The Role of Net Present Value Calculation in the Development of Experience of Knowing in Strategic Investment Decision-Making Process

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Abstract

Pondering how to explain the frequency and prominence of Net Present Value (NPV) in the pharmaceutical New Product Development (NPD) process was the starting point of our abductive single case study. This question is exciting since there are inherently many factors making the use of NPV complicated in such a context and the process is time-wise extremely long. It consists of several steps; the uncertainty is significant in many respects and the activity is decidedly knowledge intensive. By drawing on Edmund Husserl's phenomenology and especially on his core notion of 'noema', we shed light on how the 'experience of knowing' gradually accumulates during such a process. In so doing, we firstly contribute to the existing strategic decision-making literature by presenting a systematic and thorough analysis of the role and interplay of financial and non-financial information in the development of the experience of knowing over the typically very long decision-making process. We present a detailed analysis of how the degree of confidence of managers regarding the feasibility of the project gradually takes shape during the long NPD process and discuss how the relative importance of the various perspectives changes during the process. We show that managers' prior experiences and pre-understanding of similar decision-making processes play major roles in the development of the experience of knowing. Secondly, we contribute to the capital investment literature by providing insights into the managerial uses of financial and non-financial information, specifically about the role of NPV calculation in the development of the experience of knowing. We demonstrate that even though NPV is often used merely to verify the judgemental experiences of knowing obtained from multiple other sources, it can also be used in a very intensive and interactive manner for the generation of knowledge about the feasibility of the project. We show that the reciprocal validating and correcting of the vision of reality takes place in social conversations and dialogues, and that in this NPV plays a crucial role. Two significant characteristics of such learning-oriented use of information relating to NPV emerged in our empirical data: multifaceted insight and simplified accounting language and form.

Key words: Net present value, NPV, Non-financial information, Noema, Capital investment, New product development, NPD, Pharmaceutical industry

1. Introduction

It appears that Net Present Value (NPV) is used notably more often and more prominently in pharmaceutical new product development than is generally typical (e.g. Daunfeldt and Hartwig, 2014; Walker et al., 2015). This is the more interesting as in such industries it is far from obvious why NPV is so frequently used and prominent. This question is exciting since there are inherently many factors to be considered in industries like pharmaceuticals that make the use of NPV complicated: the process is time-wise extremely long, it consists of several steps, uncertainty is significant in many regards, and the activity is highly knowledge intensive. Pondering how to explain this frequency and prominence of NPV was the starting point – a kind of catalysing question – of this research. In our in-depth single case study of the strategic investment decision-making processes of a company in the pharmaceutical industry, we attempted to shed light on this question by investigating how financial and non-financial perspectives work together in the New Product Development (NPD) process. In addressing the interplay of these perspectives, we

found that the role of NPV calculations varies: While they typically appear to only have a verifying role at the various decision points, at times they also seem to play a more decisive role in facilitating the generation of new decision-relevant information. These findings led us to explore the emergent 'experience of knowing' of the decision-makers (cf. Manninen, 1995) in such processes, employing phenomenology as our 'method theory' (Lukka and Vinnari, 2014). Along these lines, our research took the form of an abductive process (Dubois and Gadde, 2002; Lukka and Modell, 2010).

A successful development of a new drug typically costs several hundred million euros (Paul et al., 2010). As a consequence, the link between success in NPD and the performance of the entire company is highly palpable in the pharmaceutical industry (e.g. Paul et al., 2010; Sharma and Lacey, 2004). NPD in the pharma field is characterised by intensive regulatory requirements. An NPD process for a new proprietary drug is typically very long, lasting up to 12-15 years. The pharmaceutical NPD process is also characterised by a very high level of uncertainty: numerous sources of uncertainty make it, in the first place, far from certain that the initiative/drug being developed will ever be launched on the market (e.g. Granlund and Lukka, 2017). Due to problems in the safety, efficacy, or the estimated profitability of drugs, attrition may occur during any phase in a project (Paul et al., 2010). In order to organise and manage the NPD process, pharmaceutical companies commonly utilise a stage-gate approach (Cooper, 1990) which entails dividing the entire NPD process into multiple sequential stages, separated from one another by stage-gates (i.e. decision points) (Hartmann and Hassan, 2006). At each gate, the continuation of the NPD process is formally decided upon by an authoritative body.

NPV calculations are much more widely used in pharmaceutical drug development projects than on average in business firms (see Appendix A). It appears that in this business, NPV is clearly the dominating, primary investment calculation method. It is invariably used in the industry for all project evaluations in the later clinical phases (Phase 2 and 3), and to a very large extent already before them, i.e. in clinical Phase 1 and in the pre-clinical phase (e.g. Hartmann and Hassan, 2006; Walker et al., 2015). In the business of original medical drugs, compared to the message of the normative capital budgeting literature, NPV calculations are started early and continued repeatedly and late in the potentially very long decision-making process. This process is a series of 'go or no go' decisions, which can be discontinued at any decision point.

In Eupharma[1], the target of our case study (research), the NPD process includes six decision points (DPs) (i.e. stage-gates), where continuation of the NPD projects is decided upon. The first two DPs relate to the continuation of the project during the research phase and the four subsequent DPs to potential continuation during the product development phase. At all DPs, project funding is approved only for the next upcoming phase.

Our findings suggest that NPV calculations can play decidedly different roles (cf. Burchell et al., 1980) at various stages of the process of an NPD project. Typically, they play a kind of verifying role at the several decision points of the process, i.e. verifying the decision-makers' judgemental experiences of knowing at those stages about the feasibility of the project, produced by numerous other sources of information, and provides 'an exact value' to be presented to the decision-makers. Importantly, however, NPV is also used in a learning generating manner to produce genuinely new decision-relevant information. It seems to facilitate the emerging and developing experience of knowing by aiding in simulating the outcomes of various scenarios and the implications of changes in some of the parameters deemed critical, for example.

Pondering upon the reasons for the high frequency and the, at least seemingly, dominant role of NPV calculations in the NPD projects of the drug development industry caused us to embark on a most thorough analysis of the investment decision-making process in that industry. Firstly, we ran an analysis of the various sources of information, and of the various roles of NPV therein as well as, finally, on how the decisions, or the experiences of knowing, emerge during the many stages of the process. These questions are even more interesting as in pharmaceutical new product development, responding to them is far from straightforward. There are inherently many relevant complicating factors in the picture: the time-wise length of the process is extremely long, consisting of several steps; uncertainty on many dimensions is notable and the activity is highly knowledge intensive. These contemplations led us eventually to the following first research question:

> *How can we explain the variation in the role of NPV calculations in pharmaceutical new product development, ranging from a verifying role to the role of a producer of new decision-relevant information?*

As we wished to specifically focus on exploring how NPV is implicated in the dynamic and step-wise development of experiences of knowing during the long decision-making process (cf.

[1] A pseudonym due to a confidentiality agreement.

Manninen, 1995), and also consider the interaction of financial and nonfinancial perspectives in developing these experiences, the *main research question* of the study is as follows:

> *How are NPV calculations involved, in an interplay with other sources and uses of information, in the development of the experience of knowing in a long decision-process, featured by high uncertainty?*

There exist of course often formal procedures for processes like those concerning NPD, and NPV calculations are typically mentioned in these. However, in this paper we by no means confine our analysis to the level of the formal procedure, but are interested in the actual decision-making process, including the informal domain and the roles that NPV plays there. As our central method theory (Lukka & Vinnari, 2014), we employ some of the key ideas of Husserl's phenomenology (Husserl, 1960; Sanders, 1982), and specifically those related to his core notion noema. According to Husserl (1960), the partial views of a whole entity can be considered its noematic phases. Each time new components of an experience emerge, the observer gains new understanding of this experience. Finally, after multiple lookings and describings the observer feels to achieve a sense of knowing what is there. In our study the noema, and consequently the focus of the analysis, is the perceived, gradually evolving appearance of the feasibility of an NPD project.

We contribute to the existing literature in two main ways. First, we extend the strategic investment decision-making literature by providing a systematic and thorough analysis of the role and interplay of financial and non-financial information in the development of the experience of knowing over the at times very lengthy decision-making process; an area so far overlooked by other scholars. In addition, we add to the accounting literature by being the first to employ Husserl's concepts related to noema. We present a detailed analysis of how the degree of experience of knowing about the various financial and non-financial perspectives gradually takes shape during the long NPD process and discuss how the relative importance of these perspectives changes during the process. Importantly, we show that managers' prior experiences and pre-understanding of similar decision-making situations and the processes related to intersubjectivity play major roles in the development of the experience of knowing.

Second, we extend the capital investment literature by providing insights into the managerial uses of financial and non-financial information and, specifically, into the role of NPV calculation in the development of the experience of knowing. We demonstrate that even though NPV is often used merely to verify the judgemental experiences of knowing obtained from multiple other

sources, it can be used in a very intensive and interactive manner for the generation of knowledge about the feasibility of a project. We show that the reciprocal validating and correcting of the vision of reality takes place in social conversations and dialogues and that NPV plays a major role in these processes. Further, two significant characteristics of the learning-oriented use of information relating to NPV emerged in our empirical data: multifaceted insight and simplified accounting language and form.

The remainder of the paper is structured as follows. The following section provides insights into the existing literature related to NPV, the use of financial and non-financial information in strategic investment decision-making (SIDM) and NPD. In addition, it presents the theoretical, i.e. phenomenological, underpinnings of our method. Section 3 addresses our empirical research method and data. Our case analysis related to the interplay of financial and non-financial perspectives in the emergent experience of knowing – and, in particular, the use and role of NPV therein – is presented in Section 4. The following Section 5 discusses our empirical analysis and concludes the paper by presenting the implications of our study for the capital budgeting and broader accounting literatures.

2. Literature

In the first section, 2.1, we will review the literature related to financial and non-financial perspectives in decision-making in general, and continue by focusing on SIDM and NPD related aspects. In Section 2.2 we will present specific characteristics of NPD in the pharmaceutical business. Thereafter we will discuss the theoretical, in this case the phenomenological underpinnings of our study in Section 2.3. Finally, in Section 2.4, we will discuss the role of NPV calculations in the process of learning.

2.1. Financial and non-financial information in SIDM

Managers in their work use both financial and non-financial information.[2] The importance of financial information derives from its ability to standardise information (Hall, 2010). It allows

[2] We consider financial information to be information in monetary form, and accordingly non-monetary information is non-financial information. In addition, we have adopted the view of several scholars, such as Van der Veeken and Wouters (2002) and Wouters and Verdaasdonk (2002) who consider financial information as accounting information. Also, Hall (2010) appears to have adopted this view, albeit less explicitly. It is, however, worth acknowledging that some scholars have suggested adopting a broader view of accounting information so as also to include inscriptions that complement or substitute calculations, for example (Gerdin et al., 2014; see also Miller, 1998).

transforming operational detail expressed in various forms into a single financial dimension. Such a single financial dimension makes it possible to aggregate data (Gerdin et al., 2014; Hall, 2010; Mouritsen and Kreiner, 2016; Wouters and Verdaasdonk, 2002). Importantly, the aggregation, such as compiling an NPV calculation, affords managers access to information unobtainable from any other sources (Hall, 2010). This aggregation also enables comparability of data against history, experience and pattern recognition (Jönsson and Grönlund, 1988; Nielsen et al., 2015; Wouters and Verdaasdonk, 2002). In addition, financial information can be used as a common language between diverse organisational actors or groups (Ahrens & Chapman, 2007; Feeney and Pierce, 2016; 2018; Hall, 2010; Rowe et al., 2008). Hence, it helps to develop knowledge and also to link and bind various actor worlds and knowledge bases (Briers and Chua, 2001; Miller and Power, 2013; Warren and Seal, 2018). The effectiveness of financial information as a common language has been suggested to be more pronounced in an organisational context, where the diversity of operational factors is high, the managers have different educational and functional backgrounds, and the need for communication flow across functional borders is high (Hall, 2010). In line with this, Rowe et al. (2008) found that, specifically, simplified accounting language, rather than technical accounting jargon and codes, helped managers in cross-functional teams to integrate dispersed knowledge, communicate with each other and debate cost issues amongst themselves. Further, Osborn (1998) suggests that simplified financial information can trigger productive discussions among managers, and facilitate building shared interpretations of the results.

Prior studies suggest, however, that it is not sufficient to examine managers' use of financial information in a vacuum, because the motives and practices related to such use are dependent on the strengths and weaknesses of other types of information (Hall, 2010). Financial information is only one part of a manager's information battery, which also includes a wide range of other information sources ranging from factual reports and market forecasts to corridor gossip and intuition (see e.g. Kotter, 1982; McKinnon & Bruns, 1993). These non-financial information sources may also include direct observations, informal reports, data related to industry, markets, competitors and economic data, and other specialist information (Preston, 1986; Simon et al., 1954). Managers are often also found to use additional information to corroborate pieces of financial information (Hall, 2010; McKinnon & Bruns, 1993). The awareness of the importance of integrating both financial and non-financial aspects into managerial work is also manifest in

the fact that the Balanced Scorecard (Kaplan and Norton, 1992) has become a common managerial approach in recent decades (Hoque, 2014).

With regard to financial and non-financial perspectives in SIDM, prior studies have predominantly addressed the use of different investment calculation techniques, and consequently focused on financial aspects therein (see e.g. Arnold and Hatzopoulos, 2000; Graham and Harvey, 2001; Hartwig, 2012; Pike, 1996; Sandahl and Sjögren, 2003; see Haka, 2007 for a review). Nevertheless, inspired by Bower's (1970) seminal work, a body of studies also addressing the non-financial aspects of SIDM has emerged in recent decades. This research shows that the SIDM process is typically complex and multidimensional; SIDMs are not based merely on financial perspectives (Harris et al., 2016, 2018). Financial evaluation modelling including DCF (NPV) analysis, however, continues to be considered of utmost importance in companies (Alkaraan and Northcott, 2007; Carr et al., 2010; Chen, 2008; Huikku et al., 2018; Turner and Guilding, 2012; Van Cauwenbergh et al., 1996).

Innumerable non-financial aspects have been claimed by scholars to have the potential to play a major role in SIDM. The requirement for strategic alignment has been reported to be a key criterion regarding whether the firm will invest (Alkaraan and Northcott, 2006, 2013; Carr et al., 2010; Chen, 1995, 2008; Jörgensen and Messner, 2010; Miller and O'Leary, 1997, 2007; Slagmulder, 1997). Ensuring top managers' commitment to the investment project is a prerequisite for its implementation (Bower, 1970; King, 1975). Lower-level managers typically sell their investment projects to their superiors during the SIDM process (Lumijärvi, 1991). In addition to financial selling arguments (i.e. profitability), they may use strategic (alignment with strategy), non-financial (e.g. social factors), and production technology (e.g. new production facilities) related arguments (Lumijärvi, 1991). Managerial judgement based on managers' intuition and experience may affect decision-making to a great extent (Alkaraan and Northcott, 2006, Emmanuel et al., 2010; Zanibbi and Pike, 1996). Butler et al. (1991, 1993), Brunsson (1990) and Sykianakis and Bellas (2005) highlight the influence of political considerations on SIDM. Vesty et al. (2015) found that due to changes in new environmental and social regulations, and the introduction of voluntary guidelines, companies started to pay more attention to non-financial, sustainability-related aspects in their SIDM. Based on the analysis of eighteen SIDM case studies Harris et al. (2016) illustrate how agents' knowledgeability of the SIDM setting and position-practice relations can influence decision-making. In addition, they present evidence for the significant impact of external stakeholders and environmental aspects on SIDM. Elmassri et

al. (2016) demonstrate that in an environment of extreme uncertainty in post-revolution Egypt, non-financial considerations and objectives took precedence over the financial measures in SIDM.

Additionally, there are studies addressing the importance of various non-financial factors in SIDM. Chen (1995) found that, in addition to strategic alignment, aspects related to flexibility and quality are important in SIDM. Abdel-Kader and Dugdale (1998) reported that customer requirements and compliance with corporate strategy are important in SIDM in general, and, for advanced manufacturing technology investments, also the quality/reliability of outputs, reduced lead-times, achieving greater manufacturing flexibility and reduced inventory levels were of particular importance. In a similar vein, Alkaraan and Northcott (2006) reported that consistency with corporate strategy was the most important non-financial factor, but requirements of customers, quality/reliability of outputs, keeping up with competition and the ability to expand in the future were considered to be of greater importance.

Regarding the use of financial and non-financial information in NPD, it has been suggested that financial approaches to measure project profitability are of little importance in the research phase due to the extreme uncertainties surrounding sources of revenue (e.g., Carlsson-Wall and Kraus, 2015; Feeney and Pierce, 2018; Karlsson and Kurkkio, 2018). Carlsson-Wall and Kraus (2015) found instead that practices such as keeping within the allocated expenditure budget and technical quantifications were decisive in the research phase. Furthermore, Nixon (1995) found that technology investment projects were heavily politicised processes, where strategic alignment and risk considerations exerted considerable influence in decision-making, whereas the role of financial information appeared to be minor. Hertenstein and Platt (2000) addressed the performance measures of NPD projects and found that product cost was the most important financial measure and that customer satisfaction and timing were the key non-financial indicators.

Miller and O'Leary (2007) addressed the role of financial and non-financial perspectives in NPD investments by drawing on the concept of mediating instruments. They showed how three distinctive methods, such as Moore's law, technology roadmaps and cost of ownership calculations, were used in capital budgeting as mediating instruments, connecting and mediating between different knowledge domains and actors. Following Miller and O'Leary's (2007) studies in the semiconductor industry, Wouters and Sandholzer (2018) addressed the mediating

role of cost of ownership calculations and present further evidence on their mediating capacity in an interorganisational setting. Also, Mouritsen et al. (2009) previously suggested that calculations can have the potential to be pivotal in shaping product development trajectories. Jörgensen and Messner (2010) investigated the relationship between accounting and strategy in complex NPD projects. Specifically, they addressed how strategic objectives may be mobilised together with financial information to make sense of particular investment choices. They observed that the firm used a stage-gate model and the divisional management board produced financial calculations at each stage as a decision routine. In addition to non-financial requirements (e.g. strategic alignment), sufficient contribution ratio and pay back ratio were required at each stage for the project to continue. They suggest that considerations about functionalities, quality and production design, for example, were not financial considerations in the first place. Nevertheless, these seemed to serve as (kinds of) shortcuts to conceiving of the expected financial impact of their decisions. Accordingly, they suggest that the influence of financial information can only be understood when considered simultaneously with other (non-financial) perspectives (cf. Hall, 2010). In other words, their study implies that managers use some kind of complementary accounts in order to compensate for the alleged weaknesses of financial information.

In summary, there exists a consensus that when investigating SIDM, the implications of multiple perspectives – financial and non-financial – should be taken into account, i.e., it is not appropriate to address them in a vacuum. Nevertheless, in spite of a considerable body of accounting research on the interactive use of financial and non-financial information, the literature on investment decision-making still lacks systematic and thorough analyses of the interaction of the forms of information over the occasionally very long decision-making process. Little is known about how the various financial and non-financial perspectives gradually take shape during this process, and how their relative importance in decision-making may change.

2.2. New Product Development in the pharmaceutical business

The pharmaceutical industry is one of the most R&D intensive industries (Messner, 2016). Developing a new drug (i.e. a new chemical entity, NCE) commonly costs several hundred million euros (Paul et al., 2010). Hence, it is crucial for the success of the company to succeed in these investments (e.g. Paul et al., 2010). NPD in this business field is characterised by intensive regulatory requirements: Authorities such as the FDA in the USA impose strict requirements on drug development and marketisation processes. In addition, the development

process of a new NCE is generally very long, lasting up to 12-15 years. To compensate for this long development process, proprietary drugs are secured by patents that often cover a period of 20 years.

In addition, the NPD process is characterised by a very high level of uncertainty (Granlund and Lukka, 2017; Henttu, 2015; Wäck, 2014). Much of this is related to uncertainty as to whether the initiative/drug being developed will ever make it to the market. Problems with safety, efficacy or estimated profitability can lead to attrition during any phase, and only about 10 per cent of projects having already entered the pre-clinical phase are estimated to ever be launched (Paul et al., 2010)[3]. Phase III (the last clinical phase consisting of extensive tests with potentially several thousand patient volunteers to confirm the safety and efficacy of the drug) is by far the most expensive phase in the pharmaceutical NPD process (Sharma and Lacey, 2004). It has been suggested that only about one fourth of R&D expenses are incurred before that phase (Paul et al., 2010).

Pharmaceutical companies utilise a stage-gate approach (Cooper, 1990) to organise and manage their NPD processes. Accordingly, the NPD process is divided into multiple sequential stages, separated from one another by stage-gates (i.e. decision points) (Hartmann and Hassan, 2006). The continuation of the NPD process is decided at each gate by an authoritative body, such as a board of directors. The decision on potential continuation is based on the best available information at the time, including a business case and analysis related to risks and the availability of necessary resources.

In recent years, the pharmaceutical industry has witnessed a significant decline in the number of new marketable drugs, partly explained by tightened regulatory requirements concerning the research and sale of drugs (Paul et al., 2010; Scherer, 2001). At the same time, development costs for each new drug product have increased dramatically. Consequently, only a small proportion of new products entering the market generate substantial profits (Gupta et al., 2007; Hamill et al., 2013; Scannel et al., 2012; Scherer, 2001). Macroeconomic factors, such as dwindling national healthcare budgets, impose additional pressure on pharmaceutical companies

[3] Significant attrition takes place even before the pre-clinical phase. The two major phases in drug development are research and development. Common stages during the research phase are target-to-hit, hit-to-lead, lead optimisation and pre-clinical phases, whereas the development phase is typically divided into Phases I-III (i.e. clinical phases) and the registration/launch phase (see e.g. Paul et al., 2010).

(Paul et al., 2010). Having to respond to these changes has had a negative impact on the industry's NPD efficiency (ibid.). In order to cope with these increased requirements and pressures, pharmaceutical companies have increased their inter-firm co-operation in terms of R&D partnerships (Roijakkers & Hagedoorn, 2006). Such contractual partnerships have the potential to provide pharmaceutical companies with a higher degree of flexibility and to make it possible to share the risks and costs associated with NPD projects (ibid.).

To sum up, drug development is a very costly, protracted and highly uncertain process, where projects may well be abandoned at any decision point (gate) or between these. In addition, the success of development is heavily dependent on external actors, such as regulatory authorities and inter-firm co-operation.

2.3. Phenomenology and the 'experience of knowing'

Our study employs as a method theory (Lukka & Vinnari, 2014) some of the key ideas of Edmund Husserl, the founding father of phenomenology.[4] According to Husserl (1960), meaning resides entirely neither in the object itself nor entirely in the observer's observation of it, but is a result of a complex interplay between these. The core concepts of Husserl's phenomenology are intentionality and the related concept of 'noema'. Intentionality refers to the direction and internal shape of the experience or consciousness of individuals. Föllesdal (1969, 680) defines (Husserl's) intentionality as "the peculiarity of consciousness to be consciousness of something". While intentionality refers to the *relation* between the object as perceived and the subjective understanding of that object, noema refers to the *way* in which individuals' consciousness is targeted at an object, i.e. to their meaning structures in the intentionally oriented situation in question (Husserl, 1960). Our study is also inspired by Manninen (1995), who has illustrated the emergence of knowing in the accounting context.[5]

Husserlian intentionality can be considered to consist of three central ideas: intentional act, intentional object and noema (i.e. intentional content) (Kosowski, 2010). Intentional act (or psychological mode of thought; also known as noesis) is a mental process where the subject, for instance, perceives, believes, remembers, judges or evaluates and the intentional object is the

[4] There are several streams representing different views and emphases within phenomenology. Other highly influential phenomenological thinkers include Brentano and Heidegger (see Moran, 2000). In a similar vein, there are competing visions of how to apply phenomenology in research (Finlay, 2009; Gill, 2014).

[5] He suggests that there are three elements that constitute a basis for experience of knowing in accounting: the typification based on earlier experience, the 'touch with reality', and the role of 'the remarkable others'.

topic (thing, state of affairs) this act is about. Noema is an outcome of such an intentional act. In the latter, the subject constructs a noema into the mind relating to an object towards which the mind is intentionally directed (Kosowski, 2010). Thus, noema can be regarded as a structure of meaning providing an understanding of an object in the mind of the subject.[6] In more plain language, noema represents the way in which a person makes sense of something. In short, noemas are about developing meanings in the world (Moustakas, 1994).

The major interest in Husserlian phenomenology is to study the way in which objects (things) appear to consciousness, i.e. how they constitute the world, rather than their objective character. The world we experience appears to us piece by piece. The image of this world is a continuously changing and sharpening presupposition about the forthcoming appearance of the different pieces. This presupposition will then be supported or revoked during the experiencing process.

One helpful and common example to illustrate the role of noema in intentional act is an observation of a tree (see e.g. Saarinen, 1986; Moustakas, 1994). Even if we can only see a figure of a two-dimensional birch tree through the window at some distance, we tend to recognise, however, that it is indeed a birch. Our consciousness can also constitute in this observation the whole three-dimensional tree. Hence, a relevant noema in our mind can constructively add to our 'naked' observation. It has the ability to combine the parts and lead us towards an experience of the object as a whole (Smith, 2018). Hence, noema acts as a kind of interpreting mechanism that organises our observations structuring them into a meaningful completeness.[7]

While Husserl's focus of interest was primarily on the noemas of individuals, we are interested in how people collectively, not just individually, develop their experiences of knowing (cf. Giorgi, 1997, 2008; Gill, 2014; Halling, 2008). Relatedly, discussions within an organisation can be viewed as a back-and-forth process where the experience of knowing is gradually inter-subjectively created (Manninen, 1995; Moustakas, 1994). In line with this, based on the interpretation of Husserl's (1970) texts, Moustakas (1994, 57) suggests that "A continuing alteration of validity occurs as people articulate and describe their experiences. Reciprocal

[6] Scholars have also proposed other partly different interpretations of Husserl's concept of noema (see e.g. Moustakas, 1994, 79-81).

[7] Our study is also closely related to the ideas of constructivism as a learning paradigm positing that learning is an active, constructive and continuous process, wherein people actively construct or create their own subjective representations of objective reality by linking new information to prior knowledge (Piaget, 1950). Furthermore, according to Vygotsky's (1980) social constructivist suggestions, learners continuously test their own presuppositions and experiences through social negotiation.

correcting of reality takes place in social conversations and dialogues." Moustakas (1994) maintains further that phenomenology is an appropriate tool for exploring and describing shared experiences related to a given phenomenon. Accordingly, we will also pay major attention to the interactive processes of the emergence of knowledge. As phenomenology can also be considered a frame for illustrating and analysing a learning process, we will discuss in the next section how NPV calculations are involved in the experience of knowing, i.e. in the process of learning.

2.4. NPV calculations in the process of learning to know

In contemporary organisations NPV is one of the most extensively applied techniques used to support SIDM (see e.g. Graham and Harvey, 2001; Hermes et al., 2007; Brounen et al., 2004; see Appendix A). Interestingly, the use of NPV appears also to be very popular in highly uncertain contexts, where its appropriateness could be considered dubious (Chittenden and Derregia, 2013; Haley and Goldberg, 1995). In these contexts, uncertain key input variables (e.g. sales volume/prices or raw material costs) have the potential to make the NPV calculation highly unreliable[8] (Haley and Goldberg, 1995; Hartmann and Hassan, 2006). It appears that NPV is clearly the dominating formal method for assessing the financial feasibility of pharmaceutical drug development projects. In this business, it is typically used for all project evaluations in clinical Phases 2 and 3, and to a very large extent earlier, in pre-clinical phase and Phase 1, and still before launching a new product in the registration phase (e.g. Hartmann and Hassan, 2006; Walker et al., 2015). Hence, NPV calculations are much more widely used in the pharmaceutical business than in business firms on average.

Prior research shows that companies use various approaches to manage the inherent limitations of NPV in highly uncertain contexts. These approaches include introducing probabilistic elements into their valuation models (Chittenden and Derregia, 2013; Verbeeten, 2006), applying more stringent hurdle rate thresholds (Chittenden and Derregia, 2013; Dobbs, 2009), using real options methodology (Busby and Pitts, 1997; Dixit and Pindyck, 1994; Remer et al., 2001; Verbeeten, 2006), or employing complementary, qualitative analysis in order to account for the difficulty of translating all critical information into a calculative form (Alkaraan and Northcott, 2006; Shank, 1996). Although these findings are helpful in that they shed light on the ways through which managers seek to cope with the limitations of NPV in highly uncertain contexts, they do not provide a comprehensive explanation for why managers use NPV in contexts in

[8] Hence, here in the context of NPV, we use the term 'high uncertainty' to refer primarily to a high level of uncertainty in regard to the *value* of key cash flow variables.

which the technique is only partially capable of informing the assessment of investment proposals (Bower, 1970; Shapiro, 2005). In this study, we will investigate another potential role of NPV; the role it may play in the process of learning, i.e. in the gradual accumulation of the experience of knowing on the NPD project.

Chapman (1997) suggests that the use of accounting in a learning-oriented way may often entail dialogue that extends beyond the bare accounting representation. This is because accounting representations are often incomplete. Dialogue may then revolve around the meaning attached to accounting numbers rather than around the absolute accounting numbers themselves. Accordingly, the broader accounting literature suggests that in highly uncertain environments accounting may come to be used in a way that differs from the conventional 'answer machine' analogy (Burchell et al., 1980; Chapman, 1997). Prior accounting research has presented evidence that a variety of accounting techniques, including budgeting systems (Abernethy and Brownell, 1999), performance measurement systems (Tuomela, 2005; Vaivio, 2004), post-completion auditing systems (Huikku, 2007), target costing systems (Kato, 1993; Tani, 1995) and enterprise risk management systems (Mikes, 2009) are being used in a learning-oriented way.

The potential capacity of NPV or other key capital budgeting methods - Internal Rate of Return (IRR), Payback Period, or Accounting Rate of Return (ARR) - to function as media for organisational learning, on the other hand, has so far been largely neglected in research. The way in which NPV has been conceptualised in the capital budgeting and broader accounting literatures can, for its part, explain this.[9] NPV is conceived of as a straightforward, computational technique that informs decision-making regarding the acceptability of potential investment proposals (see e.g. Arnold and Hatzopoulos, 2000; Graham and Harvey, 2001; Shapiro, 2005).

Another reason for this neglect in prior research can be found in the nature of capital budgeting research at large, whereby much of the empirical endeavour has focused on examining the frequency with which particular capital budgeting techniques are used. Considerably less attention has been paid to the organisational practices through which these techniques are being mobilised (Carr et al., 2010; Miller and O'Leary, 2007). Finally, the tendency of empirical

[9] We focus on the ex-ante use of NPV for learning-orientated purposes. The role of NPV for ex-post purposes (e.g. post-completion auditing) has hitherto been addressed to a limited extent by Huikku (2011) and Huikku and Lukka (2016), for example.

research to focus on single decision-making situations rather than taking into account that investment decision-making is often sequential in character (Hartmann and Hassan, 2006; Majd and Pindyck, 1987) has, for its part, contributed to the potential learning-oriented role of NPV being largely ignored. The sequential nature of investment decision-making is, however, very prevalent in many project-based industries, such as the construction industry (Madj and Pindyck, 1987), as well as in the new product development (NPD) context, where resources are typically allocated through a phased process (Cooper, 1990; Hertenstein and Platt, 2000; Jörgensen and Messner, 2009, 2010). The stream of research focusing on the role of accounting in NPD and innovation processes has, on the other hand, largely overlooked the role of NPV – and of capital budgeting techniques in general.[10]

There are, however, a few case study-based investigations that have presented evidence illustrating characteristics of learning-oriented use of NPV. The study by Van Cauwenbergh et al. (1996) indicated that in uncertain settings, capital budgeting methods, including NPV, may be used as platforms for communication rather than functioning merely as devices for valuation. With regard to NPD settings, Christner and Strömsten (2015) reported evidence of changes in the role of different financial (and non-financial) approaches during the development phase. They showed how discounted cash flow (DCF) methods can also play a central role in connection with uncertain settings by shaping the product development process by mediating between different domains and actors. Also, Feeney and Pierce (2018) suggest that NPV and its components provide frames of reference and a common language ('an organisation-wide interpretive scheme') for cross-functional dialogue taking place throughout the NPD process. Further, Karlsson and Kurkkio (2018) illustrate how managers use investment calculations to learn and discuss potential outcomes in the early phases of investment processes. They suggest that calculations help managers in uniting and creating a shared view of the investment project by providing a common frame of reference, and that they also have potential to mediate the

[10] The empirical investigation in this stream of research has often focused on accounting techniques that are more closely related to the decision-influencing, motivating role of accounting (Demski and Feltham, 1976; Sprinkle, 2003), such as performance measurement systems, budgets and project management systems (Bisbe and Malagueño, 2009; Bisbe and Otley, 2004; Henri, 2006). With regard to more decision-supporting approaches, Henri and Wouters (2020) have investigated whether and how the diversity of non-financial performance indicators and the functionality of cost information contribute to product innovation. One research strategy has been to investigate techniques that are more specific to the NPD context, such as project budgets and product portfolio roadmaps (Davila et al., 2009). Another sub-stream of NPD research has focused on abstract control variables, such as input, output, process/behaviour controls (Cardinal, 2001; Rockness and Shields, 1984), accounting, behaviour and personnel controls (Abernethy and Brownell, 1997), organic and mechanistic controls (Ylinen and Gullqvist, 2014), or belief, boundary, diagnostic and interactive controls (Bedford, 2015; Bisbe and Malagueño, 2015; Bisbe and Otley, 2004). Additionally, Taipaleenmäki (2014) has addressed the absence of management accounting in NPD.

actors' differing interests. In line with this, Warren and Seal (2018) and Warren and Jack (2018) demonstrate how NPV can frame public policy negotiations related to electricity prices, technologies and costs between different industry players and have a mediating role linking science, the economy and firms to political programmes. Warren and Seal (2018, 26) further suggest that the NPV model "enabled knowledge from individuals with diverse backgrounds (such as engineers, environmental specialists, traders, risk specialists and legal specialists) to be translated into readily comprehensible numbers."

To summarise, although there are studies presenting valuable insights of individual characteristics resembling a learning-oriented use of NPV in many settings including NPD, the research has not explicitly focused on the potential learning-oriented use of NPV. This is significant because NPV represents a particularly revealing example of an accounting technique that facilitates – and, indeed, requires – that a variety of knowledge bases are mobilised in the production of "a single, financial dimension" (Hall, 2010, p. 307). The construction of the NPV calculation typically requires that knowledge regarding, inter alia, prospective customer, competitor and regulatory behaviour as well as anticipated input and production costs are mobilised and integrated (Shapiro, 2005). Often the construction of the NPV calculation also entails utilising knowledge bases, such as those related to technological and scientific development, which are by substance and cognitive frame distant from the accounting domain (Haley and Goldberg, 1995; Hartmann and Hassan, 2006). The use of NPV in a learning-oriented way may hence entail particularly extensive dialogue and translation in order to make all critical knowledge available and comprehensible (Ditillo, 2004; Gerdin et al., 2014). It is conceivable that the empirical investigation of the learning-oriented use of NPV can also facilitate the generation of new insights related to the learning-oriented use of accounting more generally.

Our purpose in this study is to explore, employing phenomenology as our method theory, how NPV calculations are involved, together with other sources of information, in the development of the experience of knowing in a long decision-process characterised by high uncertainty. This is theorised as a learning process, where phenomenological ideas – including the notions of intentional object, intentional act and, specifically, noema – seem to provide a helpful frame for our analysis.

3. Method and Data

Initially, we set out to investigate the role of financial and non-financial aspects in the strategic investment process in a highly uncertain context and taking a significant amount of time under constant time-pressure. In order to investigate this phenomenon, we scrutinised New Product Development (NPD) projects in the pharmaceutical industry, which is considered to be one of the most R&D intensive industries (Messner, 2016). Given the scarcity of prior research addressing the collaboration of financial and non-financial perspectives in SIDM, we adopted a deep-probing single-case method that facilitates explorative, empirically sensitive enquiry (Ahrens and Dent, 1998; Vaivio, 2008). Our empirical analysis included conducting numerous interviews with case company representatives, regulatory authorities and analysts with experience in valuing pharmaceuticals companies. During the research process, we encountered surprising aspects about the prominence of the verifying role of NPV calculations, which catalysed an abductive research process and led us to reformulate our research questions (see Section 1). The new focus also inspired us to use phenomenology (Husserl, 1960; Manninen, 1995) as our method theory. As is typical of the abductive research process, our empirical analysis involved moving back and forth between the data and theories relevant to our study, flexibly combining the deductive and inductive research strategies (Dubois and Gadde, 2002; Ahrens and Chapman, 2006; Lukka & Modell, 2010).

The "European pharmaceutical corporation" (Eupharma; the real name disguised) was chosen as an empirical context for this study. Eupharma was a suitable and compliant organisation to participate in our study. Its annual revenues amount to over a billion euros and it has several thousand employees. The company invests annually about 10-15% of its revenues in the development of new drugs and it has simultaneously several major on-going development projects at different phases. Even though the company faces very high uncertainty related to the viability of its projects, it nevertheless invariably uses NPV for assessing these projects. Accordingly, Eupharma is an appropriate empirical object for the study because it represents a setting where the capacity of NPV to inform decision-making can be anticipated to be constrained. Consequently, it was conceivable that Eupharma would not use NPV merely in the 'answer machine' role.

The primary data source of the study consisted of 49 semi-structured interviews conducted face-to-face between April 2012 and March 2017 with 43 different persons.[11] In total, the interviews amounted to 67 hours of recorded and transcribed material. A list of the interviews is presented in Appendix B. Forty of the interviews were conducted within the case company. This group of interviewees included a wide variety of actors, all of whom had a key role in our case company's NPD process. In addition to discussing with R&D personnel at various hierarchical levels, we also interviewed, for example, the CEO, the CFO, R&D and business controllers as well as directors in charge of business areas, therapy areas, sales & marketing and production. In order to enhance our understanding about the firm-external aspects affecting the NPD process, we also conducted seven interviews with national regulatory authorities, involved, inter alia, in the approval of clinical trials, market authorisation, and the pricing of newly developed drugs. Additionally, we interviewed two financial analysts with experience in valuing pharmaceutical companies. In addition to the interview data, we also drew on a number of internal documents, including the Product Development Handbook and guidelines for the investment process as well as external documents including investor presentations, interim/annual reports and newspaper and magazine articles. Finally, informal corridor and lunchtime discussions also contributed to our understanding.

We used both synchronic and diachronic triangulation (Pauwels and Matthyssens, 2004) of interview data in order to enhance the validity and reliability of the study. Accordingly, we interviewed six key actors more than once.[12] We also interviewed several persons on the same topics. After the pilot phase of five interviews, there were multiple interviewers present in all but two interviews. This contributed to our ability to pose more specific questions during the interviews. It also facilitated subsequent collective data analysis and our preparation for further interviews.

[11] The first five interviews, conducted between April and October 2012, constituted a pilot interview phase. At this stage, our aim was to develop a general understanding regarding our case company's NPD process and the related decision- making practices. Special attention was also paid to decision-making about abandoning the NPD projects. These interviews enhanced our general understanding and enabled us to introduce more intriguing questions in our upcoming interviews. The five individuals interviewed during this preparatory phase included key organisational actors related to decision-making regarding the NPD process: the CFO, the Senior Vice President (SVP) for R&D; Vice Presidents (VP) for Research and Development as well as the SVP in charge of proprietary products.
We have not limited our research focus merely to the use of NPV, but simultaneously gathered empirical data more broadly about investment decision-making related to NPD.

[12] The CFO was interviewed five times, the SVP for R&D as well as the Business Controller for R&D three times, and the VP for Research, the VP for Development and the SVP for Proprietary Drugs twice.

Immediately after each interview the recorded material was transcribed. These transcriptions and other materials acquired (e.g. manuals, guidelines and project-specific materials) were read, discussed and analysed by the researchers. This procedure enabled us to modify the interview structure before upcoming interviews in order to focus discussion on interesting topics raised during previous interviews (Atkinson and Shaffir, 1998). The interview structure evolved during the interview process and partly different questions were posed to different interviewees. The data analysis proceeded in parallel with our interviews. It involved coding transcribed interview data and other material under themes that emerged primarily through the data analysis, but was also informed by prior research. This thematically compiled analysis document played a major role in facilitating the data analysis.

4. Findings

In this empirical part, we first present the NPD process of our case firm Eupharma in Section 4.1. Then, in Section 4.2., we will address financial and non-financial perspectives in the research phase and continue in Section 4.3. to discuss these perspectives in the development phase. In Section 4.4., we will focus on analysing how the experience of knowing evolved during drug development, theorising it as a noematic learning process where NPV calculations can play an important role, but jointly with other sources of information. Specifically, we show how the shared noema – related to the combination of financial and non-financial aspects guide the various actors during the long learning process to experience the feasibility of the investment project in the way they do.

4.1. NPD in Eupharma

Eupharma is a globally operating European company that develops, manufactures and markets pharmaceuticals and their ingredients in several therapy areas. It is continuously developing new drugs. It has many major drug NPD projects on-going simultaneously at different development phases. Eupharma has a matrix organisation comprising four business units (BU), which are supported by shared service functions related to business development, R&D, supply chain and sales (see Figure 1). The matrix organisation is completed by CEO and CFO offices as well as other corporate functions. We focus in our study on NPD activities related to the largest division, BU1 (division for proprietary drugs), where business is further divided into three therapy areas.

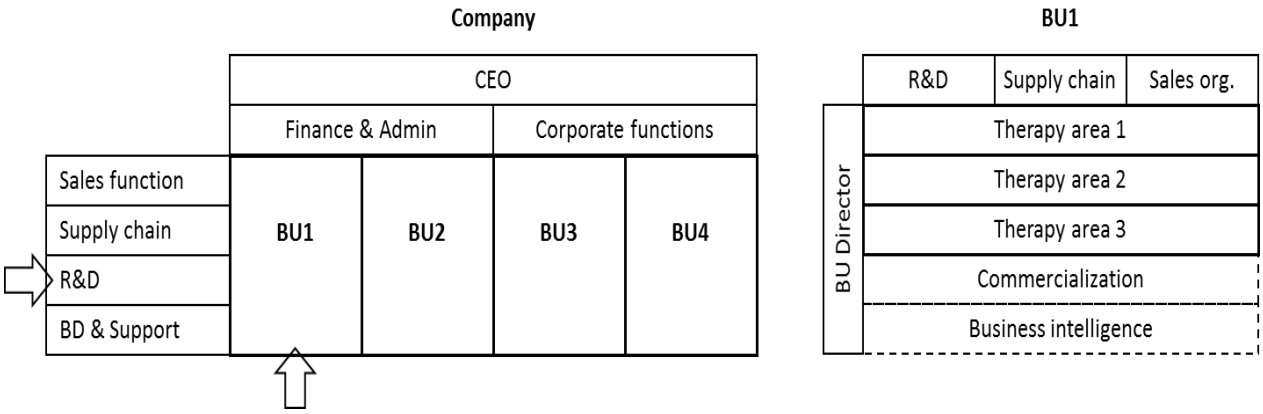


Figure 1. Case company organisation

Eupharma has several hundred employees working in NPD. In addition to these resources, the company commonly uses contract research organisations for smaller tasks. It also co-operates with universities. With regard to major projects amounting to tens or hundreds of millions of euros, the company invariably enters into partnerships with external parties before starting the expensive Phase III in clinical trials. The purpose is to share risks and development costs.

NPD is a primary process in Eupharma. As is typical of the pharmaceutical industry, it is a carefully co-ordinated chain of activities supported by a stage-gate approach (Cooper et al., 1990) (see Figure 2). The NPD process is divided into two major phases: research and development. The process starts in the research phase by developing a new idea and ends in a product launch at the end of the development phase. The NPD process typically takes up to 12-15 years in total. The expensive and long-lasting clinical exploratory and confirmatory trials with human subjects take place during development, in Phases I-III. The heaviest expenses by far are incurred during Phase III, when control studies with 500 – 3000 patients are usually conducted. In general, the required investment outlay increases from phase to phase as the CFO describes:

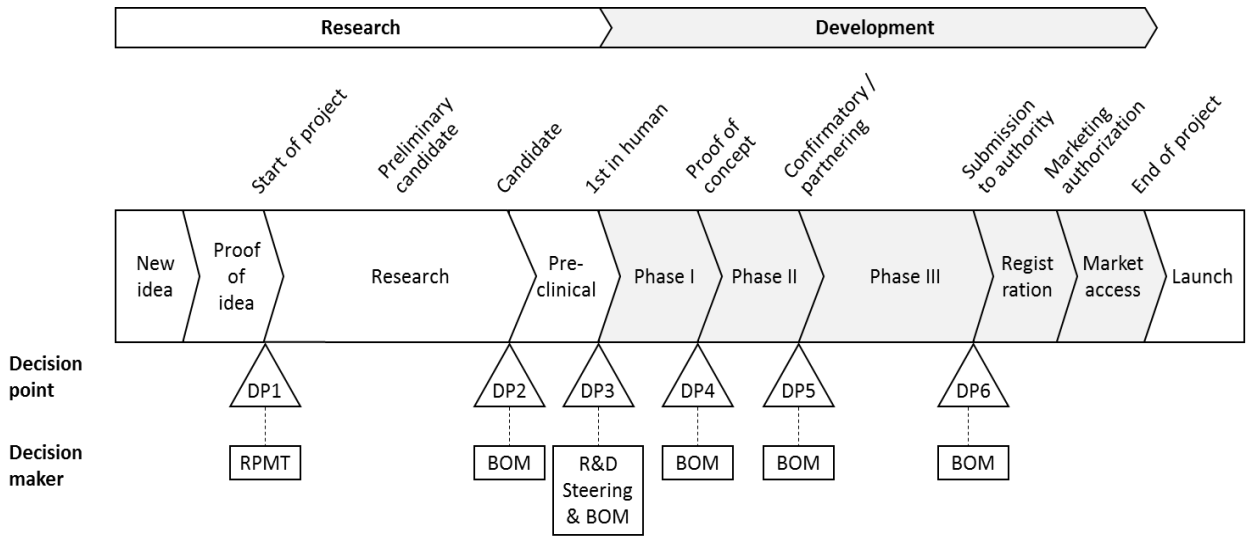
> *"The pre-clinical phase can easily cost 1 million [euro]. A Phase I decision can be about 5 million, a Phase II decision around 5-10 million and finally, a Phase III decision 100 plus [million]."*

In Eupharma, the NPD process includes six decision points (DPs) (i.e. stage-gates), where continuation of the NPD projects is decided upon.[13] The first two DPs relate to the continuation

[13] Eupharma's NPD process is described in detail in an internal Product Development Handbook. The aim of the handbook is to provide principles and guidance on how to lead and manage NPD projects efficiently within an agreed scope, schedule and budget. The handbook describes the entire NPD process from research to market authorisation. It also addresses interfaces between businesses and functional organisations and specifies the roles and responsibilities of various decision-making bodies. It also defines the roles and responsibilities of diverse project related teams, networks and team members.

of the project during the research phase and the four subsequent ones to potential continuation during the development phase. In all DPs funding is approved only for the next upcoming phase. In practice, Eupharma uses more than six decision points during the NPD process. For example, Phase II is typically divided to two sub-phases.

In DP1, a cross-functional decision-making body referred to as the Research Portfolio Management Team (RPMT) decides whether an actual NPD project will be established (see the roles and responsibilities of various decision-making bodies within the NPD process in Appendix C). In the upcoming five DPs, the continuation of a project has to be approved by many decision-making bodies. First, the R&D steering and business unit management team have to submit their recommendations to the Board of Managers (BOM) that makes the decision. All major projects (including all proprietary drug NPDs) also have to be approved by the Board of Directors. For us, NPV and its components represent the financial perspective in NPD decision-making, and correspondingly, other aspects represent non-financial perspectives.



RPMT = Research portfolio management team
BOM = Board of managers

* BOM decisions precede recommendation from R&D Steering and the Business Team

Figure 2. NPD process in the case company

4.2. Financial and non-financial perspectives in the research phase

NPV calculations are not yet required for the research phase decision points, DP1 and DP2. At these stages of the process, decision-makers, however, advance the development of their experience of knowing by acquiring a certain basic understanding of the financial key

components of NPV, such as sales and R&D costs. An understanding, perceived sufficient, of these financial aspects is a prerequisite for the continuation of research activities. However, these stages are dominated by medical considerations and checks. During the research phase, the preliminary screening, selection, and optimisation of potential drug candidate molecules is conducted by utilising computer-assisted simulation tools. Pre-clinical in vitro (test-tubes) and in vino (animal testing) trials on chosen molecules complete the research phase. Scientific aspects dominate the analysis and discussion as the CFO comments:

> *"Before clinical phases, the information used is mostly medical. Financial considerations play only a very minor role. The focus is on understanding if it is possible to create a functioning and safe drug in the first place."*

Specifically, macro level ideas about possible target diseases and the technical feasibility of the new drug are emphasised. However, towards the end of the research phase, financial considerations also come into play. Rough estimates of market potential are made. It is essential to understand whether the market potential of the new drug will suffice as the SVP for R&D explains:

> *"At this stage we make an attempt to figure out whether this particular disease is worth addressing. We do a very rough "cigarette box calculation" in order to estimate the market potential: whether we are talking about 200 million, 2 billion or 20 billion euros."*

The SVP in charge of the proprietary drug business explains, for her part, the role of the rough market volume estimates in justifying the NPD investment:

> *"Without a doubt, the role of detailed financial calculations is limited during the early stages. However, we need to have a rough understanding about the market size. Everybody understands that it will cost at least 400 million euros to develop a new drug. Hence, the market size has to be at least 1.5 billion."*

With regard to DP2 (i.e. the DP before entering the pre-clinical phase), the BOM and the Board of Directors also have to be convinced of the viability of the project. The head of one therapy area describes what type of financial and non-financial aspects are taken into account in the analysis:

> *"If we are here in the early research phases, there is no reason to try to calculate in detail something [NPV] that has so many very uncertain variables. But you must have some idea about the top line, the competitive environment and the global pipeline, i.e. what competing products there will be in the future. What is the market access environment, what is the role of the authorities on different continents that will approve the safety and efficacy of the product? We also need to have an idea about selling prices and reimbursements: The behaviour of national authorities has to be estimated. But, we are not developing our first drugs. So, we have a pretty good hunch regarding what it will cost to develop a new drug."*

Hence, even though the aspects covered in the appraisal focus on non-financial aspects during the research phase, sufficient experience of knowing about the rough sales potential and development costs (i.e. about the commercial viability) has to be presented. Understandably, the company does not try to make more detailed financial calculations at this stage. More or less all major aspects affecting the calculation are still very ambiguous, including safety, efficacy, the physical form of the medicine, the population of end users, the frequency of intake, dosage, selling price, reimbursement (by national authorities) and manufacturing costs.

4.3 Financial and non-financial perspectives in the development phases

In Section 4.3.1 we will first discuss general aspects related to Eupharma's NPV calculation practices and describe the critical components in the calculation. In the next subsection, 4.3.2, we will describe what kind of role financial information plays vis-à-vis non-financial information in decision-making during the development phase (covering decision points from DP3 to DP6) and illustrate the related gradual development of experience of knowing.

4.3.1 Financial perspectives in the development phases

In addition to discussing the NPV *per se* as an aggregate financial perspective in the development phase, we review here its key components: sales, R&D costs, cost of goods sold, sales and general administration costs (SGA) and discount rate.

NPV calculation is required for the first time in DP3, i.e. when a decision is made about entering the development phase. It is also used in the subsequent DPs (4-6). NPV is clearly the dominant capital budgeting technique: A positive NPV is a prerequisite for all decisions to go ahead in the company. Eupharma has used it for decades and the use of this particular technique appears to be motivated by it being the most common technique in the pharmaceutical sector (see also Hartmann and Hassan, 2006). In addition to NPV, the company's standard investment calculation model automatically calculates IRR and payback period. In practice, virtually no attention, however, is paid to IRR. Some attention is paid to the payback period, but it is not as decisive a technique as NPV and, no targets have been set for it.

Typically, the first NPVs (in connection with DP3) are calculated for the forthcoming 15 years out of which 5-8 years include only cash outflows (primarily R&D costs). After that sales revenue will begin when the drug is launched on the market. The time horizon for the calculation is roughly coupled with the time of proprietary patent coverage, because generic drugs are

commonly launched by competitors after a patent expires. As a consequence, the price level will plummet, and, hence, also the sales revenue.

Regarding profitability targets, the same hurdle rate (discount rate), which clearly exceeds Eupharma's WACC is used for all projects. Additionally, because of the high level of uncertainty related to key components (specifically sales), NPV has to show decidedly positive figures, not just be above zero, throughout the life of the NPV, as the CEO comments: *"We know that if our NPV is 50-60 million euros or under 100, it may very easily turn negative if we change one variable a little bit."* In a similar vein, the director in charge of one therapy area states:

> *"NPV tells us the location of the comma. If the NPV is only 20-30 million, there it makes no sense to start the development. It has to be somewhere around one hundred million euros."*

Also, the Vice President of Research emphasises the significance of 'sufficient NPV' and recalls cases where positive NPV projects have not been approved by the Board of Managers due to low NPV: *"Sometimes the Board of Managers meeting has made no-go decisions because the NPV has not been sufficiently positive."*

With regard to the main components of the NPV calculation, sales is clearly the most critical component and drives the success of the drug as the CEO explains:

> *"If the top line materialises, it is totally insignificant what this development cost is; the project will always be a success. I know that we have intensive discussions about whether a specific [medical] study costs 2.5 or 5 million or if Phase II will cost 60 or 80 million. However, these do not matter if we get the sales. This has, of course, something to do with the potential attrition risk of the drug; we may have to abandon the whole project and still bear the costs."*

Thus, Eupharma's NPV calculation is heavily determined by the very uncertain top line estimates. Two major issues greatly affect the sales estimate: the indication[14] and the actions by price/reimbursement authorities. In connection with the first NPVs, it is still decidedly ambiguous what the indication and, hence, the market potential of the product will be. The commercial feasibility of the project is, on the other hand, heavily dependent on actions by authorities. In addition to deciding on a potential licence to sell the drug, the regulatory authorities have a final say both in the selling price and in whether consumers will be entitled to reimbursement related to the drug. With regard to the majority of drugs, a certain part of the

[14] Indication is a target product profile/concept that determines the target population, and hence sales potential.

price is reimbursed to the consumer. If the drug does not obtain such entitlement to reimbursement, the sales price will fall drastically. One of the interviewees stated that the company is *"completely at the mercy of the authorities."* In practice, the authorities do not make any binding price or reimbursement decisions before the registration process. Hence, in practice all major decisions during the NPD process have to be made without knowledge of the outcome of the negotiations with the authorities. During the early part of development phase, it is the duty of the business intelligence personnel to provide estimates of sales figures. The responsibility gradually moves to business managers as the NPD process unfolds. In practice, the group sales and marketing function supports business managers in the development of sales estimates.

The major expenses of proprietary drug NPDs are related to R&D. They typically amount to several hundred million euros per project. In addition to the internal R&D expenses (salaries and maintenance of the operating infrastructure), R&D expenses include external variable costs arising from long-term clinical trials, which are typically performed in clinics located in several countries. Project managers in the R&D organisation are responsible for providing R&D expense inputs for the NPV calculations. In these calculations, expenses are shown among operating expenses; they are not capitalised due to their very uncertain final outcome. Supported by its long experience in estimating project-specific R&D expenses, the company has been able to provide relatively accurate estimates. Yet it is also common for development projects to be somewhat prolonged, causing R&D expenses to exceed expected levels. With regard to the NPV calculation, the level of R&D expenses falls during the NPD process because sunk costs are not taken into account in the calculations. Hence, NPV automatically 'improves' – ceteris paribus – throughout the development phase as a project proceeds. The final NPV calculation, conducted for the registration decision in DP6, does not include any R&D expenses.

Cost of goods sold (COGS) is a further essential cash out flow. The essential element in COGS is the cost of active pharmaceutical ingredients (API; raw materials), whereas the manufacturing costs, *per se*, are relatively low. In the early phases of development it is typical to use very rough COGS estimates; percentages of net sales, for example. The supply chain organisation is in charge of calculating the COGS estimates. The considerable uncertainty related to COGS in the early development stages is described by the CEO:

> *"When we enter more complicated chemistry done in the laboratory and produce just grams, it is still difficult to estimate how much it will cost to later produce kilos or tons. Will it be 1/10 or maybe 1/50 of the cost of the first gram? Our history has, however, shown that the cost will plummet."*

Not until Phase III will it be clearer what COGS will be as the SVP of Supply Chain comments:

> *"In the beginning of Phase III we start to finally figure out whether the drug will be tablet or powder or whatever, because at that moment we will decide the exact formulation. Then we know the cost of API that we will achieve. We then also know the batch sizes."*

Sales/marketing expenses (including sales commissions) are important components in the calculation. In the early phases of development, only rough percentage ratios (of net sales) are used for these items. In Phase III and thereafter, sales and marketing organisation will provide more detailed inputs by country for sales and marketing expenses. For external sales commissions percentages are used constantly. Administration costs and change in net working capital typically play a minor role in calculations and they are also calculated as a ratio of net sales.

The primary responsibility for compiling the NPV calculation changes within the business unit during the NPD process. The Business Intelligence (BI) personnel is responsible for compiling the NPV calculation up to Phase III. After this the responsibility is transferred to business managers. In addition to compiling the whole NPV calculation, the BI personnel provide top line information for the calculation. Its experts are best equipped to make estimates of the market potential, patient population and additionally later about sales prices and reimbursements regulated by authorities. Contrary to the common practice in companies, the controllers in Eupharma have only a minor role in activities related to NPV. They have mainly a supervisory role, checking that no technical errors have been made in the calculations. The Business/R&D controller commented on the reasons behind his limited role:

> *"I am not a doctor. I know finance. You need a special kind of expertise to assess these scientific and also market variables, so it may not be that easy with a background in finance. So, we controllers are not involved in gathering the data. Of course, the NPV calculations go through me, but I mostly look at the potential errors in the formulas… but I am not that involved."*

Hence, the responsibility for the NPV calculation is allocated to the personnel (BI) who know most about the critical component, i.e. sales revenue. In general, providing inputs to the NPV calculation is a very distributed activity in Eupharma (as we will later show). No one can decide alone what figures will be included in the calculations.

4.3.2 The emergence of financial and non-financial perspectives in Phases I-III and thereafter

As previously clearly shown for the research phase, decision-making in the development phase is likewise not merely based on taking account of financial perspectives. Accordingly, we will

next present how knowledge related to several non-financial aspects, such as safety, efficacy, strategic fit, NPD portfolio, regulatory authorities, partner options and competition contributed throughout the process to the experience of knowing in an interplay with financial perspectives.

As noted in the preceding section, the first NPV is prepared at the end of the pre-clinical phase in DP3, when the decision about entering clinical Phase I is made. During Phase I, the drug product is administered to humans for the first time. These trials focus on ensuring that the drug is safe to use in people rather than focusing on how effective it may be as a treatment for a given disease. Escalating doses of the drug product are given to a small number of volunteer patients and bodily responses are measured.

The Vice President of Research explains in more detail about the improved level of scientific knowledge at the end of the pre-clinical phase enabling for its part the calculation of the first NPVs:

> *"Here [at the end of the research phase] we choose one candidate [molecule]. We commit to invest about five million euros in it during the upcoming 12 months. So, this is an investment decision. Now we already know something about the properties of the drug molecule, potential indications, scheduling and the challenges of pharmaceutical development… We start to have something to calculate with."*

In addition to safety, efficacy is another prerequisite property for a viable drug. In practice, the efficacy of a new drug has to be better than that of the existing products on the market as noted by the SVP for R&D: "*The efficacy of the drug is imperative. If it has less efficacy than the existing drugs, then the NPV will turn negative very fast."* The Director for Project Management comments, for her part, on the great uncertainty surrounding these critical aspects:

> *"With regard to these drugs, the first clinical trials are about safety. We do not yet actually know whether the drug will have efficacy, either. Sure, we can imagine and think what it could be, but it is still pretty much up in the air. When we get the first results on safety and efficacy in our human trials, then we have a pretty certain picture… But still, we conduct that NPV estimation… pre-estimation, already for the Phase I. It's still quite uncertain at that point."*

Accordingly, the critical elements related to the success of a new drug, its safety and efficacy, are very uncertain at this stage before human trials have been started. Due to the high level of uncertainty, there have even been discussions about whether NPV should be calculated for the first time one step later, when the decision about entering Phase II is made in DP4.

> *"In connection with our process development project Z, we proposed a radical idea that NPV would be ruled out at this stage (DP3). But the problem is that there is no other*

appropriate tool for valuing these NPD projects and for selling these projects to the Board of Managers." (Director for Project and Portfolio Analysis)

In practice, at this stage, other (non-financial) criteria, such as strategic fit of the new drug with existing products and other products under development as well as the assumed competitiveness of the drug in the global marketplace play a much bigger role than NPV. The Director for Business Development explains:

> *"Typically a Phase I investment decision can be already in the millions, so we want some kind of understanding about it. I think that NPV is merely one out of many aspects to take into account, and we look at the positioning in the global development pipeline much more... A drug development project should be one of two things, first-in-class or best-in-class, there is no other alternative. Otherwise there is no reason whatsoever to invest in it."*

NPV is also calculated for decisions to enter Phase II (DP4) and Phase III (DP5). During Phase II, the drug concept (i.e. proof of concept) is tested with a large number of trial patients, typically between 50 and 200, to see the expected effect on the disease. In an expensive Phase III, on the other hand, clinical tests are extended to comparative and controlled studies of 500-3,000 patients. The experience of knowing about all the aspects (scientific and economic) is increasing throughout these phases. In addition to decision points, the NPV calculations are updated continuously between the gates if new essential information comes to light.

Sales estimates still drive the profitability of the NPD project and hence the NPV calculation. Before entering the expensive Phase III, it is critical to be able to adequately define the disease and the target population of the drug in order to generate more informed calculations as the CFO explains:

> *"For Phase III it is one of the most essential issues to determine what your exact target population is; your indication. There you have two major points to figure out: a) where do you believe you are able to achieve such an outcome that it will function for this disease, and b) where you are able to find a market niche where you will not face fierce competition."*

It appears that a high NPV requirement for the earlier calculations is related to the great uncertainty about the final indication of the drug product; it is generally known in the company that the indication has a tendency to narrow down during the development process, leading to reduced sales potential. The importance of NPV gradually increases during the NPD process together with the increased experience of knowing and decreased uncertainty. However, a firm still faces major scientific and commercial uncertainties when it has to make the major Phase III decision.

The final part of the product development process is the commercialisation process, ending with a product launch. Accordingly, at the end of Phase III the company prepares for the registration decision (DP6; the final major decision) by analysing whether the product fulfills the medical, regulatory and commercial requirements, and whether it is worth applying for registration. At this point, the brand and the preliminary pricing strategy also have to be approved.[15] During this final phase, the company makes great efforts to convince the regulatory authorities about the superiority of the new product in order to obtain favourable pricing and reimbursement decisions.

The director of one therapy area emphasises the role of NPV at this final stage by explaining that *"the most important NPV calculations are in fact made here"*. This is ironic from the capital budgeting decision-making point of view, because we know that typically over 90% of the development costs have already been incurred (sunk costs are not included in the NPV calculations) and all the income is still to come. Hence, NPVs are typically 'sufficiently' positive at this stage. They constitute no obstacles to approval by the BOM; calculation is more or less a ritual from the decision-making point of view. Uncertainty related to various aspects of the new drug has by now been reduced: The drug is medically viable, the indication/market for the drug is set, and sales and manufacturing costs can be estimated. It seems that only now do managers perceive NPV as sufficiently 'reliable' to be taken seriously. The director of a business unit explains how the degree of required precision for the NPV calculation increases dramatically during the development. Very accurate calculations are needed for the registration decision:

> *"The NPV calculation does not play a big role in the early development phases, but towards the last decision points it becomes more and more accurate. During Phase III, when we calculate NPV for commercialisation purposes, we start to use decimals in millions. We calculate how many sales representatives we allocate to this and that country, for example. It [the NPV calculation] is really based on detailed and accurate estimates."*

In Eupharma, it is essential to be able to share the significant risks and costs associated with the later stages of the development by entering into partnerships with other pharmaceutical companies. Practically all major NPD projects are conducted in co-operation. If the clinical results prove to be positive, potential partners are contacted and negotiations initiated during Phase Two. The partnering negotiations are also perceived by the investment decision-makers as a checkpoint to evaluate the attractiveness of the project. A successful collaboration deal is

[15] The global pricing strategy has to be approved later by the Board of Managers before the final market access decision, but this is considered more a formality and not a major decision point.

considered a positive indication of the attractiveness and potential of the product. This comment by the Chief Financial Officer explains this view:

> *"Not being able to find a partner signals that others don't seem to share our belief in the product. But this is also a very good and concrete way of validation. We can ask ourselves: Can it be such a promising product after all if no external party is willing to invest any money in it?*

Accordingly, in Eupharma partners act as major funders. Availability of external funding could be a major obstacle for 'go' decisions at the gates. Thanks to the strong profitability and balance sheet, it has not typically been necessary for Eupharma to raise project-specific funding from other sources.

Furthermore, time related perspectives appear to be constantly emphasised in the NPD process. The importance of the time to market target can be critical for the success of the new drug as the Controller for proprietary drug products/R&D comments:

> *"Timing is critical. The sooner the better. If we are two years delayed, we are potentially out of business; competitors are already there and the commercial situation can be totally different."*

In a similar vein, the SVP of the Proprietary Drug business explains:

> *"Time is in fact the most important steering factor we have. Sometimes, in order to motivate our project teams, we have made calculations to show how much peak sales we would lose with every delayed day."*

Taken together, we have illustrated above the managers' emerging experience of knowing about financial information (i.e. here NPV and its components) and non-financial information during the very long NPD process. The process is characterised by constant time pressure, where the role of financial information can be understood only when analysed vis-à-vis other perspectives. Table 1 summarises the development of the experience of knowing about various perspectives. The decision-making related to the DP-5 (i.e. entering Phase III) can clearly be considered the most crucial investment decision. At that time managers appear to have at least a moderate experience of knowing regarding all the perspectives, and even high regarding medical efficacy, strategic fit, competitive environment, obtaining a sales licence, R&D costs, funding and cost of goods sold. At this stage, partner negotiations have already been finalised. Nevertheless, there is still only a moderate experience of knowing about the critical sales related components (volume and price).

With regard to NPV calculations, NPV is calculated for the first time when the company is preparing for the decision to enter the development phase and it has already some data available to make the calculations. However, many uncertainties persist and the role of NPV as a formal decision-making tool is limited. Due to enormous uncertainties related to the market and technical feasibility aspects, strategic analysis still clearly dominates decision-making and NPV has only a minor role. Gradually during the upcoming phases the experience of knowing about critical aspects (e.g. technical feasibility and market potential) increases and NPV gains more and more ground. NPV calculations are also updated between the formal decision points if new essential information emerges or if calculations are needed for the Board of Directors' semi-annual project portfolio reviews. Interestingly, it appears that NPV is perceived to be reliable enough at a paradoxically late stage; only at the final decision point (DP6), when all major investment outlays have already occurred.

Importantly, we illustrate above how managers' prior experiences in similar situations greatly affect their pre-understanding of the feasibility of the project and its main components, and hence the noema, i.e. what they see each time they look at them. The familiar and preordained aspects help them to make sense of the information available and they appear to typify the projects and see them as representatives of their types.

	Research (for DP-2)	Pre-clinical (for DP-3)	Phase I (for DP-4)	Phase II (for DP-5)	Phase III (for DP-6)	Registration, market access, Launch
Perspectives						
Medical functioning	X	X	XX	XXX	**XXXX**	XXXX
Sales volume	X	X	XX	XX	XXX	**XXXX**
Sales price	-	X	X	XX	XX	**XXXX**
Net sales	-	X	X	XX	XX	**XXXX**
Strategic aspects	X	XX	XXX	XXX	XXX	**XXXX**
Competition	X	XX	XX	XXX	XXX	**XXXX**
Sales license	X	XX	XX	XXX	XXX	**XXXX**
Partner options	-	-	XX	**XXXX**	XXXX	XXXX
Funding	-	X	X	XXX	**XXXX**	XXXX
R&D cost	X	XX	XX	XXX	**XXXX**	XXXX
COGS	-	X	XX	XXX	**XXXX**	XXXX
Sales and marketing costs	-	X	X	XX	XXX	**XXXX**
Administration costs	X	X	XXX	XX	XXX	**XXXX**
NPV	-	X	X	XX	XXX	**XXXX**
The degree of experience of knowing about the perspectives in the NPD decision: None or Trivial: -, Low: X, Moderate: XX, High: XXX, and Very high: XXXX						

Table 1: The development of experience of knowing about financial and non-financial perspectives in drug development decision-making

4.4. NPV in the development of the 'experience of knowing'

In this section we will elaborate in greater detail on the role of NPV calculations in developing experience of knowing during the NPD process. First we will discuss the varying roles of NPV in this process in Section 4.4.1. and then in Section 4.4.2. we will illustrate how NPV calculations can be used as a platform for enhancing organisational learning in drug development, and, hence, become an integral part of the development of experience of knowing.

4.4.1. Varying roles of NPV

In this section we will discuss our first research question ("How can we explain the variation in the role of NPV calculations in pharmaceutical new product development, ranging from a verifying role to the role as a producer of new decision-relevant information?"). It appears that in our case company the NPV calculations play varying roles throughout the process, such as the verifying role and facilitating the generation of new decision-relevant information. Typically, it has a kind of verifying role at the several decision points of the process, i.e. it primarily confirms decision-makers' judgemental experiences of knowing regarding the feasibility of the project – experiences that had been produced by numerous other sources of information. In these cases, NPV provides 'an exact value' to be presented for the formal, higher-level decision-makers and is hence employed as a kind of rationalisation machine after the *de facto* commitment to the decision (Burchell et al., 1980).

The verifying role can be better understood by taking a closer look at the other perspectives beyond NPV. By far the most important tipping point in the NPD process is related to DP5, i.e. whether to continue the project to Phase III development. At this phase, typically, the company has many reference points to assess the feasibility of the drug to be developed even without considering calculating the NPV. A relatively good understanding of the medical functioning (i.e. efficacy and safety) of the drug has been developed, because it has already been tested on a large number of patients. The disease to be treated and the target population have been defined, and hence, sales volumes can be estimated with some accuracy. Managers have obtained a certain understanding of the potential future pricing of the product, for example, by comparing the pricing scenario with similar prior situations and careful benchmarking of the competitors' products.

Hence, due to combining these pieces of knowledge, there already exists sufficient experience of knowing regarding the most critical components driving the financial success of the drug. In addition, knowledge about the R&D costs, likelihood of being granted approval by the regulatory authorities, and partner arrangements (and thus funding/risk sharing) has advanced to a certain acceptable level. All these components, if favourable, act together as a proxy for a financially successful drug. On the other hand, problems in any of these components have the potential to halt the project. In addition, at this already rather late phase of the NPD process, it is noteworthy that since the decision taken at DP3, multiple versions of NPV calculations have already been

made and presented in the earlier phases of the process. Accordingly, based on the history of the particular project in question, managers have a certain prior feeling of knowing regarding the magnitude of its NPV even without calculating a new, updated 'exact' value.

However, it appears that NPV is also used for the generation of new decision-relevant information. Occasionally, for example, the feasibility of the project is not evident from the above-mentioned sources as the CFO explains:

> *"We do also develop drugs that are probably not so innovative and thus face tougher competition. Then we need to figure out whether we are able to get a proper price. In such situations NPV calculation begins to gain more weight as an essential criterion."*

Still, it is worth noting that the decision is not based solely on NPV in these situations, either. In addition, NPV is typically used alongside its verification role for more genuine learning purposes on those projects where the feasibility is sufficiently evident.

We will next illustrate in some detail how our case organisation uses NPV in a learning-oriented way. Hence, we will address how NPV is involved in the construction of managers' images (noema) of the feasibility of a drug project (intentional object). We show how NPV works in this evaluation (intentional act, noesis) by continuously changing and sharpening the image during the experiencing process, and, following noematic thinking, how the image of feasibility sharpens piecemeal to managers at various tipping points of the process. In so doing, we will focus on intersubjective aspects of this learning process. Even though every perception begins with sensemaking at the individual level of what an issue or object or experience means, it is also possible in phenomenological investigations to address the intersubjective reality at all points in this process (Moustakas, 1994, 57-59). Hence, in this process "a continuing alteration of validity of perceptions occurs as people articulate and describe their experiences" (Moustakas, 1994, 57). Specifically, we address here NPV's potential to act as a *platform for dialogue* in this intersubjective process. In a sense, the NPV calculation acts as a vehicle among managers to create and mobilise a collectively shared noema about the relevant aspects regarding the feasibility of the project (various financial and non-financial factors), helping them to learn about these, and, enhancing their experience of knowing during the long development processes. In investigating NPV as a platform for dialogue, we will also discuss the two characteristics of the learning-oriented use of information that emerged from our empirical data: multifaceted insight and simplified accounting language and form. These characteristics appear to be closely linked to the capacity of NPV to enhance decision-makers' learning throughout the process.

4.4.2. NPV as a platform for dialogue in an intersubjective validation process

In order to manage the significant uncertainties present at the NPD investment decision points, the company places a premium on effectively harnessing all the professional skills and knowledge available. The challenge is how to fully exploit the fragmented and dispersed knowledge within the organisation, under conditions of considerable uncertainty. Additionally, people working for NPD do not only represent different knowledge bases (e.g. natural and medical sciences vs. business), but also have different frames of cognition, which both challenge and help in constructing a collective, intersubjectively shared noema. Scientists who have been working for a long time with molecules and clinical tests typically find it hard to *"bury their babies"* as one interviewee put it. On the other hand, 'business people' stick to the economic issues and are *"the cruel sort of people, who clip the wings of projects that to the scientists still seem like perfect opportunities"*, as explained by one therapy area director.

Ample dialogue is needed to articulate knowledge and to make it understandable to other parties in order to gain a sufficiently converging sense of knowing. This requires that the group of decision-makers at each gate, for instance, somehow acquire a shared noema about the NPD proposal at hand to be confident about their understanding of the situation, thereby getting ready to make the needed decisions. Accordingly, Eupharma has established many cross-functional teams and decision-making bodies to gather diverse viewpoints and best knowledge for discussion. It seems that the open and discursive culture of the company supports constructive dialogue and enhances mutual understanding. Yet there are also occasional heated debates related to the issues raised. Extensive dialogue is conducted in horizontal (cross-functional) teams (business teams, the Board of Managers and the Board of Directors). Project related discussions take also place in R&D steering, project management, and therapy area teams consisting of representatives of multiple domains of knowledge. Separate components of NPV are already extensively discussed and analysed in the respective functions (sales related income and expenses at group sales/marketing, R&D expenses at R&D, and cost of goods sold at supply chain management) before they are forwarded to the other teams for inclusion in the NPV calculation. NPV plays a major role in the company, being commonly located at the centre of the dialogue in NPD decision-making. The NPV calculation facilitates the articulation and sharing of the numerous pieces of information deemed relevant, potentially notably facilitating an intersubjective sense of knowing. The NPV calculation achieves this especially by functioning as a platform for transforming knowledge into an integrated, condensed and 'tangible' form.

NPD project teams are used to ensure information flow across cross-functional boundaries. Each member of the project team is expected to share their specific knowledge in the team, and in turn report the main learning derived from the project team back to their respective functional organisations. Nevertheless, dialogue within the company is not without challenges. Pharmaceutical NPD is a highly interdisciplinary domain including a diverse group of internal stakeholders (Henderson & Cockburn, 1994). The Vice President of Research even suggests that it could be "*among the most cross-disciplinary industries"*. During the research phase, the functions and people involved represent to a large extent the fields of natural sciences including chemistry, physical pharmaceutics and genome research. Insight from the business perspective, however, is ensured by including senior business managers as members of the Resource Portfolio Management Team. When the process proceeds to the development phase, the business perspective becomes more salient and personnel from business and group sales/marketing are increasingly involved in the process.

It is important for the accumulation of experience of knowing that NPVs are updated continuously during the long NPD process, not only in connection with the formal decision points in Eupharma. In addition to updating the NPV calculations for presentation purposes for formal decision-making bodies, there are also various, local updates to the calculations by business managers. Continual use of NPVs has a major role in facilitating that the image of project feasibility is also continuously changing and that the presupposition about the upcoming appearance of various pieces affecting the noema sharpens.

New NPV versions are typically calculated and presented several times per year. In addition to formal reviews at decision points, NPV calculations are updated constantly if new essential issues are discovered, as the Business Controller (Proprietary Products & R&D) explains:

> *"Yes, we update this calculation for all the decision points. Additionally, if we learn something critical, we update the calculation. It may be something about the scope of the indication. For example, if we learned that this drug cannot be used by over 50-year-old individuals, we recalculate to check whether the NPD project is still profitable."*

Hence, NPVs are not updated only for the DPs. The Vice President of Development emphasises: *"It [NPV] lives all the time, it is monitored all the time."*

It is common that the NPV is updated and presented in different forums 10-20 times during the NPD process. One therapy area director reported: *"I think we have updated this NPV calculation a dozen times. We have obtained new information, had decision points and presented it to the BOM [Board of Managers]."* NPVs are also updated twice a year for the Board of Director's project portfolio reviews. Typical project-specific reasons for updating the NPV are change in indication, altered market outlook, delayed development and cost overruns.

It appeared that there are two characteristics in particular which closely relate to using NPV extensively as a platform for dialogue: Multifaceted insight and simplified accounting language and form. These will be elaborated on next.

Multifaceted insight

The development of shared experience of knowing, based on a sufficiently similar noema, is a particular challenge in firms like Eupharma. The location of knowledge in Eupharma is dispersed over several functions that provide multifaceted insights into the decision process. The scientific, project management, and other R&D related knowledge is located at R&D, whereas knowledge about manufacturing and logistics is located at the supply chain function. Knowledge related to market potential and sales estimates, on the other hand, is in the early phases provided by the BI function, but the group sales/marketing function plays a major role in providing sales estimates in connection with the later decision points. Hence, the location of the most essential knowledge (sales) for NPV calculation actually gradually changes. The Director of Therapy Area 1 explains the co-operation and interaction between the business and group sales/marketing functions regarding the sales estimates in the NPV calculation. She emphasises the role of constructive debates in which reciprocal correcting of reality takes place:

> *"We do challenge each other. With regard to these last decision points, even though we conduct these NPV calculations here within the business organisation, we request figures from group sales/marketing. We compare them with our own estimates. Usually the figures we get from them are more optimistic than our own figures. Then we tell them that it will not be that good. This brings more perspective to the estimates. Both make their estimates and we will find the 'truth' somewhere in between."*

Hence, in intersubjective communication the persons test their understanding of each other and their knowledge of sales (Moustakas, 1994). In practice, the head of group sales/marketing is already involved with the sales estimates of the NPD projects before her function begins to provide sales input for NPV as she describes:

"We are an informal company. We play well together and discuss the assumptions behind the figures. I can attend their [business unit] meetings informally and I can say if I think that now we are talking about a totally wrong order of magnitude. So, when it [giving sales estimates] later comes to my desk, it is not the first time I am involved with it."

Hence, the assumptions behind the NPV components are in focus rather than the final outcomes per component or the aggregate NPV values as such. Also, a director of a business unit emphasises the role of intensive interaction between business and group sales/marketing teams in bringing domain-specific knowledge to the discussion:

"These global marketing teams are of utmost importance, because the product managers of the major geographical regions participate there and constantly bring us knowledge about the market. We discuss how it looks for our products in the future."

Further, the Director of Therapy Area 3 pinpoints the important role of dialogue in the business and project teams in gathering and synthesising diverse viewpoints:

"We have there people who understand the commercial aspects, and people who understand other aspects. It is a richness that people can then challenge issues from their own points of view. Finally, the best outcome will emerge as a synthesis of the team's expertise."

Even though the provision of different components to the NPV calculation is distributed throughout the organisation, all interviewees emphasise the teamwork behind the figures. The Director of Therapy Area 1 explains:

"We do everything in teams; we do co-operate intensively. All assumptions for the figures are agreed upon. We do not just say that do something and then we get numbers. No."

The Director of Analysis adds similarly:

"Business directors co-ordinate but all issues such as NPVs are prepared in these cross-functional teams. Functions provide input for discussions."

A common language for communicating the aspects related to the feasibility of a project is essential. The SVP of R&D emphasises the ability of NPV calculation to provide a common language facilitating informed discussion around various aspects to be taken into account:

"The most important issue is that the NPV calculation brings things into a quantitative format. You need to be able to discuss quantitatively, not just qualitatively. Then you can discuss where this and that figure is coming from and whether it is right or wrong."

NPV summarises many projections and creates a common language that has the ability to communicate project potential as the CFO describes:

"NPV is a kind of summary of various issues. All those R&D costs, sales estimates and competitor issues are there. This is its role more than being a separate decision-making tool, which gives a decisive answer regarding whether we will invest or not. It is easy to discuss with the aid of it about sales and marketing, for example. You have here X million

per year, how much you are going to sell, how much sales and marketing efforts will be needed…"

In a similar vein, the director of one business unit continues about the central role of NPV in the dialogue: *"It [NPV] is what we look at. We bring in discussion on risks, weaknesses, strengths, synergies and… It is in the middle."*

After the approval of the business team, the project appraisal has still to be approved by the BOM and the board of directors.[16] In the BOM meeting the discussion focuses on the overall NPV value and its main components. Specifically, the discussion is related to the market assumptions: price, market share, penetration velocity, competitor situation and differentiation and marketing.

At Eupharma, various NPV versions gathering diverse knowledge within the company are calculated and sensitivity and scenario analysis utilised to generate and share new, multifaceted knowledge to be taken into account for the decision-making. Additionally, critical non-financial issues elucidating different angles of the analysis are continuously taken into account (e.g. safety, efficacy, and competitor actions). The Director of Proprietary Drug Business emphasises the facilitating role of NPV calculation in shedding light on the sub-components of sales estimates and, specifically, enabling sensitivity analysis.

"I see this NPV model as a simulation tool especially for describing the market. By using it we can drill down to the components behind the sales figures and play with these components."

In addition to the formal NPV calculation owners (BI/business), sensitivity analyses are also used by other actors within the organisation. Specifically, group sales/marketing function commonly conducts what-if analysis with sales figures using the same NPV calculation template and rough (preliminary) estimates for the other NPV components as the SVP of Sales and Marketing explains:

"We do not have only one calculation; we have multiple calculations. I use for example a 30% lower price and see what happens to the calculation. Sometimes I do it upside down. I put some target value for the bottom line [NPV] and check how much market share or price or volume would be needed. Then I forward our sales estimates to the business team and they continue with the calculations. When it is ready I again sit down with the head of the business team and our controller and check all the figures."

[16] At the Board of Managers meeting 3-4 slides per NPD project are presented and discussed for about 30 – 45 minutes. These slides and a lot of background slides including the NPV calculation are distributed to all members not less than three days in advance in order to facilitate more in-depth dialogue. At the Board of Managers meeting, as such, a project is presented by the person responsible for the project (i.e., the business, a project manager or a scientific expert). Presentation visuals are related to the safety, pharmaceutical issues and project management (including scheduling and costs), risks and profitability.

NPV's ability for sensitivity analysis was also frequently used for 'pedagogical' purposes, i.e. to show and communicate the effects of changes in key parameters to those people who are not necessarily familiar with investment calculations as the Business Manager states:

> *"It was easy to play with the model and show what happens if market share halves, for example. Those who did not otherwise know what's in the model and did not know investment calculation techniques also understood these effects easily.*

She further explained the convenience of their NPV model for planning and analysing the sales in one NPD project:

> *"The functioning of our NPV model was very helpful. It progressed step by step. You defined the number of patients, how many of them are in intensive care, how many need mechanical ventilation, and accordingly how many our sedation* [tranquiliser]. *You were able to build this countrywise. This was of course necessary, because the prices vary country by country."*

Especially with regard to the indication choice, Eupharma occasionally uses scenario analysis. Hence, in addition to changing just one component at a time, multiple components, such as sales volume and indication specific R&D costs, are changed simultaneously.

In addition, 'a willingness to pay' study to obtain insights for the critical sales price component during the early part of development phase was also often utilised in Eupharma. The Director of Therapy Area 1 comments this with regard to one major project:

> *"We conducted a willingness to pay study; we tried to understand what kind of price would be possible in the market. Then we discussed the outcome pretty much. It was about the price strategy and it had a direct effect on these NPV calculations."*

To sum up, the findings presented above clearly demonstrate how the multifaceted insights are used in the company, and specifically how the development of collective experience of knowing and converging noema is based on a process involving numerous parties of the organisation.

Simplified accounting language and form

One aspect of the decision-making process relating to NPV at Eupharma is particularly significant with a view of developing a shared noema and thereby facilitating drawing conclusions. Eupharma namely intentionally uses simplified accounting language and form to enhance the potential for dialogue and mutual understanding between people representing different knowledge bases and cognitive frames. Inherently, in Eupharma's NPD process,

different knowledge bases are mobilised. Also, the cognitive frames among different parts of the staff vary a lot; scientists want to see their *"baby born and save the world"*, whereas businesspeople focus on business thinking and cold monetary values. Knowledge about accounting subjects cannot be expected to be on a high level throughout the organisation. A simplified accounting language and form appears to focus dialogue on essential issues rather than the details and minor aspects in the NPV calculation in Eupharma. The 'simplicity' manifests specifically in choices related to the NPV model as such, non-sophisticated approaches to estimate cash flows, as well as the hurdle rate.

The same simple NPV model including an overview of the main assumptions and hurdle rate has been used for years. The SVP for one business unit advocates this stability:

> *"I think it makes it easier to get the picture as everybody knows the rules. No one tampers with them, so you immediately see what it is all about. You are used to looking at them… You can assess it."*

He continues about the overall simplicity and specifically about not using probabilities in cash flow estimations, for example:

> *"Of course we could think that let's put in these complicated elements, probabilities, possibilities and others, but then it gets too complicated, I think. Most people would not have a clue about what the numbers stand for. I think it [the NPV calculation] is simple enough and reflects the corporate needs in a sense. It is like a bridge here in between [i.e. between the representatives of various knowledge bases]. With it we can also easily communicate with the Board of Directors."*

More complex real option approaches have moreover been ruled out in order to keep the calculation simple as the CEO notes:

> "*We tried to use them [real options]. We tried to understand whether this value X is better than value Y, but it is too complicated. Also difficult to communicate. We prefer simplicity."*

The 'keep it simple' approach has also been adopted for estimating certain components in the NPV calculation. Sales/marketing expenses (including sales commissions) are important components in the calculation. In the early phases of development, only rough percentage ratios (of net sales) are used for these items as one business manager explained:

> *"With regard to marketing and sales costs, we used in earlier versions just a lump sum type of estimates, 30% of sales."*

However, in Phase III and later, sales and marketing organisation will provide more detailed inputs by country for sales and marketing expenses. For external sales commissions percentages are used all the time. Administration costs and change in net working capital typically play a minor role in calculations and they are also calculated as a ratio of net sales.

The choice of the hurdle rate has typically potential to profoundly affect the NPV. Eupharma has used for several years the same high hurdle rate (over ten %) for all its NPD projects to keep the calculation simple and stable, and hence to support comparability and dialogue. It is about double the company WACC. The CFO comments their choice:

> *"We have emphasised simplicity regarding our choice of hurdle rate. Honestly, we have not discussed what this rate tells us. We have just decided to use the same rate to enable comparability and simplicity. Of course, it does not reflect the riskiness of a particular project. Is this a good way or bad way, it's another story. In fact, it is now, as such, relatively much higher than for example five years ago, because our cost of capital is lower now."*

Another reason, in addition to the 'keep it simple and comparable' approach, the reason for not paying much attention to the hurdle rate appears to be the dominance of highly uncertain sales figures and technical feasibility for the project profitability. One business controller explains:

> *"That top line is, however, the major issue as well as is technical feasibility. If we start to discuss our hurdle rate in proprietary business, then, I think, we are talking about inessentials."*

Similarly, the SVP of R&D continues about the importance of top line estimates versus the hurdle rate:

> *"In at least over 50% of our projects the final peak sales have been about five times higher than we have expected; peak sales of 300 million can easily be 1.2 billion. Then it does not make a big difference what kind of discount rates we use."*

Thus, stable hurdle rate enables focusing more attention in NPV analysis to the most substantive aspects, such as sales estimates.

Simplicity is also related to the assumptions used in NPV calculations. The company shows the components of the calculation on a one-sheet NPV calculation, and hence, the calculation allows critical project capabilities and parts of the rather intangible NPD process to become visible in a comprehensible manner. The communicative capabilities of NPV can be seen to relate closely to the practice of carefully documenting underlying assumptions related to the calculation. By keeping them visible, the analysis is anchored in something more concrete and the actors can see the origin of the figures.

Hence, simplicity and stability characterises the NPV calculation choices in Eupharma: the same NPV calculation model and the same hurdle rate are used for all projects, no probability or real option thinking is integrated, and proxies for costs are commonly used. This simple and stable approach is expected to enhance dialogue and understanding about the NPD decisions, and facilitate focusing on substantial issues. Not only does this aspect of the process support the emergence of a shared noema, but also channels it towards an arguably decision-relevant kind of noema.

Taking all findings together, a many-sided interplay between financial and non-financial aspects characterise the development of the experience of knowing in the NPD decision-making process of the case firm. In the research phase, scientific aspects around the technical feasibility of the drug dominate the discussion, even though a consensus about a sufficient market potential is also required to justify further research efforts. For entering the clinical phase, the first "preliminary" NPV is required, but everybody seems to understand that it is still a highly uncertain calculation. Despite the highly uncertain nature of the first NPVs, 'sufficiently' positive NPVs are already expected at this phase for a continuation decision. More attention on decision-making is at this time, however, paid to non-financial aspects, such as safety and efficacy, own and competitors' R&D pipelines and potential reactions on the part of the authorities regarding pricing and reimbursement. During the entire product development process, decisions are based on multifaceted insights – both non-financial and financial – but the NPV calculation gains more prominence towards the end of the process as uncertainties diminish. In the next section we will discuss our findings.

5. Concluding discussion

Pondering how to explain the surprisingly high frequency and prominence of NPV in pharmaceutical new product development was the starting point of our abductively progressing, single-case study. Inherently, it appears that in industries like pharmaceuticals, the use of NPV would be complicated, because the NPD process is time-wise extremely long, it consists of several steps, uncertainty is notable in many respects and the activity is highly knowledge intensive. We endeavoured to cast light on our conundrum by addressing the roles of NPV calculations and found that these calculations have two varying roles: A verifying role at the various decision points and frequently also a role that facilitates learning. However, our findings demonstrate that NPV calculations are just one part of a much bigger picture. This observation

led us to our main question, namely how NPV calculations are involved, in an interplay with other sources and uses of information, in the development of the experience of knowing about the feasibility of an NPD investment.

As our first contribution, we extend the literature on strategic investment decision-making by being the first study to explicitly provide a systematic and thorough analysis of the role and interplay of financial and non-financial information in the development of experience of knowing over the very long decision-making process. In addressing the development of experience of knowing, we employed phenomenology as our 'method theory' and mobilised particularly Husserl's concepts around his core notion of noema. In so doing, our study also contributes to the accounting literature by being the first to mobilise these concepts. Husserl calls the partial views of a whole entity its noematic phases. Accordingly, each time new components of an experience emerge, we obtain a new understanding of the experience, and, finally after multiple lookings and describings, we arrive at a breaking point, i.e., we feel we have a sense of knowing what is there before us. Noema is the meaning generated in an intentional act (i.e. noesis); hence the process of forming noemas always requires a certain orientation towards something – for instance, being able to feel confident in making decisions at the consecutive checking points in new product development projects. In our case the perceived, constantly changing appearance of feasibility of the NPD project is the noema in the focus of our analysis.

Consistent with the noematic ideas, the world the managers of Eupharma experience appears to them through a piecemeal process. Of particular relevance here, their image of the feasibility of NPD projects is continuously revised and sharpened when new information emerges from many sources and in many forms. During this process of experiencing, their presuppositions may be confirmed, but if these are revoked, the development project may be abandoned during the experiencing process. If the managers, for instance, see that the sales of the new drug will be high, they may experience that the project will be feasible without seeing the NPV (cf. 'the whole tree' example in section 2.3, for instance). Their consciousness constitutes the whole picture of the project feasibility by adding more and more pieces to this observation over time. The evolving noema assembles and organises the parts and leads them towards an experience of the feasibility as a whole.

By following noematic ideas, we present a detailed analysis of how the degree of experience of knowing about the various financial and non-financial perspectives gradually takes shape during

the long NPD process. Simultaneously, we discuss how the relative importance of these perspectives changes during the process. Our approach addressing various perspectives is in accordance with Hall (2010) and McKinnon and Bruns (1992), maintaining that when investigating managers' use of information, it is not appropriate to address financial and non-financial aspects in a vacuum. In congruence with the findings of Carlsson-Wall and Kraus (2015) and Feeney and Pierce (2018), it appears that in Eupharma financial considerations are of only little importance in the research phase. In this phase, scientific aspects around the technical feasibility of the drug are at the centre of the discussions, but some kind of preliminary understanding of the market potential is also required. NPV is required in Eupharma for the first time for entering the clinical phase, but at this time, non-financial aspects, such as safety and efficacy, still dominate the discussion. In line with the findings of Feeney and Pierce (2018), NPV calculation gains more emphasis during the later development phases, when uncertainties related to NPV components gradually diminish. Jörgensen and Messner (2010) found in their NPD study that in the early phases of development many non-financial aspects were considered a kind of shortcut for the expected financial impacts. Similarly, in our study, safety, medical functioning, and market potential seem to act as such shortcuts in these early phases of development. Our empirical evidence highlights the important impact of external agents, such as regulatory authorities, regarding pricing and reimbursement, partners and competitors in drug development decision-making during clinical phases. Contrary to the findings of Butler et al. (1991, 1993), Nixon (1995), Sykianakis and Pellas (2005), we did not observe that investment decision-making processes were notably political in our case company.

As an important finding, we found that managers' prior experiences in similar situations emerged as a major aspect in the development of the experience of knowing. It appears that managers' memories of their former experiences in similar situations in both research and development phases greatly influence their pre-understanding of the object, and consequently the noema. Their wealth of prior knowledge enables them to see the things as familiar and preordained (Manninen, 1995), and helps them in making sense of the information available. Accordingly, they know that market indication has a tendency to diminish during the development process leading to reduced sales potential; they have a 'hunch' as to how much it costs to develop a drug; they are able to anticipate the price or reimbursement decisions of authorities and they know that the manufacturing costs of the drug will plummet, for example. In other words, when the projects bear a resemblance to managers' former experiences, the managers seem to typify the projects and see them as representatives of their types (Smith, 2018). Hence, following Moustakas' (1994,

53) ideas, it seems that in looking and reflecting on the components of feasibility of a project, acts of memory relevant to the phenomenon have the ability to reawaken feelings and images and bring past meanings and qualities into the present. In a similar vein, Jakovaara (2020, 89) suggests that in strategic investment decision-making "emotion processes and the feelings of emotion appear to be tightly linked to learning mechanisms, since our memory not only stores the factual outcome of our earlier decisions, but also the emotional result of those particular experiences." Furthermore, in line with our findings, Grant and Nilsson (2020) have found that long experience of managers dealing with M&A decisions combined with feedback and reflective processes of prior investment projects have the potential to enhance their learning and consequently the development of their expertise. They suggest that post-completion auditing could be an appropriate tool to render feedback processes systematic and consequently enhance organisational learning (see e.g., Huikku and Lukka, 2016).

With regard to our method theory, we are able to demonstrate that Husserl's concepts can be appropriately used as sensitising devices in addressing the emergent process of the experience of knowing. Accordingly, we use them as a frame to illustrate and analyse a learning process. In our study, we strove to obtain comprehensive descriptions of experiences and Husserl's concepts provided us with a toolkit for reflective structural analysis portraying the process of formation of these experiences (Finlay, 2009). As also suggested by Sanders (1982), we feel that our phenomenological approach yielded a new, helpful way of exploring what is genuinely discoverable and potentially there, but often is not discovered. Specifically, our phenomenological analysis helped us to adequately address and reveal essential elements in the process of the emergence of knowing, such as managers' prior experiences and pre-understanding of similar decision-making situations and the processes related to intersubjectivity. Overall, our study highlights, with the aid of the Husserlian approach, the importance of adopting a wide and holistic view of financial and non-financial perspectives and not to examine them in isolation from their wider context when seeking to profoundly understand how managers get to know during longer decision-making processes.

As the second contribution, we add to the capital investment literature by providing insights on the managerial uses of financial and non-financial information and, specifically, on the role of NPV calculation in the development of the experience of knowing. It appears that NPV helps to develop the experience of knowing in two major ways. NPV has potential to verify the judgemental experiences of knowing that managers have obtained from other, non-financial,

sources (cf. Huikku, 2007, in a post-completion auditing context). In these instances, decision-makers' noemas can shape a sufficient picture of the feasibility of the project already without the calculation of the NPV, but the established procedure still requires it to be conducted – indeed to further formally verify what was already experienced to be known. Our findings about the verifying role of NPV are closely related to the findings of Feeney and Pierce (2018) and Jörgensen and Messner (2010), suggesting that accounting information in the NPD context is often about legitimising decisions that have, in practice, already been taken.

We found, particularly, that even though NPV is often used merely to verify the judgemental experiences of knowing obtained from multiple other sources, it is anyhow typically used in a very intensive and interactive manner for the generation of knowledge about the feasibility of a project. NPV calculation can be an integrating and important part of a wider set of sources of getting to know, even though the rough result of NPV calculations is typically 'known' already in advance based on numerous non-financial sources of knowing. There are studies that cover certain aspects of the learning-orientated use of NPV within NPD settings (e.g., Christner and Strömsten, 2015), but none of them have explicitly focused on such use. Consequently, by focusing specifically on this topic, we are able to relate our findings to earlier contributions, accumulate the knowledge and extend the literature by providing a more holistic picture of the role of NPV than in the literature so far.

We show that reciprocal validating and correcting of the vision of reality takes place in social conversations and dialogues, and that NPV has a major role in these processes. NPV links different NPV components developed by different functions, helping the parties to decision-making develop in their intersubjective dialogues a converging, common meaning, i.e. a collective, shared noema, among themselves. NPV facilitates managers' learning about the various financial and non-financial factors, and consequently enhances their experience of knowing during the long development processes. Dialogues also make these various factors more readily understandable to others involved in the interaction and contributes to the various perspectives being given a voice (Coad, 1997; Vaivio, 2004). Even though sensemaking of what an experience means begins at the individual level, this perception is continuously validated or altered when people articulate and describe their experiences to each other in dialogues. Managers continuously test their own presuppositions and experiences through social negotiations (Gill, 2014; Giorgi, 1997).

Two characteristics of particular significance in the learning-oriented use of information emerged in our empirical data: multifaceted insight and simplified accounting language and form. It seems that these characteristics appear to be closely linked to the capacity of NPV to enhance decision-makers' learning throughout the process. Managers use NPV to conduct multiple sensitivity or scenario types of accounting calculations in order to gain more multifaceted insight into decision-making than what could be achieved by a single calculation (Burchell et al., 1980). In addition to conducting multiple calculations, the generation of multifaceted insight typically also involves addressing issues of a non-financial, potentially more qualitative, nature (Hall, 2010; Jörgensen and Messner, 2010). Furthermore, as also suggested in other contexts (Hall, 2010; Osborn, 1998; Rowe et al., 2008), we note that the accounting language and form may need to be simplified in order to facilitate dialogue and to make accounting representations more easily accessible and understandable across various knowledge bases. Moreover, our analysis highlights the continual use of NPV (cf. Simons, 1990, 1991, 1995). In practical terms, this entails continual recalculation as knowledge accumulates, and uncertainty related to key parameters decreases.

The results of our study should be considered in light of certain limitations. Generalising in the contextual mode is always possible, at least to some extent, in case studies, too (Lukka and Kasanen, 1995). Nevertheless, our results regarding the interplay between various financial and non-financial perspectives in the development of experience of knowing and specifically the role of NVP therein may not be directly generalisable to, for instance, such contextual settings where the level of uncertainty and the difficulty in translating critical knowledge into a financial form are not as pronounced as in our empirical setting. In such settings, while we may still expect to find characteristics of the learning-oriented use of NPV, for example, they may appear with a less prominent manifestation. The extent of dialogue can be expected to be more confined if the number of knowledge bases being mobilised is smaller and if these knowledge bases are less distant from the accounting domain than in our empirical setting (Nonaka et al., 2001).

Further, although our empirical focus on pharmaceutical NPD has been helpful in probing the learning-oriented use of NPV, it poses additional limitations to the generalisability of our results. More specifically, the continual recalculation of NPV is potentially less extensive in settings where the recalculation is not enforced by a formal stage-gate model. In our empirical setting, however, the recalculation also took place between the gates, suggesting that such recalculation may also take place also informally as new knowledge emerges about key parameters.

Recalculation is also likely to be relevant in connection with other major strategic investments, i.e. in “one decision settings”, where planning and evaluation phases extend over a long period, but the stage-gate approach, as such, is not adopted. Accordingly, it would be fruitful to investigate how the experience of knowing develops in these companies before the decision takes place.

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Appendix A

NPV use in different countries (Large companies)

Country	Total	Other major methods	Ranking of methods	Source
US	75% (always or almost always)	IRR 76%, PB 57%	1. IRR, 2. NPV, 3. PB	Graham and Harvey (2001, 198)
Canada	76% (always or almost always)	IRR 72%, PB 64%	NPV primary method in 57.7%, IRR in 42,3%	Bennouna et al., 2010, 232)
UK	87% (always or mostly)	IRR 81%, PB 48%, ARR 48%	NPV and IRR almost as popular	Arnold & Hatzopoulos (2000, 606)
Nordic countries	65% (primary or secondary method)	PB 62%, IRR 46%	NPV primary method in 41%, PB 25% and IRR 19%	Brunzell et al. (2013, 100)
Sweden	61% (always or frequently)	PB 54%, IRR 30%	NPV and PB almost as popular	Daunfeldt & Hartwig (2014, 103)
Finland	57% (among the three primary methods)	PB 94%, IRR 59%	NPV primary in 20%, PB 63%, IRR 11%	Huikku et al. (2018, 527)
Australia	86% (important or very important method)	IRR 64%, PB 59%	1. NPV, 2. IRR, 3. PB -43% do not rank NPV very important	Truong et al. (2008, 103)
Italy	51%[a]	IRR 39%, PB 35%	NPV not used in 49% of the firms	Rossi (2015, 49)
Netherlands	89% (always or almost always)	PB 79%, IRR 74%	NPV, IRR and PB all very typical	Hermes et al. (2007, 640)
Germany	48% (always or almost always)	PB 50%, IRR 42%	1. PB, 2. NPV, 3. IRR -52% do not use NPV always/almost always	Brounen et al. (2004, 31)
France	35% (always or almost always)	PB 51%, IRR 44%	1. PB, 2. IRR, 3. NPV -65% do not use NPV always/almost always	Brounen et al. (2004, 31)
Spain	66% (always or almost always)	PB 75%, IRR 74%	1. PB, 2. IRR, 3. NPV -34% do not use NPV always/almost always	De Andres et al. (2015, 46)

[a] This percentage also includes companies where NPV was used less frequently than always or almost always.

Appendix B: List of interviews

No.	Function	Date	Min
1	SVP, Research and Development, Chief Medical Officer	13.4.2012	60
2	VP, Research	14.9.2012	60
3	Chief Financial Officer	14.9.2012	60
4	SVP, Proprietary Products (PP)	14.9.2012	60
5	VP, Development	12.10.2012	60
6	Chief Financial Officer & Business Controller, PP & R&D	6.6.2013	90
7	Chief Financial Officer	5.8.2013	120
8	Business Controller, PP & R&D	9.8.2013	130
9	SVP, Research and Development, Chief Medical Officer	26.8.2013	120
10	SVP, Proprietary Products	11.9.2013	105
11	Director, Therapy Area 1	24.9.2013	180
12	Director, Analysis	2.10.2013	90
13	VP Development, R&D	3.10.2013	75
14	Director, Therapy Area 2	4.10.2013	120
15	Business Development Director	6.2.2014	90
16	Director, Project Management	4.4.2014	120
17	Director, Business Planning and Control	7.4.2014	75
18	VP, Research, R&D	10.4.2014	105
19	Business Manager, Product X	22.4.2014	75
20	Head of Packaging Technology	22.4.2014	90
21	SVP, Supply Chain & Business Controller, Supply Chain	29.4.2014	75
22	Director, Project and Portfolio Management, R&D	29.4.2014	60
23	Head of Critical Care, Development, R&D	7.5.2014	105
24	R&D Project Coordinator	13.5.2014	60
25	Business Controller, Generative Products	15.5.2014	135
26	Director, Therapy area 3; Business, Commercialisation & Launch Supply	20.5.2014	60
27	Head, Generative Development and Outsourcing	30.5.2014	65
28	Finance Manager	30.5.2014	90
29	Business Controller, PP & R&D	30.5.2014	90
30	SVP, Sales & Marketing	9.6.2014	60
31	SVP, Proprietary Products (Prior Generative Products)	17.6.2014	60
32	Head of Unit, Market Authorisations (Regulatory authority 1)	28.8.2014	75
33	Business Controller, Global Sales	29.8.2014	90
34	Business Analyst, Investment Control	29.8.2014	60
35	Business Analyst, Project Finance	29.8.2014	75
36	Director, Chemistry and Safety Sciences, R&D	3.9.2014	55
37	Senior Research Scientist, R&D	3.9.2014	25
38	Principal Pharmacological Officer & Director (Pharma Pricing Board, Regulatory authority 2	8.9.2014	90
39	Director, Assessment of Pharmacotherapies (Regulatory authority 1)	10.9.2014	90
40	Senior Equity Analyst (Investment Bank 1)	15.9.2014	70
41	Financial Analyst (Investment Bank 2)	15.9.2014	70
42	Statistician, Pharmacoeconomy (Regulatory authority 1)	28.10.2014	85
43	Pharmacoeconomist 1. (Regulatory authority 1)	28.10.2014	70
44	Pharmacoeconomist 2. (Regulatory authority 1)	28.10.2014	70
45	Head of Medical Research & Senior Researcher, Health Economics (Regulatory authority 3)	4.11.2014	60
46	Chief Financial Officer	21.11.2014	120
47	SVP, Research and Development, Chief Medical Officer	25.11.2014	90
48	President and CEO	15.12.2014	70
49	Chief Financial Officer	14.3.2017	23

Appendix C: Roles and responsibilities of key decision-making bodies within Eupharma's NPD process (extract from Product Development Handbook)

Body	Role	Key responsibilities
R&D Steering	Decision-making on risk-benefit profile. Decision-making on other scientific aspects.	Recommend and give directions to therapy area strategy. Share decision-making recommendation to higher level decision-making bodies. Scientific follow-up and advice on projects. Review of project costs.
Resource Portfolio Management Team	To ensure alignment of research phase activities to overall business view.	Strategy and shape of research portfolio, including maintenance of balanced portfolio. Recommend candidate molecule selection. Authorise start of project (DP1). Nominate Business Team. Approve business goals in research phase. Prioritise research phase projects. Recommend in/out-licensing and collaboration projects.
Business Team	To maximise value of business.	Approve target product profile & concept (indication) in development phase. Go/no-go decisions in development phase, recommendations on new projects according to business strategy. Approve development activities. Project team steering in development phases. Monitor deviations in project plan, propose actions to BOM
Board of Managers (BOM)	Sponsor all development projects. Prioritise projects. Go/no-go decision-making.	Review decisions at development phase decision points. Decide on actions in case of deviations. Decide on project termination. Decide on in/out-licensing of development projects. Prioritise development stage projects. Forward decision-making to Board of Directors if needed.