2.2). It is however possible that there are competencies that do not need to be applied very often to have an impact on team performance. Some may be needed only in specific creation processes, which do not seem to occur as frequently as general innovation processes. This is confirmed by the fact that specific open innovation competencies were on average applied less frequently compared to general innovation management competencies (see section 6.3.1). In addition, there could be competencies that only need to be applied once to have a big impact (e.g. handling conflicts).

3. Suppression situations. Simple correlations showed many significant relationships between competencies and team performance. Interpersonal and project management competencies were especially related to the success of general innovation process and content management competencies to the

success of specific creation processes. However, the regression models only showed a significant positive relationship for 'monitor' for both the success of general innovation processes and specific creation processes. This competency was significantly related to most other competencies. The results showed that when this competency was removed from the model the content management competency 'combine' became a positive predictor of the success of specific creation processes. The model of the success of general innovation processes stayed essentially the same after its removal. The small impact on the models when this competency is removed (the direction and size of the regression coefficients essentially stayed the same) suggests that a suppression situation exists, which is proved by the opposite directions of the simple correlations and regression coefficients of many competencies. The concept of suppression implies that there are cases in which the effects of some (independent) variables of interest are blurred by criterion-irrelevant variance (Tzelgov & Henik, 1991). Suppression happens either because there is a variable that contributes to an explanation by its statistical feature of being correlated with other independent variables and is therefore more an irrelevant variance cleaner, or because a variable reflects a relationship of theoretical interest (ibid). Analysis of the suppression situation in the general innovation processes model showed that when (after 'monitor') the team emergent states 'team climate', and 'shared cognition' were removed, the competency 'handle conflicts' got a positive regression coefficient. In other words, the variables measuring monitoring, team climate, and shared cognition clear out the variance from 'handle conflicts'[*]. This leads to the suggestion that when sufficient attention is given to the 'monitor' competency, 'team climate' and 'shared cognition', the competency 'handle conflicts' becomes less relevant, and that in teams with a low performance, low 'shared cognition' and low 'team climate', professionals need to use the competency 'handle conflicts' more frequently. However, more research needs to be done to verify these relationships. Focusing on this issue would contribute to theoretical thinking about open innovation competence and team performance.

6.5 Conclusion

The aim of this chapter was to test the relationship between competencies and team performance. The research question guiding this construction was: Does the reported application of the competencies in the competence profile significantly contribute to team performance, and if so, how? A survey among open innovation professionals measured the reported frequency of use of the competencies and team performance, which consisted of the success of general

[*] The suppression situation in the success of General innovation processes could also explain the fact that there is more variance explained in this model compared to the success of Specific creation processes.

innovation processes, the success of specific creation processes and both their outcomes. Multiple regression analysis on the data showed that the competencies as a set accounted for 15% explained variance compared to the control variables, which was significant for the success of general innovation processes, but not for the success of specific creation processes. The competency 'monitor' significantly positively contributed to the success of general innovation and specific creation processes and the competency 'compete' was significantly negatively related to the success of general innovation processes. Further analysis of the results showed that the competencies were even stronger predictors of both the success of general innovation processes and specific creation processes compared to the team emergent states. These findings do not confirm the suggestion of Lee and Choi (2003) that it is the environment that determines team performance rather than individual competence. The findings in this chapter suggest that both have a significant influence. Further research should investigate how interactions between competencies and context variables impact team performance; when and how often certain competencies, especially 'compete', need to be applied to impact team performance; and the suppression relations between the competencies and team emergent states. The next chapter will discuss in more depth how this can be done. Figure 6.2 summarizes the outcomes of this chapter.

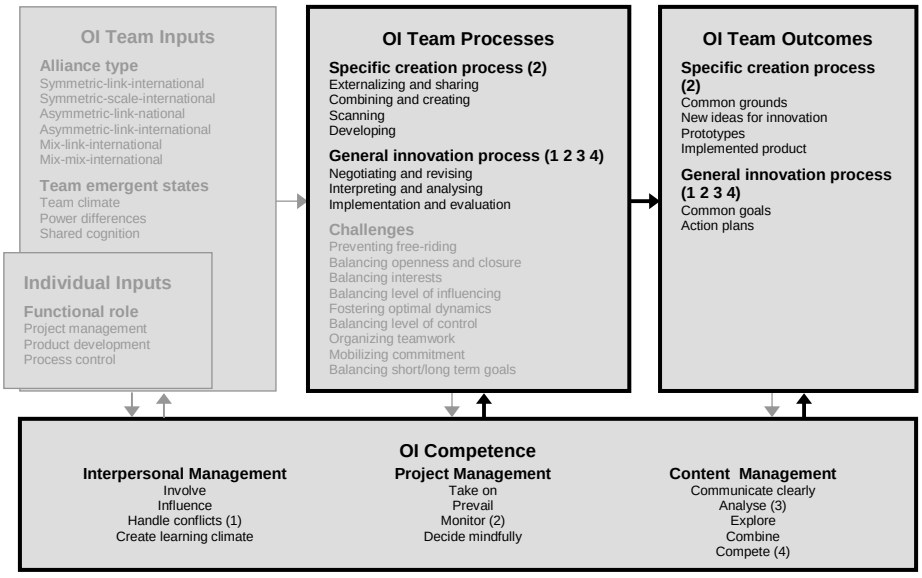


Figure 6.2: Input-Process-Outcome framework for open innovation (OI) teams with team performance variables that are influenced by the competencies, based on the findings in Chapter 6 (relationships are shown by numbers between brackets)

Chapter 7
General Discussion and Conclusion

7.1 Introduction

Innovation is needed for organizations to grow and survive, and for society to enhance the quality of life. Developments such as globalization encourage organizations to interact with their environment in order to achieve successful innovations. Organizations form so-called open innovation teams in which they co-develop new products or services. Collaboration with external partners has proven to be a critical success factor, since it increases the variety of available ideas, skills and resources. However, recent research has shown that it has a dark side as well: failure rates are high due to social and communicative dilemmas. Research has come up with many success and failure factors at both the organizational and the project level, but the human factor has been missing until now, even though the competence of the professionals involved is seen as an essential condition for the success of open innovation teams. In this study, an attempt has been made to answer the following main research question:

> *Which competencies do professionals in an open innovation team need in order to contribute to its success?*

A rationalistic multimethod-oriented approach was adopted to tackle the main research question. Five sub-questions were formulated accordingly, which addressed (a) the activities that need to be performed in open innovation teams, (b) competency elements needed to perform these activities, (c) clustering of these competencies into a competence profile, (d) context dependency of the resulting profile and (e) the link between competencies and team performance. Three studies were conducted to answer the sub-questions: an inter-disciplinary literature study combining literature in organizational, management, HR and educational studies; a qualitative study, consisting of explorative interviews and focus group discussions; and a quantitative study consisting of an online survey and group interviews. The main findings are summarized in Figure 7.1 and will be further discussed in section 7.2. Section 7.3 will discuss suggestions for further research. Section 7.4 will discuss the managerial implications of these findings. The chapter ends in section 7.5 with the main conclusions.

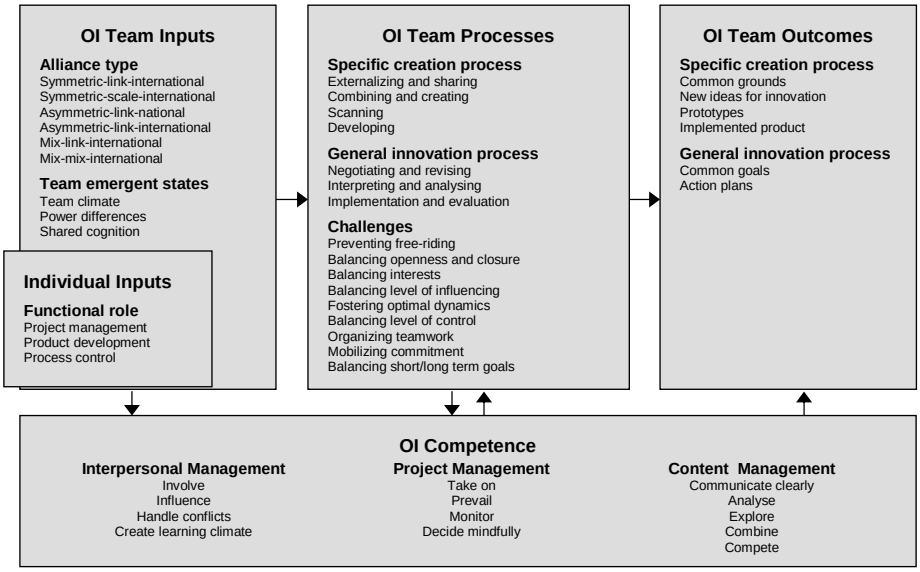


Figure 7.1: Input-Process-Outcome framework for open innovation (OI) teams with factors and relationships investigated in this PhD thesis

7.2 Main Findings

7.2.1 Main Activities in Open Innovation Teams

In accordance with the rationalistic multimethod-oriented approach for competence identification, a task analysis was undertaken first, mainly based on literature. The question guiding this study was:

> *Sub-question a: What are the main activities professionals need to perform in open innovation teams?*

Instead of focussing on the technical activities such as marketing research and product design, which may vary across open innovation contexts, the analysis focussed on the key underlying mechanisms that guide inter-organizational collaboration activities, which are universal across open innovation teams. Study 1, a literature study that combined literature on learning, (inter) organizational learning, (open) innovation management, business alliances and networks in organization, management, HR and educational studies, identified three main activities: managing the overall innovation process, managing the collaborative knowledge creation process and dealing with the challenges caused by inter-organizational collaboration (see section 2.2). The next step focussed on the process of collaborative knowledge creation, which was argued to be the key

underlying mechanism that guides each type of activity open innovation professionals undertake together, irrespective of innovation phase and other contextual factors. In order to construct a model nine different knowledge creation models from various disciplines were compared and combined into one (see section 2.2.2, Table 2.1, and Figure 2.2). It was found that the models complement rather than contradict each other and that there were four common process stages: (1) externalizing and sharing, (2) interpreting and analysing, (3) negotiating and revising and (4) combining and creating. The resulting new model is the first to combine different aggregation levels, incorporate different views on knowledge and provide insight into how individuals interact in the process of collaborative knowledge creation. The model fills a gap in organizational studies, as knowledge creation models have until now pertained only to the organizational or group level (Malerba, 2002). It further helps organizational scientists better understand process outcomes, since these can only be understood by obtaining insight into how individuals that generate these outcomes interact (Doz, 1996). Moreover, the model adds to educational and HR studies by providing insight into how the participation and acquisition metaphor and the different views on knowledge can be combined into one model of knowledge creation.

In order to understand how and why the overall innovation and the collaborative knowledge creation processes are stimulated or hindered by inter-organizational collaboration, open innovation team characteristics were described and their influence on the two processes was explored. Comparing and combining literature in different research disciplines resulted in an extensive overview of the specific challenges that play a role in open innovation teams and how they are interrelated (see section 2.2.3). Table 2.2 describes how each challenge influences the overall innovation process and the collaborative knowledge creation process. These challenges were also regarded as activities for open innovation professionals and included:

1. Being a good partner, but preventing free-riding;
2. Balancing openness and closure and building trust in a non-trusting environment;
3. Balancing individual and alliance interests, creating common meanings, goals and work plans;
4. Finding a balance between exerting influence and having no influence;
5. Fostering optimal dynamics;
6. Finding a balance between being in control and having no control;
7. Deciding when to work together and when apart;
8. Coping with role overload;
9. Efficiently and effectively organizing teamwork;
10. Rapidly building good relationships;
11. Mobilizing commitment;
12. Balancing short- and long-term goals, stability and risk; and
13. Sustaining good relationships.

Study 2, the qualitative study, confirmed that these challenges play a role in open innovation teams and make the innovation process more complex (see section 3.3.1). Illustrative comments made by participants are for example:

> *'In fact, the collaboration shouldn't be complex, but we make it complex because we participate in projects because of strategic and political reasons and not because of the project itself. In that case everybody is pursuing their own interests and not common interests.'*

> *'When you collaborate inside the company there is already an existing structure of hierarchy, routines, etc. In this situation everything is 'open' again. For instance, who has the right to decide? This has to be fought out with the partner.'*

Challenges 7, 8, 10 and 13 were not mentioned in the qualitative study and are probably not specific enough for the open innovation context. These findings make clear which specific social and communicative dilemmas play a role in open innovation teams, and by combining different research strands a fuller understanding of why and how they play a role was reached. This overview contributes to (open innovation) management literature since a clear overview was lacking until now, especially with respect to how these dilemmas are interrelated and affect the overall innovation and collaborative knowledge creation process. Furthermore, it contributes to network literature that has tended to focus on success stories, instead of the dark side of relationships (Ritter & Gemünden 2003a). It also adds an extra dimension to HR studies that have not yet discussed the factors that can constitute barriers to collaborative knowledge creation in inter-organizational settings.

7.2.2 Competency Elements to Perform Main Activities

The second step in this research consisted of identifying the competency elements that open innovation professionals need to perform the main identified activities. The question guiding this step was:

> *Sub-question b: Which competency elements do professionals need in order to perform the main activities in open innovation teams?*

First, Study 1 derived competency elements required to perform these activities from existing competence lists described in the literature that addressed the specific activities. Based on these elements, a preliminary competence profile was developed (see Table 2.4). The competency elements were clustered according to the rationalistic multimethod-oriented approach, which resulted in four competency clusters (self management, interpersonal management, project management, content management) and thirteen competencies. These competencies comprised being able to 'commit oneself', 'govern oneself', 'show social astuteness', 'influence', 'socialize', 'build trust', 'invent', 'control

and coordinate', 'cope with chaos', 'externalize', 'interpret', 'negotiate', and 'combine'. Second, a qualitative study was conducted in Study 2 that confirmed the competency elements identified, except for one that concerned a higher cognitive capability. Some additions were made to the profile, which led to a more nuanced and elaborated competence profile (see Table 3.3). Third, a quantitative study was conducted in Study 3 to validate the content of the profile, and most of the competency elements appeared to be relevant (to highly relevant) for the open innovation professionals (see Table 4.5). It is striking that all eight broad competence factors for performance in the workplace, the 'Great Eight' (Bartram, 2005; Bartram, et al., 2002; Kurz & Bartram, 2002), are recognizable in the open innovation competence profile. The Great Eight include Leading and Deciding, Supporting and Cooperating, Interacting and Presenting, Analysing and Interpreting, Creating and Conceptualizing, Organizing and Executing, Adapting and Coping, and Enterprising and Performing. For instance, the Great Eight competencies Supporting and Cooperating, Adapting and Coping are almost entirely incorporated in the current profile. In addition, it contains many elements of the Great Eight Competencies Creating and Conceptualizing, Leading and Deciding, Interacting and Presenting, Analysing and Interpreting. It seems therefore at first glance that the current profile might deal with rather general management competencies, but a closer look reveals that the devil is in the details. The open innovation competence profile is more specific on certain behaviours. The Great Eight, for instance, only mentions Acting with Integrity as a competency element, whereas the current profile is more specific in describing behaviours such as being reliable and being considerate of others. In addition, the current profile contains certain competency elements that are not mentioned in the Great Eight. For instance, the Great Eight does not describe competing behaviour and does not specifically address the competency elements 'trusting others', 'detecting fallacies' and 'being curious'. These findings illustrate that the open innovation competence profile covers a broad and diverse area of competencies and that the profile is more specific in describing certain areas. The findings contribute to the open innovation management literature by giving an overview of competency elements that are important for open innovation professionals in order to contribute to the success of the open innovation team, by specifying among other things what is actually meant by possessing strong reflective skills, communication abilities, absorptive capacity (Lane & Lubatkin, 1998), and the ability to build trust and exert power (Swan & Scarbrough, 2005; section 1.2.3).

7.2.3 Clustering of the Competency Elements

The identified competency elements were tentatively clustered into competencies by main activity, according to the rationalistic multimethod-oriented approach. To validate the clustering of the competency elements empirically the next question was formulated:

Sub-question c: What is the optimal clustering of the identified competency elements in the competence profile?

Factor analysis on the data gathered in Study 3 showed that the clusters (competencies) were not valid constructs and should be changed (see section 4.3.4). The overall profile structure stayed intact, but the cluster self management was incorporated in the clusters interpersonal, project and content management. Analysis of the data showed that the most optimal clustering of the competency elements resulted in thirteen new competencies, which entailed being able to 'involve', 'influence', 'handle conflicts', 'create learning climate', 'take on', 'prevail', 'monitor', 'decide mindfully', 'communicate clearly', 'analyse', 'explore', 'combine' and 'compete' (see Table 4.8). An interesting detail is that the new clustering based on empirical data showed that many newly derived competencies consisted of knowledge, skills and attitude competency elements, which empirically confirms the idea that a competence is the integrated set of and can be subdivided into knowledge, skills and attitudes - an idea whose validity is sometimes questioned (Stoof et al., 2002). Although many elements moved to other competencies, the meaning of most competencies still fit the identified activities and specific challenges. For instance, the newly derived competency being able to 'create learning climate' fit well with the challenges caused by a low level of social cohesion and an unsafe learning climate, and there was still a competency for each collaborative knowledge creation process stage. Consequently, the clustering of the competency elements is still in accordance with the rationalistic multimethod-oriented approach. This means that clustering of competency elements based on, for instance, the worker-oriented approach, into threshold (basic competencies needed to undertake the job) and performance competencies (which differentiate between levels of performance) and hard and soft (such as sensitivity and organization) competencies is possibly less tenable than grouping them by domain (such as procedural and interpersonal competencies) (section 2.3.3), as was done in this research.

Based on these data the view of Boyatzis (1982, 2008) on the construction of specific competencies can be challenged. Although he has the same view on competencies that was adopted in this study (as a capability or ability that is defined by related but different sets of behaviour) and on how a competency should be constructed (relating different behaviours that are considered alternate manifestations of the same underlying construct), his competency elements are clustered in a different manner. He clusters the behaviours or competency elements by the similarity of the consequence of their use in social or work settings, which results in the threshold clusters of competencies (expertise, knowledge and basic cognitive competencies, such as memory) and three clusters of competencies differentiating outstanding from average performers (cognitive competency, emotional intelligence competency, and social intelligence competency). The emotional intelligence competency is an ability to

recognize, understand, and use emotional information about others that leads to or causes effective or superior performance and includes, for instance, self-awareness and self-management competencies, such as emotional self-awareness and emotional self-control. However, based on the data analysis in this research, many behaviours described by Boyatzis did not appear to belong to the same underlying dimension as developed by Boyatzis. For instance, being self-aware and being good at one's job underlay the competency being able to 'decide mindfully'; self-management capabilities such as emotional self-control appeared to underlie the competency being able to 'take on'; and relationship competencies such as empathy underlay the competency being able to 'create learning climate'. Consequently, the analysis in this research especially challenges the way Boyatzis clusters his competency elements. It is striking that the way the competency elements are clustered in the open innovation competence profile contains more information about when and to what purpose a certain element needs to be used. The competencies constructed by Boyatzis do not contain this information. This is a logical consequence of the competence identification approach chosen. Boyatzis adopts a rationalistic worker-oriented approach that clears out any context information, losing the context-specificity of the competencies. The profiles derived through this approach are therefore often criticized for resulting in an abstract and overly narrow and simplified description that may not adequately represent the complexity of competence in work performance and are difficult to use in professional practice (Sandberg, 2000). A professional should not possess empathy for the sake of being emotionally competent, but, according to the results of this study, rather for the sake of being able to handle conflicts. So, this study shows that by adopting a multimethod-oriented approach it is possible to keep track of the context-specificity of the competencies. Another possible argument in favour of the method of clustering found in this study could be that hardly any studies were found that analysed all the competency elements of the different competencies defined by Boyatzis in one factor analysis. If factor analyses were done at all, they pertained to one single competency. In this way, the competencies as defined by Boyatzis are not entirely based on empirical data.

These findings contribute to the competency modelling literature, since 'there is a dearth of empirical research relevant to competence models (Lievens et al., 2004; Schippmann et al., 2000). According to Lievens et al. (2004), this is due to some degree of scepticism within the scientific community towards the validity of 'competencies' as measurable constructs. Specifically, this stems from the fact that the process of deriving competencies requires a rather large inferential leap, because competence modelling often fails to focus on detailed task statements prior to inferring competencies (Schippmann et al., 2000). In this study, this methodological challenge was overcome by first conducting a thorough study on the processes underlying the tasks and activities in open innovation teams, and subsequently identifying the competency elements that

are needed to perform these activities and conducting a factor analysis on these competency elements all together to identify underlying dimensions.

7.2.4 Competence Profile and Context Variation

In order to test the validity of the profile across different contexts, the following sub-question was formulated:

> *Sub-question d: Does the perceived importance of the competencies in the competence profile vary across contexts, and if so, how?*

Multiple regression analysis on the data gathered in Study 3 showed that the perceived importance of the competencies does not vary significantly across contexts (see section 5.3). However, the competencies 'take on', 'prevail' and 'communicate clearly' were more important in more complex forms of alliances types. Although there is as yet no theory available to explain this finding, it is understandable from a practical point of view. Processes in more complex alliances would likely be more surrounded by uncertainty, through which competency elements such as 'thinking positively', 'keeping an overview', and 'having a vision' become more important. Moreover, it appeared that professionals in charge of project management perceived more competencies as being important for their role in the project, compared to professionals in charge of product development or process control. Specifically, they perceived the competencies 'involve', 'influence', 'prevail', 'create learning climate' and 'monitor' as being more important for their role in the project, than did professionals in charge of product development or process control. This finding empirically confirms earlier suggestions that teams consisting of complex alliances need strong leadership (Fagerberg, 2005) or a 'heavyweight manager' (Zhang & Doll, 2001). This further indicates that inter-personal and project management competencies are more important for project managers than for other team members. However, although slight differences were found across different contexts, the competencies are generally perceived as being important. Moreover, the explained variance of the context variables was low.

The competence profile can thus be said to be generic, at least within the research population. This finding is interesting for two reasons. First, it shows that by adopting a multimethod-oriented approach and focussing on key processes underlying activities, the resulting competence profile is generic, but still contains the context-specific elements that are typical for an open innovation context. Thus, the multimethod-oriented approach seems to be adequate for competence modelling if one needs a generic profile for use in an open innovation context. This finding contributes to the competence modelling literature that suffers from a lack of comparative research on different kinds of competence modelling and the resulting outcomes (Lievens et al., 2004; Schippmann et al., 2000). Second, the fact that the model contains opposing

behaviours (see section 3.3.2) and the lack of strong differences across contexts confirm the theory of behavioural complexity (Denison et al., 1995; see also section 3.4), which implies that effective open innovation professionals are those who have, apart from the competencies mentioned in the profile, the capacity to recognize and react to paradox, contradiction and complexity in their working environment. This fits the notion raised in one of the group interviews that the profile should contain more items about self management (see section 4.3.3).

Another finding was that participants perceived the competencies as being more important when the team had a good team climate. The fact that a good team climate is crucial for team performance is not new. Various researchers have shown that team climate is important for team learning (Van den Bossche et al., 2006) and innovation (Bain et al., 2001). There were, however, no empirical studies up until now that showed such a positive relationship between team climate and the perceived importance of competencies. This could indicate that environmental factors, such as team climate, have a major influence on how competencies are used, and that the environment therefore is more decisive for team performance than individual competencies, which is also suggested by Lee and Choi (2003). The next section will elaborate on this issue in more detail.

7.2.5 Open Innovation Competence and Team Performance

To test the assumption made in the previous section and to investigate the relationship between open innovation competence and team performance, the following and final sub-question was formulated:

> *Sub-question e: Does the reported application of the competencies in the competence profile significantly contribute to team performance, and if so, how?*

Based on the data gathered in Study 3 team performance was divided into the success of the general innovation processes and the success of the specific creation processes. The first construct consisted of processes related to general innovation, such as evaluation moments and designing action plans. The second construct related to specific creation processes such as developing new ideas for innovation and constructing prototypes. Multiple regression analysis on the data showed that the competencies significantly contributed to the success of general innovation processes and specific creation processes and were even stronger predictors of team performance than (some of the) environmental factors. More specifically, the reported application of the competency ‘monitor’ was significantly positively related to the success of general innovation and specific creation processes and the application of ‘compete’ was significantly negatively related to the success of general innovation processes. These findings are interesting for three reasons. First, this study is one of the few that empirically confirms the relationship between competence and (team) performance. Barrett

and Depinet (1991) criticized the competence approach since users of the concept of competencies had not yet been able to produce any professionally acceptable empirical evidence that their concept was related to occupational success, and little has changed since then (Markus et al., 2005). Although this criticism pertains to individual performance, it also applies to team performance. This study not only found a link between competence and team performance, but also found that the competencies explained much variance in the data; the latter of which is not always clearly reported in tests of the relation between intelligence and personal traits on the one hand and performance on the other hand. This is an important contribution to the field of competence modelling, empirically showing that individual competence has considerable explanatory value.

Second, the findings reject the suggestion of Lee and Choi (2003) that it is the environment that determines performance rather than individual competence. The findings suggest that although both are of significant influence, competencies are stronger predictors of team performance. A possible explanation is that Lee and Choi focussed on a specific area of competence, what they called T-shaped skills (see section 5.4), which is just a small area of competence that matters. Moreover, they asked the respondents to rate the skill items on mastery and not on actual or reported performance. They asked participants to respond, for example, to statements such as: 'Our company members… can understand not only their own tasks but also others' tasks'. There has been a huge debate on whether mastery of a competency necessarily implies that it is being used (Hager, 2004). This thesis specifically addresses the actual or reported performance of a certain competency by asking respondents to rate how often they applied a certain competency element, which is probably a better way to examine the relationship between competence and team performance. Thus, the way individuals behave has a great influence on open innovation team performance. It can be argued, however, that the significant influence of individual behaviour disappears when success is measured at higher aggregation levels, for instance when the success of a product in the market is measured. This measure of success is also highly dependent on factors such as market competition and environmental factors (Fortuin et al., 2007), which cannot be easily influenced by open innovation professionals who take part in the team. However, success at team level generally is a prerequisite for success at higher aggregation levels: If the team does not deliver a good product, it is not likely that the product will be a success in the market. Nevertheless, the findings in this research contribute to the literature on knowledge creation in organizations showing that the individual factor does significantly contribute to the success of collaborative knowledge creation and innovation performance.

Third, the competency 'monitor' is the only competency that is positively related to the success of both general innovation processes and specific creation processes. This outcome suggests that for open innovation professionals in general the application of the competency 'monitor' will enhance open

innovation team performance. This competency not only entails communicating well enough to do one's job effectively, but also making results visible and trusting others. As such, it is good to note that the competency comprises more than a passive form of watching over the process. In fact, it entails an active form of monitoring one's own work, and a more passive form of monitoring others' work. The content of this competency seems to fit the idea of Maccoby (2003) on how trust should be built. Trust is an important construct for performance in strategic alliances (see section 2.2.3) and can be seen as the expectations about positive motives that the network partners have (Mayer et al., 1995). Maccoby states that an ideal relationship is one in which the parties can trust each other, and that trust will be built only by practicing transparency (making results visible) and increasing participation (communicating enough). Trusting the other party is an efficient way of 'monitoring'. It is difficult to influence what happens in other organizations (Haakansson & Ford, 2002) and just trusting the other party probably is a good way of effectively dealing with this challenge. Trust is important because the likely alternative would involve monitoring network participants through more extensive use of bureaucratic or other control mechanisms, the costs of which may be prohibitive in terms of financial, time and human resources (Das & Teng, 1998). Making results visible is important for dealing with the challenges of determining whether and how to continue a developmental effort in the absence of concrete performance information, which is a central problem in innovation processes (Van de Ven & Polley, 1992). Frequent evaluation and explication of results would reduce some of the fundamental uncertainty inherent in innovation processes (Schumpeter, 1934; Van de Ven et al., 1999) and help determine whether and how to continue. Moreover, this competency seems to support the notion of Larsson et al. (1998) that ensuring both partners' transparency as well as receptivity should be substantial steps forward in understanding and managing the learning alliance. Transparency can be interpreted as communicating sufficiently and receptivity can be interpreted as absorbing or taking what the other party offers, for which trusting the other party is a prerequisite. They state that if the transparency (or the communication) of the first 'good' partner (the partner who shares) is absorbed (or trusted) by the other partner, this in turn leads the second partner to reciprocate transparency such that the first partner will then absorb this offered knowledge in return. Thus, for all open innovation professionals it is important to trust the other partner (be receptive to what is being offered) and create transparency by communicating sufficiently and making results visible. In inter-organizational learning literature, transparency is often interpreted as sharing knowledge. It is argued that this is especially difficult in inter-organizational learning settings, since transparency or sharing knowledge is not only dangerous from a competitive point of view, but also far from sufficient to generate learning for the 'good' partner in question (Larsson et al., 1998).

The results of this study could shed light on the concept of transparency. It suggests that the knowledge that is crucial to be shared or communicated

specifically concerns the results of one's own work and that of the team. Furthermore, sufficient communication is needed in order to do one's own work efficiently and effectively. This seems to concern the communication of more procedural information rather than for instance (confidential) company information. These findings are an important contribution to the scientific knowledge base on inter-organizational learning and open innovation management. Moreover, the relationship between individual competencies and open innovation team performance was studied with the inclusion of factors at different aggregation levels, which fills a gap in organizational studies, where relationships between factors are often studied in isolation (Lee and Choi, 2003).

7.3 Suggestions for Further Research

The findings of this study are interesting, but they should be seen in the light of its limitations. In the different chapters it was already indicated that to enhance the applicability of the findings, future research should include more respondents to validate the newly derived competencies and the relationships found among them. This could be done, for example, through confirmatory factor analysis or multilevel analysis (see sections 4.4, 5.4, 6.4). Other methodological issues concern the representativeness of the open innovation teams used for this research, and the problem of self perception. These issues are described in the following sections and suggestions for further research are given that concern the distinctiveness of open innovation competence, the accuracy of the open innovation competence profile and HR support for open innovation competence.

7.3.1 Distinctiveness of Open Innovation Competence

To investigate the concept of open innovation, this research focussed on open innovation teams, using a varied group of open innovation teams in prospector companies. This approach provided the opportunity to study the concept of open innovation in depth, develop a generic profile and gather enough data (see section 4.2.1). However, the main downside of this approach is that the distinctiveness of open innovation competence could not be investigated. In competence modelling literature a distinction is often made between general or common versus distinct or specific competencies (Brownell, 2006). Although multiple interpretations of these concepts are in use, the difference between them is interpreted here as the difference between competencies that are universal to innovation and group learning and those that are unique to an open innovation context or unique to a specific form of open innovation.

The previous section noted that uncertainty is greater in open innovation teams than in closed innovation teams or normal teamwork, which makes

application of the competency ‘monitor’ even more important. However, it can be argued that this competency is also crucial in closed innovation teams and normal group work. The uniqueness of open innovation competence may actually lie in the complex combination of skills needed (see section 7.2.4). Another possibility is that the distinctiveness of open innovation competence does not so much concern the uniqueness of its specific content, but rather the level on which the competencies should be mastered. For example, being able to combine different views is also necessary in closed innovation teams, but the required mastery level of this competency in open innovation teams might be higher. Further research that compares, for instance, open innovation with closed innovation teams or other kinds of teamwork is needed to reveal how the required competencies for open innovation settings differ from those for closed innovation settings or other teamwork. This would yield important information about the variety of areas the developed competence profile supports.

The teams studied in this research varied on three dimensions, which were used to identify a number of alliance types. Further research could be done to compare alliance types in more detail and determine how distinct some competencies are for a specific kind of open innovation team. Although no significant differences between alliance types with respect to the importance and frequency of use of the competencies was found in this study (see sections 5.3.2 and 6.3.1), relationships between the importance and frequency of use of the competencies and alliance type were found (see Table 5.6 and Table 6.3). These could not be adequately investigated, however, in part because of the ratio between the number of groups and the number of respondents per group. It would therefore be interesting to further explore which factors influence the kind of competencies needed: the alliance type or for instance cultural diversity in the team, or a combination of both. Another interesting approach would be to compare open innovation teams in multinationals with open innovation teams of for instance national research projects; or to compare subsidized and unsubsidized open innovation projects. There are already indications that differences exist. For instance, Study 2 included some government-organized and subsidized projects and those respondents complained more about the fact that some professionals took part only for strategic and political reasons. Would this be less of a problem in strictly commercial innovation projects? Moreover, it would be interesting to investigate the influence of the innovation goal on the competencies needed. The findings of this study showed that it is crucial to make results visible, and, compared to product innovation projects, this might be more problematic in process innovation projects, where results often remain implicit and tacit since the delivery is not a tangible product.

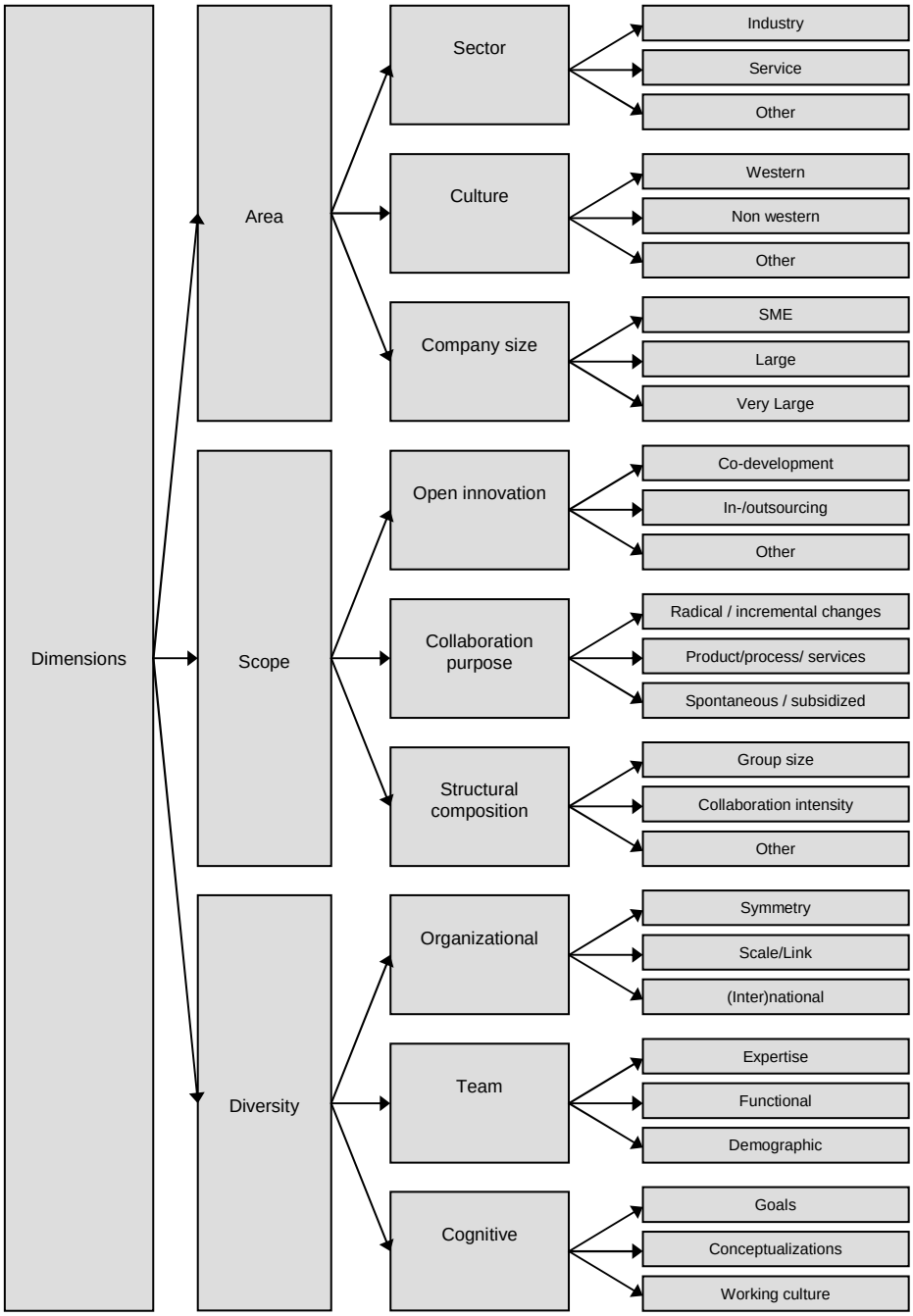
Figure 7.2 graphically shows the possible dimensions and factors that could characterize collaboration activities in organizations. The figure makes it clear that there are many comparisons between different forms of collaboration possible. The selection of relevant cases to conduct comparative research would be much helped by a clear overview of what kind of (open) innovation or (inter-)

organizational collaboration takes place most frequently in practice, which is still lacking. This knowledge could also help to further check the generalizability of the profile, for instance by conducting a respondent analysis. The current research mainly relied on open innovation teams that came from prospector companies. This was done because it is commonly assumed that the chance to find open innovation teams in that context is higher, but in fact it is not known which kind of open innovation (teams) occur often in which area. The representativeness of the respondents group is therefore hard to determine, since there is no data on the dimensions of the group of open innovation professionals as such. Further research should therefore focus on what kinds of collaborations take place most frequently in practice in order to select a representative group of open innovation professionals and further investigate the generalizability or distinctiveness of the competence profile through comparative research. Before using the questionnaire in further research it is recommended that researchers look critically at the items that were removed from further analysis (the items developed for the competency elements 'Shares with a feeling for boundaries, knowing value of knowledge', 'Is professional, takes a role in the group, works independently and is clear about his or her own role' (see section 4.3.4 and the items for team efficacy, section 5.2.2) and redesign them so that they can be taken into account.

7.3.2 Accuracy of the Competence Profile

This research adopted a rationalistic approach to identify open innovation competence, since this approach gave the best opportunity to develop a competence profile that is generic and contains information specific to open innovation contexts, but remains 'simple', that is, easy to understand. By definition, an ideal competence profile is generalizable (i.e. applicable across a wide range of organizations), simple (easily understood) and accurate (it reflects the needs and culture of an organization) (Thompson et al., 1997: 59). However, it has been argued that profiles can possess only two of the three desirable characteristics (ibid); the profile developed in this research could thus be said to have lost some credibility with respect to the characteristic accuracy. For instance, the profile does not contain specific technical competencies that might be crucial for open innovation team performance. The interpretative approach seems to be an adequate way to complement the competence profile in terms of its accuracy. The interpretive approach views worker and work as inextricably related and competencies used in accomplishing work as situational (Sandberg, 2000). It views competencies as deeply influenced by organizational culture, social interaction and the unique way people make sense of their jobs within organizations (Capaldo et al., 2006). This approach pays more attention to meaning and to the situated nature of competencies, by promoting a strong

Figure 7.2: Dimensions and factors that characterize collaboration activities in organizations



degree of involvement of organizational members in the building of systems in several phases of development, from eliciting competencies through explanatory discourses to mapping and assessment (ibid). Adopting the interpretative approach in future research could make the profile more accurate in three different ways.

First, it would provide information on the specific situations in which certain competencies are effective. It is argued that some competencies or interventions only become effective in certain circumstances (Postrel, 2009). This could enable further exploration of how team roles and other contextual factors influence the effectiveness of certain competencies, for instance of the competency 'compete' (see section 5.4), and explain why there were only a few significant relationships found between the identified competencies and team performance (see section 6.4). One of the contact persons in this research reported that in the first innovation phase it was those professionals with a lot of technical knowledge who came up with the most brilliant ideas. However, they often lacked the acquired social competencies to communicate them well. Therefore the company took care that these persons got 'coupled to' a socially capable person who was responsible for communicating the ideas of these brilliant, but not very socially competent, professionals. So the technical skills of these persons only became effective when they were connected to more socially competent persons. The interpretative approach would also elicit information about which specific technical competencies are needed in specific situations. To keep the profile applicable across contexts, it is based on underlying processes rather than technical activities in open innovation teams. Consequently, specific technical skills are lacking, which probably also play a crucial role in the innovation process (Baum et al., 2001). It is worth noting that in this study more variance was explained related to the success of general innovation processes than to the success of specific creation processes. It is possible that for specific creation processes more specific technical competencies are needed. Thus, the interpretative approach has the potential to make the profile more accurate by identifying situation-specific competencies and clarifying when certain competencies become effective, which could depend on for instance a (combination of) team roles or innovation phases (although it would then first have to be investigated whether the nature of collaboration differs per innovation phase).

Second, the interpretative approach would clarify when certain competencies are perceived as being effective and as a result, whether they should be appealed to or not. It is argued that many professionals have the competencies to be effective, but just choose not to use those (Boyatzis, 1993). The interpretative approach argues that possessing the competencies is a prerequisite to potentially creating the right action strategies for when and how to use them, but also argues that there are other factors that influence the action strategies, for instance work pressure, incentives used during the innovation process such as contracts in which agreements and expectations are clearly laid

down, and support of higher management in the form of time, money, and advice. The findings in this study further suggest that a good team climate has a significant positive influence on the perceived importance of the competencies (see section 5.3.2). This could indicate that professionals feel more enabled to use certain competencies in optimal circumstances and that in a non-optimal circumstance they 'do not feel like' using the competencies, underestimate the impact they could make by applying certain competencies or do not see opportunities to show their competencies. Moreover, it is argued that the use of competencies, such as knowledge sharing, is driven by rather specific combinations of certain factors rather than by a single factor alone (Siemsen et al., 2008). This was confirmed by the suppression situation found in the data (see section 6.4), however, the approach taken did not make it possible to investigate what combination of factors this suppression entailed. The interpretive approach has the potential to better clarify the suppression situation, the significant positive relationship between team climate and perceived importance of the competencies and other factors that might positively influence the application of competencies. Moreover, although self perception did not seem to play a big role in this research (see section 4.3.3), adopting the interpretative approach would make it easier to recognize and deal with this problem. This would also improve the competence profile, since the approach requires participative action (e.g. observation) by the researcher in the field (Sandberg, 2000).

Third, the interpretative approach might reveal the complex interplay between different factors that play a role in open innovation teams. Many of the identified input, process and output factors, including the competencies, are dynamic and are both the basis for and the result of interaction processes, which means that during the open innovation process many factors are optimized and changed (Doz, 1996). As stated earlier, the competencies as bottom line in the open innovation process can be part of the input, process and outcome, which means that they are shaped by the process and in turn shape the process (see Figure 7.1). To get an overview of the competencies needed in the entire process, the focus in this research was on the end result, which entailed that the dynamics between input, process, outcome factors and competencies was not taken into account. For further research, adoption of an interpretative approach that takes into account dynamic, recursive processes is recommended to better describe the interrelationships between the various factors.

7.3.3 HR Support for Open Innovation Competence

This research started with the question of what individuals can do themselves to contribute to the success of open innovation teams. The approach taken resulted in a valuable profile that gives new insights into how they can contribute to open innovation teams. The question is whether this is enough to support individuals in furthering the success of open innovation teams. To quote one of the contact

persons in this research: 'We started the collaboration because we had a technical problem. From the moment we came together, however, the dominant topic was no longer the technical problem, but problems concerning human interrelationships. We are experts in technology, not human relations. We need help solving these problems.' This person explicitly mentioned that support for open innovation competence from the perspective of the open innovation professionals was highly desirable. But also from the organizational point of view, it is important to stimulate open innovation competence, considering the increasing role played by open innovation in organizations and the crucial impact individuals can have on the success of open innovation teams. HR strategies and practices are effective incentives in organizations to enhance human competence in the organization, which leads to enhanced organizational performance (Agarwala, 2003; Wright & Boswell, 2002). Attention has recently been paid to extending HR practices to inter-organizational roles and enhancing the interactive learning abilities of employees who are active in inter-organizational alliances (Larsson et al., 1998). This fits in the recent trend to broaden the scope of HR to Strategic Global HRM or HRD (Fenwick & De Cieri, 2004; Harvey et al., 2000). HR practices can be categorized as involving employee skills (practices aimed at developing the skills of the workforce through recruitment and selection, training and development), motivation (practices that elicit high motivation), and empowerment (practices that enhance employee input and influence, such as performance management and participation/work design) (Wright & Boswell, 2002: 253). Current literature on competency-based perspectives on HR practices mainly concern, although very marginally, employee skills and empowerment. More specifically, they concern the following issues.

It is argued that the assessment of competencies can be problematic, because perceptions of a respondent's behaviour may vary between him- or herself and another observer (Garavan & McGuire, 2001) and because it is difficult to assess both observable and non-observable elements of competence.

How to develop human competence at work in a way that enables an organization to remain viable is another fundamental managerial issue (Sandberg, 2000). Surprisingly, few studies in organizational behaviour and applied psychology (Maurer et al., 2003) have addressed which types of knowledge, skills and abilities or other characteristics are believed to be changeable. The learnability of each separate competency is questionable and some authors even conclude that effective professionals cannot be developed; although others state that competencies are indeed developable (Boyatzis, 2008; Boyatzis & Saatcioglu, 2008) and that competency-based training activities should pertain to the workplace. These should focus, for instance, on active learning (professionals learn by tackling real problems with real implications), experiential variety (participants apply their knowledge and skills in a variety of situations) and learning from errors (participants learn from their mistakes) (Bell et al., 2006). This shift from off-the-job learning to on-the-job-learning implies

that HR practices are more concerned with performance management and participation or work design. Usually professionals *understand* what they should do if it concerns non-technical areas, but they need help practicing their understanding (Goldsmith, 2006). This can be stimulated through performance management incentives such as performance appraisal systems, which could consist of multisource feedback or 360-degree feedback (Hezlett, 2008). Quotes from the explorative interviews suggest that it is this very process that is complicated in open innovation teams: 'It is difficult to give each other direct feedback, because you are quite dependent on your partner and do not want to lose him.' 'You don't have any direct responsibilities towards each other, which makes it difficult to call the partner to account concerning his or her conduct.' From HRD literature it is known that for giving feedback, a good team or learning climate is crucial (see for instance Knowles, 1990), which was also confirmed by the finding in this study that team climate had a significant influence on perceived importance of the competencies and team performance. Perhaps this is the greatest difficulty in open innovation teams – not the lack of certain competencies in the team, but the difficulty of applying certain competencies if there is not a supportive environment, which is complicated to create. This finding indicates that HR support for open innovation competence should not focus only on the individual, but should be broader. HR professionals could for instance participate in open innovation teams taking on the role of Learning Process Facilitator or Knowledge Transfer Agent (Athey & Orth, 1999) and help foster a social environment and team climate (Wheeler, 2008), team learning (Huber, 1999; Julian, 2008) or knowledge management (Choi & Lee, 2002). During the group discussions in this study (see section 4.2.1), it appeared that evaluation of team results, for diverse reasons, hardly took place in practice. Since this process is crucial for (organizational) learning, HR professionals could play a major role in facilitating evaluation moments in open innovation teams and make this a routine.

Despite the growth and increasing importance of open innovation, hardly any research has focussed on how HR practices could foster open innovation competence in organizations. It is even doubtful whether HR professionals are involved in open innovation or related practices at all. Recent research found that training and development or other HR practices were not used in the area of building relationships with customers, suppliers and business partners (Coulson-Thomas, 2004; Fenwick & De Cieri, 2004). This was confirmed by the fact that the HR professionals approached for participation in this research were not involved in any form of open innovation or related practices. However, the same research also found that there was a need for HR involvement (Fenwick & De Cieri, 2004). Further research must therefore focus on the question of whether HR involvement in open innovation or related practices is desirable; if not, why, and if so, in what way. This information would fill a gap in innovation management literature that hardly discusses the role of HR professionals before, during and/or after the open innovation process.

7.4 Managerial Implications

The validated open innovation competence profile has high practical value for organizations, offering an opportunity for organizations to monitor competencies of open innovation professionals. The profile contains specific and crucial competencies and is suitable for use across open innovation contexts. The profile developed can be used for managing and developing these specific human resources. It can enhance selection, development, promotion and reward processes to meet both individual and organizational needs. Although the previous section indicated that more research is needed on how these processes should take place in practice, the following suggestions can already be made.

First, it has been observed that organizations often have difficulty in identifying the right professionals to cooperate in (open) innovation projects, because these persons are not necessarily the silver-tongued or the best presenters, who come to mind automatically (Coulson-Thomas, 2004). With the profile developed in this study, professionals responsible for selecting open innovation professionals and composing open innovation teams can know what to look for and which competencies should be present in the team. It is recommended that they focus on those competencies that are hard to develop, such as 'take on' and 'prevail', which mainly represent attitudes and are closest to personality characteristics. While composing the team they could consider the fact that open innovation project managers need to be more 'all rounded' than other team members who serve as product developers or process controllers. More specifically, various interpersonal and project management competencies are more important for the mangers' role in the project. This implies that it is important that these projects are managed by a 'heavyweight' manager.

Second, it has been argued that competence must be treated as an item for discussion and interpretation, rather than as a 'fixed template of boxes to be ticked' (Lans et al., 2008: 364). As stated earlier, professionals often do understand what kind of behaviour needs to be shown, but they need help in showing this behaviour. The profile can then be used as a diagnostic tool in ongoing team processes to make explicit which behaviours need to be shown more. Whenever problems come up, the team members can reflect on the profile and analyse in which areas they can improve, and decide which specific interventions (e.g. peer coaching or just adding an extra team member) could help them enhance their working behaviour and team performance. An additional advantage of plenary reflection on the profile is that team members explicitly specify what is expected from every single team member, which contributes to team performance (Griffin et al., 2007). During the study, a first attempt was already made to use the profile as a diagnostic tool in an ongoing open innovation team, by using the questionnaire. Team members completed the questionnaire in advance and results were discussed in a plenary meeting. Indeed, it appeared that the tool elicited implicit problems in the team that had not been recognized and openly discussed before. This gave the team renewed

motivation to make the project a success. It is recommended that the team focus on monitoring behaviour that consists of trusting the other party, communicating sufficiently and making results visible, since this competence appears to be of crucial value for open innovation team performance.

Third, the competence profile could serve as a self-evaluation tool for open innovation professionals to deal with the challenges they face. Many professionals undertake action without awareness (Custers & Aarts, 2005) and the profile can make the professionals aware of what they do and should (or should not) do. This awareness is a prerequisite for developing certain competencies to a higher level. Competence profiles can make professionals more conscious of the relationship between their competence and performance (Lans et al., 2008). Reflection on such profiles makes them aware of their strengths and weaknesses, which enables them to work on improving themselves in areas in which they are weak. Apart from to the competencies 'handle conflicts', 'take on', 'decide mindfully', 'analyse' 'explore', 'combine' and 'compete', project managers should pay special attention to the competencies 'create learning climate', 'monitor', 'prevail', 'involve', 'influence' and 'communicate clearly', since these competencies appeared to be more important for their role in the open innovation team. The results in this study also show that open innovation professionals in more complex alliances need to pay special attention to the competencies 'prevail' and 'communicate clearly', which are perceived as being more important in these contexts. Table 7.1 summarizes which relationships were found between competencies, contextual factors and team performance.

Finally, it is recommended that organizations consider the involvement of HR in the open innovation process. Particularly in multinational enterprises, HR departments generally possess knowledge about human relations and (team) learning that could be of great help in enhancing open innovation competence throughout their organizations. Making results visible appears to be an important element of open innovation competence, however many results in innovation processes remain implicit and are difficult to explicate. HR professionals specialized and experienced in evaluation processes directed toward learning could help make such implicit results more explicit. If an organization decides to involve its HR department in open innovation processes, it could also consider stimulating collaboration with the HR department of the partner involved in the open innovation team. Joining HR efforts could lead to HR activities that are more adequate for the team as a whole. Moreover, it has been argued that the more relationships a network is made up of, in this case the open innovation teams, the more each company generally seems to learn from their participation (Haakansson et al., 1999).

Table 7.1: Relationships found between competencies, contextual factors and team performance

Competencies of extra importance in certain contexts	
Project Management	**Involve:** Identifies human, material, and experiential resources for accomplishing various kinds of learning objectives. Organizes complementarities. Identifies situations for participative group problem solving, using the proper degree of participation, and recognizes obstacles and corrective actions. Knows who to inform and when. **Influence:** Appropriately adapts, calibrates ones behaviour to each situation in order to elicit particular responses from others. Uses influencing skills (as opposed to instructing): position, coalition, stimulation. Knows how to play the political game. **Create learning climate:** Shares successes, allows people to make mistakes. Is honest: possesses high levels of integrity, authenticity, sincerity and genuineness. Can be counted on to represent situations fairly. Develops, maintains and uses effective networks. Is approachable, develops friendships easily and strong beneficial alliances and coalitions. Develops a team spirit. Deals with unexpected situations, is flexible with plans, deadlines, improvises. Is not too systematic, rigid. Deals with a flexible team composition.
Both	**Prevail:** Has an overall picture of the project and influencing factors. Understands and manages complexity. Supports many things on his/her mind at the same time. Has self confidence. Is competent: able to perform the tasks required by his or her position.
Complex alliances	**Take on:** Is aware of, and regulates, own thinking and feeling. Manages tensions created by multiple accountabilities, tasks and roles. Has perseverance, keeps on thinking positively, having end-goal in mind. Is reliable: ensures that the others can depend upon him/her to come through for them, acts consistently, follows through. Is pro-active. Comes up with ideas him/herself and takes initiatives. **Communicate clearly:** Creates a vision. Appreciates the learning domain and has the motivation to learn, has a sense of urgency. Is open: shares information freely with others, even when (s)he is not sure. Communicates clearly and understandably. Recognizes open and supportive communication methods.

Competencies related to team performance	
Positively	**Monitor:** Coordinates and synchronizes activities, information, and tasks between team members. Designs a plan of strategies. Carries out the plan systematically and sequentially. Feels responsible for the team and acts as such. Monitors, evaluates, and provides feedback on overall team and individual performance. Accepts feedback about his/her performance non-defensively. Collects evidence of accomplishments. Asks many critical questions. Trusts the other party.
Nega-tively	**Compete:** Is critical (but constructive). Is aware that he or she represents an organization; refuses to accept less.
Positively or negatively	**Handle conflicts:** Openness: treats differences as important opportunities. Respects, values and appreciates people and their ideas. Possesses basic knowledge and perceptions of various technical/ professional areas and business languages. Has experience working in partnerships. Is assertive, extroverted. Communicates own perceptions and feelings (in a diplomatic way). Is straightforward. **Analyse:** Wants to learn from others. Understands social situations as well as interpersonal interactions. Is sensitive to the roles and responsibilities of all partners, aware of their collaborative motivations and expresses understanding and empathy. Has good reflective skills and applies techniques of analysis. Is competent in techniques of lateral thinking or divergent thinking.

Other relevant competencies	
Relevant for all open innovation professionals	**Decide mindfully:** Knows what his/ her qualities are, does not take the position of the underdog. Possesses basic knowledge and perceptions. Establishes specific, challenging, accepted team goals. Diagnoses, formulates learning objectives in performance outcomes (but not too quickly). Is benevolent: has the best interests of others at heart. **Explore:** Combines high advocacy (egocentrism) with high inquiry. Recognizes types and sources of conflict, encourages desirable conflict but discourages undesirable conflict. Picks up signals, sees opportunities, has intuition for innovation. Balances short- and long-term goals. Identifies problem. Discerns sub from main issues. **Combine:** Employs integrative (win-win) negotiation strategies rather than distributive (win-lose) strategies. Brokers solutions or outcomes. Thinks in ways that differ from established lines of thought. Agrees to disagree (lose-lose strategy). Considers common goal as most important. Adapts without violating own ideas.

7.5 Conclusion

This PhD thesis has defined and empirically tested the competencies professionals need in open innovation teams. The research question guiding this research was: Which competencies do professionals in an open innovation team need in order to contribute to its success? A rationalistic multimethod-oriented approach was adopted with the use of multiple research methods and data sources, comprising an extensive literature study, qualitative, and quantitative research, as well as self-reported and objective data collected from a varied group of open innovation professionals. This resulted in an overview of the activities open innovation professionals need to perform: managing the overall innovation process, managing the collaborative knowledge creation process, and dealing with the challenges caused by inter-organizational collaboration. In addition, it resulted in an overview of the competencies needed to perform these activities: 'involve', 'influence', 'handle conflicts', 'create learning climate', 'take on', 'prevail', 'monitor', 'decide mindfully', 'communicate clearly', 'analyse', 'explore', 'combine' and 'compete'. These competencies were clustered into three groups, namely interpersonal management, project management and content management, and described in detail in a competence profile.

Although some competencies proved to be of particular importance for project managers and some others for complex alliance forms, the profile appeared to be generic and thus applicable across different contexts. This implies that effective open innovation professionals are those who have, apart from the competencies mentioned in the profile, the capacity to recognize and react to contradiction and complexity in their working environment. Another finding showed that participants perceived the competencies as being more important when the team had a good team climate, except for competing behaviour. This could indicate that team climate fulfils the role of an enabler for desired competence, which could in turn mean that the environment is a greater determinant for team performance than individual competencies. The results show, however, that the application of the competencies, in particular the competency 'monitor', appeared to have explanatory value for open innovation team performance. Competing behaviour was negatively linked to the success of general innovation processes. These outcomes contribute to the field of (open) innovation management and HR in several ways. First, the collaborative knowledge creation model developed for understanding the key process underlying the activities undertaken in open innovation teams adds to (open) innovation management and HR studies by combining the participation and acquisition metaphor for learning with the different views on knowledge. Second, the outcomes add to HR literature by eliciting knowledge on real problems and challenges that may occur in complex collaborative knowledge

creation processes but were largely overlooked until now. Third, the profile adds a new perspective to and fills a gap in studies on (open) innovation management that undervalued the human factor in collaborative knowledge creation and innovation processes. Fourth, it contributes to competency modelling literature by showing that by adopting a rationalistic multimethod-oriented approach and viewing underlying processes as job activities, a profile can be obtained that contains information specific to an open innovation context and at the same time is applicable across open innovation contexts. Fifth, the findings confirm the theory of behavioural complexity, which contests the idea that particular categories of behaviours can be matched with certain professionals and advocates the idea that many phenomena may fit multiple opposing categories simultaneously. Sixth, the findings confirm the importance of a good team climate in open innovation teams, by revealing a link between team climate and perceived importance of desired competencies, which suggests that team climate acts as a competence enabler. Seventh, it contributes to the fields of (open) innovation and HR by being one of the first studies to empirically reveal a link between individual competence and team performance controlled for factors at higher aggregation levels, and thus to show that individual competence contributes more significantly to open innovation team performance than environmental factors. Finally, the most crucial competency that came out of this study, 'monitor', sheds light on the concept of transparency and trust in inter-organizational alliances. It suggests that the knowledge that needs to be shared specifically concerns the results of one's own work and the work of the team, and a sufficient level of communication is needed to do one's own work efficiently and effectively.

Directions for further research were given to enhance the validity and usability of the competence profile. Future research should focus on comparing open innovation teams, closed innovation teams and other collaboration forms in organizations to reveal areas in which the competence profile could best be applied and examine the distinctiveness of open innovation competence. To support relevant comparative research, it is important that research investigate what kind of (open) innovation teams or other collaboration forms in organizations take place most frequently. Moreover, further research should investigate the accuracy of the open innovation competence profile in different situations and the role of the situation in enhancing the use of open innovation competence. Finally, further research should investigate whether HR should support open innovation competence, and if so how. The developed competence profile is highly relevant to practice, since it can be used as a selection, diagnosis and (self-) evaluation tool in open innovation teams. Organizations are advised to explore the possibility of involving HR professionals in open innovation processes. Figure 7.3 summarizes the findings presented in this thesis and the suggested directions for future research.

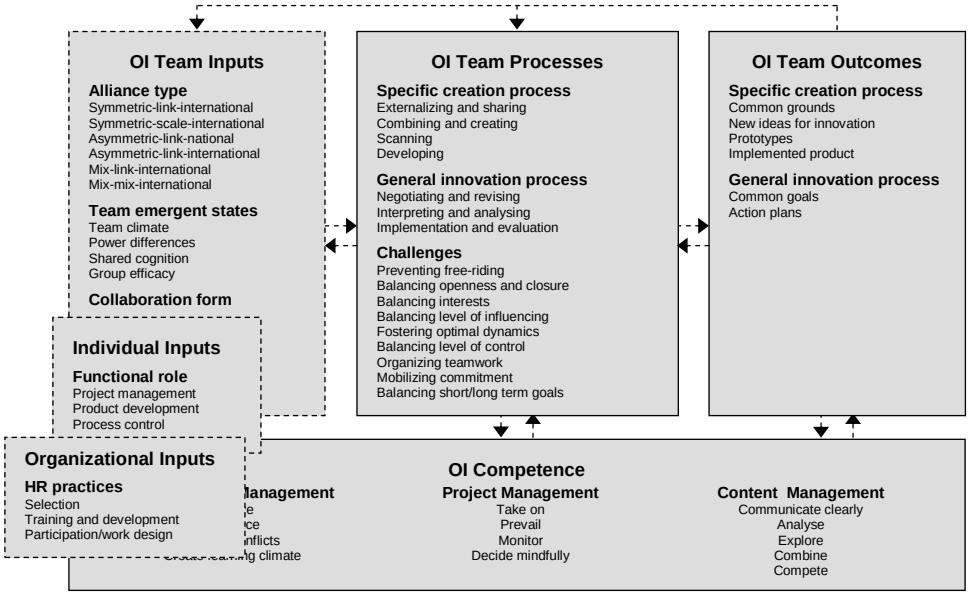


Figure 7.3: Input-Process-Outcome framework for open innovation (OI) teams with factors and relationships investigated in this PhD thesis and directions for future research (indicated with dashed lines)

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Summary

Open innovation competence: Towards a competence profile for inter-organizational collaboration in innovation teams

Globalization has resulted in an innovation trend called 'open innovation', in which companies develop new products, services or markets collaboratively, by using each others' know-how, technology, licenses, brands or market channels. A complex form of open innovation is pooled R&D or co-development in strategic partnerships, or *open innovation teams*. These partnerships embody mutual working relationships between two or more parties aimed at creating and delivering a new product, technology or service. In this way, human resources, technology and customer information are pooled to improve and speed up the innovation process. Although inter-organizational collaboration has often proved to be a prerequisite for successful innovation processes, not every external collaboration results in a success story. It appears that the diversity of organizational backgrounds in open innovation teams can be a source of creativity, but also a source of social and communicative dilemmas resulting in conflicts and project failures. Success factors for (open) innovation projects have been investigated extensively, but most studies undervalue and under-investigate the human side. Yet, research in this area is needed, since individuals are assumed to be the driving forces behind all organizational processes, and this aspect was consequently placed high on the research agenda of open innovation. Therefore, the research presented in this PhD thesis focussed on individual *competence* in open innovation teams. The concept of competence is often used to describe the range of skills and personal qualities people need for a certain job or task. Competence consists of competencies: integrated capabilities, consisting of knowledge, skills and attitudes, which are necessarily conditional for task performance, and for being able to function effectively in a certain job or situation. These competencies are usually clustered in a competence profile. In this way, the concept represents not only what an individual knows and does, but also what kind of a person he or she is and avoids the conceptual confusion between skills, abilities or traits and other terms. The main research question guiding this research was:

> *Which competencies do professionals in an open innovation team need in order to contribute to its success?*

A rationalistic multimethod-oriented approach (Sandberg, 2000) was adopted to tackle the main research question. In line with this approach, five sub-questions were formulated, which addressed (1) the activities that need to be performed in

open innovation teams, (2) competency elements needed to perform these activities (3) an optimal clustering of the competencies and competency elements in a competence profile (4) context variation of the resulting competence profile and (5) the link between open innovation competence and team performance. Multiple sources of evidence were used to investigate these questions, combining various ways of identifying and assessing competence that included qualitative, quantitative, objective and self-reported data. Three studies were conducted to answer the sub-questions: an inter-disciplinary literature study, a qualitative study and a quantitative study. The literature study consisted of an extensive literature review combining literature on learning, (inter-) organizational learning, (open) innovation management, business alliances and networks in organizational, management, Human Resource (HR) and educational studies. This study focused on the first two sub-questions and resulted in a preliminary competence profile based on literature. The qualitative study consisted of explorative interviews and focus group discussions, which adopted the critical incidents technique and took place with professionals and experts from different organizations and intermediaries who had been working in or with open innovation teams (N=37). This study also focused on the first two sub-questions and resulted in an elaborated competence profile. The quantitative study consisted of a cross-sectional online survey and group interviews with professionals from 15 open innovation teams from mainly prospector companies (N=73). This third study focused on the last three sub-questions and resulted in a validated competence profile with information about its context dependency and how it is linked to team performance. The results are as follows.

> *Sub-question a: What are the main activities professionals need to perform in open innovation teams?*

Instead of focusing on the technical activities, such as marketing research and product design, which may vary across open innovation contexts, the studies focused on the key underlying mechanisms that guide inter-organizational collaboration activities, which are universal across open innovation teams. Study 1 identified three main activities: managing the overall innovation process, managing the collaborative knowledge creation process, and dealing with the challenges caused by inter-organizational collaboration. Thirteen challenges were identified and most of them were confirmed by Study 2, the qualitative study, indicating that these challenges make the innovation process more complex in open innovation teams:

1. Being a good partner, but preventing free-riding;
2. Balancing openness and closure and building trust in a non-trusting environment;
3. Balancing individual and alliances interests, creating common meanings, goals and work plans;

4. Finding a balance between exerting influence and having no influence;
5. Fostering optimal dynamics;
6. Finding a balance between being in control and having no control;
7. Deciding when to work together and when apart *[not confirmed by Study 2]*;
8. Coping with role overload *[not confirmed by Study 2]*;
9. Efficiently and effectively organizing teamwork;
10. Rapidly building good relationships *[not confirmed by Study 2]*;
11. Mobilizing commitment;
12. Balancing short- and long-term goals, stability and risk; and
13. Sustaining good relationships *[not confirmed by Study 2]*.

Sub-question b: Which competency elements do professionals need in order to perform the main activities in open innovation teams?

Study 1 derived competency elements needed in order to perform these activities and a preliminary competence profile was developed. The competency elements were clustered according to the rationalistic multimethod-oriented approach, which resulted in four competency clusters (self management, interpersonal management, project management, content management) and thirteen competencies. These competencies comprised being able to: 'commit oneself', 'govern oneself', 'show social astuteness', 'influence', 'socialize', 'build trust', 'invent', 'control and coordinate', 'cope with chaos', 'externalize', 'interpret', 'negotiate' and 'combine'. Study 2 confirmed the competency elements identified, except for one that concerned a higher cognitive capability. Some additions to the profile were made, which led to an elaborated competence profile. Study 3 validated the content of the profile, and most of the competency elements appeared to be relevant (to highly relevant) for the open innovation professionals. The open innovation competence profile covers a broad and diverse area of competencies and describes certain behaviours in detail that are specific to an open innovation context.

Sub-question c: What is the optimal clustering of the identified competency elements in the competence profile?

Factor analysis on the data gathered in Study 3 showed that the competencies were not valid constructs and should be changed. The overall profile structure remained intact, however, the cluster self management was incorporated in the clusters interpersonal, project and content management. Analysis of the data showed that the most optimal clustering of the competency elements resulted in thirteen new competencies, which were: being able to 'involve', 'influence', 'handle conflicts', 'create learning climate', 'take on', 'prevail', 'monitor', 'decide mindfully', 'communicate clearly', 'analyse', 'explore', 'combine' and 'compete'. Although many elements moved to other competencies, the meaning of most competencies still fitted the identified activities and specific challenges.

Consequently, the clustering of the competency elements is still in accordance with the rationalistic multimethod-oriented approach. Comparing the new clustering of competency elements with competence profiles developed based on the worker-oriented approach shows that adopting a multimethod-oriented approach leads to a profile that contains more information about when and to what purpose a certain element needs to be used.

Sub-question d: Does the perceived importance of the competencies in the competence profile vary across contexts, and if so, how?

Multiple regression and one-way ANOVA analysis on the data gathered in Study 3 showed that the perceived importance of the competencies does not vary to a large extent across contexts. However, the competencies 'take on', 'prevail' and 'communicate clearly' were more important in more complex forms of alliances types. Moreover, it appeared that professionals in charge of project management perceived certain competencies as more important for their role in the project, compared to professionals in charge of product development or process control. These competencies were being able to 'involve', 'influence', 'prevail', 'create learning climate' and 'monitor'. This finding empirically confirms earlier suggestions that open innovation teams need strong leadership or a 'heavyweight' manager. However, although slight differences were found across different contexts, the competencies were generally perceived as being important; the competence profile can thus be said to be generic, at least within the research population. The fact that the model contains opposing behaviours and the lack of strong differences across contexts confirm the theory of behavioural complexity (Denison et al., 1995), which implies that effective open innovation professionals are those who have, apart from the competencies mentioned in the profile, the capacity to recognize and react to paradox, contradiction, and complexity in their working environment. Another finding was that participants perceived the competencies as more important when the team had a good team climate, apart from competencies that dealt with competitive behaviour. This could indicate that team climate fulfils the role of an enabler for desired competence, which suggests that the environment is a greater determinant for team performance than individual competencies. To test this assumption the next question was formulated.

Sub-question e: Does the reported application of the competencies in the competence profile significantly contribute to team performance, and if so, how?

Multiple regression analysis on the data gathered in Study 3 showed that the competencies significantly contributed to the success of general innovation processes and specific creation processes and were even stronger predictors of team performance than (some of the) environmental factors. More specifically,

the reported application of the competency ‘monitor’ was significantly positively related to the success of general innovation and specific creation processes and the application of ‘compete’ was significantly negatively related to the success of general innovation processes. The competencies ‘handle conflicts’ and ‘analyse’ appeared to be negatively linked to the success of general innovation processes, but this was due to a suppression situation. This study not only found a link between competence and team performance, but also found that the competencies explained much variance in the data. These outcomes suggest that for open innovation professionals in general the application of the competency ‘monitor’ will enhance open innovation team performance. This competency not only entails communicating well enough to do one’s job effectively, but also making results visible and trusting others. As such, it is good to note that the competency comprises more than a passive form of watching over the process. In fact, it entails an active form of monitoring one’s own work, and a more passive form of monitoring others’ work. Table 1 summarizes which relationships were found between competencies, contextual factors and team performance, and describes the content of each competency.

These outcomes contribute to the fields of (open) innovation management and HR in several ways. First, the collaborative knowledge creation model developed for understanding the key process underlying the activities undertaken in open innovation teams adds to (open) innovation management and HR studies by showing how the participation and acquisition metaphor and different views on knowledge can be combined into one collaborative knowledge creation model that clearly shows how knowledge is created at individual and group level. Second, the outcomes add to HR literature by eliciting information on real problems and challenges, which may occur in complex collaborative knowledge creation processes but were largely overlooked until now. This overview also contributes to literature in (open) innovation management, in which a clear overview of these challenges and their background was missing until now. Third, the profile adds a new perspective to and fills a gap in studies on (open) innovation management that undervalued the human factor in collaborative knowledge creation and innovation processes. Fourth, it contributes to competency modelling literature by showing that by adopting a rationalistic multimethod-oriented approach and viewing underlying processes as job activities, a profile can be obtained that contains information specific to an open innovation context and at the same time is applicable across open innovation contexts. Fifth, the findings confirm the theory of behavioural complexity, which contests the idea that particular categories of behaviours can be matched with certain professionals and advocates the idea that many phenomena may fit multiple opposing categories simultaneously. Sixth, the findings confirms the importance of a good team climate in open innovation teams, by revealing a link between team climate and perceived importance of desired competencies, which suggests that team climate acts as a competence

enabler. Seventh, it contributes to the fields of (open) innovation and HR, by being one of the first studies that empirically reveals a link between individual competence and team performance controlled for factors at higher aggregation levels, and thus by showing that individual competence contributes more significantly to open innovation team performance than environmental factors. Finally, the most crucial competency that came out of this study, 'monitor', sheds light on the concept of transparency and trust in inter-organizational alliances. It suggests that the knowledge that needs to be shared specifically concerns the results of one's own work and that of the team, and that a sufficient level of communication is needed to do one's own work efficiently and effectively.

Directions for further research to enhance the validity and usability of the competence profile are as follows. Future research should focus on comparing open innovation teams, closed innovation teams and other collaboration forms in organizations to reveal areas in which the competence profile can best be applied and the distinctiveness of open innovation competence. To support relevant comparative research, it is important that research concentrate on what kind of (open) innovation teams or other collaboration forms in organizations take place most frequently. Moreover, further research should investigate the accuracy of the open innovation competence profile in different situations and the role of the situation in enhancing the use of open innovation competence. Finally, further research should investigate whether HR professionals should support open innovation competence and if so how. The developed competence profile is highly relevant to practice, since it can be used as a selection, diagnosis, and (self-) evaluation tool in open innovation teams. Organizations are advised to explore the possibility of involving HR professionals in open innovation processes.

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Table 1: Relationships found between competencies, contextual factors and team performance

Competencies of extra importance in certain contexts	
Project Management	**Involve:** Identifies human, material, and experiential resources for accomplishing various kinds of learning objectives. Organizes complementarities. Identifies situations for participative group problem solving, using the proper degree of participation, and recognizes obstacles and corrective actions. Knows who to inform and when. **Influence:** Appropriately adapts, calibrates ones behaviour to each situation in order to elicit particular responses from others. Uses influencing skills (as opposed to instructing): position, coalition, stimulation. Knows how to play the political game. **Create learning climate:** Shares successes, allows people to make mistakes. Is honest: possesses high levels of integrity, authenticity, sincerity and genuineness. Can be counted on to represent situations fairly. Develops, maintains and uses effective networks. Is approachable, develops friendships easily and strong beneficial alliances and coalitions. Develops a team spirit. Deals with unexpected situations, is flexible with plans, deadlines, improvises. Is not too systematic, rigid. Deals with a flexible team composition.
Both	**Prevail:** Has an overall picture of the project and influencing factors. Understands and manages complexity. Supports many things on his/her mind at the same time. Has self confidence. Is competent: able to perform the tasks required by his or her position.
Complex alliances	**Take on:** Is aware of, and regulates, own thinking and feeling. Manages tensions created by multiple accountabilities, tasks and roles. Has perseverance, keeps on thinking positively, having end-goal in mind. Is reliable: ensures that the others can depend upon him/her to come through for them, acts consistently, follows through. Is pro-active. Comes up with ideas him/herself and takes initiatives. **Communicate clearly:** Creates a vision. Appreciates the learning domain and has the motivation to learn, has a sense of urgency. Is open: shares information freely with others, even when (s)he is not sure. Communicates clearly and understandably. Recognizes open and supportive communication methods.

Competencies related to team performance	
Positively	**Monitor:** Coordinates and synchronizes activities, information, and tasks between team members. Designs a plan of strategies. Carries out the plan systematically and sequentially. Feels responsible for the team and acts as such. Monitors, evaluates, and provides feedback on overall team and individual performance. Accepts feedback about his/her performance non-defensively. Collects evidence of accomplishments. Asks many critical questions. Trusts the other party.
Negatively	**Compete:** Is critical (but constructive). Is aware that he or she represents an organization; refuses to accept less.
Positively or negatively	**Handle conflicts:** Openness: treats differences as important opportunities. Respects, values and appreciates people and their ideas. Possesses basic knowledge and perceptions of various technical/ professional areas and business languages. Has experience working in partnerships. Is assertive, extroverted. Communicates own perceptions and feelings (in a diplomatic way). Is straightforward. **Analyse:** Wants to learn from others. Understands social situations as well as interpersonal interactions. Is sensitive to the roles and responsibilities of all partners, aware of their collaborative motivations and expresses understanding and empathy. Has good reflective skills and applies techniques of analysis. Is competent in techniques of lateral thinking or divergent thinking.

Other relevant competencies	
Relevant for all open innovation professionals	**Decide mindfully:** Knows what his/ her qualities are, does not take the position of the underdog. Possesses basic knowledge and perceptions. Establishes specific, challenging, accepted team goals. Diagnoses, formulates learning objectives in performance outcomes (but not too quickly). Is benevolent: has the best interests of others at heart. **Explore:** Combines high advocacy (egocentrism) with high inquiry. Recognizes types and sources of conflict, encourages desirable conflict but discourages undesirable conflict. Picks up signals, sees opportunities, has intuition for innovation. Balances short- and long-term goals. Identifies problem. Discerns sub from main issues. **Combine:** Employs integrative (win-win) negotiation strategies rather than distributive (win-lose) strategies. Brokers solutions or outcomes. Thinks in ways that differ from established lines of thought. Agrees to disagree (lose-lose strategy). Considers common goal as most important. Adapts without violating own ideas.

Samenvatting

Open-innovatiecompetenties: Naar een competentieprofiel voor samenwerking tussen organisaties in innovatieteams

De globalisering heeft tot een nieuwe trend geleid: open innovatie. Open innovatie houdt in dat verschillende organisaties gezamenlijk nieuwe producten, diensten of markten ontwikkelen, zodat ze gebruik kunnen maken van elkaars kennis, technologie, vergunningen, merken of afzetmarkt. Dit kan op verschillende manieren. Een complexe vorm van open innovatie is 'co-development', een vorm die verder als een 'open-innovatieteam' aangeduid zal worden. Open-innovatieteams worden gekarakteriseerd door een wederzijdse werkrelatie tussen twee of meer partijen met als doel de creatie en implementatie van een nieuw product, technologie of dienst. Op deze manier worden menselijke en technologische vermogens gebundeld om de kwaliteit en snelheid van het innovatieproces te verhogen. Hoewel vaak is gebleken dat samenwerking met andere organisaties een vereiste is voor succesvolle innovatieprocessen, leidt de zogenaamde externe samenwerking niet altijd tot een succesverhaal. Het verschil in organisatieachtergrond kan, naast een bron van creativiteit, ook een bron van sociale en communicatieve dilemma's zijn, resulterend in conflicten en mislukkingen. Succesfactoren van (open-) innovatieprojecten worden intensief onderzocht, maar in de meeste studies op dit gebied bleef de menselijke component onderbelicht en ondergewaardeerd. Onderzoek naar deze component is echter nodig, omdat wordt aangenomen dat individuen de drijvende krachten achter alle organisatieprocessen zijn. Als gevolg hiervan is de menselijke component hoog op de onderzoeksagenda van open innovatie komen te staan. Dit onderzoek draait om de bekwaamheid van professionals in open-innovatieteams. Het begrip bekwaamheid wordt vaak gebruikt om het scala aan persoonlijke kwaliteiten aan te duiden, dat nodig is om een specifieke baan of taak uit te voeren. Bekwaamheid bestaat uit competenties: geïntegreerde vermogens - die bestaan uit kennis, vaardigheden en houdingen - die voorwaardelijk zijn om bepaalde taken uit te voeren en effectief te functioneren in een bepaalde functie of situatie. De verschillende elementen waaruit een competentie is opgebouwd (kennis, vaardigheden en houdingen), zullen verder competentie-elementen worden genoemd. De hoofdvraag in dit onderzoek is als volgt geformuleerd:

> *Welke competenties hebben professionals in een open-innovatieteam nodig om bij te dragen aan het succes van het team?*

Een zogenaamde rationalistische, multi-methode-georiënteerde benadering (Sandberg, 2000) is gebruikt om de onderzoeksvraag te bestuderen. In lijn met deze benadering zijn vijf subvragen geformuleerd, met als onderwerpen (1) de activiteiten die uitgevoerd moeten worden in open-innovatieteams, (2) de competentie-elementen die nodig zijn om deze activiteiten uit te voeren, (3) een optimale clustering van de competentie-elementen in competenties, (4) de contextafhankelijkheid van de competenties, en (5) de relatie tussen competenties en teamprestatie. Verschillende manieren van gegevens-verzameling zijn gebruikt, waarbij kwantitatieve, kwalitatieve, objectieve en zelfgerapporteerde data zijn gecombineerd. Drie verschillende studies zijn uitgevoerd: een interdisciplinaire literatuurstudie, een kwalitatieve studie en een kwantitatieve studie. De eerste studie, de literatuurstudie, richtte zich vooral op de eerste twee subvragen en bestond uit een uitgebreide review van literatuur, die betrekking had op leren, (inter-)organisatie leren, (open-) innovatie-management, business allianties en netwerken in studies op het gebied van organisatie, management, Human Resources (HR) en onderwijs. Dit resulteerde in een eerste en voorlopig competentieprofiel. De tweede studie, vestigde eveneens de aandacht op de eerste twee subvragen, maar onderzocht deze op een empirische en kwalitatieve manier met behulp van explorerende interviews en focusgroepdiscussies, gestructureerd volgens de kritieke- incidentenmethode. De respondentengroep bestond uit professionals, experts en intermediairs van verschillende organisaties ervaren op het gebied van open innovatie (N=37). Het resultaat was een meer genuanceerd en uitgewerkt competentieprofiel. De derde studie onderzocht de laatste drie subvragen op een kwantitatieve manier. De studie omvatte een online vragenlijst en groepsinterviews met professionals van 15 open-innovatieteams uit hoofdzakelijk bedrijven die aan kop staan op het gebied van innovatie (N=73). Dit resulteerde in een gevalideerd competentieprofiel en tevens informatie over de contextafhankelijkheid van de competenties in het profiel en hun relatie met teamprestatie. De resultaten zijn als volgt samen te vatten.

> *Subvraag a: Wat zijn de voornaamste activiteiten die professionals moeten uitvoeren in open- innovatieteams?*

In plaats van op technische activiteiten, zoals marktonderzoek en productontwerp, richtte dit onderzoek zich op de onderliggende processen die ten grondslag liggen aan de externe samenwerkingsactiviteiten. Deze processen zijn universeel geldig en minder afhankelijk van de context van het open-innovatieteam, vergeleken bij de technische activiteiten. De eerste studie identificeerde drie hoofdactiviteiten: het managen van het algehele innovatieproces; het managen van het gezamenlijke kenniscreatieproces, en het omgaan met de uitdagingen veroorzaakt door samenwerking tussen verschillende organisaties. Dertien uitdagingen zijn geïdentificeerd, waarvan de meeste werden bevestigd in de tweede kwalitatieve studie:

1. een ‘goede’ partner zijn, maar meeliftgedrag vermijden;
2. balanceren tussen open- en geslotenheid bij het opbouwen van vertrouwen in een onveilige omgeving;
3. balanceren tussen persoonlijke belangen en die van de partner bij het creëren van gezamenlijke begrippen, doelen, en werkplannen;
4. een balans vinden tussen invloed uitoefenen en geen invloed uitoefenen;
5. bewerkstelligen van een optimale dynamiek in het team;
6. een balans vinden tussen controleren en niet controleren;
7. beslissen wanneer wel en niet samenwerken [niet bevestigd in studie 2];
8. om kunnen gaan met rol-overbelasting [niet bevestigd in studie 2];
9. efficiënt en effectief organiseren van teamwerk;
10. snel opbouwen van een goede relatie [niet bevestigd in studie 2];
11. mobiliseren van betrokkenheid binnen en buiten het team;
12. balanceren van korte- en lange-termijndoelen, stabiliteit en risico;
13. in stand houden van goede relaties [niet bevestigd in studie 2].

Er wordt gesuggereerd dat de teams alleen succesvol kunnen zijn, als de professionals in deze teams over de bekwaamheid beschikken om de activiteiten goed uit te voeren, inclusief het om kunnen gaan met de uitdagingen. De volgende subvraag is daarom geformuleerd.

> *Subvraag b: Welke competentie-elementen hebben professionals nodig om deze voornaamste activiteiten uit te kunnen voeren in open-innovatieteams?*

De eerste studie identificeerde verschillende competentie-elementen die open-innovatieteams nodig hebben om bovengenoemde activiteiten uit te voeren en met de uitdagingen in het innovatieteam om te gaan. Op basis hiervan is een voorlopig competentieprofiel ontwikkeld. De competentie-elementen werden geclusterd op basis van de rationalistische, multi-methode-georiënteerde benadering. Dit resulteerde in dertien competenties: in staat zijn tot zichzelf betrekken, zichzelf besturen, sociale scherpzinnigheid tonen, beïnvloeden, socialiseren, vertrouwen bouwen, uitvinden, controleren en coördineren, omgaan met chaos, zichzelf uitdrukken, interpreteren, onderhandelen, en combineren. Deze competenties werden op hun beurt geclusterd in vier clusters: zelf-, interpersoonlijk-, project-, en inhoudsmanagement. In de tweede, kwalitatieve studie zijn, op één na, alle competentie-elementen bevestigd. Daarnaast zijn enkele extra competentie-elementen genoemd, die zijn toegevoegd aan het voorlopige profiel. Dit resulteerde in een uitgewerkt competentieprofiel. De derde studie toonde aan dat de meeste competentie-elementen vaak tot zeer vaak door de open-innovatieprofessionals uit de respondentengroep werden toegepast en tevens als belangrijk tot zeer belangrijk werden gepercipieerd. Hoewel deze elementen valide leken te zijn, was er minder zekerheid over de validiteit van clustering van de competentie-elementen in competenties. Deze was namelijk hoofdzakelijk op een kwalitatieve en *top-*

down manier tot stand gekomen. De volgende subvraag is daarom geformuleerd en op een kwantitatieve, *bottom-up* manier onderzocht.

> *Subvraag c: Wat is de optimale clustering van de geïdentificeerde competentie-elementen in het competentieprofiel?*

Factor analyses op de data, vergaard in de derde studie, lieten zien dat de competenties, zoals die samengesteld waren in de eerste twee studies, geen valide constructen waren. De algemene structuur van het profiel bleef in tact, maar de cluster zelfmanagement werd geïntegreerd in de overige drie clusters. De data-analyse resulteerde in dertien nieuwe competenties, te weten: in staat zijn tot betrekken, beïnvloeden, conflict hanteren, een leerklimaat creëren, aanpakken, overwicht tonen, monitoren, overwogen beslissen, helder communiceren, analyseren, exploreren, combineren, en concurreren. Hoewel verschillende competentie-elementen werden verplaatst naar andere competenties, bleef de betekenis van de meeste competenties zodanig dat ze bij de eerder geïdentificeerde activiteiten en uitdagingen pasten. De nieuwe clustering wijkt zodoende niet af van de vorige, in die zin dat de wijze waarop de competentie-elementen geclusterd zijn, nog steeds past bij de rationalistische, multi-methode-georiënteerde benadering. Aangezien de hoeveelheid bewijs voor de vorige clustering laag was en de nieuwe clustering geschikter lijkt te zijn - zowel qua inhoud, als hoeveelheid bewijs - lijkt deze laatste clustering meer valide te zijn. Dit leidde zodoende tot een gevalideerd competentieprofiel. Echter, het profiel gaf nog geen duidelijkheid over welke competenties ten minste één persoon of enkele in het team moeten beschikken en of de competenties wel voor alle soorten open-innovatieteams gelden. Als gevolg daarvan is de volgende subvraag geformuleerd.

> *Subvraag d: Varieert de gepercipieerde importantie van de competenties in het competentieprofiel per context, en zo ja, hoe?*

Met context wordt op individueel niveau het soort taak bedoeld, die de professional heeft in een open-innovatieteam: projectmanagement, productontwikkeling, of procescontrole. Op teamniveau wordt hiermee de alliantievorm aangeduid, die het open-innovatieteam karakteriseert. Deze vorm kan bestaan uit een (combinatie van) horizontale, verticale, symmetrische, of asymmetrische allianties. Multipele regressieanalyses en één-factor variatieanalyses op de data verzameld in de derde studie, lieten zien dat de gepercipieerde importantie van de competentie niet sterk verschilt per context: er zijn significante relaties gevonden maar de verschillen zijn klein. Belangrijkste observatie was dat de competenties *aanpakken*, *overwicht tonen* en *helder communiceren* van meer belang leken in complexere alliantievormen (d.w.z. alliantievormen met een mix van zowel horizontale en verticale, en/of symmetrische en asymmetrische allianties). Bovendien bleek dat professionals,

die als taak projectmanagement hadden, verschillende competenties van groter belang achtten voor hun rol in het project, vergeleken bij professionals met als taak productontwikkeling of procescontrole. Het bleek hier specifiek te gaan om de competenties *betrekken*, *beïnvloeden*, *overwicht tonen, leerklimaat creëren*, en *monitoren*. Deze bevinding bevestigt eerdere suggesties in de literatuur dat (open-) innovatieteams sterk leiderschap vereisen ofwel een 'zwaargewicht' als manager. Echter, hoewel kleine verschillen in importantie zijn gevonden tussen verschillende alliantievormen en rollen, werden de competenties over het algemeen als belangrijk beschouwd over de gehele onderzoekspopulatie. Het competentieprofiel kan daarom als 'generiek' beschouwd worden en als algemeen toepasbaar voor de individuele professionals in open-innovatieteams, tenminste, binnen de onderzoekspopulatie. Een bijkomende bevinding suggereerde dat de respondenten de competenties als belangrijker percipieerden indien het team over een goed teamklimaat beschikte. Dit gold echter niet voor competitieve competenties (*beïnvloeden* en *concurreren*). Dit zou kunnen betekenen dat teamklimaat een voorwaardenscheppende factor is, die professionals aanzet om bepaald gewenst gedrag te vertonen. Dit zou kunnen impliceren dat omgevingsfactoren meer bepalend zijn voor teamprestatie dan persoonlijke competenties. De volgende subvraag is daarom geformuleerd.

> *Subvraag e: Draagt de gerapporteerde toepassing van de competenties in het competentieprofiel bij aan teamprestatie en zo ja, hoe?*

Multipele regressieanalyse op de data uit de derde studie toonde aan dat de toepassing van de competenties significant bijdraagt aan het succes van het algemene innovatieproces en het meer specifieke creatieproces. De competenties bleken zelfs sterkere voorspellers te zijn dan (sommige) omgevingsfactoren, zoals teamklimaat, machtsverschillen of cognitieve afstand. De bevindingen suggereren dat vooral frequent gebruik van de competentie *monitoren* door open-innovatieprofessionals over het algemeen een aanzienlijke positieve invloed heeft op teamprestatie. De mate van toepassing bleek namelijk significant positief gerelateerd aan het succes van beide bovengenoemde processen. Deze competentie bestaat niet alleen uit *vaak genoeg communiceren om je werk effectief uit te kunnen voeren*, maar ook uit het *zichtbaar maken van resultaten* en het *vertrouwen van anderen*. Het is goed op te merken dat deze competentie meer omvat dan slechts een passieve vorm van monitoren. In feite bestaat het uit een actieve vorm van toezicht houden waar het *eigen* werk betreft en een meer passieve vorm waar het werk van *anderen* betreft. De mate van gebruik van de competentie *concurreren* was significant negatief gerelateerd aan het succes van het algemene innovatieproces. Ook de competenties *conflict hanteren* en *analyseren* bleken significant negatief gerelateerd te zijn aan het succes van het algemene innovatieproces, maar dit werd veroorzaakt door een zogenaamde suppressiesituatie. Tabel 1 beschrijft elke competentie in detail en

vat de gevonden relaties tussen competenties, contextuele factoren en teamprestatie samen.

De bevindingen van de studies in dit proefschrift dragen op verschillende manieren bij aan het onderzoeksveld van (open-) innovatiemanagement en HR. Ten eerste, het gezamenlijk kenniscreatiemodel, dat is ontwikkeld om het proces te doorgronden dat ten grondslag ligt aan alle gezamenlijke activiteiten in open-innovatieteams (zie hoofdstuk 2), draagt bij aan zowel (open-) innovatiemanagement en HR-literatuur door inzichtelijk te maken hoe individuen gezamenlijk kennis creëren. Tevens laat het model zien hoe verschillende zienswijzen op leren (de participatie- en acquisitiemetafoor) en verschillende visies op kennis gecombineerd kunnen worden in één model voor kenniscreatie. Ten tweede dragen de bevindingen bij aan HR-literatuur en literatuur over open innovatie door een overzicht te geven van welke problemen professionals kunnen ondervinden bij kenniscreatie in complexe omgevingen als open-innovatieteams en waar deze problemen door ontstaan. Ten derde voegt het competentieprofiel een nieuw perspectief toe en vult het een lacune in studies op het gebied van (open-) innovatiemanagement, waar de menselijke factor tot nu toe ondergewaardeerd is gebleven. Ten vierde dragen de bevindingen bij aan literatuur op het gebied van competentie-identificatie. Door de rationalistische, multi-methode-georiënteerde benadering te hanteren en daarbij professionele activiteiten te beschouwen als onderliggende processen, is aangetoond dat dit tot een profiel kan leiden dat zowel gedetailleerde specifieke informatie bevat, als generieke informatie, toepasbaar over verschillende contexten heen. Daarbij levert het profiel ook nog informatie over met welk doel bepaalde competentie-elementen toegepast moeten worden. Deze combinatie is doorgaans moeilijk te verkrijgen op basis van andere competentie-identificatie benaderingen. Ten vijfde bevestigen de bevindingen de theorie van gedragscomplexiteit, die zich kant tegen de idee dat bepaalde gedrags-categorieën kunnen horen bij een bepaalde beroepsgroep en daarom pleit voor de idee dat bepaalde verschillende tegenstrijdige categorieën tegelijkertijd eenzelfde rol of situatie kunnen toebehoren (Denison et al., 1995). Reflectie op het profiel leidt tot het inzicht dat het verschillende tegenstrijdige competentie-elementen bevat. Dit samen met de bevinding dat er geen grote verschillen zijn gevonden tussen verschillende contexten, lijkt de theorie van gedrags-complexiteit te bevestigen. Deze observatie zou impliceren dat effectieve open-innovatieprofessionals diegene zijn, die naast het bezitten van de competenties in het profiel, over de capaciteit beschikken om paradoxale, tegenstrijdige, en complexe situaties in hun werkomgeving te herkennen en daarop adequaat te reageren. Ten zesde bevestigen de bevindingen het belang van een optimaal teamklimaat in open-innovatieteams, wat suggereert dat teamklimaat mogelijk een belangrijke voorwaardenscheppende factor is voor het kunnen toepassen van bepaalde competenties. Ten zevende dragen de studies in dit proefschrift bij aan zowel (open) innovatie en HR-literatuur, door een van de eerste studies te zijn

waarin empirisch een link is vastgesteld tussen persoonlijke bekwaamheid en teamprestatie, gecontroleerd voor factoren op hogere aggregatieniveaus en door aan te tonen dat persoonlijke competenties mogelijk sterkere voorspellers zijn voor het succes van open-innovatieteams, dan omgevingsfactoren. Ten slotte werpt de meest cruciale competentie, monitoren, een ander licht op de begrippen transparantie en vertrouwen in allianties. Deze competentie suggereert dat de kennis die moet worden gedeeld om transparantie en vertrouwen te kweken, vooral de resultaten van persoonlijk en gezamenlijk werk betreft en communicatie die nodig is om eigen werk efficiënt en effectief uit te kunnen voeren.

Aanbevolen wordt de validiteit en bruikbaarheid van het competentieprofiel verder te onderzoeken. Vervolgonderzoek zou zich daarbij moeten richten op het vergelijken van open-innovatieteams, gesloten innovatieteams en andere samenwerkingsvormen in en tussen organisaties, om daarmee inzichtelijk te maken hoe onderscheidend open-innovatiecompetenties zijn en welke competenties het best toegepast kunnen worden in welke context. Om vergelijkend onderzoek te vergemakkelijken, is het van belang dat eerst wordt onderzocht welke samenwerkingsvormen in de praktijk vaak voorkomen. Bovendien zou verder onderzocht moeten worden hoe accuraat het huidige competentieprofiel is, door te kijken naar hoe toepasbaar de competenties zijn in verschillende specifieke omstandigheden en of ze nog meer genuanceerd moeten worden. Ten slotte zou verder onderzoek zich kunnen richten op de vraag of HR een rol zou kunnen spelen bij het ondersteunen van open-innovatiecompetenties, en zo ja, hoe. Het ontworpen competentieprofiel is tevens relevant voor de praktijk. Het kan worden gebruikt als een selectie, diagnose, en (zelf-) evaluatie-instrument in open-innovatieteams. Organisaties wordt geadviseerd de mogelijkheid te exploreren om HR-professionals bij open-innovatieprocessen te betrekken.

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Tabel 1: Gevonden relaties tussen competenties, context factoren en teamprestatie

Competenties van extra belang in bepaalde contexten	
Project management	**Betrekken:** Identificeert menselijke, materiële en experimentele hulpmiddelen voor verschillende leerdoelen. Organiseert complementariteit. Identificeert situaties voor gezamenlijke probleemoplossing, participeert in juiste mate, en herkent obstakels en corrigerende maatregelen. Weet wanneer wie te informeren. **Beïnvloeden:** Past zich op gepaste wijze aan, ijkt eigen gedrag aan elke situatie om bepaalde reacties van anderen op te wekken. Gebruikt beïnvloedingsvaardigheden (in plaats van te onderrichten): positie, coalitie, stimulatie. Weet hoe het politieke spel te spelen. **Leerklimaat creëren:** Deelt successen, staat anderen toe fouten te maken. Is eerlijk: bezit over een hoog niveau of integriteit, eerlijkheid en echtheid. Kan op gerekend worden eerlijke voorstelling van zaken te geven. Bouwt, onderhoudt en gebruikt effectieve netwerken. Is benaderbaar, ontwikkelt gemakkelijk vriendschappen en sterke nuttige allianties en coalities. Ontwikkelt een teamgeest. Kan omgaan met onverwachte omstandigheden, is flexibel met plannen, deadlines, improviseert. Is niet te systematisch, en rigide. Kan omgaan met een dynamische teamsamenstelling.
Beide	**Overwicht tonen:** Heeft algemeen overzicht van het project en de beïnvloedende factoren. Begrijpt en managet complexiteit. Verdraagt veel dingen tegelijkertijd aan zijn hoofd. Heeft zelfvertrouwen. Is competent: in staat om de taken behorende bij positie uit te voeren.
Complexe allianties	**Aanpakken:** Is bewust van en reguleert eigen denken en gevoelens. Managet spanningen veroorzaakt door verschillende verantwoordelijkheden, taken en rollen. Heeft doorzettingsvermogen, blijft positief denken, het einddoel voor ogen houdend. Is betrouwbaar: verzekert dat anderen op hem/haar kunnen bouwen, handelt ernaar, en gaat er mee door. Is proactief. Komt met ideeën en initieert. **Helder communiceren:** Creëert een visie. Waardeert het leerdomein en heeft de motivatie om te leren, heeft een gevoel van urgentie. Is open: deelt vrijelijk informatie met anderen, ook al is hij of zij er niet zeker van. Communiceert duidelijk en begrijpelijk. Herkent open en ondersteunende communicatiemethoden.

Competenties gerelateerd aan teamprestatie	
Positief	**Monitoren:** Coördineert en synchroniseert activiteiten, informatie en taken tussen teamleden. Ontwerpt actieplannen. Voert het plan systematisch uit. Voelt zich verantwoordelijk voor het team en gedraagt zich daarnaar. Houdt toezicht, evalueert en voorziet van feedback op team en individuele prestaties. Accepteert feedback dat zijn of haar eigen prestaties betreft zonder zich te weren. Verzamelt bewijsmateriaal voor prestaties. Stelt vele kritische vragen. Vertrouwt de andere partij.
Negatief	**Concurreren:** Is kritisch (maar constructief). Is zich bewust een organisatie te vertegenwoordigen en handelt daarnaar door geen genoegen te nemen met minder.
Positief of negatief	**Conflict hanteren:** Is open: behandelt verschillen als belangrijke mogelijkheden. Respecteert, waardeert en stelt (ideeën van) anderen op prijs. Beschikt over basiskennis en percepties op het gebied van verschillende professionele gebieden en business taal. Heeft ervaring met het werken in allianties. Is assertief, extravert. Communiceert percepties en gevoelens (op een diplomatieke manier). Is recht vooruit. **Analyseren:** Wil van anderen leren. Begrijpt zowel sociale situaties, als interpersoonlijke interacties. Is gevoelig voor de rol en verantwoordelijkheden van alle partners, bewust van hun participatie motivatie en uit begrip en empathie. Beschikt over reflectievaardigheden en past analysetechnieken toe. Is competent in technieken van lateraal of divergerend denken.

Overige relevante competenties	
Relevant voor alle open-innovatieprofessionals	**Overwogen beslissen:** Weet wat zijn of haar kwaliteiten zijn, neemt niet de positie van de underdog aan. Beschikt over basiskennis en percepties. Legt specifieke, uitdagende en acceptabele doelen vast. Diagnosticeert, formuleert leerdoelen in de vorm van gewenste leeruitkomsten (maar niet te snel). Is welwillend: heeft het beste met de ander voor. **Exploreren:** Combineert verdediging van eigen ideeën met navraag naar andere ideeën. Herkent aanleidingen voor conflicten, bemoedigt gewenste conflicten, maar ontmoedigt ongewenste conflicten. Pikt signalen op, ziet kansen, heeft een intuïtie voor innovatie. Balanceert korte- en lange-termijndoelen. Identificeert het probleem en onderscheidt hoofd- van bijzaken. **Combineren:** Gebruikt eerder integrerende (win-win) onderhandelingstechnieken dan verdelende (win-lose) strategieën. Vormt een brug tussen oplossingen of uitkomsten. Denkt anders dan doorgaans gebruikelijk is. Accepteert het oneens te zijn (lose-lose strategie). Beschouwt gezamenlijk doel als meest belangrijk. Past zich aan zonder eigen ideeën geweld aan te doen.

About the Author

Elise du Chatenier was born on 3 November 1980 in Almelo, the Netherlands. In 1999, she finished high school (VWO) at OSG Erasmus in Almelo. The same year, she started her studies in Educational Science and Technology at the University of Twente. She graduated in 2003 with a Master's in Human Resource Development, combined with a minor in International Management. Her Master's thesis dealt with the effects of coaching and learning on the job in international perspective, which she conducted for a large multinational company in France. After completing her Master's thesis, she participated in an international volunteer project in Norway, where she managed the daily food supply of about 400 persons in collaboration with a multicultural team. In December 2004, she started as a PhD candidate at the Education and Competence Studies Group, in collaboration with the Management Studies Group of Wageningen University. The research topic entailed open innovation competence: towards a competence profile for inter- organizational collaboration in innovation teams. She combined research with other activities among which chairing PREBEM, the Dutch organization for PhD Researchers in Business Economics and Management. In addition, she supported the start up of and chaired the PhD platform on chains and networks of Wageningen University. Moreover, she consulted open innovation teams in the Dutch horticulture sector, supervised Master's students with their theses and gave guest lectures about human resource development and knowledge management. In addition, she has been member of the educational committee of the national research school ICO, the board of the Mansholt Graduate School PhD-day, and the board of alumni union Topos of Educational Science and Technology, University of Twente.

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Du Chatenier, E., Mulder, M., Omta, S.W.F., Biemans, H.J.A. (2006, May). *Inter-firm learning competencies that foster successful innovations in international chains and networks*. Paper presented at the Doctoral workshop of the International Conference on HRD Research and Practice Across Europe Tilburg, the Netherlands.

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Du Chatenier, E. (2005, June). *System innovation by inter-firm learning: Influencing group characteristics*. Unpublished manuscript, written for the EUDOKMA international PhD seminar on organizational learning, networks and communities: innovations in the emerging strategic entrepreneurship field, Amsterdam, the Netherlands.

Completed Training Plan

ico

Description	Institute / Department	Year	ECTS[1]
Courses:			
Scientific Writing	CENTA[2]/Wageningen Graduate Schools (WGS)	2006	1.5
Quantitative Research Methods	Mansholt Graduate School of Social Sciences (MG3S)	2007	4.0
Socio-cultural Field Research Methods	MG3S	2006	4.0
Mansholt Introduction Course	MG3S	2005	1.0
Organizational learning, networks and communities	European Doctoral School on Knowledge and Management (EUDOKMA)	2005	6.0
Study visit Iceland	European Centre for Development and Vocational Training (CEDEFOP)	2005	1.5
ICO Introduction course	Inter University Centre for Educational Research in the Netherlands (ICO)	2005	7.0
ICO Master class Qualitative analysis	ICO	2006	3.5
ICO Winter school on Process Research and Conceptual Change	ICO	2008	4.0
Teaching and supervising activities	Wageningen University	2006 2007	4.0
Board membership of PREBEM including the organization of a conference for all PhDs in business economics and management in the Netherlands and Flanders	PREBEM[3]	2005 2006	5.0
Presentations at conferences and workshops:			
Mansholt Multidisciplinary seminar, Wageningen, NL		2006	1.0
ICO Toogdag, Amsterdam, NL		2007	1.0
University Forum of Human Resource Development, Oxford, GB		2007	1.0
Doctoral Colloquium European Academy of Management, Paris, F		2007	1.0
Academy of Human Resource Development, Panama City, Florida, US		2008	1.0
Academy of Management Annual Meeting, Anaheim, California, US		2008	1.0
Total (minimum 30 ECTS)			**46.5**

[1] One ECTS on average is equivalent to 28 hours of course work
[2] CENTA, currently Language Services, is the language desk for Wageningen UR.
[3] PREBEM stands for PhD REsearchers in Business Economics and Management, which is part of NOBEM, which stands for Netherlands Organisation for research in Business Economics and Management

Appendices

Appendix A: Factors influencing collaborative knowledge creation and similar or identical labels in various streams of literature

Factors influencing collaborative knowledge creation	**Referred to in learning literature as:**	**Referred to in (inter) organizational learning literature as:**	**Referred to in (open) innovation management literature as:**	**Referred to in business alliances and networks literature as:**
Group efficacy	Group efficacy	Reciprocity	Equity, fair dealing	Reciprocity
Social Cohesion	Social cohesion	Care		Relational embeddedness, Strong ties, weak ties
Learning climate	Psychological safety	Learning climate	Team atmosphere, trust	Psychological proximity
Cognitive distance	Shared cognition	Common meanings	Cognitive distance	Cognitive distance
Power differences	Interdependencies	Power	Power (distribution)	Dominance
Team diversity	Interdisciplinary Multicultural teams	Team diversity Multicultural teams	Organization, job, demographical related diversity	Link, scale, complementary, supplementary alliances, symmetry
Team stability		Stability	Stability	Stability
Hierarchy	Interdependencies	Hierarchy		Centrality or hierarchy
Leadership	Regulation	Facilitation	Coordination, controlling	Managing
Structural composition		Split up of teams into subgroups	Hierarchical decomposition	Network structure
Functional composition		Team roles	Roles	
Geographical proximity		Team dispersion	Geographical proximity	Physical proximity
Learning history	Learning history	Learning history	Partner specific experience	
Autonomy	Autonomy	Autonomy	Autonomy	
Resource availability	Resource availability	Resource availability	Resource availability	Resource availability
Level of uncertainty		Creative turmoil	Level of uncertainty	
Learning future				Short/long term relationship alliance duration

Appendix B: Interpretation of response on 'job or function in organization'

	Response open innovation professional on 'job/function in organization'[1]	Category[2]
1.	NPD manager	2
2.	Manager technical procurement	2
3.	Manager purchasing and technology	4
4.	Production manager	3
5.	Business manager	1
6.	Junior product developer	2
7.	Senior quality assurance manager	3
8.	Product manager	4
9.	Manger technical procurement	2
10.	Manager technology team	2
11.	xxx Sales manager	4
12.	xxx Engineering manager	2
13.	Engineering manager	2
14.	Manager xxx	2
15.	Operations manager NPD	2
16.	Doctor	2
17.	Project manager	1
18.	Category specialist factory equipment	2
19.	Project leader R&D	2
20.	Manager innovation projects	1
21.	xxx Developer	2
22.	R&D category manager xxx	2
23.	Key account manager	4
24.	Director	1
25.	Category Manager	4
26.	Competitive intelligence	2
27.	Technical product development as project manager	2
28.	NPD manager external manufacturing	2
29.	Category manager xxx	4
30.	R&D xxx development	2
31.	Manager sourcing	4
32.	Product developer	2
33.	Marketing manager	4
34.	For xxx interim; CEO, founder own company	1
35.	Product developer	2
36.	General director	1
37.	Logistics account manager	4
38.	Project manager / senior scientist	1
39.	xxx Development	2
40.	Outsourcing manager	4
41.	Science manager xxx	2
42.	Project manager R&D xxx	2
43.	Category procurement manager	4
44.	Senior scale-up manager	2
45.	Unit manager xxx	1
46.	Key account manager	4
47.	Senior marketing manager global brand xxx	4
48.	Senior brand manager	4
49.	Manager food safety and quality assurance - sourcing	3
50.	xxx Innovation process manager	1

[1] Specific company details were removed from the list (indicated with 'xxx') to protect confidential company information.

[2] 1. Overall (project) management
2. Product development and technology
3. Quality assurance or production management
4. Marketing or account management

51.	Account manager	4
52.	Senior product engineer (xxx)	2
53.	xxx Division director	1
54.	Contract manager	4
55.	xxx Engineer manager	2
56.	Plant manager xxx	1
57.	Project coordinator	1
58.	Entrepreneur	1
59.	Purchaser	4
60.	Process technologist	2
61.	Quality assurance manager	3
62.	xxx Division director	1
63.	R&D project Manager	2
64.	Product developer	2
65.	Brand manager xxx	4
66.	Interim manager and consultant	1
67.	Manager food safety and innovation	3
68.	Account manager	4
69.	Director xxx	1
70.	Account manager	4
71.	General manager	1
72.	Project manager	1
73.	xxx Innovation process manager	1

Appendix C: Structure factor matrix for frequency of use[1] and factor correlation matrix

Item		Factor													
		Com-pete	Ex-plore	Com-municate clearly	In-volve	Monitor	Handle conflicts	Create learning climate	Under-take	Pre-vail	Com-bine	Influ-ence	Decide mind-fully	Ana-lyse	
g26	Initiating activities				*.343*				**.393**	*-.312*					.757
k35	Good at analysing					*.309*				-.364			*.304*	**-.345**	.634
k38	Good at one's job					*.345*				-.519			**.354**		.545
a1	Having sense of urgency			**.465**										-.361	.483
l40	Recognizing other ideas	-.343		*.386*			**.323**								.390
k36	Criticizing other ideas	**.812**										-.330			
l43	Pushing ideas forward	**.722**										-.305			
f19	Counting with others	-.469											**.425**	-.332	
g23	Experimenting		**.743**												
l45	Using conflicts		**.724**											*-.358*	
g24	Picking up signals		**.677**					-.392							
i32	Balancing goals		**.674**								.369				
l44	Detecting fallacies		**.539**		*.482*										
k39	Being curious	-.339	**.529**			.403					.340			*-.442*	
l42	Raising questions		**.408**			.341			.352		.395		.314	-.339	
g25	Having a vision			**.865**											
f15	Sharing all knowledge	-.490		**.541**		.431				-.512				-.302	
j34	Getting message across			**.391**										*-.383*	.355
c9	Informing strategically				**.723**	.339				-.316					.301
h29	Involving others			*.351*	**.668**										
h28	Communicating enough					**.802**									
f21	Trusting others					**.698**							.356	*-.305*	
e13	Creating team spirit					*.560*	*.454*	-.433					*.337*		.439
a2	Having need to learn				*.336*	*.509*					.337			**-.365**	
h30	Making results visible					**.485**	*.343*								.360
k37	Knowing other cultures						**.663**								.302

[1] Method: Principal Axis Factoring with Oblimin rotation. Items that loaded on the same factor in the two different solutions are shown in bold, items that did not load on the same factor in the two different solutions are shown in grey font, and items that loaded on more and the same factors in both solutions, but were not assigned to a particular factor are shown in italic font. Only factor loadings > .30 are shown.

d12	Recognizing conflicts						**.654**					-.344			
f14	Keeping information							**-.703**							
f20	Allowing mistakes							**-.554**							
i33	Dealing with chaos							**-.392**	*.314*			*-.345*			
b5	Being emotionally stable								**.609**				.357		
b6	Being able to focus				*.315*				**.540**			*-.367*	.319		
b7	Being positively minded	.409							**.532**	*-.507*	.356	*-.337*			.382
b3	Having self confidence									**-.734**					.413
l31	Keeping overview		.425				.352		.306	**-.697**					
f17	Having authority						*.342*	-.328	*.322*	**-.589**			.377		
f22	Being reliable								**.317**	-.375					
m46	Creating win-win	*.475*						-.315			**.744**				
m47	Abandoning own ideas										**.588**				
d11	Playing political games											**-.842**			
d10	Using influencing skills								*.329*			**-.635**			
b4	Having self knowledge												**.830**		
h27	Setting goals						*.408*			*-.333*		*-.457*	**.488**		.416
l41	Being conceptual flexible					.318					**.564**			*-.727*	
c8	Understanding others													**-.691**	

Factor correlation matrix frequency of use

Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	1													
2. Compete	-.139	1												
3. Explore	.102	.018	1											
4. Communicate clearly	.160	-.128	.085	1										
5. Involve	.125	-.088	.088	.097	1									
6. Monitor	.187	-.200	.117	.175	.115	1								
7. Handle conflicts	.164	-.077	.064	.136	.062	.142	1							
8. Create learning climate	-.128	.001	-.140	-.023	.000	-.128	-.018	1						
9. Undertake	.158	.047	.111	.116	.199	.022	.088	-.068	1					
10. Prevail	-.273	.022	-.095	-.183	-.137	-.155	-.196	.085	-.161	1				
11. Combine	.129	-.167	.241	.022	.121	.189	.084	-.157	.117	-.081	1			
12. Influence	-.095	-.189	-.085	-.057	-.177	.013	-.057	.119	-.215	.180	-.006	1		
13. Decide mindfully	.244	-.105	.048	.036	.098	.223	.133	-.122	.166	-.182	.114	-.029	1	
14. Analyse	-.132	.085	-.176	-.217	-.100	-.260	-.001	.093	-.012	.073	-.199	.013	-.026	1

Appendix D: Structure factor matrix for importance[1] and factor correlation matrix

Item		Factor												
		Compete	Explore	Com-municate clearly	Involve	Monitor	Handle conflicts	Create learning climate	Under-take	Prevail	Combine	Influence	Decide mind-fully	Analyse
j34	Getting message across			**.453**	.414	-.321	.333		.437			.466	-.343	*.622*
k37	Knowing other cultures				.362		**.305**			.315		.305		.578
d12	Recognizing conflicts		.439	.414	.427		**.398**	.315	.371		.350			.456
l45	Using conflicts		**.750**		.308			.362				.330		*.381*
g24	Picking up signals		**.741**											
k39	Being curious		**.741**		.326			.370	.333					*.363*
l42	Raising questions		**.724**		.379			.328						
i32	Balancing goals		**.691**			-.362								
m46	Creating win-win		*.587*						.374	.319	**.388**	.347	-.338	.328
g23	Experimenting	.321	**.439**											
k36	Criticizing other ideas	**.815**												
l43	Pushing ideas forward	**.734**												
c8	Understanding others	.528	.331		.496			.312	.328					**.425**
f21	Trusting others		.340			**-.839**	.344							*.301*
f14	Keeping information					-.511		**.414**			.343			
m47	Abandoning own ideas										.943			
f20	Allowing mistakes							**.838**						
e13	Creating team spirit		.336			*-.412*	*.339*	**.479**		.454	.322	.397	*-.437*	.412
k35	Good at analysing		.370		.466	*-.333*	.359				.360	.392	*-.667*	**.355**
b4	Having self knowledge						.401						**-.626**	
g26	Initiating activities				*.369*	-.391	.326		**.327**	*.320*	.356	.447	-.519	
g25	Having a vision	.306		**.821**			.352			.334				
a1	Having sense of urgency			**.679**			.371		.329	.628			-.583	
h29	Involving others			*.671*	**.588**		.357				.311			
k38	Good at one's job			.492		*-.388*			.370		.347	.415	**-.323**	.429
b5	Being emotionally stable								**.846**	.321		.338		

[1] Method: Principal Axis Factoring with Oblimin rotation. Items that loaded on the same factor in the two different solutions are shown in bold, items that did not load on the same factor in the two different solutions are shown in grey font, and items that loaded on more and the same factors in both solutions, but were not assigned to a particular factor are shown in italic font. Only factor loadings > .30 are shown.

i33	Dealing with chaos			.480	.397			**.341**	*.626*			*.312*	-.313	
l31	Keeping overview									**.826**				
f17	Having authority			.388	.394	-.327	*.337*		*.429*	**.569**		.473		.476
h30	Making results visible					**-.307**	*.787*			.349			-.324	
f19	Counting with others			.335	.317		.734			.350	.369	.333	**-.333**	
f15	Sharing all knowledge		.375	**.474**	.322		.657					.326		
l44	Detecting fallacies		**.326**		*.535*		.541					.336		.526
f22	Being reliable				.389	-.463	.528		**.416**				-.343	
b6	Being able to focus				*.324*		.511		**.324**	.409		*.342*		
d10	Using influencing skills								*.366*	.356		**.725**	-.349	
l40	Recognizing other ideas		.512	*.434*	.417	-.317	**.323**	.325				.541		
d11	Playing political games							.396	.357	.504		**.508**		
b3	Having self confidence			.486			.488		.467	**.428**		.507	-.364	
h27	Setting goals		.317		.411		*.362*		.322	*.324*		*.418*	**-.318**	.337
b7	Being positively minded				.684		.344		**.508**	*.429*		*.417*	-.453	
c9	Informing strategically				**.674**					.477		.429		.356
h28	Communicating enough				.545	**-.316**	.345		.331	.337			-.383	.380
a2	Having need to learn		.431		*.492*	*-.444*						.431		**.445**
l41	Being conceptual flexible	.312	.328		.467		.458				**.373**	.374		*.302*

Factor correlation matrix importance

Factor	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Analyse	1.000												
2. Explore	.233	1.000											
3. Compete	.120	.203	1.000										
4. Monitor	-.229	-.204	-.048	1.000									
5. Combine	.056	.194	.166	-.203	1.000								
6. Create learning climate	.100	.221	.047	-.150	.056	1.000							
7. Decide mindfully	-.080	-.095	-.115	.089	-.173	.008	1.000						
8. Communicate clearly	.171	.116	.140	-.107	.122	.037	-.191	1.000					
9. Undertake	.114	.109	.122	-.095	.136	.182	-.225	.197	1.000				
10. Prevail	.135	.091	.086	-.047	.108	.068	-.247	.213	.260	1.000			
11. Handle conflicts	.150	.161	.180	-.134	.191	.100	-.263	.305	.158	.265	1.000		
12. Influence	.170	.205	.103	-.077	.198	.125	-.198	.213	.269	.293	.234	1.000	
13. Involve	.291	.243	.148	-.183	.171	.199	-.172	.189	.236	.229	.272	.318	1.000

Appendix E: Interpretation of response on 'functional role in team'

	Response open innovation professional on 'functional role in team'	Category[1]
1.	Packaging project manager	1
2.	Technical product development and scale-up	2
3.	Implementation in factory	3
4.	Operations/Production representative in the project[2]	1
5.	Project manager	1
6.	Product development	2
7.	Risk assessment	3
8.	Operational support	2
9.	Technical responsible for development	2
10.	Technical support	3
11.	Technical support	3
12.	Engineering project for the factory	2
13.	Production mapping, feasibility and development	2
14.	Implementation	3
15.	All operations activities in project	3
16.	Thinking along and participating)	2
17.	Overall project manager	1
18.	Up scaling production packaging components	2
19.	Developing product and R&D project leader[3]	1
20.	Encouraging innovation and changing thinking	2
21.	Developing performing xxx[4]	2
22.	Evaluation of technical opportunity	2
23.	Co-ordinate the scale-up	2
24.	Member of MT	1
25.	Represented sales	1
26.	Initially coordinate, later product formula	1
27.	Formula development, secure functionality product	2
28.	Handling operations aspects	3
29.	Organizing resource and client linkage	1
30.	R&D packaging development	2
31.	Supplier selection and contracting	1
32.	Product development	2
33.	Leading it from marketing	1
34.	Project leader: to manage the project and the team	1
35.	Developing the product	2
36.	Development of xxx	2
37.	Supply chain / logistics manual supplier	1
38.	Starting new developments	1
39.	Develop a good xxx	2
40.	Commercial	3
41.	Idea generator + development/developer of the test	2
42.	Various: technical service, R&D work, support, etc.	2
43.	Commercial	3
44.	Production process and associated equipment	3
45.	Participant	2
46.	Coordinating all involved departments as team leader	1
47.	Ensure the project was a market and P&L success	1
48.	Project leader	1

[1] 1. ,Project management: consisting of tasks related to project management, business control and external relations management;
2. Product development, consisting of tasks related to the development of new products;
3. Process control and operations, consisting of tasks related to process management and quality control.

[2] Representatives had management tasks and were as such assigned to project management.

[3] If professionals had both management tasks and development tasks, they were given the code for project management.

[4] Specific product details were removed from the list (indicated with 'xxx') to protect confidential company information.

49.	Food safety and Quality assurance at the co-packer	3
50.	Project manager	1
51.	Make sure it can be produced in our factory	2
52.	Re-engineering of the complete system	2
53.	Management	1
54.	Negotiating supply agreements	1
55.	Factory implementation	3
56.	Project manager	1
57.	Project coordinator	1
58.	Study group consumers retail	2
59.	Guide	2
60.	Advisor	2
61.	Quality assurance	3
62.	Management	1
63.	Coordinate the R&D activities and represent R&D	1
64.	Development of xxx	2
65.	Project leader & marketing	1
66.	Process coordinator	1
67.	Initiator	2
68.	Manage the best possible xxx proposal	2
69.	Constructing advice for future organization[1]	1
70.	Manage the best possible xxx proposal	2
71.	Project manager	1
72.	Solve issues of project after its launch	2
73.	Project manager	1

[1] Through a remark made by the respondent at the end of the questionnaire, it was known that this respondent was responsible for the management of the team.