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Norsk Hydro's R&D organisation

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Master Contract



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- uttak av masteroppgave

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Preface

This master thesis is written for the Department of Industrial Economics and Technology Management at the Norwegian University of Science and Technology during the spring 2011. The assignment serves as main delivery in the subject Innovation and Entrepreneurship TIØ4945.

The work is related to Hydro's CROC (Centre for Radical Organisational Change) project, and the problem definition has been formulated in collaboration with Hydro representatives. The purpose of the study is to review Norsk Hydro's R&D organisation, and propose actions for improving its performance.

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Executive Summary

The problem definition for this master thesis is formulated in collaboration with Hydro representatives, and is related to Hydro's CROC project. The thesis aims to critically review Hydro's R&D organisation, and reveal factors which hinder synergies from being realised, and innovation to take place. A proposal for improvement has also been prepared.

A broad literature study on the topic "Radical innovation in mature organisations" provides the theoretical foundation for the perspective of this master thesis. The study focuses on the problems of large and mature organisations in promoting and responding to radical innovation in their industries. The concepts of Dynamic Capabilities and Absorptive Capacity are particularly focused upon, and the study emphasises resource-based theories for strategy with an inside-out perspective.

Four case studies have been carried out in Hydro's mid- and downstream R&D organisation. Empirical data has been collected through interviews and meetings; six interviewees in Hydro's R&D management have provided rich data for analysis. Main themes include cross-sectional cooperation, innovation challenges, cultural differences and structural assets within the R&D organisation.

Hydro's R&D organisation employs a polycentric, decentralised model, and is characterised by high centre autonomy and unrealised synergies. The organisational structure bears evidence of a history of acquisitions. Building Systems' R&D department and Upstream R&D are omitted from the central R&D organisation for no evident reason. The remaining R&D organisation serves all of Hydro's business areas, however, mid- and downstream R&D is line organised under one single business sector. This leads to problems at top level, as the head of R&D reports to the representative of one business sector, although personally representing an organisation which serves the entire value chain.

The R&D centres are tightly connected to their internal clients, which operate within distinct business sectors. The clients have strategic power as a result of financial power over R&D, and are free to define projects as they wish. There are few multisite R&D projects, and in all, little collaboration between the centres. Competence overlap is evident between some sites. Silo mentality is present at all sites, and is evident both between and within the R&D centres. There is little common culture and identity marking the R&D organisation, and this complicates internal collaboration. Limited internal collaboration leads to a

weak social capital, in turn making the organisation less flexible when faced with the challenges represented by a radical change in the environment.

Strong customer dedication along with strict key performance indicators and reward systems, leads to short term focus. Routines for Technology Watch¹ are absent; technology watch happens sporadically and randomly. The strategic focus on Step Change² (radical) innovation in Hydro is not translated into practice in the organisation. Processes for facilitating innovation projects are lacking, and although the New Ideas programme functions relatively well, there is a lack of follow-up on the New Ideas projects. The organisation relies heavily on individuals' initiative to promote innovation. My proposal involves three main changes, which are listed below.

1. **Gathering of all R&D activities in one central R&D organisation.** The head of the R&D organisation should report directly to the Group Chief Executive and be seated in corporate management.
2. **Financial empowerment of the R&D organisation.** More projects should be financed by the central R&D organisation, allowing a more long-term approach and focus on step change projects.
3. **Establishment of a hub for innovation;** responsible for taking care of Hydro's efforts to create step change. The hub is a transversal organisational entity, employing key people from every business sector and every R&D centre.

If executed properly, these structural and formal changes may significantly enhance the organisation's internal social capital and rate of collaboration, as they provide a fresh foundation on which a uniform creative R&D culture and identity can be built. This will stimulate a realisation of latent synergies in the organisation and improved R&D performance. A unifying and creative culture also makes the workforce more flexible and their behaviours more predictable, which positively affects the dynamic capabilities of the organisation. The hub takes on responsibility for technology watch and screening and selection of innovation projects, directly improving the absorptive capacity and innovation processes in Hydro's R&D organisation. Combined with a creative culture, this makes the organisation more prone to promoting step change innovation.

The proposed changes may help direct Hydro's R&D organisation towards the integrated R&D network model.

¹ Technology Watch is Hydro's expression for activities related to monitoring the external environment for new trends, technologies and competitors.

² Step Change Innovation is the commonly used term for radical innovation in Hydro

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1. Introduction



1.1 Introduction

1.1.1 Problem Definition and Research Objectives

The overall title for this master thesis is "Norsk Hydro's R&D organisation". The master thesis is a continuation of the project assignment executed during autumn 2010. The project assignment was a literature study with the title "Radical innovation in mature organisations". The problem definition has been formulated in collaboration with Hydro representatives.

Problem Definition

The problem definition goes "How should Norsk Hydro's R&D body be organised in order to create the most value for the company?"

Research Objectives

1. I seek to reveal factors in Hydro's R&D organisation, which inhibit synergy effects from being realised and propose actions for elimination of these.
2. I will map Hydro's innovation problems and propose concrete actions for solving those problems.

2. Theory Section

2.1 RBT and R&D

2.1.1 Resource-Driven Strategies

Strategic management is about gaining and sustaining competitive advantage in order to succeed in the market place and create wealth. R&D and innovation is closely tied to strategic management in that it states that a firm must innovate in order to sustain its competitive advantage. Innovation and R&D are tied together in most cases; in that research and development is a necessary precaution for creating new technologies, products and services based on vague, creative ideas. R&D activities are concerned with bundling different types of resources together in order to create capabilities and competences (Teece et. al., 1997). To be strategic, these must be dedicated to a user need so that they will yield revenue streams. Preferably, they should also be unique so that pricing does not become an object of competition, and difficult to replicate, to prevent imitation (Teece et. al., 1997). A resource-driven strategy involves setting long-term directions for resource infrastructure; which includes building a corporate culture and identity and identifying market opportunities where the strengths of the resources can be exploited. Adopters of the resource-based view stress that strategy should be built around the firm's strengths rather than being a result of exogenous influences. Whereas the outside-in perspective appreciates the importance of market structure and emphasises that the product offering should be adjusted to fit the most attractive market, Resource-Based Theory (RBT) suggests that the firm should rely on its strongest resources, and then identify market opportunities where its strengths can be exploited. A strong resource base yields access to unfolding market opportunities (De Wit & Meyer, 1998). A strong resource base is built over time, and the starting point for a resource-driven strategy is the question of what kind of resource base the firm desires.

2.1.2 Firm Resources

Resources include, according to Barney (1991), every asset, capability, organisational process, firm attribute, information and knowledge, which is controlled by the firm, and enables it to implement strategies to improve its efficiency. Firm-specific resources that are valuable, rare, imperfectly imitable and non-substitutable (VRIN resources; Barney, 1991) yield sustainable competitive advantage. Barney classifies firm resources into three categories: physical capital resources, human capital resources and organisational capital resources.

Physical Capital Resources

Physical capital resources are tangible assets, and include buildings, machines, unskilled labour, and financial capital. Physical capital resources are either

monetary, or they can be bought for money, and hence they yield no sustainable competitive advantage.

Organisational Capital Resources

Organisational capital resources are intangible in nature. Intangible resources are assets, which cannot be bought in factor markets - they must be built internally in the organisation (De Wit & Meyer, 1998). Organisational capabilities are one kind of organisational capital and include all kinds of routines, procedures and operations that the organisation engages in. Among organisational capital resources, are also the resources represented by social capital. Social capital is a form for structural assets and includes the set of relationships between individuals and between individuals and organisations that facilitate action (Ireland, Hitt & Vaidyanath, 2002; Hitt, Lee, et al., 2002, cited in Ireland et. al., 2003). We distinguish between internal social capital and external social capital. Internal social capital includes all relationships and relations within the organisation in question. External social capital refers to the organisation's external relations and commercial partners. An effective external social capital can provide new streams of knowledge in to the organisation. Internal social capital includes all relationships and social ties within the organisation. Effective internal social capital will make the creation of lateral and vertical collaboration among organisational members easier, and also influence the degree, to which these collaborations are successful (Ireland et. al., 2003).

Human Capital Resources

Human capital resources are also intangible, and defined as the capabilities, knowledge, skills and experiences of individuals within the company - which are relevant for the tasks to be performed (Dess & Lumpkin, 2001, cited in Ireland et. al., 2003). The most unique resource in an organisation is exactly the organisational members, who represent the organisation's human capital and who also are in charge of the organisation's social capital. These two categories of resources are driving factors for bundling resources to become competences and capabilities, and because of this, they represent some of the most central resources for establishing and developing a strong resource base and competitive advantage. Human capital resources are particularly momentous in organisations, which engage in R&D activities. R&D organisations are knowledge-intensive and cannot be sustained without the asset of human capital. Human capital involves a capacity to add new knowledge, skills and experience to the firm's resource base through individual learning (Dess & Lumpkin, 2001, cited in Ireland et. al., 2003).

2.1.3 The Knowledge-Based View

From the basis of the traditional RBT, have germinated the knowledge-based view (De Wit & Meyer, 1998). The knowledge-based view identifies knowledge as the firm's most important strategic resource. Knowledge is of particular strategic value to organisations, which engage in R&D activities internally. The R&D body of the organisation's objective is to assimilate, apply and create knowledge in order to create new technologies for which there is a market demand.

2.1.4 R&D and Innovation

According to Fagerberg et al. (2004), innovation is typically understood as "the successful introduction of something new and useful", such as new methods, processes, practices or new or altered products and services. R&D is in many cases a precaution for innovation to take place. Viewed from the other side, innovation is in many ways the superior goal for R&D activities. The two go hand in hand, but it need be stressed that R&D activities not automatically lead to innovation. On the other hand, innovation does not happen spontaneously either. It must be initiated by people; and research and development is needed for it to be realised.

We distinguish between incremental innovations and radical innovations. Hill and Rothaermel (2003) define an incremental innovation as a technological innovation, which builds on the established knowledge base owned by the firm in question. Incremental innovations are associated with existing firms. A series of incremental innovations ensure that the firm steadily improves processes methods or materials necessary to satisfy the customers' needs and achieve the firm's objective of profitability. An incremental innovation does not entail shifts in corporate strategy, new work processes, or the need for radically recombining resources. Radical innovation is defined by Leifer, O'Connor, Rice and Colarelli (2001) as a product, process or service that transforms existing markets or create new ones by significant improvements in performance, functionality or cost. Hill and Rothaermel (2003) add that a radical innovation requires an alteration of the firm's knowledge base either through recombination of pieces of the current knowledge base, or as a stream of new knowledge into it (Freeman & Soete, 1997, cited in Hill & Rothaermel, 2003). Radical technology innovation; or disruptive technologies, Christensen (1997) argues, involves methods and materials that are novel to incumbents.

2.1.5 Exploration vs. Exploitation

March (1991) introduces the terms exploration and exploitation, which are related to radical and incremental innovation, respectively. Exploitation is about

refining and extending existing competences, technologies and paradigms. Returns from these activities are predictable, positive and immediate. Exploration, on the other hand, entails experimentation with novel knowledge and new resources, and the results are often highly uncertain, distant in time and negative.

A Fine Balance

Incumbent firms are generally competent when it comes to developing and sustaining the competitive advantages needed for exploiting opportunities over time (Ireland et. al., 2003; Teece, Pisano & Schuen, 1997), yet they are not as efficient in recognising and pursuing new business opportunities. Thus, their response to radical innovation is too often lagged, and they totally lose their ability to recognise the many opportunities for pioneering radical innovations. Firms need to combine search for new opportunities with the quest for continuous improvements to enhance advantages in order to stay competitive and create wealth (Ireland et. al., 2003).

This means that also large, mature organisations must become capable of sustained product innovation, and be able to pioneer, or at least cope with radical innovation– for competitive reasons. Businesses, which have been successful in the long run, are the ones who have strived to continuously innovate; and been open for both incremental innovations and radical innovations when they have represented new business opportunities or the entrance in or even creation of new markets (Morone, 1993, cited in Leifer et. al., 2001).

2.1.6 R&D for Ambidexterity

In a 1996 article, Tushman and O'Reilly define ambidextrous organisations, which are organisations that succeed in finding an appropriate balance between exploration and exploitation. Organisations, which are successful in the long run, are the ones that have structures, processes and strategies, which allow them to balance and create a harmony between the contradicting requirements of exploration and exploitation (Raisch et. al., 2009). Ambidexterity is positively related with performance (Gibson & Birkinshaw, 2004; He & Wong 2004; Lubatkin et al. 2006, cited in Sharma & Chrisman, 1999). Recent research describes organisations capable of exploiting their existing resources and competences, and at the same time being engaged in exploration of new opportunities. The roles of informal networks, firm context and leadership have in recent years received attention and recognition as being antecedents for the ambidexterity of the firm, together with the obvious role of organisational structure and processes, as well as the human capital.

Four Tensions for Ambidexterity

Raisch et al. (2009) identify and point at four fundamental tensions concerning ambidexterity in organisations situated in changing markets. They represent dilemmas, which are especially relevant for organisations, which are engaged in R&D activities, and particularly to the R&D body itself. The first tension is between differentiation and integration; and concerns the dilemma whether explorative and exploitative activities should be separated into different organisational units (differentiation), or addressed within the same organisational unit (integration). The second tension is about the question of whether ambidexterity resides at an individual or organisational level. The common approach is to credit organisational mechanisms such as formal structures and coordination processes for ambidexterity. However, the individuals' abilities to explore and exploit must also be attributed (Raisch et al., 2009). Whereas organisational mechanisms are important antecedents for ambidexterity, it is the individuals of the organisation who make it useful (Raisch et al., 2009). The third tension concerning ambidexterity in organisations, points to the classic dilemma on whether exploration and exploitation can or should be executed simultaneously, or whether the two orientations of activities should be pursued in sequential order (Raisch et al., 2009), and is hence a dilemma between a dynamic and a static approach to R&D. The fourth and final tension involves whether to focus on how exploration and exploitation is addressed internally, or on acquiring knowledge for exploration externally (Raisch et al., 2009).

2.1.7 Combining Resource-Based Theory and Entrepreneurship

Ireland et al. (2003) introduce the concept of Strategic Entrepreneurship (SE) – an integration of entrepreneurship and strategic management knowledge. They state, that “both opportunity-seeking (i.e., entrepreneurship; exploration) and advantage-seeking (i.e., strategic management; exploitation) behaviours are necessary for wealth creation, yet neither alone is sufficient”. SE involves taking entrepreneurial actions with strategic perspectives (Hitt, Ireland, Camp, et al. (2001, 2002, cited in Ireland et al., 2003). The thought is that firms create wealth by identifying opportunities in their environments and then developing capabilities and competitive advantages to exploit them.

Ireland and his colleagues define an entrepreneurial mindset as a growth-oriented perspective, encouraging flexibility, creativity and continuous innovation and renewal. An organisation, which possesses an entrepreneurial mindset is always alert for new opportunities for wealth creation, and has established well-functioning frameworks for making quick and confident decisions concerning whether to decide whether to seize the opportunity. These aspects are particularly relevant for R&D organisations, whose purpose is to

create new knowledge and technology, which the overall organisation can benefit and profit from.

Entrepreneurial leadership is about leaders who manage to influence the organisational members to manage the resources strategically, so that the organisation is engaged in both opportunity-seeking and advantage-seeking (exploration and exploitation) activities. Entrepreneurial leadership influences the culture to become entrepreneurial-oriented, and vice versa; the entrepreneurial culture influence managers and organisational members to develop an entrepreneurial mindset (Ireland et. al., 2003). Jelinek and Schoonhoven (1990) add that when members of the organisation are included in the innovation process, they will more easily understand the objective, and create a shared responsibility for success.

2.2 Organisational Culture and Innovation

The greatest way for firm executives to promote radical innovation in their organisation is to shape the corporate culture so that the issue of radical innovation becomes accepted, valued and natural (Leifer et. al. 2001; Ireland et. al., 2003). Dess and Picken (1999, cited in Ireland et. al., 2003, p. 970) define organisational culture as a “system of shared values (i.e., what is important) and beliefs (i.e., how things work) that shape the firm’s structural arrangements and its members’ actions to produce behavioral norms (i.e., the way work is completed in the organization)”.

2.2.1 A Creative Culture

Amabile, Conti, Coon, Lazenby and Herron (1996) are among researchers who support the notion that creativity is a necessary property for innovation, and hence entrepreneurship, to occur (cited in Drazin & Schonhoven, 1996). They emphasise the psychological context in which entrepreneurs work, and how it can promote or inhibit creativity (Drazin & Schoonhoven, 1996). For any innovation project, a corporate entrepreneur is needed to drive it in its initial phase. Culture, leadership and mindset are heavy influencers on the context they work within (Ireland et. al., 2003). An entrepreneurial culture is a creative culture, and can be characterised by its commitments to the search for both new opportunities and advantages from existing resources. It challenges employees to promote innovation and change and justifies breaking of set rules if the goal is to pursue an attractive business opportunity (Leifer et. al. 2001).

An organisation wanting to facilitate an entrepreneurial culture should include innovativeness in their strategic objectives (McDermott & O’Connor, 2002) and provide the necessary means to execute the implications for such a culture and to sustain it (Dougherty & Hardy, 1996). This involves providing a necessary financial slack and also not to reject opportunities and ideas that might cannibalise the existing core business of the organisation if they simultaneously represent attractive business opportunities (McDermott & O’Connor, 2002).

2.3 Knowledge Functions

2.3.1 The Resource of Knowledge

Knowledge is integrated in practice, culture, and the human and social capital of the firm. Organisations, which are capable of building, acquiring, combining, recombining, deploying and redeploying their knowledge assets in congruence with the needs of their customers, are favoured in the competitive environment of today (Teece, 2000). Teece (2000) argues that it is the knowledge-based and high-flex companies, which are successful firms of the future. Knowledge is of little commercial value if it is not bundled with other knowledge or other assets. Teece (2000) states that only when bundled with other intangible or tangible resources, can the full value of knowledge be extracted. Research and development involve highly knowledge-intensive activities, and in this respect, R&D organisations stand for much of a firm's competitiveness.

Explicit and Tacit Knowledge

Literature on knowledge makes a distinction between knowledge and knowing (Orlikowski, 2002, cited in Easterby-Smith & Prieto, 2008). Polanyi (1967) theorised this distinction between two groups of knowledge early, the forms of explicit and tacit knowledge. Explicit knowledge is knowledge, which can easily be captured, transformed and articulated (Polanyi, 1967; Easterby-Smith & Prieto, 2008; Ireland et.al., 2003). Tacit knowledge is associated with individual skills and is often experiential and thus difficult to articulate and communicate to others (Polanyi, 1962; Alvarez & Busenitz, 2001; Easterby-Smith & Prieto, 2008). Tacit knowledge on the other hand resides in the human and social capital, in the forms of intuition, know-how, experience, procedures and relationships (Alvarez and Busenitz, 2001) and makes up important ingredients of an organisation's functional capabilities. Tacit knowledge is critical in the exploitation entrepreneurial opportunities and sustaining competitive advantage, in that it is necessary in order to bundle resources appropriately so that they make up capabilities. R&D involves extremely knowledge-intensive activities, and tacit knowledge is of particular importance for an R&D organisation. However it is important that the parties involved in the R&D activities have a shared interpretation of knowledge (Dougherty, 1992). Managerial decisions for forming efficient leveraging strategies for exploiting opportunities require tacit knowledge (Ireland et. al., 2003).

2.3.2 Knowledge Management

As a consequence of the increasing awareness of the strategic importance of knowledge, knowledge management has become a hot topic. The knowledge-based view assumes that knowledge is accumulated through a creative process

of exploration, and implemented through organisational exploitation (Alvarez & Busenitz, 2001). The process of utilising the knowledge in the exploration and exploitation processes helps the firm's knowledge to grow and add up to new knowledge.

Knowledge management is much about making the right knowledge available to the right people to the right time. Knowledge, which is placed in closed databanks, drawers or trapped in the minds of individual employees, cannot yield much value, because it is not readily available to other organisational members who might need it. Information float is defined as the time it takes from the absorption or creation of new knowledge until it is transferred, and a slow information float can be expensive in terms of opportunity costs (Teece, 2000). The multiplicity of routines, procedures and techniques whose purpose is to derive the most value and efficiency from the firm's knowledge assets make up knowledge management, and it is thus tightly tied to R&D. Information technology is a valuable assistant for knowledge management however the concept of knowledge management spans much more than clever use of IT tools.

Social Capital is Important for Knowledge Management

Management of social processes, networks and internal communities in organisations is important for an organisation attempting to handle the problems of sharing tacit knowledge, as well as assimilating new knowledge. Hence, Easterby-Smith and Prieto (2008) argue, should initiative of knowledge management involve processes for developing, sharing, and utilising tacit knowledge, skills and expertise. Management and shaping of the organisation's human and social capital becomes important in this instance. Internal social capital, or internal networks must be deliberately formed in order to ensure efficient diffusion of new knowledge and best practices. Networks, which are casually formed networks is not sufficient for this (Burt, 1997; Teece, 2000).

When individual human talent is employed and discharged, one can say that a transaction of personal knowledge takes place. Organisational knowledge and organisational competence is a different matter, as they are embedded in processes, routines and structures in the organisation. These types of knowledge are not mobile and replaceable; they cannot be transferred without the transfer of clusters of individual organisational members who possess established patterns of working together (Teece, 2000). The common way to obtain this is through personal relations or alliances, joint ventures or M&A's of entire business units (Teece, 2000).

Why Knowledge Management?

Managing knowledge is especially relevant for R&D organisations, as it concerns identification, development and leveraging of knowledge in order to help the organisation to compete (Alavi & Leidner, 2001, cited in Easterby-Smith & Prieto, 2008). Even the technology leader can be perceived as a laggard if it manages and transfers technology and information in a poor way compared to competitors (Teece, 2000).

Within large international organisations, the distribution of competence is dispersed globally, and because knowledge is so important for building competitive advantage internal knowledge transfer is of particular strategic and competitive importance (Teece, 2000). R&D sites, plants or top management's offices are just examples of where relevant and important knowledge may be stored. The critical capability is the capability to weave all important and related knowledge together so that it makes sense and meaning in total amount. Geographical and cross-functional integration of knowledge is of crucial importance (Teece, 2000).

2.3.3 Organisational Learning

Learning, investigation, imitation, regeneration, and technological change are components of organisational efforts to improve performance and strengthen competitive advantage (March, 1991). They all involve adaptation to changing market conditions and trade-offs between exploration and exploitation strategies (March, 1991). The trade-off involves conflicts between short-run and long run concerns - and between gains to individual knowledge and gains to collective knowledge (March, 1991).

Organisational learning processes are social and collective in nature, and occur either through imitation of other actors or because of joint contributions to the understanding of complex problems (Teece et. al., 1997). Individual skills are highly relevant for organisational learning, however their value depends on their employment in the organisational setting (Teece et. al., 1997). Organisational knowledge is stored in procedures, rules, norms and forms, and accumulated over time; as the organisation learns from its members (March, 1991). Also the individual members of the organisation learn from the organisation, in that they are socialised and adopt organisational beliefs. This mutual learning is a valuable and important feature, determinant for how the organisation is equipped for meeting changes in the competitive environment and managing the exploration-exploitation trade-off (March, 1991).

Knowledge Equilibrium

Members of organisations become socialised to the languages, beliefs, procedures and practices that together comprise the organisational code (Whyte, 1957; Van Maanen, 1973, cited in March, 1991). A too rapid socialisation process will be at the expense of the amount of exploration activities the organisation commits. When the beliefs and knowledge of the code and individuals converge, the possibilities for improvement of the code are reduced. March (1991, p. 80) claims, that “once a knowledge equilibrium is achieved, it is sustained indefinitely”. This has a negative impact in the long run, especially for organisations operating in industries with turbulent conditions, as the beliefs of the organisation and its members remain the same, and are unable to change, even as the environment changes (March, 1991). An appropriate turnover of people within the organisation, will according to March (1991) increase exploration and improve accumulated knowledge. This is much due to the fact that the wide knowledge of “organisational veterans” is already implemented in the organisational code, and thus becomes redundant. It follows, that the veterans don’t contribute with new knowledge for the code to adopt. On the other hand, newcomers to the organisation - or “aspirants”- have less individual knowledge, however their knowledge is not redundant with the code, and often more updated than the code’s knowledge. This way, aspirants are more likely to contribute with new knowledge and thus improve the code (March, 1991).

Innovation and change go hand in hand, and so does change and learning. For an organisation to be able to change, it has to be able to absorb new knowledge, transform and apply it. Again, it is the people in the organisation, who represent the crucial ingredient for learning and integration of new knowledge.

2.4 Innovation-To-Organisation Problems

Much of an organisation's innovation feats stem from the R&D body of the organisation. Organisations, wanting to be innovative, must raise a creative culture within their research bodies, first and foremost. However the R&D departments may be as creative as they wish for no purpose, if their ideas are not supported and followed at the organisation's top level.

2.4.1 Organisational Inertia

Organisational inertia is a major reason for why incumbents so often fail to respond to changes in the market place and when they do respond; why their response is so often hobbling. The phenomenon appears in large and complex organisations, as a result of the organisation's size, complexity, internal structures and processes; and also by external relationships. The sub-factors, which in an innovation-context, make up organisational inertia; are referred to as Innovation-to-Organisation Problems by Dougherty and Hardy (1996). Innovation-to-organisation-problems are the problems connected to an organisation's inability to connect new products to organisational resources, processes, and strategy, and its consequent lack of power to pioneer innovation (Dougherty & Hardy, 1996). Innovation-to-organisation problems also slows down the response to challenges brought forth by radical innovations in the market, such as changing customer demands, new and powerful entrants, or even creative destruction of the entire industry. Innovation-to-organisation problems appear on an organisational level, however the research organisation may experience its own unique innovation-to- organisation problems. I will focus my attention towards the innovation-to-organisation problems concerning the research organisation mainly, as general innovation-to-organisation problems are out of the scope of this assignment.

2.4.2 Innovation-to-Organisation Problems

Innovation and Strategy

Studies show a correlation between a lack of strategic connection and innovation failure (e.g., Cooper & Kleinschmidt, 1987, cited in Dougherty & Hardy, 1996). Fast (1978, cited in Dougherty & Hardy, 1996) found that many new product ventures failed because they suddenly no longer fit with the strategic orientation of the organisation, or their political positions faded away and became rejected by the organisational power structure. When innovation is excluded from the organisation's strategy, it becomes excluded from senior management's agenda (Burgelman, 1983).

Stability Appreciation and Fear for Cannibalisation

Economic models suggest that incumbent firms which enjoy a certain market power will invest less in producing radical innovations themselves, in the fear of cannibalising the profitability of their existing product lines (Gilbert, Newbery & Reinganum, 1984; Reinganum, 1983, cited in Hill & Rothaermel, 2003), and in the fear of an upheaval in the market which may become out of their control and produce attractive business opportunities for new entrants or even competitors (Henderson, 1993; Reinganum, 1983, cited in Hill & Rothaermel, 2001). These organisations will seek incremental innovations rather than radical ones. Incremental innovations require only small “addings” to their existing knowledge base without making parts of the organisation and business, such as core competencies or existing product lines, redundant (Gilbert & Newbery, 1982; Reinganum, 1983, cited in Hill & Rothaermel, 2003). As for R&D organisations, one should assume that they are intrigued by radical innovations and the opportunities it brings with it. However, researchers too, are creatures of habit, and may be afraid of cannibalisation of existing research projects.

Core Competencies and Core Rigidities

The challenge of connecting innovations with routine operations is widely recognised (Burns & Stalker, 1961; Kanter, 1983, cited in Dougherty & Hardy, 1996). Optimised routines, highly integrated capabilities and core competencies; developed and refined through years of stable operation yield a certain competitive edge in stable markets. However, core competencies can, in the occasion of rapid change in the environment, suddenly become core rigidities. Ireland et. al. (2003) describe core rigidities as inflexible capabilities hindering the acquisition of new resources, which in turn can be bundled into value-creating capabilities. Core rigidities contribute to organisational inertia and an inability to create wealth, and thus lead to declining competitive advantages (Leonard-Barton, 1995, cited in Ireland et. al., 2003).

Blinker Capabilities

Highly integrated capabilities often hinder the organisation from searching for knowledge and solutions outside of its organisational boundaries (Levitt & March, 1988, cited in Hill & Rothaermel, 2003). Once profit-yielding capabilities can over time become blinkers and prevents discovery of new opportunities. Cohen and Levinthal (1990, cited in Hill & Rothaermel, 2003) blame this phenomenon on a lack of absorptive capacity, and they use this to explain the inability of incumbents to respond to market discontinuities brought forth by a radical innovation. Absorptive capacity will be discussed further in a later chapter.

Path Dependency

Because the organisation has developed specific paths and formulas for bundling resources, it loses its abilities to radically alter the resource base in order to exploit opportunities and develop competitive advantages – or respond to challenges and remain their current market position (Ireland et. al., 2003). This may lead to only incremental changes in capabilities - also when the time has come, when more significant changes are required (Lei, Hitt & Bettis, 1996; cited in Ireland et. al., 2003). The asset of dynamic capabilities, deals with this pitfall explicitly. Dynamic capabilities will be discussed in chapter 2.6.

Conflicting Interests

As a large organisation consists of heterogeneous groups of individuals with different priorities and ambitions, there are numerous different – and conflicting interests within all large organisations (Hill & Rothaermel, 2003), and also within research organisations. This, combined with the competition for scarce resources, leads to complex management systems and bureaucracy; and hence to inflexibility and a time lag in any initiative involving change, whether structural or strategic. Innovation becomes exposed for negative responses.

Strategic Value and Meaning

Without strategic meaning, innovation becomes tenuous and fragile, and easily rooted out, much due to the uncertainty and risks associated with it. When meaning is lost, processes and resources also fall apart (Dougherty & Hardy, 1996). Dougherty and Heller (1994, cited in Dougherty & Hardy, 1996) found that the activities of product innovation were illegitimate in large, mature firms, either violating prevailing norms or falling into a vacuum; no shared understanding existed to make them meaningful. When innovation is not emphasised in the corporate strategy, then the organisation's culture will not value innovation, hence no such innovation-friendly atmosphere will arise. When the organisation does not value innovation, the innovation-oriented strategic behaviour also becomes illegitimate and not a part of anyone's responsibilities (Dougherty & Hardy, 1996).

Negative Autonomous Strategic Behaviour

If the organisation's management fails to motivate the organisational members, consequences can be fatal. The concept of autonomous strategic behaviour is not always merely positive for an organisation. If an organisational member is not satisfied with top management's strategic orientation or decision making, then he or she may spread the dissatisfaction to other organisational members, influencing and encouraging them to act differently from top management's instructions. This negative behaviour may be apparent, as a demonstrative act, or hidden, secretly opposing or boycotting the initiative for innovative R&D efforts.

Institutional Leadership and Segmental Structures and Processes

Structures and processes in mature organisations are too often not designed for organisation-wide collaboration and problem solving (Dougherty & Hardy, 1996). Rather than innovation, they tend to emphasise and sustain routine work, a solution that does not work well in R&D organisations attempting to be innovative. Fixed structures can hinder decision making from flowing upwards and sideways, and hence cause power imbalances between organisational divisions and individuals. Dougherty and Hardy state that organisational routines limit inter-functional interaction and inhibit the development of customer understanding. The problem of institutional leadership entails managers' protection and promotion of values internally in the division (Selsnick, 1957), which may lead to incongruence and suspiciousness among divisions in the organisation; further inhibiting communication and collaboration, and change. Institutional leadership and the feature of specialised tasks may bring about unhealthy culture in an organisation. Resources are prevented from flowing across organisational boundaries, and a too high specialisation of tasks makes employees routine-oriented and improvisation becomes an illegitimate activity. The Not-Invented-Here syndrome (NIH-syndrome) also represents a severe barrier to innovation (Katz and Allen, 1982). The NIH-syndrome asserts itself when researchers at one R&D centre neglect to apply research results and technology, which is not developed at their own site and can be a direct consequence of institutional leadership.

Reward Systems

Burgelman (1983) explains that because managers at divisional levels are well aware that their career prospects depend on their achievements – which will be measured – they tend to become more risk averse. Hence the organisation becomes more risk averse when it comes to innovation, because the new idea must pass through a number of middle managers who are focused on how the organisational risk related to the innovation will transform into a personal risk for them (Burgelman, 1983). Middle managers will evaluate ideas and proposals in the light of measurements and rewards. Dougherty and Hardy (1996) claim that the reward system punishes people for stepping out of established work roles, and thus hinders innovation.

Resource Unavailability

It is a problem in large organisations that resources do not always flow smoothly to innovation, because practices and routines support established activities (Dougherty & Hardy, 1996). A new innovation project may not be able to connect with supporting assets unless someone with organisational power steps in to strengthen its position, according to Day (1994; Dougherty & Hardy, 1996).

Dougherty and Hardy advice mature organisations against relying on product champions and networks of entrepreneurial roles and relationships, to take care of innovation in the organisation and making sure that resources are appropriated for the purpose. In many R&D organisations, resources are spent on “reinventing the wheel” as a result of lack of communication between the different R&D units. If communication and collaboration are enhanced, more efficient use of resources will be possible.

Power and Politics

Both processes of exploration and exploitation are of vital importance for organisations, however the two compete for scarce resources (March, 1991). The control of scarce resources causes political conflicts. Every organisational change will bring along a redistribution of power and influence over the resources in the organisation, which can throw the organisation into upheaval and chaos if no strong leader appears. Such internal strifes can in turn slow down or hinder attempts to transform the organisation and bring it back to balance. The result of this will be a relative organisational inertia and organisational decline (Pfeffer, 1992, cited in Hill & Rothaermel, 2003).

2.5 Innovation-to-Organisation Connections

2.5.1 Strategic Behaviour and Innovation Champions

Burgelman (1983) makes a distinction between two kinds of strategic activities; the ones that are induced by the firm's outspoken strategy and the ones that emerge as autonomous activities – and fall outside the current strategic scope of the organisation. Induced strategic behaviour identifies opportunities within the frames provided by the strategy. Typical examples are behaviours related to new product development for existing businesses, market development for existing products, and capital investments in existing businesses (Burgelman, 1983); induced behaviour follows the corporate strategy. Autonomous strategic behaviour on the other hand is related to exploration, and brings to the firm new categories in the definition of opportunities. Autonomous strategic behaviour involves internal entrepreneurs who recognise the opportunities, engage in championing efforts and perform strategic persuasion efforts in order to create momentum for the development (Burgelman, 1983). Autonomous strategic behaviour is inclined to propose ideas, which conflict with the corporate strategic objectives, and in this way cause tension or reluctance among managers. Middle managers behaving autonomous for innovation, typically try to convince top management to support a broader scope of strategy, which opens for new business activity. People who are prone to autonomous strategic behaviour for innovation are commonly referred to as innovation champions (Day, 1994).

Innovation champions may lead the company in to new and attractive markets as they propose to alter the current strategic scope; on what is considered the relevant environment for the business. Burgelman (1983) describes autonomous strategic behaviour as a source of raw material for strategic renewal, and claim that they precede changes in corporate strategy.

2.5.2 Dependence on Innovation Champions

Dougherty and Hardy found in their 1996 study that innovation creation depended primarily on individuals rather on the organisational system. This means, that organisation systems are often not arranged to accommodate autonomous strategic behaviour among employees, rather they are arranged in ways that inhibit it.

Management must not rely on innovation champions for fighting the system for bringing forth innovations. Rather, they must reorganise parts of the organisational structure in order to accommodate them. If the organisational system is designed to accommodate innovation processes, then more innovation

champions are likely to appear – in turn providing the organisation with a larger selection of opportunities for innovatively expanding the business scope. The organisation should make innovation-to-organisation connections in order to encourage innovation champions and facilitate an entrepreneurial culture within the organisation.

2.5.3 Making Innovation-to-Organisation Connections

Many mature organisations have difficulties with achieving sustained innovation because the innovators within them are unable to solve innovation-to-organisation problems (Dougherty & Hardy, 1996). In order to overcome innovation-to-organisation problems, the organisation needs to make innovation-to-organisation connections (Dougherty & Hardy, 1996). Innovation-to-organisation connections aim at solving innovation-to-organisation problems, which cause; and are caused by, organisational inertia. Dougherty and Hardy point at three keys for overcoming innovation-to-organisation problems; (1) collaborative structures and processes, (2) resource availability and (3) innovation drivers incorporated in the strategy.

(1) Collaborative Structures and Processes

Innovation projects need administrative processes appropriate to their specific development stage; and access to decision-making across the organisation (Jelinek & Schoonhoven, 1990). Structures and processes can be designed for continuous decision-making, problem raising and follow-up. Collaborative structures should connect in all directions; laterally and vertically, encouraging employees from all organisational levels and from all divisions to participate in the R&D processes and to make sure that resources are available and can flow smoothly to the projects which need them (Kanter, 1983, 1988; Quinn, 1985; cited in Jelinek & Schoonhoven, 1990). By facilitating communication and collaboration across boundaries, the social capital and culture will grow stronger, making the flow of resources and the organisation as a whole, more flexible (Burt, 1997).

(2) Strategic Value and Meaning

A corporate strategy which articulates and illustrates in practice that it values innovation, encourages and welcomes initiative, and rewards individuals and groups who resolve problems, will motivate organisational members to pursue and welcome innovation and change, and enhance organisational learning at the same time. New ideas should be nurtured; and problems should be raised and solved at a continuous basis (Kanter, 1983, cited in Dougherty & Hardy, 1996). This yields for the R&D organisation especially; as it is in R&D that new ideas for innovation are often captured. The corporate strategy should not contain any contradictory features to innovation, like cost control or stability pressures. If it

does, then the organisation's members are likely to mistrust the top management's devotion to innovation, leading to a decrease in personal motivation and a decay of the creative culture (Dougherty & Hardy, 1996).

(3) Resource Availability

Financial means, human resources, information, competencies, expertise and equipment are different types of resources, which need to become available for an innovation to be developed and commercialised within the organisation. Resources should be channelled to the innovators and provide a slack for errors and mistakes. These resources should be allocated deliberately to promote and foster innovation. Information about markets and customers should be made available and flow unrestrained throughout the organisation (Moorman, 1995, cited in Dougherty & Hardy, 1996). Expertise and equipment from all organisational divisions should be made available so that the new ideas can be tested and verified (Dougherty, 1992). In order to successfully manage both innovation projects and mature businesses, organisations should ideally have a resource system that channels money, equipment, expertise, and information to all of these activities at the same time. Examples of such concrete systems are idea libraries, pockets of seed money and innovation hubs.

Idea Library for Innovation: An organisation, which possesses an entrepreneurial culture and benefits from entrepreneurial leadership, encourages innovative ideas to be presented, and has the possibility of building an idea library. All suggestions and ideas are gathered in one place. This makes it easier to gather and combine related ideas, and to make the channelling of resources to the innovative projects easier and more accepted. Every opportunity and idea should of course not be pursued, however the larger selection, the greater potential for one of them being the path to success. When an idea library exist, real options logics should be applied in order to screen the ideas, possibly combine some of them, and decide which ones to pursue.

Pockets of Seed Money: Jelinek and Shoonhoven (1990) suggest that pockets of seed money for innovation projects should be made available throughout the organisation in order to encourage innovative autonomous strategic behaviour. This structural financial feature provides a financial slack for innovation, and permits innovators to experiment without having to worry about penalties if they do not succeed.

Innovation Hub: Establishing a hub for innovation is taking the idea library one step further. A hub is an independent organisational entity, whose objective is to gather, screen, select and commercialise new opportunities for the business (Leifer et. al., 2001). Hubs should be located centrally, and manage the

organisation's idea library for innovation. A hub should have access to all kinds of resources, whether human or financial, throughout the organisation. "Idea hunters" and "idea gatherers" employed by the hub, search the organisation and the environment for new opportunities and ideas, and specialise on the process of evaluating them and selecting the ones worth to pursue. The hub should also be responsible for putting together a project team for the selected innovation projects. Van de Ven (1986; Wheelwright & Clark, 1992, cited in Jelinek & Schoonhoven, 1990) say, that multifunctional teams should be put in place early in any internal new venture, and have access to human resources in the form of task forces.

2.6 R&D and Dynamic Capabilities

2.6.1 What are Dynamic Capabilities?

The concept of Dynamic Capabilities is an own framework, and originated within the field of strategic management. According to Teece and his colleagues (1997), the framework integrates and builds upon a whole string of different research fields; such as R&D management, product development, process development, manufacturing, technology transfer, intellectual properties, human resources and organisational learning.

The shadow side of strategising from an inside-out perspective, is that competencies can become too specialised, and thus cause a lock-in effect on the firm if market demand changes and core competences turn into core rigidities (Leonard-Barton, 1995; Dougherty & Hardy, 1996). In order to be prepared for changing market demands, or other industry features, the firm should possess well-developed dynamic capabilities.

Definitions

Teece, Pisano and Schuen (1997) introduced the dynamic capability framework in 1997. Though profitability flows partly from the firm's asset structure and the degree of VRIN resources, Teece and his colleagues argue, that it is also derived from the firm's ability to adapt, transform and reconfigure. A capability is defined as the capacity of a group of resources, to execute tasks or activities. Dynamic capabilities (DC) are capabilities that make the organisation capable of reconfiguration, transformation and change. They are embedded in the organisation's processes and oriented towards enabling organisational evolution and change (Zott 2001, cited in Zahra & George, 2002). The assets of dynamic capabilities are crucial for firms, which value new technology, and seek to gain competitive advantage through R&D and innovation. The larger and more complex the organisation is, the more lagged response on market or industry changes, and an organisation possessing functional dynamic capabilities, will have great advantage when faced with a radical innovation.

The concept of dynamic capabilities is strongly related to resource-based theory, because it concerns the ability to combine, configure, recombine and reconfigure resources in order to keep up with - or create - changes in the market place. Dynamic capabilities rest on firm processes that can alter current positions; which brings on effects on the firm's competitive advantage and performance and may also have an impact on future paths and positions of the firm (Helfat & Peteraf, 2009).

2.6.2 Absorptive Capacity – a Dynamic Capability

Teece (2007) view dynamic capabilities as made up of three dimensions; (1) the capacity and ability to discover opportunities and threats (2) the capacity and ability to seize the opportunities and turn them in to wealth-generating capabilities or offers and (3) the ability to sustain competitive advantage through improving, combining, protecting and reconfiguring the firm's material and immaterial resources. The first two dimensions are commonly referred to as Absorptive Capacity in literature. Absorptive capacity appeared as a research area long before the emergence of the dynamic capability concept, however it has, in recent years become accepted as part of the dynamic capability framework. Zahra and George (2002) viewed absorptive capacity as a dynamic capability; which could also be object of change and redefinition, and considered it part of the firm's knowledge-based assets (Floyd & Lane, 2000, cited in Zahra & George, 2002).

The definitions of absorptive capacity are manifold, however Cohen and Levinthal (1990, cited in Zahra & George, 2002) have offered the most widely cited one; viewing it as an organisation's ability to recognise the value of new information, assimilate it, and apply it commercially. This makes absorptive capacity a vital prerequisite for R&D and innovation. Ireland et. al. (2003) refer to absorptive capacity as the organisation's ability to access and internalise externally generated knowledge and claim that it in this manner represents a source of opportunities for value creation. These definitions include Teece's first dimension of dynamic capabilities in the concept of absorptive capacity; the capacity and ability to discover opportunities.

Viewed differently, absorptive capacity is a collective term for dynamic capabilities, which deal with knowledge creation, acquisition, transformation and application. This reasoning is consistent with Zahra and George's (2002) statement, that absorptive capacity is in fact a dynamic capability, concerned with creation and utilisation of knowledge with the objective of enhancing the firm's ability to obtain and sustain competitive edge.

Realised and Potential Absorptive Capacities

Zahra and George reconceptualised the term of absorptive capacity in 2002, and introduced a differentiation between potential and realised absorptive capacities; where potential capacity comprises knowledge acquisition and assimilation capabilities (Teece's first dimension of DC), and realised capacity includes transformation and exploitation of the knowledge - including also Teece's second dimension of DC into the absorptive capacity bundle; the ability to seize the opportunities make them generate wealth.

Potential absorptive capacity, Zahra and George (2002) argue, yields flexibility to adapt and evolve in high-velocity environments. The ability to scan the environment and evaluate market changes and competitor behaviours is crucial for any firm (Teece et. al., 1997), in order to detect threats and opportunities in the market. Potential absorptive capacities involve processes for efficient prioritising of internal and external R&D activities and choosing new technologies. Processes for identifying changing customer needs and requirements, customer innovation and market systems are also important components of the opportunity-recognising dimension of dynamic capabilities.

Realised absorptive capacity involves a different, but related set of assets, namely the structures and procedures for seizing opportunities. These include the ability to change the business model to correspond to the product or service, and processes for selecting the right opportunity to seize. It follows, that decision-making protocols are crucial for these activities. Here, it is important that the firm emphasises that decision errors caused by what Teece calls “anti-cannibalisation proclivity” is avoided. The ability to recognise market shifts is also part of this second dimension of dynamic capabilities. The reasoning for setting boundaries for the business in order to find a suitable business scope is also considered a dynamic capability, which helps the firm stay focused and pursue the right opportunities. Shaping of the attitudes and evoking loyalty, as well as commitment, participation and motivation among organisational members, is underscored as a particularly important dynamic capability. In all, Teece’s second dimension of dynamic capabilities involve creating and shaping the organisational culture so that employees and the organisation are fit to seize and pursue opportunities.

2.6.3 Maintaining a Dynamic Resource Base

Teece’s third dimension of DC is about how to sustain competitive advantage through improving, combining, protecting and reconfiguring the firm’s material, and immaterial resources. This includes features such as organisational learning, knowledge transformation and conversion, and protection of know-how and intellectual property rights; all of which are relevant actions for R&D. Also, structures for decentralised decision-making, openness to “open innovation”, and development of capacities for integration- and coordination are important (Teece, 2007). On the managerial and functional side, systems for incentives and reward should be adjusted to match the desire for flexibility and dynamic adaptability.

Dynamic Capabilities and Organisational Learning

Teece et. al. view dynamic capabilities as a coordinative management process; which facilitate inter-organisational and intra-organisational learning. All

capabilities embody past learning, and may therefore be depreciated if they remain unused over periods of time (Helfat et al., 2007; Nelson & Winter, 1982; cited in Helfat & Peteraf, 2009). Alliances and partnerships with other organisations as well as internally between divisions of one organisation can catalyse organisational learning, in that it helps recognising dysfunctional routines and provides linkages to new knowledge bases (Doz & Schuen, 1990; Mody, 1993, cited in Teece et. al., 1997). Teece also emphasises a feature, which he calls co-specialisation. In this term, lies the importance of specialising on what the firm does good, and team up with other actors who possess complementary assets in order to create a product or service that generates rents. Here, it must be underlined that all commitments to external actors should be analysed for the possibility of becoming restraining factors in the face of a radical innovation. In all, strategy should be adapted so that the combinations of resources yield increased value (Teece, 2007); in true RBT spirit.

Dynamic Capabilities and the R&D Organisation

Essentially, DC is really much of what R&D activities of an organisation is all about (Winter, 2003): reconfiguring and recombining different assets and resources to make new resources, which can yield competitive advantage for the organisation.

Senior researchers who are able to recognise and combine new advancements within R&D from different areas make up an important factor for corporate R&D strategies (Kuemmerle, 1997), and may make up key employees for the organisation's dynamic capabilities. Absorptive capacity in the R&D organisation is made up by several mechanisms; participation in informal and formal meeting circles within the area the R&D unit is located or in knowledge clusters is one of them. Employing staff with work experience from within competitor organisations is another one, and also the sourcing of R&D equipment and services from suppliers, which are also used by competitors (Kuemmerle, 1997).

R&D outcomes are often highly uncertain, requiring continuous reconsideration and adjustment of the research agenda and strategy of the company. Speed and firmness are keys for succeeding in the marketplace; both in terms of making decisions for terminating projects that seem to have no positive future and in terms of pushing projects that bring about unexpectedly positive results.

Dynamic Capabilities and the Ability to Innovate

Within the functional perspectives, there are many different aspects, which can be connected to the activities related to innovation. Knowledge certainly plays a central role for innovation. Without the ability to screen the environment for new knowledge, the organisation will be unable to discover opportunities for

innovation. Similarly, without the ability to absorb the knowledge, which is necessary in order to make the decision on whether to pursue an entrepreneurial opportunity or not, and without the ability to transform new knowledge and make it usable in order to successfully innovate, the organisation is not likely to succeed in a market where change and innovation is common.

Teece (2000) claims that superior performance depends on the firm's ability to protect knowledge resources and to use them in order to be innovative. Using knowledge assets covers up some complex processes related to (i) integration of intangible resources with other intangible resources and also with tangible assets; (ii) the transfer of intangible resources inside the firm; and (iii) discerning external licensing of technology when and where appropriate (Teece, 2000).

2.6.4 Who Needs Dynamic Capabilities?

Dynamic capabilities are of critical importance to companies operating in environments characterised by rapid and discontinuous change. In addition the asset of dynamic capabilities provides a potential to ensure an ongoing adaption so that disruptive change within the firm becomes less necessary (O'Reilly & Tushman, 2007; Helfat & Peteraf, 2009).

Teece et. al. (1997) underline that narcissistic organisations, which are operating in environments characterised by continuous change, will in time be impaired. Whether organisational change, change in production operations, market demand or competitive landscape, or change in product offering and competitive attributes, large and complex organisations face challenges and need dynamic capabilities to meet them. New knowledge needs to stream in to the organisation, and the ability to reconfigure and transform the resource base; even perhaps the organisation as a whole, can be reckoned as a learned organisational skill, and this is what dynamic capabilities is all about.

Teece argues, that in order to behave more entrepreneurial, firms should exhibit dynamic capabilities (Teece, 2000). High-flex and responsive firms possess some attributes: (1) flexible organisational boundaries, which are a presumption in favour for strategic alliances and outsourcing, (2) high-powered incentives, as an encouragement to ready response to competitors, (3) non-bureaucratic and decentralised decision-making structures, autocratic or self-managed where feasible, (4) flat structure to facilitate rapid and smooth flows of information and effective decision making, and (5) a creative and entrepreneurial culture which favours nurturing of specialised knowledge and rapid response (Teece, 2000).

2.6.5 Summing Up: Dynamic Capabilities for Innovation

Innovation entails some kind of change. For incumbent organisations, this change can be associated with the environment; or the way the organisation operates; with whom it interacts, what kind of services or products it offers; change in how the organisation is organised; or in the way the business units collaborate. Mature organisations with long histories of stable operations and predictable demand and profitability have had the opportunity to refine and perfect their core competences and capabilities through years of routine operations (Dougherty & Hardy, 1996). These organisations have limited experience with change, and thus, their response to external changes is often lagged in time and hobbling in performance. That is – if they respond at all. Some organisations are so reluctant to change, they refuse to view their market position as threatened, and merely go on with their operations as if nothing has changed around them – eventually eliminating their own competitiveness.

In any case, radical innovation will lead to an organisational change, which in turn requires the organisation and its members to adopt, and adapt to, new knowledge. Teece and his colleagues (1997) state that it is the ability to learn, acquire skills, and accumulate organisational experience and knowledge, that represent the greatest strategic potential.

Knowledge and organisational change are two important dimensions tied to the challenge for complex organisations of being innovative. New knowledge is necessary for the discovery of new opportunities, and organisational change is essential for seizing the opportunities and developing competencies, which can again turn in to competitive advantage. Human beings are the central players and determinants for the assimilation and utilisation of knowledge, and also for the facilitation of organisational change. Human reactions and actions are determinant when the organisation is faced with challenges set forth by a radical innovation. It is the skills of the human capital, which makes the organisation capable of qualitatively analysing the successfulness of new initiatives and change, and how one can proceed, in order to improve processes and operations. Therefore, people are also the decisive factors for developing dynamic capabilities.

2.7 R&D Organisations and R&D Trends

2.7.1 R&D Trend Towards Internationalisation

Today's increasing globalisation of markets along with the rapid change in technologies and the regionalisation of technical and scientific expertise are requiring technology-based companies to continuously adjust their R&D organisations (Gassmann & Zedtwitz, 1999). The trend of R&D internationalisation is driven by two main factors: proximity for relevant markets and the search for centres of innovation (Vöhringer, 1997, cited in Gassmann & Zedtwitz, 1999).

R&D laboratories have traditionally been concentrated in the western world. However increasingly, new R&D sites are created in South-East Asia's recently industrialised economies. Competition from these economies may be harsh, as they benefit from low labour costs. Additionally, protectionism tends to stand strong in developing countries, and especially for primary industries because a country's first steps into industrialisation usually start with heavy industries (Gassmann & Zedtwitz, 1999). Nevertheless, Gassmann and Zedtwitz (1999) argue that the extensive international distribution of R&D in many companies is more a result of strategic decisions which are not directly connected to R&D, such as mergers and acquisitions, tax considerations or political pressures, than an effect of the ascending trend of rationally and strategically planning of R&D locations.

In the 60s and 70s, internal knowledge transfer was regarded as flowing one-way mainly; from the R&D sites to other departments in the organisation, and further out to the rest of the world (Teece, 2000). This perception has changed dramatically since then; R&D is no longer centralised in the same manner, and knowledge flows in all directions within and outside of the organisation. Sources of new knowledge are geographically dispersed, so the flow is required to flow from the decentralised units to the R&D centre, and also between and among the different decentralised units (Teece, 2000). The R&D department is no longer considered merely a factory for producing new knowledge. Rather, it makes use of external knowledge and combines it with internally developed technologies to create products and solutions, which will possibly yield competitive advantage.

With R&D internationalisation come cross-national R&D management; and managing organisational boundaries is a significantly more complex and costly process than is the management of local R&D departments. Gassmann and Zedtwitz (1999) suggest that the additional costs of coordinating R&D internationally, should be levelled out by synergy effects like enhanced

efficiency, a decrease in the time-to-market and better organisational capabilities for learning.

Traditionally, firms with home bases in industrialised countries have employed foreign manufacturers because of the lower wages or with the objective of overcoming barriers for trade. Nowadays, the objective is different; the foreign manufacturing facilities' tasks are increasingly complex in nature requiring close cooperation with R&D facilities. In order to cut down the period of time it takes to transfer a new technology to become a manufactured product, R&D facilities are often located in geographic proximity of the plant. Globalisation, continuous technological development, technological breakthroughs and hyper competition have augmented the competitive scope of most businesses and industries, forcing them to see their position and industry with faint geographical boundaries and not allowing them to take their position within the industry for granted.

2.7.2 Challenges Concerning Acquisition Strategies

Mergers and acquisitions of innovative, new thinking firms have become a common strategy among large organisations to obtain access to new technologies quickly. This strategy brings about challenges for the acquiring part, to rearrange R&D activities for both firms in order to ensure synergy effects. The decision of what is the optimal organisation of R&D should be based on the category of R&D activities and the present dispersion of value-adding activities such as the coordination of the many contributors to the R&D process, and also production, marketing and sales (Gassmann & Zedtwitz, 1999).

According to Gerpott (1994; cited in Gassmann & Zedtwitz, 1999), post-acquisition strategy decisions should be made centrally in order to gain advantages of a clear R&D strategy and rapid implementation of necessary organisational changes. The benefits of this should outweigh motivational costs that may incur at the acquired R&D units. Gerpott underlines the importance of initiating integration programs for additional improvement of the R&D cooperation between the sites of the acquiring and the acquired part (Gassmann & Zedtwitz, 1999).

2.7.3 Five Main Types of R&D Organisation

Despite a number of typologies of international R&D, a description of the dynamics of international R&D organisation is still missing. The development and change of concrete organisational configurations and their basic behavioural orientations deserves more attention in research (Gassmann & Zedtwitz, 1999).

Gassmann and Zedtwitz distinguish between five different forms of R&D organisations. They are the (1) Ethnocentric centralised R&D, (2) Geocentric centralised R&D, (3) Polycentric decentralised R&D, (4) R&D hub model, and (5) Integrated R&D network.

Ethnocentric Centralised R&D: For an ethnocentric centralised R&D organisation, the assumption is made that the home country is technologically superior to subsidiaries and affiliates in other countries. This assumption affects the structures of decision-making and information flows in favour of the R&D unit in the home country. Standardised management systems and a common understanding of values and vision among the physically consolidated R&D employees facilitates information flows and control of R&D activities. On the other hand, the ethnocentric centralised R&D model provides an insufficient sensitivity for changes and signals from foreign markets and hinders the firm from providing an adequate consideration of market demands (Gassmann & Zedtwitz, 1999). This may negatively affect the dynamic capabilities of the firm, to observe, discover and capture opportunities in the markets in which it operates.

The Not-Invented-Here syndrome (NIH-syndrome) is also more likely to appear in an R&D organisation based on the ethnocentric centralised model. The structure also tends to be rigid (Quinn, 1985; cited in Gassmann & Zedtwitz, 1999). The ethnocentric organisation is inappropriate in companies, which depend on foreign markets and local competencies.

Geocentric Centralised R&D: The geocentric centralised organisation is globally oriented, but also retains the efficiency advantage of centralisation. Strong ties between the home-based R&D centre and global production plants are present, and the plants are main providers of customer feedback and new market demands. IT network systems connect the organisation and may accelerate innovation processes as employees outside the R&D organisation gain access to the researchers and their work (Gassmann & Zedtwitz, 1999).

The thought is that knowledge of externally available technologies from international R&D societies is to be accumulated at a central R&D site. R&D personnel exchange between R&D units across national borders is encouraged in order to enhance communication and collaboration with local suppliers and customers. Such exchange of R&D personnel at all levels foster cross-functional collaboration, which represents an indirect mean for R&D coordination.

Polycentric Decentralised R&D: A polycentric R&D structure contains a decentralised union of R&D sites, but lacks a supervising R&D centre. This

structure is often the result of M&A activities where the potential synergies in R&D reorganisation have yet to be exploited. Information flows between foreign sites and the home base may be limited in amounts and contents. This R&D organisation model is optimal for local market monitoring and exploitation of local resources, however drawbacks are potential principal-agency problems (little incentive to share information with other R&D units) as a result of a too high autonomy. Cross-border coordination may also be restrained because of strategic autonomous behaviour in efforts to preserve national identity and site autonomy. This again, can potentially lead to organisational inefficiency and redundant R&D activities. A polycentric R&D structure may also lead the firm to lose focus on a particular technology and hence hinder technology convergence, making the portfolio inconsistent (Gassmann & Zedtwitz, 1999).

R&D Hub Model: The hub model for R&D involves a central R&D centre, which coordinates the activities of several decentralised R&D centres. This model makes the risk for R&D duplication and suboptimal resource allocation less significant. The flow of information between the R&D centre and all of the dispersed R&D units should be thorough and regular. The R&D centre is also required to occupy the necessary competence to maintain the role as technology leader and coordinate the global R&D activities in a justifiable manner (Gassmann & Zedtwitz, 1999).

The R&D hub is controlled centrally and provides a quick sensing of local demands simultaneously as global R&D integration is sustained (Gassmann & Zedtwitz, 1999). The model ensures a variety of input from markets and exploits the competences in dispersed R&D sites. Coordination costs are however high for a hub model, and the risk for creativity, initiative and flexibility suppression become imminent at the decentralised R&D sites (Gassmann & Zedtwitz, 1999).

Integrated R&D Network: The integrated R&D network involves a competency centre among several interdependent R&D units. The competency centre does not necessarily need to be the centre of control of the firm's R&D activities. The R&D units are related and interconnected by multiple flexible coordination mechanisms (Gassmann & Zedtwitz, 1999).

Every R&D units have equal rights and duties, and the flexible connections between them enable an enhanced allocation and exploitation of the competencies possessed by the organisation. In this manner, scale and specialisation effects can be realised and the risk of duplicate R&D is decreased. Multi-site projects makes focusing on common goals easier achievable, and also makes the R&D organisation more flexible because of their temporary character (Gassmann & Zedtwitz, 1999).

The main difference from a hub structure is that in the integrated network, each R&D unit assume a strategic role, which may affect the whole firm. The competence centre takes on the role as monitor and sensor for external changes, and defines the appropriate strategies for development of new businesses or markets. A condition for making the network operations and coordination of activities efficient is a well-functioning global IT infrastructure (Boutellier et al., 1998; cited in Gassmann & Zedtwitz, 1999).

2.7.4 Trend Towards Integrated R&D Network

The centralised approaches to R&D are becoming more and more inappropriate in many markets because (1) increasing amounts of sources for relevant knowledge are emerging across the world. This makes presence at an increasing number of locations vital for firms; they need to gain access to new technologies and knowledge and absorb trends and new knowledge from local competitors and universities. The other reason (2) is that the speed with which products must be moved from a development stage to the commercialisation stage is increasing as companies are competing on a global scale. R&D networks for tapping into new centres of knowledge, and commercialising products in local markets around the world becomes crucial for firms in order to remain their competitiveness (Kuemmerle, 1997).

Multinational companies have commonly shifted their R&D organisations from a hub or a polycentric structure to an integrated network structure. The motivation for this shift in configuration is to identify and exploit potential synergies between the manifold R&D units (Gassmann & Zedtwitz, 1999).

Integrated R&D networks should be supported by career paths; offering both vertical and cross-functional and lateral assignments. This asset should increase the breadth of perspective both for individual employees and for the organisation as a whole. Such mechanisms also increase inter-organisational flexibility and enhance learning processes (Gassmann & Zedtwitz, 1999).

2.7.5 Categorisation of R&D Units

The purpose and objective of all R&D sites should be clearly articulated and communicated to the R&D staff throughout the organisation. Kuemmerle (1997) has made a two-branched categorisation of mission for R&D units. The first category concerns what he refers to as home-base-augmenting R&D; sites established with the objective of tapping knowledge from competitors and universities in markets all around the world. Information flow is directed from the foreign R&D site towards the central competency centre. The second category involves home-base-exploiting R&D; the sites in this category are

established to provide support for production facilities in foreign markets or to adapt products to the local demands of their worldwide markets. Information flow is directed to the foreign R&D site from the central competency centre.

2.8 Theory Discussion

2.8.1 Strategic Entrepreneurship, Ambidexterity and Dynamic Capabilities' Interrelationship

An entrepreneurial mindset, leadership and culture, combined with a strategic management of the firm's resources will help the organisation to strike the difficult balance between exploration and exploitation (Tushman & O'Reilly, 1996; Ireland et. al., 2003). An ambidextrous organisation can be viewed as an organisation, which has overcome the innovation-to-organisation problems by means of its dynamic capabilities, and which masters the fine balance between exploration and exploitation. Ambidextrous organisations successfully manage the four tensions mentioned previously, and improvise and decide in each situation which alternative is best. They possess sets of dynamic capabilities, appropriately developed for their contexts and environments. The abilities to reconfigure and transform the firm's resource base in a timely manner relative to the market evolution are processes assisted by structural attributes, such as local autonomy and decentralisation. When these are refined and perfected, they make the firm high-flex (Teece et. al., 1997), and enable it to be ambidextrous.

Strategic entrepreneurship theory does not mention dynamic capabilities explicitly, however the moves an organisation must make in order to employ strategic entrepreneurship are moves, which can potentially lead to growth of dynamic capabilities. Ambidexterity and strategic entrepreneurship are also concepts, which can be viewed as linked. An ambidextrous organisation makes use of strategic entrepreneurship in order to strike the difficult balance between exploration and exploitation, and I argue, that the ability to do so entails the possession of dynamic capabilities. The dynamic capabilities, which enable the organisation to become ambidextrous, must be rooted also in the research organisation of the firm. If the R&D body is not creative, flexible or innovative, then the dynamic capabilities and other capacities of the rest of the organisation is likely to fall through. Much of a company's dynamic capabilities are sourced from the R&D organisation.

Exploration activities may result in a new venture in the organisation, causing the organisation to act entrepreneurial. Innovation and organisational renewal or transformation involves a redefinition of the business concept and entails system-wide organisational changes (Zahra, 1993, cited in Sharma & Chrisman, 1999). Resources must be redeployed, the corporate mission may be altered and redefined and this should lead to new combinations of technologies and products - innovations (Zahra, 1993). O'Reilly and Tushman (2007) argue that the property of ambidexterity can become a dynamic capability only if firm

resources are reconfigured repeatedly and intentionally; so that they are able to meet internal and external demands in change.

The theoretical concepts of strategic entrepreneurship, dynamic capabilities and ambidexterity can be understood as closely related. One way of viewing their interrelationships is to say that the approach of strategic entrepreneurship provides a favourable context for dynamic capabilities to grow, and dynamic capabilities make the firm ambidextrous and able to balance between exploration and exploitation.

2.8.2 Context for Growth of Dynamic Capabilities

The development of dynamic capabilities will seldom or never happen automatically in an organisation, it needs to be accommodated by top management and members of the organisation. Dynamic capabilities cannot be put in place overnight, but must be built, shaped and developed over an extended period of time. Top management should strive to create a context, which facilitates and encourages the growth of dynamic capabilities. The creation of such a context involves structural, strategic and cultural moves.

Structural Moves

The R&D organisation should structurally be organised in a way that makes communication and collaboration across organisational boundaries possible and valued. This will inhibit destructive factors, such as institutional leadership, and strengthen the internal social capital of the organisation. An efficient social capital and increased collaboration across boundaries will ease the flow resources across the organisation, and make them more accessible for innovation projects. Collaboration across boundaries will also prevent parallel development and “reinventing of the wheel”. Financial resources should be made readily available for new projects; for example in the form of pockets of seed money earmarked for innovation purposes. This will provide a financial slack for experimentation, and encourage autonomous strategic behaviour for the purpose of innovation. Independent organisational entities like hubs can also be put in place. Hubs can be beneficial in large and complex organisations, because they represent a place where all new opportunities and ideas can be gathered and evaluated. Employees in the hubs have the chance to build strong networks internally and externally, which become useful in the process of commercialising new ideas. Hubs should also be empowered to access all kinds of resources from all organisational subdivisions, and put together appropriate teams for each innovation project.

Strategic Moves

A valuation of innovation and change must be articulated and emphasised in the organisation's strategy if the organisation wishes to become innovative. Short-term profitability should not outmanoeuvre long-term objectives for innovation, and anti-cannibalisation proclivity among managers must be eliminated (Teece, 2000). An innovation-oriented organisation should possess a dynamic work force, which does not get caught up in habits and routines, but rather values challenges, improvisation and change. Innovation and change must have a strategic meaning for organisational members.

Cultural Moves

The work force of an innovative organisation must possess entrepreneurial mindsets both individually and collectively. Entrepreneurial leadership and a strategy which emphasises innovation and change will yield change a strategic value and meaning for organisational members. When change is expected, and the organisation works for continuous renewal and improvement, then the organisational culture may also become oriented towards change.

The organisational culture is the most powerful tool for top management to manage the people of the organisation. The culture must be developed and instilled in the organisational members over time, but it can be influenced through entrepreneurial leadership, an innovation-oriented strategy, clearly defined core values and also by recruitment routines; what kind of people and mindsets are the organisation looking for? An entrepreneurial culture will influence the mindsets of individuals to become more entrepreneurial, and likewise, entrepreneurial mindsets of individuals will influence the collective mindset and culture to become entrepreneurial. This iterative and mutual process of influence will constantly reinforce the entrepreneurial culture and mindsets, further orienting the organisation towards change and innovation.

2.8.3 A Dynamic Interplay

It is the interplay between an innovation-oriented structure, strategy and culture, which provides a breeding ground for the growth of efficient dynamic capabilities. An entrepreneurial organisation needs dynamic capabilities in order to be able to change rapidly and be flexible to seize entrepreneurial opportunities when they arise. Mechanical moves, such as organising the organisation and formulating the strategy in favour for change and innovation can easily be obtained. However when these structural and strategic moves have been executed, the dynamic capabilities must be allowed to develop and grow over time. In the end, it is the people of the organisation who are the final determinants of the development of most dynamic capabilities.

2.8.4 Human Beings are the Core of R&D Activities

Most of a firm's knowledge and skills reside in the people who work there (Hitt, Bierman, et al., 2001; Miller, 2002, cited in Ireland et. al., 2003) and it follows, that human capital is an essential factor for R&D. Human beings are the most important factor for the assimilation and utilisation of knowledge, and also for the facilitation of organisational change. Because human beings are needed to come up with creative ideas and suggestions, their actions and reactions are determinant for the performance of the R&D organisation. If innovation and change are to occur they need to be initiated by people within the organisation. It is first and foremost the humans, who must be influenced to welcome change and be prone to innovation.

Without human beings, innovation cannot take place. It takes a human being to come up with an idea, to present it to others, and persuade them to pursue it, and to make it happen. Without the support from humans, no innovation would occur because IT systems, procedures and routines cannot think or act creatively. On the other hand, human beings also represent frequent inhibitors of innovative projects. Change reluctance, risk averseness and a favour for the known are attributes, which reside in many human beings, and which make their appearance when resisting innovation and change in the organisation.

2.8.5 Organisational Culture as a Governance System

Getting the People Aboard

Motivating the people of the organisation seems to be the "secret sauce" for establishing an encouraging, creative culture and well-functioning dynamic capabilities. Whereas organisational mechanisms are important antecedents for dynamic capabilities, organisational culture and ambidexterity, it is the individuals of the organisation who make them useful (Raisch et. al., 2009).

Large organisations are faced with the challenge of managing the collective beliefs, attitudes and behaviour of the human capital of their organisations, and I believe, that the key for being able to develop well-functional dynamic capabilities lies in getting the organisational members aboard. An organisation can make manifold structural innovation-to-organisation connections; but if the masses of organisational members dislike or disagree with top management's objectives, all incentives may be to no avail. The people of the organisation make up a vital factor for building functional dynamic capabilities. The dynamic capabilities, which are partly or wholly made up by human skills and tacit knowledge, are the resources, which are the most difficult to imitate, and represent the greatest strategic value.

Involvement and Anchoring

Activities of bringing forth a successful innovation are not straight forward, and cannot be taught by books. Dynamic capabilities are needed for the organisation to be able to improvise and pull through innovation processes, and the human capital should be influenced through leadership, core values and the corporate culture (Ireland et. al., 2003). These factors help encouraging them to behave in congruence with the organisation's goals. Strategic and structural approaches for overcoming innovation-to-organisation problems are, at the end of the day, really about accommodating the organisation so that a healthy entrepreneurial culture can arise, and human behaviour can shape and develop dynamic capabilities. In order to build dynamic capabilities, the organisation must *get the people aboard*. However, in order for the people to get aboard, they must agree with the organisation's strategic objectives and feel an anchoring in the organisation.

From a functional perspective, activities related to innovation and managing internal new ventures, should be promoted and accepted as important activities, in which all members in the organisation can participate (Dougherty, 1992). Top level managers should set the strategic orientation and direction, however all organisational members should be invited to help solve problems and make criteria for assessment (Quinn, 1985, cited in Burgelman, 1983). Involvement creates shared responsibility, legitimates and energizes people for innovation (Jelinek & Schoonhoven 1990; Dougherty & Hardy, 1999). Autonomous strategic behaviour should be encouraged, because it represents a substantial source of innovative ideas and opportunities. This kind of involvement may make autonomous strategic behaviour apparent to top management. Autonomous strategic behaviour for innovation is often hidden in early phases; out of fear that top management will turn the potential project down prematurely. If autonomous strategic behaviour is embraced by top management, and considered a source of new opportunities; like Burgelman (1983) argues it to be, then more of it will occur, providing the organisation with more knowledge, more opportunities and more dedicated employees. Innovation champions in particular should be given the freedom to steer some of the choices to be made (Dougherty & Hardy, 1996).

Behaviour for Innovation

Organisational culture is the most powerful tool for managing the behaviour of the organisational members. The culture of an organisation actively influences the ability of individuals within the organisation to innovate. A strong entrepreneurial and creative culture encourages innovation in that new ideas will not be frowned upon, and that there is an underlying positivity for innovation among the individuals on all levels in the organisation. In order to

create such an entrepreneurial culture, the organisation needs leaders with an entrepreneurial mindset, and a corporate strategy, which accepts innovation as part of it (Ireland et. al., 2003). Dougherty and Hardy point at the importance that innovation has strategic value and meaning among organisational members as a mean for overcoming innovation-to-organisation problems and inertia. The strategic meaning of innovation can be reinforced by changes in processes and resources. If implemented concurrently with changes in the meaning of innovation, new processes can begin to link the right people and emphasise the right criteria, and resources can begin to flow to the right places (Dougherty & Hardy, 1996). When the organisation takes these actions for shaping a healthy and change-prone culture and for structurally facilitating flexibility in the organisation, it starts the process of building dynamic capabilities.

Management should seek to eliminate unhealthy cultures and thereby, unwanted strategic behaviour in the organisation. Organisations seeking to be innovative should emphasise the building of a strong entrepreneurial culture and rely on it as a government structure. When the organisational members are empowered, they become energised, and more inclined to change and dynamism. When the organisation's strategic objectives gain anchoring among the individual organisational members, they strive to behave for the benefit of the organisation.

Social capital is influenced by a healthy culture, which brings with it relationships based on respect and trust. Without these features, relationships are typically defined by contracts, which cost both time and money, and increase the risk for opportunistic behaviour from one of the parts involved. Effective internal social capital will make the creation of lateral and vertical collaboration among organisational members easier, and also influence the degree, to which these collaborations are successful (Ireland et. al., 2003), making the organisation more flexible. A unifying organisational culture leads to more collaboration across of organisational boundaries, and more flexible organisational entities. This in turn, makes the flow of resources and knowledge exchange within the organisation more simple and smooth.

An organisation, which actively uses its culture as a system for governance, becomes more flexible than an organisation relying on more formal governance structures. A strong organisational culture makes the management system more flexible, and levels out the hierarchy of the organisation. This may make organisational entities more autonomous, and positively encourages strategic autonomous behaviour among the organisational members, which is positive for the development of a healthy attitude toward change, and for building functional dynamic capabilities.

The minds and mindsets of the individual members of the organisation influences, and are influenced by, the organisational culture, and if all of these are healthy and entrepreneurial, the organisation should be well equipped for defining relevant dynamic capabilities, and building them. In order to keep a dynamic work force, issues should be raised; and goals should be renegotiated at regular bases; and thorough follow-up should ensure that set targets are achieved (Jelinek & Schoonhoven, 1990; Dougherty & Hardy, 1996).

3. Hydro Introduction

3.1 An Introduction of Hydro

3.1.1 About the Corporation

Norsk Hydro ASA (Hydro) is a Norwegian aluminium company. Headquartered in Oslo, Norway, Hydro operates in over 40 countries on all continents, and is the world's fourth largest integrated aluminium corporation. The corporation employs about 23 000 people, and the Norwegian state holds a 43.8 percent ownership interest in it. As a global supplier of Aluminium, Hydro controls the value chain from extraction of bauxite to production of extruded and rolled aluminium products and building systems.

Hydro is one of the world's leading suppliers of primary aluminium, fabricated aluminium products and fabricated aluminium products. The company is an industry leader for several downstream markets and products. Hydro serves a bundle of different industries; including electronics, automotive and transport, building and construction, packaging, consumer goods, printing, general engineering, solar and heat exchanger industries.

3.1.2 History of Expansion and Divestiture¹

Hydro was founded in 1905, building on a new technology for using electricity to capture nitrogen from the atmosphere, invented by professor Kristian Birkeland. As access to hydroelectric power was simple in Norway, the cost and complexity of creating nitrogen-based fertilisers was relatively low, and this became the corner stone product of the new firm, which was about to become one of the first industrial giants in the young country Norway. After some challenging periods during the depression in the 1930s and World War 2, the company experienced substantial growth, moving into new business areas in petroleum, light metals and plastics. Hydro started international expansion in the 1970s. The following decades, the aluminium and petroleum activities were further expanded, and in 2004, Yara International was established as an independent company, taking the industrial gas and fertiliser businesses out of the Hydro corporation. Through the StatoilHydro amalgamation of 2007, Hydro's oil and gas operations were merged with Statoil, leaving behind what constitutes Hydro today; a global integrated Aluminium company. Hydro has acquired the German company VAW and the Brazilian company Vale since then.

3.1.3 The Aluminium Industry

The aluminium industry depends heavily on international trade, as markets for aluminium are global. The industry's top markets are transportation, food

¹ Source: www.hydro.com 2010

packaging, beverage cans and building construction, all of which in Hydro is involved. Especially, the transportation market has experienced a considerable growth from the mid-90's and the trend is expected to continue as more and more of the middle class throughout the world is expanding, and more and more people can afford to buy cars. Aluminium has overtaken iron in the transportation industry.

Recycling is a critical factor in the aluminium industry, as it is environmentally more friendly than mining new raw material and also its impact on production costs is favourable. The recycling process requires only about 5 percent of the energy needed for the process of producing aluminium from bauxite, and because of this, it also represents a significant opportunity for aluminium companies.

The aluminium industry is oriented towards consolidation and global competition. The rise of China, volatility in raw material prices together with efficient cost management in the industry are among factors which have driven these trends. Critical factors in the industry are size of operation, efficient management, access to production inputs and raw materials and research and development. Competitive advantage can be derived from access to unique energy sources, raw material and proprietary knowledge of among others, smelters technologies. The industry is mature, so cost leadership is important, driving R&D on process innovation.

3.1.4 Hydro's Strategy and Corporate Commitments

Hydro aims at constantly improving production efficiency and securing continuous access to bauxite, alumina and electrical power. The organisation has gone through some major structural and strategic changes the last decade, with divestitures and acquisitions. The fertilisation and petroleum businesses have been sold out, and Hydro has acquired aluminium companies to ensure competence and access to raw material in the future. The acquisition of Vale secured production of bauxite and alumina for the foreseeable future.

Minimising Waste: Hydro has an outspoken goal of minimising the amount of waste and to reuse and recycle it. Projects are running at a continuous basis, working on different ways to achieve this goal.

Reducing Emissions: Hydro has reduced emissions significantly the last years and strives to achieve further reductions.

Remelting and Recycling: Aluminium possesses the unique property that it can be recycled over and over again with no quality degradation. The recycling process requires up to 95 percent less energy than primary production of aluminium.

Hydro is a large global remelter of aluminium, owning more than 30 remelting facilities worldwide. The recycling strategy of Hydro is to grow faster than the market for recycling and take a leading position in this relatively young part of the value chain. The aluminium industry has become recognised as a pioneer in the field of recycling and materials recovery. Aluminium is currently the most recycled post-consumer metal in the world. 75% of all aluminium ever produced in the world is still in use.

Dedication to Innovation

Hydro states that their core activities concerns implementing and commercializing innovative product ideas. Innovation often happens in joint projects with customers whose needs have been identified. Close collaboration with customers with the purpose of reducing energy consumption and emissions is also valued in the organisation's strategy. Hydro constantly seeks to achieve incremental innovations in their production and operations. Efforts to reduce power consumption and emissions and to enhance productivity, performance and safety stand strong in the organisation.

3.1.5 Value Chain

Hydro's value chain looks roughly like illustrated in the figure.



Figure 1: Hydro's value chain

Primary Aluminium (PA) comprises the upstream part of the value chain, involving mining and refining of Bauxite and Alumina. Raw aluminium is delivered to Metal Market (MM), which produce and sell semi-manufactured articles such as bolts and billets. Extruded Products (EP) is the next step in the value chain, and represents a large business area extruding products, which are used in a number of different industries, such as the car industry and the construction industry. The last step is Rolled Products (RP), manufacturing products for the packaging industry, the car industry and the printing industry. The steps in the value chain represent the different business sectors the corporation Hydro operates within.

3.1.6 Research and Development

Hydro About Their R&D

Hydro's technology board aims to enhance innovation and ensure that Hydro maintains its position as a technology leader. President and CEO Svein Richard Brandtzæg is the head of the board. A number of Hydro R&D sites are located in Europe and there is a technology and competence centre in Doha, Qatar, and one in Holland, Michigan. Main R&D tasks are connected to smelter technology and product development. The goal for R&D in Hydro is to reduce costs and broaden potential areas for growth. Expertise and technology development within the field of alloys triggers product innovation by offering materials with new and unique sets of properties. The R&D organisation of Hydro is characterised by technical competence of high levels, and a low turnover of people.

R&D's Strategic Objective

The strategic objective of each R&D centre is to support and yield value to their business partners, or internal clients within their specific business sector. They are to have the competence, which is required by their clients. Process improvement, cost reduction and development of new technologies are activities, by which the R&D centres serve their clients.

Project Execution

The head of each centre is responsible for managing the project portfolio at any time. He or she reports to an operational committee, where the head of R&D is seated, along with the head of the business sector the centre serves.

The business partners and R&D centres collaborate on project planning. Budgetary frames and project regulations are set for one year each autumn. The leaders of the R&D centres present their results and operations once a year to the business partners. Each project is dedicated a steering committee with representatives from the customer, who makes decisions on technical matters regarding the project. The steering committees monitor the progression of the projects, and the steering committee's leader is a client representative.

3.1.7 Presentation of the Case Centres

The case centres in this assignment are the core of Hydro's mid and downstream R&D organisation.

RTD at Sunndalsøra

Research Technology Development (RTD) at Sunndalsøra is one of the larger R&D centres in the R&D organisation, with approximately 50 employees. The

centre's main clients are Metal Market and Primary Metal. Focus for R&D activities is optimisation of the casting houses, and process and product are important areas. RTD has a flat structural model with a small managing team.

The location at Sunndalsøra is historical; the old casting house needed to be located close to energy, and the R&D centre had to be close to the casting house. The location is not close to Hydro's current markets however it is close to Sunndal Verk, and also to NTNU, with which RTD have several joint projects.

RDB in Bonn

Research Development Bonn (RDB) is the largest R&D centre in mid and downstream R&D, with around 100 employees. The centre in Bonn entered into the R&D organisation when the German company VAW was acquired by Hydro in 2002. The centre's main client is Rolled Products, which is situated in geographic proximity. Within the Rolled Products business area, RDB has strategic research partnerships with the University of Aachen in Germany, aiming at modelling the whole rolling process chain.

ECC

Extrusion Competence Centre (ECC) consists of 15 people, spread out in different parts of the organisation. The client group is made up of 18 shingling roll plants all over Europe; Extrusion Eurasia. Process improvement and enhanced quality on the products are focused upon, in addition to development of production tools. The geographical dispersion makes the team very virtual, however they meet at telephone regularly. The structure in ECC is flat. ECC's work is project related, and mostly oriented towards process improvement projects. While RTD and RDB have more pure research, and cooperate with universities and other research milieus, the tasks in ECC are more dedicated to improvement of operations.

PTTC at Karmøy

Precision Tubing Technology Centre (PTTC) employs thirteen people, who are spread at different sites in different countries. The main client of the "centre" is Extruded Products, and PTTC's research is very focused on process and product optimisation. Eight tubing plants make up the customer base, and they produce thin-walled aluminium tubes. PTTC is tightly integrated with their customers.

PTTC and ECC are very alike. PTTC are dedicated to precision tubing, which is a client within the same business sector as ECC serves; Extruded Products. PTTC was originally part of ECC.

3.1.8 R&D Management

Hydro's R&D management team meet roughly every 1,5 month. R&D management includes one representative from each R&D centre in mid and downstream R&D, along with Head of R&D Helge Jansen, and his economist. The extended management team also include all of the field managers from ECC, and the leader teams from RTD and RDB. The extended management team are supposed to work with innovation, creativity, and how to get people in R&D to come together, exchange personnel and knowledge, and collaborate more closely. They meet 2-4 times a year. The extended management team is also involved in the revision.

4. Methodology

4.1. Methodology

4.1.1 Introduction

The original Greek meaning of the word method is “a route that leads to the goal” (Kvale, 1996) and this chapter will present the strategy, design and methodology of my research. The time limit for this assignment is 14 June 2011, and it was therefore natural to limit the number of interviewees to make up the empirical foundation for my findings. The interviewees were selected in cooperation with my Hydro contact person, Trond Furu, and the selection was based on their positions within the research organisation as well as their role and involvement in the process of revision, which Hydro’s R&D organisation is currently going through.

I will not formulate and test any hypothesis but rather collect information concerning critical factors hindering the performance of Hydro’s R&D organisation. The qualitative approach for information collection is consistent with the objective of the study, namely to identify factors impacting the performance of the R&D organisation. The tool for information gathering in this thesis is the case study method, and as method for analysis, grounded theory has been applied.

4.1.2 Academic Literature Search

Preliminary Study

My preliminary project assignment was written with a master thesis in collaboration with Hydro in mind, although I did not know exactly what the problem definition and focus for the master thesis would be prior to the project assignment. I was acquainted with the CROC project, which Hydro was involved in, as my supervisor had told me about it, and I had a talk about it with other students who had been involved in the Hydro CROC project in relation to their master theses. The project assignment is a broad literature study with the vast topic “Radical Innovation in Mature Organisations”.

Formulation of Problem Definition

Trond Furu and I discussed the theme and scope of the assignment, and formulated the problem definition and research objectives of the thesis. I had little knowledge on the specific topic of R&D organisation beforehand, however, I was determined to use much of my knowledge from the project assignment when defining the scope of the thesis. The problem definition is closely related to the themes of the project assignment.

Literature Search

After having decided on the problem definition and research objectives for the master thesis, I carried out a search for relevant literature. The preliminary work focused on mature organisations' relationship to radical innovation in general. The intention behind the new literature search was to gain more knowledge about the specific role of the R&D organisation in relation to radical innovation, and about different types of R&D organisations and how they are arranged.

I started out broadly, using general and simple search words and phrases, in order to see if I could identify one or more links between the subjects I had focused on in the project assignment and the new problem definition. My objective was to obtain a wide understanding and general overview of how the R&D body of large organisations is connected to the topics I had investigated before, when looking at radical innovation in mature organisations. I mainly searched for articles, as my time was limited. I wanted to gain a broad overview of different perspectives and theories within the field rather than a deeper understanding of selected theories.

The complete list of search words goes: R&D and dynamic capabilities, R&D organisation, strategic R&D, R&D and competitive advantage, R&D and innovation, R&D and corporate venturing, international R&D organisations, global R&D activity, R&D and internal venturing, R&D and absorptive capacity, R&D management

Authors

I was already familiar with a collection of authors from several research fields from my work with the project assignment. When searching for complementary literature, I looked first at the titles of the new articles I had found, when deciding upon which articles to read. The names of the authors were not decisive.

Rating

I had three criteria for ranking the articles during the literature search. These were, in prioritised order: (1) the degree of relevance based on the title and abstract of the articles, (2) authors whose names I recognised were prioritised over authors of whom I had not heard, and (3) number of citations of the articles.

The most frequent search word I used, was the combination of "R&D" and "large", and "mature organisations". I used these words in combination with several of the subjects from the different chapters in my project assignment. From this point of departure, I browsed the titles in the list of articles, and downloaded and printed out the ones that had a compelling title, which gave me

an idea that the content of the article would be relevant material in order to link the subjects from the project assignment to the issue of R&D restructuring

4.1.3 What is Research?

Research is a systematic and stringent investigation, from which a better understanding of a phenomenon is sought (Bryman, 2001). A specific set of steps and procedures is to be followed, the procedure of research is always planned and a methodology is set up.

Empiricism, Epistemology and Ontology

These terms are basic to all research work, and deserve a short introduction at this point. *Empiricism* suggests that the only knowledge acceptable is the knowledge, which is gained through the human senses and derived from experience. Empiricism is inductive in approach. Induction involves that the researcher bases his or her conclusions and implications on the collected data. Rather than formulating hypotheses to be tested, the investigation starts with a relatively thin foundation of theory, and the findings lead to new theory. *Epistemology* is the theory of knowledge, and concerns particularly the method, validity, scope and the distinction between justified belief and opinion. In short, epistemology is about what is accepted as knowledge within a discipline (Bryman, 2001). Epistemology is bifurcated into two orientations; interpretivism and positivism. Positivist positions argue, that methods applied in natural sciences can also be applied in studies of social reality. Interpretivism on the other hand, advocates that studies of the social world require a wholly different research approach and logic, reflecting the position that human beings are distinctively different from natural phenomena (Bryman, 2001). Interpretive orientations acknowledge the researcher's subjective understanding of the social interaction as part of the research results. *Ontology* is the enquiry into the nature of existence, and social ontology is concerned with the nature of social entities. The dilemma regarding social ontology is whether social entities can and should be considered objective entities, existing independently from the social actors, or if they are constructed by social actors based on their actions and perceptions. The former of these is referred to as objectivism, and the latter constructivism (Bryman, 2001). In the constructivist paradigm, it is accepted that the researcher's values and perceptions will by necessity influence the research results.

The epistemological orientation in this thesis is interpretative, meaning that human beings, institutions and social phenomena are perceived as fundamentally different from the domains of natural science, and cannot be investigated as scientific objects, in the way that a positivist position suggests (Bryman, 2001). The researcher's ontological orientation in this assignment is

constructivist. It is assumed that the social factors impacting the performance of the R&D organisation are shaped, and continuously revised by the communication and meanings of social actors in the organisation.

Influencing Factors

Personal values, emotions and beliefs of the researcher, along with his or her sense of ethics influence the choice of research design and the research process and results (Bryman, 2001). It is desirable, that the research strategy is defined in a way that lets the research be as little as possible impacted by the personal bias of the researcher. Practical considerations, such as resource availability, scope of time or the size of the selection are also factors, which influence the choice of research design of the study.

4.1.4 Strategy of Research

The research strategy describes the succession and order of the data collection and theory compilation. When defining the research strategy, one makes the decision whether the research is to have a quantitative or qualitative approach, or a combination of the two. Quantitative methods are usually deductive in nature, and associated with positivism and objectivism. Qualitative methods on the other hand, most often influenced by constructivism, and have an interpretive and inductive approach.

Social sciences rely heavily on qualitative methods, as they attempt to analyse everyday happenings and relationships between people and/or institutions. As the human being is placed at centre in social sciences, the qualitative methods applied are usually not fully repeatable. This study applies a qualitative research strategy, as the objective is to create an in-depth understanding of the challenges and dilemmas which Hydro's R&D management are facing. A goal is also to gain insight in their personal perceptions and understanding of the situation, and provide a third party contribution to their future work. By applying a qualitative research design, the participants are to a greater extent welcomed to explain their experiences and comprehensions, giving the researcher a deeper insight in the situation.

Qualitative Method

The objective of qualitative research is to understand the world, or a certain situation or phenomenon, from the subject's point of view. Qualitative interviews and observation aim at uncovering peoples comprehension of their lived world, independently of, and prior to, scientific explanations, by unfolding the meaning of their experiences (Kvale, 1996). Kvale (1996) denotes the qualitative interview as a "construction site of knowledge". Qualitative methods take into consideration subjective meanings and experiences in the data collection process

and analysis. If the researcher has limited prior knowledge about the conditions or phenomena he or she wishes to investigate, as in this case, a qualitative, inductive research strategy is often appropriate. Applying inductive methods, the researcher begins his or her study by identifying a phenomenon he or she wishes to investigate. Then it must be defined, what type of data is to be collected, and it must be reasoned as to why they are collected; about what they are meant to tell something about (Bryman, 2001). The collected data make up the foundation for the theories and conclusions proposed by the researcher for explaining the observations and phenomena. Inductive research is highly influenced by grounded theory.

Grounded Theory

Strauss and Glaser introduced grounded theory in 1967, as an inductive research methodology, where the researcher does not formulate any hypotheses prior to the data collection, but rather develops theories to explain observations made during the data collection process. Grounded theory is equated with qualitative research methods, while positivistic research can be more related to quantitative studies. Grounded theory's former name, constant comparative method, suggests that the researcher should be constantly open for new theories, which may even undermine and reject the theories already formulated. Though inductive, grounded theory also contains some deductive aspects, as it continuously compares research results to observations and analysis. In research processes based on grounded theory principles, the collection of data and analysis of collected data are run as parallel processes. The researcher is to make new investigations based on the theories and ideas he or she formulates based on the collected data, and systematically compare the observations (Charmaz, 2000). This way, grounded theory can be viewed as an interplay between both induction and deduction (Strauss & Corbin, 1990). The researcher is allowed to structure and restructure the results during the data collection process, evaluating and comparing former results to recent results after each interview (Martin & Turner, 1986), evaluating and comparing former results to recent results after each interview (Martin & Turner, 1986).

4.1.5 Choice of Research Design

The research design functions as a framework for data collection activities and analysis, and describes the plan for how the researcher will go about to obtain answers to his problem definitions.

The aim of the assignment has been to reveal potential areas for improvement of efficiency and latent synergy effects which have not been realised within Hydro's mid- and downstream R&D organisation. This study is exploratory in nature, and seeks to explore what conditions, circumstances, attitudes and relationships

affect the operations in the R&D organisation and explain them, rather than testing predefined hypotheses concerning cause-and-effect relationships. Based on this reflection, the case study method was chosen as research design for this study.

Multiple Case Studies

Case study research design can be exploratory, explanatory or descriptive in nature (Yin, 1993). In exploratory case studies, problem definitions and hypotheses are created based on the collected data. Explanatory research seeks to explain phenomena and problems and conclude on possible solutions or explanations to them. Descriptive case studies usually start with a theoretical point of view, leading to the investigation. Data is collected to describe the observed cause-and-effect relationships, but the researcher does not attempt to explain them.

By applying the case study method with multiple cases, I seek to gather subjective information about each of the four main centres in Hydro mid- and downstream R&D, and to get the viewpoint of the head of the R&D organisation as well. I seek to point out common factors between the R&D sites, but I am also interested in revealing conflicting issues. The problem definition for the assignment contains the interrogative “how”, and the research objectives are also interrogative in nature. This implies that the assignment will be of explanatory sort, and supports the choice of case studies (Yin, 1994) for the research design.

4.1.6 Choice of Analytic Tool

When the research strategy is set, and the research design selected, the researcher needs to decide upon what instrument he or she wishes to apply for data collection, the analytical tool (Bryman, 2001).

The purpose of this assignment is to make a recommendation to Hydro, on how their research body should be organised in order to gain the most value from it. There are many ways to gather information on how the current structure and system function, what aspects with it function well and where one can find factors that may be improved. As the author had limited knowledge about the organisation and its operations prior to the study, it was anticipated that information would come about, which was not thought of beforehand. Because of this, it fell natural to choose an inductive, qualitative method for data collection. Semi-structured interviews in four case studies applied in this assignment. Semi-structured interviews have the advantage that they let unforeseen, but relevant information come through, but still the researcher has an interview guide to lean

on during the interview. The pre-defined themes also simplify the coding process.

I will conduct a series of qualitative, semi-structured interviews with top-level managers in the part of Hydro's research body which is relevant in this thesis. The interviewees are key persons in R&D management, engaged in reorganising the R&D body. The interviews will be structured loosely in a series of superior main themes, which are all related to the structure and performance of the R&D organisation. Many of the themes are overlapping, and the thought is that the interviewees should be allowed to steer much of the focus of the interview, talking about the aspects of the R&D organisation that they personally feel have potential for improvement.

4.1.7 Disposition of the Case Study

Sample

This thesis' empirical foundation and research study is limited in amount, and the main focus is on revealing aspects in Hydro's research organisation, which could have worked better so that Hydro's return on investment in R&D is optimised. The selection of interviewees was limited to the R&D organisation's top-level managers, and it is assumed that they make up a representative selection for the R&D centres. This simplification is not entirely justified, however, the time limitation to the master thesis made it necessary. The head of the research organisation, and his R&D management team have all been interviewed. They are all heavily involved in the discussions and dilemmas concerning the revision of Hydro's R&D body, and they all know their R&D sites well. These people are familiar with the challenges that Hydro face, and know the cultures, work methods, processes and procedures of each R&D site.

Presentation of the Interviewees

The interviewees for this thesis are members of the management team for mid and downstream R&D. The management team includes the leaders of each of the R&D centres in mid- and downstream R&D, serving as case sites for this assignment. Beneath follows a short presentation of each of the interviewees.

Helge Jansen is the Head of the mid- and downstream R&D organisation in Hydro. He reports to the leader of the business area ECC, but also has a close relationship to Svein Richard Brandtzæg, Hydro's chief executive. Jansen has worked in different positions in the Hydro organisation for many years, and possesses a wide organisational network as well as a thorough understanding of

Hydro's organisation and operations. Helge Jansen is the owner of the process of revision, and the head of the R&D management team.

Trond Furu is a Senior Advisor in Hydro's mid- and downstream organisation, and is settled in RTD at Sunndalsøra. He attends both R&D Management Team meetings and Extended Management Team meetings. Trond takes care of much of RTD's cooperation with external affiliates such as Sintef and NTNU, and is also heavily involved in the revision process.

Nina Dahl is the leader of ECC, serving Extrusion Eurasia. She has been employed in Hydro for 2.5 years, and has a background from Sintef. She is responsible for managing the project portfolio, and also the relationship to the clients.

Hans Ivar Laukli leads RTD at Sunndalsøra, however, he is currently on leave in Switzerland, finishing a master's degree. Although not directly involved in the revision, he possesses thorough knowledge about the R&D organisation and especially about the conditions at RTD.

Kjersti Myhre currently holds three positions in Hydro. Originally, she is controller for mid- and downstream R&D. In addition, she occupies a 50% position for central R&D under the Head of R&D, and also a 50% as controller for RTD at Sunndalsøra. Now that Hans Ivar Laukli is on leave in Switzerland, she is also the acting leader of RTD. Although she has not been in Hydro for a long time, her insight in the organisation is vast.

Ole Daaland leads PTTC, serving Extruded Products. He manages the project portfolio and also has a close contact with the sector management; which represents PTTC's client plants.

Wolfgang Schneider leads RDB in Bonn. The intention was that he should have been interviewed as well, however it did not turn out that way.

Modus Operandi during Interviews

The semi-structured interviews were, as mentioned, loosely arranged in categories of themes and the intention was to execute the interview more like a natural conversation rather than a strict interview with questions and answers. The interviewee was given the opportunity to let his or her answers slide naturally over to other themes without being cut off by another question.

As I had limited knowledge about the R&D organisation, I was not sure what to look for, and where to start looking. I started broadly, with numerous interview themes and pertaining wide questions. The very first interview I executed was

intended to be a kind of a test of the interview guide and a practice in the activity of interviewing. My contact person at Hydro, Trond Furu, was the interviewee, and it turned out to be as much a presentation as an interview, as he brought power point slides from previous presentations. The purpose of the initial interview was as much to gain some fundamental knowledge about the R&D organisation as to be led in the right direction for defining the interview guide.

Initial interview themes included: Communication and Cooperation, Knowledge Transfer and Learning Across Boundaries, Culture and Competition, Strategic Value and Meaning, Strategy, Operations and Performance, Structure and Categorisation of R&D Organisation. Questions were spanning widely, and the themes were broad. After the "test" interview, the interview guide was revised, and the interviews could start. The second edition of the interview guide included the themes Organisational Culture, Objective and Focus, Performance, Structure and Communication and Knowledge Functions. The first round of interviews included interviews with head of the R&D organisation, Helge Jansen, Nina Dahl and Trond Furu. When these interviews were done with and transcribed, I started coding the results theoretically, looking for interesting findings, and common features in the interviewees' answers. The purpose of this initial analysis was to sharpen the interview guide, and maybe skip a few themes and include others.

Using the approach of an inductive-deductive interplay in this research study, the interview guide was continuously under alteration, as the interviews were completed and interesting observations and subjects were identified. The second round of interviews was executed after the Extended R&D Management Team meeting in Bonn, where the ongoing revision was the main theme. The third edition of the interview guide included the following themes: the Process of Revision, Communication and Collaboration, Innovation in Hydro, Organisational Culture, Organisational Structure and Focus and Strategy. The theme Innovation was included after my interview with Helge Jansen, who had many interesting thoughts around it. Some themes were omitted, and other themes were toned down a bit, and more tied to the theme of innovation.

The interview with Hans Ivar Laukli and Ole Daaland were carried out over phone, for practical reasons. I met Kjersti Myhre face to face, and before this second round of interviews, I sent out the interview guides in advance. It was planned that I would interview Wolfgang Schneider over telephone, too. However, after receiving the interview guide, he replied, that he was neither able nor willing to answer my questions before he had confirmation, that all information I obtained was kept confidential. A standard confidentiality agreement between NTNU, myself and Hydro has been signed, however we did

not succeed in arranging a new time for the interview before the analysis was finished and the proposals were set.

4.1.8 Data Analysis

Theoretical Coding

A factor which differentiates grounded theory from other qualitative research methodologies is the process for analysis; namely theoretical coding (Glaser, 1978). Glaser's system for coding is called "coding families", and is the common method for analysis of qualitative interviews. The method is simple, and four-stepped. Firstly, the collected data is dissected, and codes, which set off the key points of the data, are identified. Then, the codes, or anchors, are grouped into concepts, which are collections of codes with similar content. The "data portions" are then placed in categories by substance (Glaser, 1978) and the codes are grouped after the researcher's conception of correlation and connection. The categories are broad groups of similar concepts, making up the foundation for new theories anchored with empirical evidence (Glaser & Strauss, 1967).

In this assignment, Glaser's coding family system has been applied for theoretical coding of the data collection before analysis. During and after completion of the data collection process, the most important factors and observations were marked after substance, and the categories applied were: Step-Change Innovation, Internal Competition, Not-Invented-Here Syndrome, Setting of Budgets, Communication Across Business Sectors, Cultural Differences Between Sites, Structural Differences Between Sites, Integration of Bonn, Attitudes Towards Change, Strategic Focus, Multisite Projects, Best Practice, Setting the Strategic Agenda, Innovation Processes, Technology Watch², Measurement of Success in R&D, Sharing of Information and Knowledge, Unrealised Synergies and Internal Career Ladder. These codes were further grouped in concepts and placed in categories on which the theories and conclusions of this thesis are based (Glaser & Strauss, 1967). Some codes were cut in an early phase. The cut-down I did underway was based on where I thought I had interesting findings, and as a consequence of limited time scope and resources. The categories for the coding families are (1) Background for the Revision, (2) Organisational Structure, (3) Collaboration Between Sites, (4) Organisational Culture, (5) Competence Management and (6) Innovation Challenges.

All empirical data is available in the form of record tapes and transcripts of the interviews, though they are not handed in as part of this assignment.

² Technology Watch involves observation, tracking, screening and assessment of opportunities and threats appearing in the organisation's environment.

Theory and Empirical Data

It has been a goal for the researcher that the empirical data should be allowed to speak for themselves, and not be too influenced by the theories, which lie as a foundation of the researcher's interpretation.

As stated previously, grounded theory is a research methodology, where the processes of data collection and data analysis are run in parallel. This mix of induction and deduction is often referred to as axial coding. In axial coding, the concepts and categories are revised and altered continuously during both the data collection process and the data analysis process. Axial coding has been applied in this assignment, in that the "themes" of the interview guide have been changed, cut off and expanded. Those themes were directly linked to the codes, concepts and categories, and when the interview themes were changed under way, then it had direct implications for the theoretical coding as well. The focus of the assignment has been under constant revision during the data collection and analysis phases.

4.1.9 Methodology Critique

Critique of the Sample

All of the informants are highly educated, and have experience either from the Hydro organisation or from other R&D milieus. As the number of informants is limited to seven, it was important that all of the informants would be able to contribute a lot of information and knowledge, and that they were talkative and easy to communicate with. It fell natural to listen to Trond Furu's suggestions, as he had personal relationships to each of the interviewees and vouched for them. It was also important that the information they could give was relevant for the task at hand, and it made sense to choose representatives from each of the topical R&D sites, who were involved in the process of revision.

The informants' high positions within the R&D organisation can be both a strength and a weakness for the observations to be made. They are all in leader positions at their "own" R&D centres, and they know each other in that the R&D management team meets every 4-6 weeks to discuss R&D matters and strategies. These regular meetings with discussions may have shaped the opinions and comprehensions of the R&D organisation and its challenges, so that they are more alike than would be if one compared the opinions and comprehensions of participants who did not communicate with participants at the other sites. This again, may have affected the results, in that the informants are likely to share a somewhat uniform understanding on many of the problems the R&D organisation is facing. A broader selection containing participants from all levels

at each R&D site would solve this asymmetry, however, the scope and time limitations for this study have laid boundaries on the execution. It can be argued, that it would be interesting to make investigations at lower levels only, in each of the R&D sites, and skip the interviews with the R&D management team. This approach could possibly provide the researcher with observations of inequalities between the sites, which will be impossible to reveal by interviewing the management team only. Nevertheless, this too would likely produce a workload too heavy for one person and one master thesis only.

Strengths regarding the sample are that the sample constitutes all of the key decision makers in the revision process. The R&D management team and R&D committee are also involved in the setting of the research agenda, and are involved in the formulation of R&D strategy of Hydro. This means, that it is these people, who together have the overview of how the R&D organisation functions as a whole, and how each single R&D centre operates, and how the attitudes to the overall R&D organisation are at each site. As the ongoing process in Hydro's R&D organisation is at an early stage, and it is uncertain, whether distinct changes are to be made in the organisation, I found it wise to start with a sample of interviewees from the R&D top level management.

The sample would have appeared more complete if the leader of RDB in Bonn had been interviewed too. However, a time came, when I felt, that I had reached a satisfying theoretical saturation (Strauss & Corbin 1998). Theoretical saturation in this respect means that in the context of the findings I had made, the data collected by another interview would no longer illuminate my concept and findings (Bryman, 2001). I therefore chose not to push him for setting up a second interview date.

Representatives from RTD at Sunndalsøra are in majority in the sample. Three of the six interviewees have direct ties to RTD, while two are connected to ECC and PTTC respectively, and the remaining one is the head of R&D mid and downstream. Nevertheless, two of the three people with direct ties to RTD are also positioned in the central R&D organisation, directly under the Head of R&D, and therefore possess valuable knowledge and information about the organisation in its totality. It can so be argued, that they represent the R&D organisation centrally, rather than the one R&D centre at Sunndalsøra.

It also needs to be mentioned that in retrospect, when my proposal to Hydro is formulated, it makes sense to interview the leaders of the upstream R&D centre and Building Systems' R&D too. However, the time available limits the scope of the assignment, and further interviews and findings are left for an eventual sequel of the assignment, or a continuation of it, into a new master thesis.

Critique of Data Collection

I had access to consultant reports containing results from previous investigations of a similar theme in the same R&D organisation. These results may have shaped my opinions and perceptions of the R&D organisation, and lead the interview guide in a certain direction. I was not entirely unbiased when developing the interview guides and performing the interviews. However, the results from the report have not been examined thoroughly, and only once, at the beginning of the research process.

4.1.10 Justification for Choice of Methodology

The scope of the problem definition and the choice of research method have been influenced by the fact that this study is carried out by one person only, within a limited period of time. Initially, the plan was to execute qualitative semi-structured interviews with representatives from the two highest levels of management in the R&D organisation, and in parallel carry out questionnaires at lower levels, however, it was decided that this would mean a workload three or four times as big as the average workload of a masters thesis. The inductive approach is reasoned with the fact that the author had no initial knowledge of the specific features of Hydro's R&D organisation, and personally wished to gain a deep understanding of the challenges it faces through personal interviews and conversations. Although a theoretical foundation from the project assignment, I did not have any theoretical point of departure for the research, and wished to let the observations speak for themselves, and lead to as unbiased research results as possible. The constructivist ontological orientation goes hand in hand with the principles applied from grounded theory, that aspects from both inductive and deductive methods have been utilised. As the researcher went through the process of data collection, the process of analysis was also initiated. This resulted in an ever-changing interview guide, as new findings were revealed, and the researcher's focus changed. I acknowledge that, although I have attempted to view data as objectively as possible, my personal reasoning has influenced the research results - this is a natural part of constructivist orientation.

4.1.11 Trustworthiness

Any qualitative study should be accountable in order to appear trustworthy (Lincoln & Guba, 1985), and objectivity, reliability and validity are typical constructs for trustworthiness if quantitative studies, and not as adequate for qualitative studies. Validity and reliability are often associated with quantitative methods and positivism. This assignment is oriented towards interpretivism and constructivism; knowledge and meanings are constructed in collaboration with the subjects of the qualitative interviews. The constructivist approach makes it difficult to justify this study after positivistic concepts such as objectivity.

Confirmability, dependability, credibility and transferability are the equivalent constructs for trustworthiness of qualitative studies (Lincoln & Guba, 1985). In what follows, I will give a brief explanation of each of these, and thereafter explain how I have applied them to this study.

Confirmability can be established through an audit trail (Lincoln and Guba, 1985). An audit trail is a way of organising and documenting in-progress research, and a "residue of records stemming from the inquiry" (Lincoln & Guba, 1985. p. 319). My audit trail includes the recordings of all of the interviews, write-ups of the notes I made during the interviews and the transcriptions of them. The ever-changing interview guides and personal notes concerning the next step in the process, change of focus and altering of themes are also factors, which contribute to the complete audit trail (Lincoln & Guba, 1985). As stated, an extensive audit trail can make up confirmability of the study, but it can also determine its dependability (Lincoln & Guba, 1985). Dependability can be displayed by showing that it has been taken "into account both factors of instability and factors of phenomenal or design induced change" (Lincoln & Guba, 1985, p. 299).

A study's credibility depends on the researcher's skills in proving that the collected data is representative, and that his or her theories and conclusions are credible to the original reality (Lincoln & Guba, 1985). The credibility can be paralleled to the concept of ecological validity, which is appropriate for quantitative methods. I have enhanced the credibility of this study by handing in drafts of the assignment to my supervisors, and taking note of their feedback. The preliminary literature study also enhances credibility, functioning like a strong theoretical foundation on which my conclusions are based. Member checking is also a way of enhancing the credibility of the study, and all of the citations used in the analysis and research results have been sent to their respective subjects for confirmation.

Transferability is concerned with how the researcher explains his or her process for reconstruction of the data (Lincoln & Guba, 1985). By thoroughly describing the phenomenon studied as well as the research strategy, transferability is ensured. This chapter treats the methodology for my research, and contributes to the transferability of the study.

5. Findings and Analysis

5.1 The Revision

5.1.1 Making R&D More Efficient

Hydro's entire organisation has gone through some radical changes the last few years. Divestiture and acquisitions have caused cultural challenges, as many Hydro employees have been moved out of the organisation and employees in companies like the acquired VAW and soon, Vale have been included in the organisation. This has caused the need for a restructuring in many areas, however until now, the R&D organisation of Hydro has been more or less untouched by these processes.

"I think it can be challenging to external parties, as well as to our own, to see the totality of the R&D in Hydro" Ole Daaland, PTTC

5.1.2 Objectives for the Revision

"Our objective is to identify the weaknesses and strengths of the R&D organisation, and come up with concrete actions for generating more value from every invested NOK" Trond Furu, RTD

Hydro's R&D management have realised that the organisation can potentially gain a lot if the system is influenced to become more long-term oriented in product development and process development. There is no outspoken objective of making significant changes to the R&D organisation, however there is consensus that there are aspects in the running of the R&D organisation, which could have worked better.

"There is an understanding that there is unused potential within the R&D organisation, and that we can generate more value together, than we do separately" Nina Dahl, ECC

Hydro state themselves, that "restructuring and continuous improvement are essential elements of our business operations" (www.hydro.com, 2011), and the organisation aims at involving the employees in these processes in order to create the best result possible for the company and for each individual. The process owner of the revision is Head of R&D, Helge Jansen. He made the initiative, that the entire R&D organisation should be revised and investigated for latent synergies. His R&D management team supports him in this process.

"Helge, Trond and myself are the only ones in Hydro who have transversal positions in Hydro; everyone else is dedicated to a certain business area. This makes us see that there are unexploited synergies in the R&D organisation. Even corporate

management are oriented towards substantially differing directions – each one being most concerned about his own business area.” Kjersti Myhre, RTD

5.1.3 Challenges Concerning the Revision

“Reorganisation processes are, by nature, unpopular. Especially, problems related to personnel politics are difficult to solve” Trond Furu, TITTEL

When people are forced to quit their job they face a wavering situation; they are ripped away from the secure work place that they knew so well. This may affect the motivation and culture negatively, in turn impacting the performance of the organisation. In any process of organisational change, people are afraid that there will be cost cuttings in the form of letting personnel go. This fear is probably the reason why the revision process is unofficially initiated, and why there is no consensus of any wish to change the organisation of R&D.

The positive aspect of change processes is that some people may get out of their locked-in positions. By taking on new positions, they get on in the organisation, and yield more value to the organisation. Employee turnover is a positive feature in terms of organisational learning abilities and knowledge – and competence management (March, 1991). This is particularly relevant for the organisation of Hydro, where loyalty to the organisation is high, and people generally stay in their jobs for a long time.

5.1.4 Reflections on the Revision

The R&D management team in Hydro agree, that the organisation is not run in an optimised manner. Based on my interviews, I have got the impression that Hydro's R&D organisation employs an R&D staff, which is very loyal to the organisation, and pleased with their employer. However there are some tendencies to deep-rooted patterns of behaviour and attitudes, which are to a certain extent, contributing to making the organisation somewhat rigid and change-reluctant.

Revision as a Dynamic Capability

As stated in the theory section, change and learning go hand in hand. For an organisation to continuously learn, it must continuously change, and for an organisation to be able to change, it must be able to absorb and apply new knowledge. A revision process of the current organisation makes the management reflect over the organisation and its operations and performance, and think about what the organisation does well, and in what areas it performs poorly. Large and mature organisations value stability and reliability (Hill &

Rothaermel, 2003), and in order to prevent bureaucracy from growing too severe, such revision processes should be executed at regular intervals.

Path dependency is another reason for regularly revising the organisation. Resources can be sticky, and in order to ensure that the organisation is moving towards a desirable direction, its operations and performance should be continuously reflected upon. When the bundling of resources becomes path dependent, the organisation loses its ability to alter the resource base, and becomes less flexible (Ireland et al. 2003). Dynamic capabilities and flexibility are highly related subjects, and a revision can help the organisation maintain its flexibility and dynamic capabilities. One acknowledged definition of dynamic capabilities goes: "the capacity of an organisation to purposefully create, extend, and modify its resource base" (Helfat et al., 2007, p. 4). In this lies that in order to develop dynamic capabilities the organisation needs to go through some changes. A revision of the R&D organisation can both represent a dynamic capability in itself, and it can yield further dynamic capabilities to the organisation.

The objective of such a revision will be to check whether the resource base is fully exploited or if there is unused potential within it. Maintaining a dynamic resource base also involves constant monitoring of the utilisation of resources, and questioning, whether that is the right way to take advantage of them (Teece, 2007). Dynamic capabilities also include the ability to transform the resource base in a timely manner compared to market evolution (Teece, 1997), and the revision is an effort for doing so.

Revising also involves checking whether the R&D organisation is aligned with its external environment, both within and outside the Hydro corporation. As such, the revision process represents an effort from Hydro, to become an ambidextrous organisation. O'Reilly and Tushman (2008) speak for repeated and intentional revision of any organisation in order to be equipped to meet changing internal and external demands. The process of revision is healthy for the R&D organisation in all ways; in order to realise latent synergies and make the organisation more efficient, in order to practice and enhance Hydro's dynamic capabilities and to make Hydro ambidextrous.

5.2 Organisational Structure

5.2.1 Distinct Business Sectors and Distinct R&D Centres

A Partitioned R&D Organisation

The R&D body of Hydro is far from homogenous. The R&D centres are closely tied up to their distinct business areas, which do not collaborate with each other. It is the business partners who finance R&D projects at each centre, and they define much of the research agenda and the work to be done.

“We are very focused on serving our customer, who are clear on what they want us to do and we have to specify our projects from that point of view” Nina Dahl, ECC

This arrangement of having distinct business areas with R&D centres attached to them seems to be working well in many ways. The ties to the customers are strong, and the R&D centres know their business partners well. However the prioritising and focus on the needs and wants of the distinct business partners, makes the overall entirety of the R&D organisation more or less left out. Although there are positives sides of the current organisation, ideas about a better organisation of R&D are circulating among the R&D management.

“We say that we are well integrated in Hydro, but we are not in reality. (...) When the business sectors, our customers, work in different directions, we will too in R&D.” Kjersti Myhre, RTD

Centre Autonomy

The centres are highly autonomous in their relationships to the central R&D management, however in relation to their customers, they are entirely dependent and subordinate. The centres are highly autonomous with regard to the central R&D organisation, but with regard to their clients, they are to the greatest extent steered and monitored.

“Each R&D centre manage themselves but needs to relate and respond to their customers' requirements at all times” Trond Furu, RTD

Principal-agency problems have been apparent between R&D centres and the central management of mid and downstream R&D. There have been cases, where the resources earmarked for central R&D projects have been spent on customer-specific projects. This kind of principal-agency problems is typical for decentralised organisation models where the decentralised units have become

too autonomous and detached from the central management (Kuemmerle, 1997).

5.2.2 A Complicated R&D Organisation

The way the R&D organisation is arranged today is based on historical accounts. Hydro's R&D organisation has been allowed to evolve and develop over time, rather than it has been designed for optimised performance and efficiency of operations. The structures of the distinct R&D sites are complex, and the organisation as a whole is fragmented and compounded of different models. This hinders synergies from being realised and leveraged in that it slows down or even inhibits collaboration across organisational boundaries. The current organisation bears evidence of a history of mergers and acquisitions, and the localisation of each R&D centre has to do with tradition and "the way it has always been" rather than by practical considerations. In addition, the R&D organisation appears to be fragmented and undefined, and difficult to grasp to outsiders. There are several factors taking part to this, and some of them will be discussed in the following paragraphs.

The R&D Organisation Does Not Comprise All R&D

Firstly, what I have referred to as the "central R&D organisation," only comprises the R&D centres positioned in mid and downstream segments, with the exception of Building Systems' R&D department, which is run independently. The R&D organisation does not encompass upstream R&D or Building Systems' R&D department. This raises a question; why are some R&D centres gathered in one organisation, while others are not? There does not seem to be any good answers to this question, and the reason why it is exactly these R&D centres which are organised together, remain diffuse. Building Systems' R&D division is organised under Extruded Products, independently from the rest of mid-and downstream R&D.

Structural Mess

The other dilemma is that the entire mid and downstream R&D organisation is organised under Extruded Products, even though it is serving different customers in business sectors all along the value chain. Objectively, it does not make sense that the head of R&D in Hydro reports to the leader for only one of the business sectors served by R&D. Rather, it gives rise to a few problems. The leader for EP is seated in Hydro's corporate management together with leaders from the remaining of Hydro's business areas. It is natural, that he pleads EP's case in all situations, and therefore, it is highly unfavourable that also the R&D centres serving the remaining business sectors are arranged under one single business area. The current organisational structure is illustrated in the figure below.

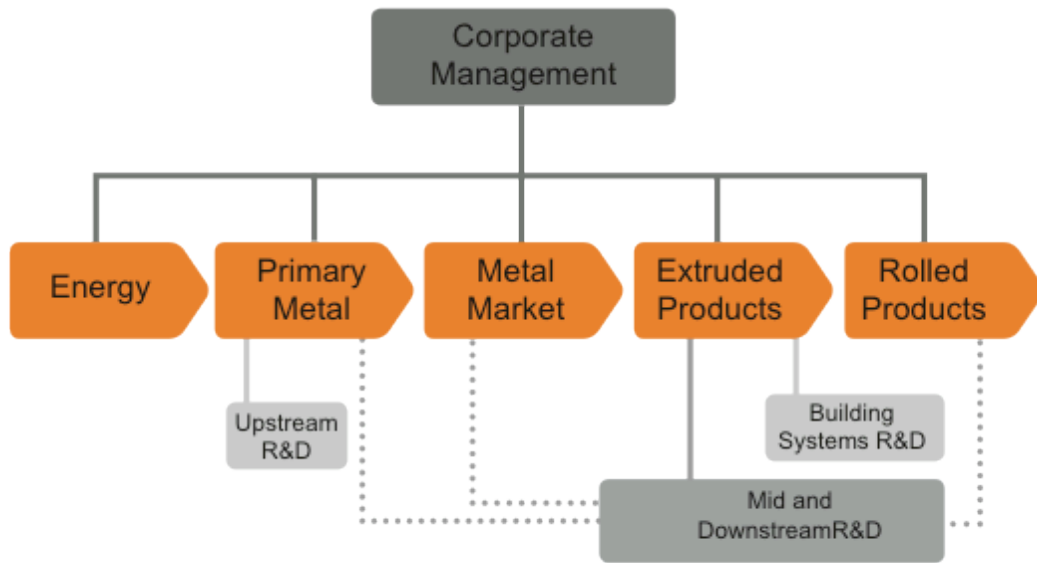


Figure 2 The current arrangement of Hydro's R&D activities.

The current organisational muddle can have a discouraging effect on R&D employees, in that it becomes unclear, who represents them at top levels (Dougherty & Hardy, 1996). Extruded Products is only served by ECC and PTTC, and not by RDB or RTD, which are really the main R&D centres in the R&D organisation. So who plead their cases for top management? The fact that the head of R&D reports to the leader of EP sends signals downwards in the organisation that R&D is not taken seriously.

5.2.3 Poor R&D Integration

A Static Resource Base

Because of the orientation towards distinct business sectors, R&D centres work very much independently from each other and their managers communicate to a little extent. There are no R&D gatherings or conferences where R&D employees meet and are introduced to each other's work. Much of the reason for the poor integration is that the centres are so tied up to their business partners, who work within distinct business sectors. The business sectors are run independently from each other, and their strategies and objectives are not synchronised. When the business partners and their orientations are so distinct, it becomes difficult for the R&D centres to integrate their operations with each other. Poor integration of R&D centres mean poor integration of the resources available at each centre, in turn leading to poor utilisation of the R&D organisation's resource base. In turn, poor utilisation of the total set of R&D resources means that the resource base within Hydro's R&D organisation becomes somewhat

static (Teece, 1997). There are latent synergies in relation to Hydro's utilisation of resources, and Hydro R&D needs to develop dynamic capabilities for realising them, and for keeping the resource base dynamic (Teece, 2007).

"We see that the aluminium markets are becoming more and more integrated. Products may be enhanced if the work of the business areas is connected so that they can work together up against their markets, whether the car industry, renewable energy or other industries. We believe there are synergies across these industries, and that is why we are interested in more cooperation across our business areas. We want them to think about the application of aluminium in a broader sense" **Helge Jansen, Head of R&D**

Competence Overlap - A Sore Point

Competence overlap seems to be a sore point in Hydro's mid and downstream R&D. Especially between the two largest centres, RTD at Sunndalsøra and RDB in Bonn, there are some overlapping fields of competence. It became apparent at an early stage after the VAW acquisition that both sites had casting competencies, which, although slightly different, covered the same needs. There was some competence-based competition between them, and there are still overlapping competence fields.

"It was a challenge, when the centre in Bonn was included in the R&D organisation, that the competence profiles of Bonn and Sunndalsøra were overlapping. The two centres had developed their own ways of operating, and both had ownership to their own processes and technologies, wishing to keep them." **Trond Furu, RTD**

The organisation has lived with this overlap for years, however in order to realise synergies and prevent parallel development and "reinventing of the wheel", the R&D organisation should emphasise co-specialisation (Teece, 2000). Co-specialisation in Hydro's case involves that the fields of expertise be cultivated at one centre, allowing the other centres to "borrow" expertise when needed. Such a feature will ease the pressure on the silo mentality in the organisation as well as enhance organisational learning and expand internal social capital (Hitt, Lee, et al., 2002; Ireland et. al., 2003); by making collaboration across boundaries a necessity.

The silo mentality present in Hydro makes it difficult to eliminate the competence overlap. The organisational units are self-centred, and wish to keep their expertise, and not being forced to seek it elsewhere in the organisation. A common positive culture is important for development of dynamic capabilities, especially when it favours nurturing of specialised knowledge (Teece, 2000). A common and positive R&D culture and identity will be crucial if Hydro is to cut down on competences at some sites in order to cultivate them at other sites.

Differentiation Between Exploration and Exploitation

An organisation's structure influences the ambidexterity of the firm, along with its strategies, processes and culture (Raisch et. al., 2009). The structure determines the conditions for informal networks to rise, enhancing the value of the social capital. Hydro's partitioned organisation of R&D centres, along with the structural tangle complicates the formation of informal, cross-boundary networks and collaboration between the sites; hindering the organisation from becoming ambidextrous (Raisch et. al., 2009). Raisch et. al.'s (2009) first tension for ambidexterity concerns the dilemma of differentiation and integration of explorative and exploitative activities in the organisation. Hydro's current arrangement totally separates the two, in that explorative projects are financed by the central R&D organisation and exploitative projects are initiated and financed by the centres' distinct customers. The way the organisation is structured today yields little choice, because the clients are not likely to finance explorative projects as long as the strategic orientation remains the same.

5.2.4 Structural Differences Between R&D Centres

The structures at centres in Hydro mid-and downstream R&D differ. RDB and RTD are the largest R&D centres, and look the most like the traditional definition of an R&D centre. RDB and RTD are the most comparable, but also the most different, R&D centres in Hydro mid and downstream R&D. Although of the same size, they are structured in different ways. The organisation in Bonn is hierarchical while the model at Sunndalsøra is flat; with a large project group reporting directly to the managing team. The structure in PTTC is quite similar to the Sunndalsøra structure, only they are much fewer people. ECC is also a small unit, but it is more decentralised than is PTTC; with employees spread at different sites and in different countries. Job descriptions and job titles are different for each site.

The structural untidiness is not regarded a big problem, however it may cause confusion for people in the organisation, wanting to contact researchers at other sites for help or advise. Non-comparable job descriptions and position titles complicate collaboration between the R&D sites.

5.2.5 Categorisation of Hydro's R&D Organisation

Hydro's mid and downstream R&D organisation has many common features with the polycentric decentralised R&D organisation (Gassmann & Zedtwitz, 1999). The R&D centres are decentralised, and there is no supervising centre among them, serving as the main R&D competence centre. The decentralisation and the location of each centre is to a great extent a product of M&A activities,

and there are latent synergies in the organisation, waiting to be exploited. As in the description of the polycentric decentralised R&D organisation, the information flow between the R&D sites is limited both in scope and contents. The figure below shows the structural model of the current R&D organisation, and the relations between the R&D centres and the business sectors.

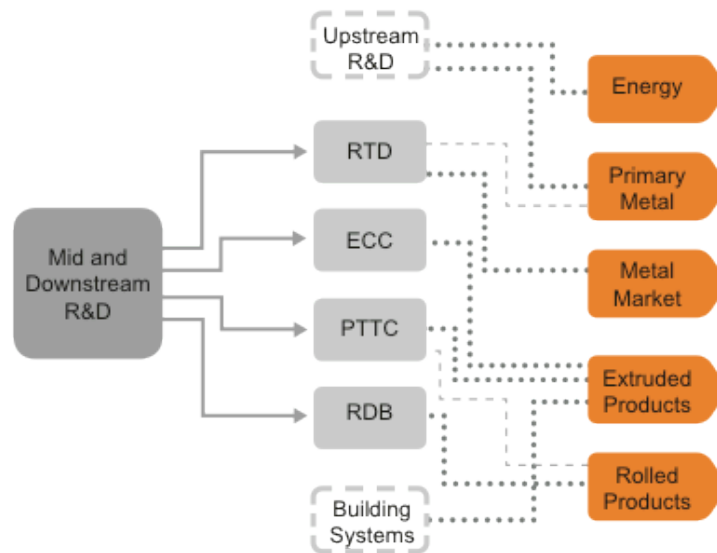


Figure 3 Hydro's polycentric decentralised R&D organisation. Several of the R&D centres serve customers within the same business sector, however the centres collaborate only to a little extent.

The polycentric decentralised R&D organisation model is acknowledged to be optimal for exploitation of local resources and local market monitoring, however these are not activities, which Hydro engage much in. Hydro's markets and customers are global, and the decentralised R&D sites are positioned where they are on grounds of tradition and convenience rather than proximity to local markets and resources. Drawbacks concerning this organisation model are potential principal-agency problems, which can be a result of a too high autonomy. This seems to be the case with Hydro's R&D organisation, and I will come back to this issue in a later section. Among other drawbacks is that strategic autonomous behaviour may restrain cross-functional collaboration in an attempt to preserve site autonomy and national identity; in Hydro's case centre identity. This may lead to, or be a result of, institutional leadership, which is not healthy for the organisation either. Organisational inefficiency, redundant competences and parallel R&D activities are a result, which can be seen in Hydro's R&D organisation.

The final drawback concerning the organisation model, involves loss of technology focus, which inhibits technology convergence and makes the overall technology portfolio inconsistent (Gassmann & Zedtwitz, 1999). In mid and

downstream R&D in Hydro today, there are no processes for ensuring that the en bloc technology portfolio is converging. The strong ties to distinct business partners reinforce this disadvantage.

In the case of Hydro, the drawbacks concerning the R&D organisation model seem to override the advantages, so the question comes forward: why does Hydro hold on to the polycentric decentralised R&D organisation model?

5.2.6 Summing Up: A Desultory R&D Structure

Hydro's R&D organisation employs a polycentric decentralised model, which is characterised by unrealised synergies and structures lingering from previous acquisitions and divestitures (Gassmann & Zedtwitz, 1999). There is a distinction between upstream R&D and mid and downstream R&D, and the two divisions do not seem to collaborate at any point. In addition, Hydro Building Systems employ their own R&D department, which is excluded from the rest of the mid and downstream R&D organisation. What more, the mid and downstream R&D organisation is line organised under the single business sector Extruded Products, although serving clients from within all of the other business sectors in Hydro's value chain.

The centres in mid and downstream R&D are highly autonomous from the central R&D management, but strongly connected to, and steered by their respective clients within distinct business sectors. The strong ties to the business sectors undermine the central R&D community, and the centres are formally and structurally different from each other. As a result of strong orientation towards distinct business sectors, mid and downstream R&D is not integrated, and cooperation between the centres is limited. Little integration of R&D makes the resource base static and immobile (Teece, 2000). When the centres do not communicate, it becomes difficult to take advantage of resources, which are localised at other centres. The current structure of Hydro's R&D is not favourable for developing dynamic capabilities (Teece, 2000).

Drawbacks concerned with the employment of the polycentric decentralised R&D model seem to override the advantages in Hydro's case, so the question comes forward: why does Hydro hold on to the polycentric decentralised R&D organisation model?

5.3 Organisational Culture

5.3.1 A Fragmented R&D Culture

Historical Differences

The history of acquisitions and divestitures will always put its mark on the culture in Hydro. Historically, RTD at Sunndalsøra was subordinated to ÅSV, Årdal og Sunndal verk. Hydro had their R&D centre at Karmøy. When ÅSV was acquired in 1985 and the R&D centre at Sunndalsøra was to be integrated in Hydro's R&D, the cultures at the two sites proved to be very different. Whereas ÅSV worked with pure research, Hydro had a more process oriented R&D approach. Still, one can see in the organisation, people who have been there since the merger who have this cultural difference in their backbone, however the people who were employed after the 80's are more open. Also with the acquisition and integration of VAW, the centre in Bonn employed a different culture and type of mindset than the remaining centres.

"I think that the formal differences were striking for previous VAW-employees when they were included in the organisation. The structure is somewhat more anarchistic in Norway, and we operate with different command lines. We have had the time to adjust to each other now, and although the lines are still more hierarchical in Bonn, the cultural differences do not represent a major obstacle in any way." **Trond Furu, RTD**

Hydro's R&D culture is fragmented, and more a collection of explicit sub-cultures, than a uniform R&D culture (Trice and Beyer, 1993). This is much a result of the distinct orientation towards different business sectors. Trond Furu characterises the culture at Sunndalsøra as social democratic. The distance is small between a researcher and a laboratory assistant, and everyone is respected. Researchers are not foreign to working at the lab, resulting in a more dynamic, hands-on approach and positive relations between laboratory assistants and researchers. The hierarchy is more visible at RDB in Bonn, with clearer responsibilities and command lines, leading to a greater distance between researcher and laboratory assistant.

Ole Daaland describes the culture in PTTC as driven by a wish of serving the customer, and generate solutions, which are more than just research results.

"We are not too keen on just generating knowledge – maybe too little in fact – because we are interested in implementing our results and work at a plant, and increase productivity" **Ole Daaland, PTTC**

The culture at ECC is complex, and unique, according to Nina Dahl. The organisation is geographically dispersed, and all sites exercise close relations to customers.

“We are working for and together with the extrusion plants. Close cooperation is a prerequisite for good results and thereby very important for the following implementation and roll-out of the results.” Nina Dahl, ECC

The cultures at the R&D centres are coloured by the cultures prevailing at their customers' sites, and shaped by the unique collaboration with them. ECC and PTTC are very focused on operations and incremental improvements, whereas RTD and RDB are more involved in joint projects with external affiliates. The former two centres land in the home-base- exploiting category of R&D sites, whereas the latter two are also slightly oriented towards home-base- augmentation.

5.3.2 Silo Structure Leads to Silo Mentality

The differing systems at the R&D centres serve as evidence of a poor integration of the R&D organisation. Although not perceived as a significant problem, the structural differences are likely to reinforce the self-centred mindsets, which are present at all sites. The phenomenon is referred to as a “silo mentality” internally in the organisation.

“We are talking about a silo structure in the organisation today. People and divisions are organised in silos, and we need to try to make the look to the side, outside our own focus. I think this can be done with the help of innovation” Helge Jansen, Head of R&D

Silo mentality and structure is present both between the R&D centres, but also within the centres. Traditions for closed office environments still stand strong at Sunndalsøra and Bonn. This set-up limits knowledge sharing and communication in that an arena for informal discussions is taken away. The internal silo structure is less apparent at the small centres ECC and PTTC.

“With open plan offices, we have experienced that several interesting discussions have arisen, and in some cases, new projects may even have been initiated based on this” Nina Dahl, ECC

The silo mentality in mid and downstream R&D reinforces the cultural differences between the centres. When there is no arena where researchers from different centres get to know each other at an informal level, then they will not

have any incentive for communicating informally, and sharing of ideas and collaboration between the sites is inhibited (Kuemmerle, 1997).

5.3.3 Factors Shaping the Culture

Tight Customer Ties

The cultural differences between Hydro's R&D sites is much a result of the strong customer orientation, the culture at the respective centres is shaped and influenced by the culture of their customers. The close ties to the clients influence the culture at the R&D centres. This reinforces the differences within R&D, as the cultures in the distinct business sectors are varying.

A Business Driven Approach

Hydro's R&D culture has moved from being academic and focused on pure research to being business driven and committed to serving their customers in the best way possible. Researchers in Hydro understand the importance of the business potential of the research work they do.

"(...) We have moved towards a more relevant interplay with our business partners. Our researchers understand the business aspect of their work, and are more interested in creating value for the customers. The typical researcher culture has been twisted towards a culture more prone to serving customers" **Helge Jansen, Head of R&D**

Low Turnover

Personnel turnover in Hydro's R&D centres and also within the departments within each centre is low. A low turnover and people in deep-rooted positions may impact the organisational culture negatively in that it becomes less prone to innovation and change. Personnel exchange between the R&D sites is also not facilitated or executed in Hydro, causing the organisation to potentially miss out on discovery of valuable synergies and opportunities for cross-boundary projects. The internal social capital remains of low value, and the organisation remains inflexible (Ireland et. al., 2003).

Silo Structure

As mentioned previously, silo structures lead to silo mentality. In an organisation where the silo mentality stands strong, subcultures are likely to arise (Trice & Beyer, 1993), potentially undermining the overall organisational culture. Along with Hydro's history of acquisitions and a low turnover of people in organisational departments, the silo structure contributes to significant cultural differences between the R&D centres.

5.3.4 A Culture for Lenience

It is clear that there are some significant structural weaknesses in the current structural arrangement of R&D, however there is no outspoken and articulated consensus on this issue among members of the R&D management team. When interviewing members of Hydro's R&D management team separately, I got the impression that their thoughts and meanings concerning the R&D organisation of today were quite similar. However when the citations were sent to them for approval, two informants requested that I removed several of their citations. It need be mentioned, that the citations were presented to them independently, and not in context. The assignment is confidential and only available to the examiners of the thesis, besides chosen people within Hydro's staff. The fact that some members of the R&D management team did not want their utterances to be connected to their names implies that there may be a culture in the organisation, for being lenient and cautious when it comes to statements concerning any organisational change. The reason for this lenience may be fear for disapproval among business partners, which can impact R&D's customer relationships. A culture where critique against the system is unwelcomed and considered inopportune is an unhealthy culture, and may harm the performance of the organisation, and inhibit processes for organisational improvement - such as the ongoing revision.

5.3.5 Internal Competition

Conflicting Interests

Corporate management consists of leaders from each of Hydro's business sectors. Clearly there are some conflicting interests internally among them, and among the different R&D sites as well. The R&D organisation is partitioned, and the centres work in different directions, following different trends and demands from their respective customers. If the entire Hydro organisation became more integrated, then the R&D organisation could become more integrated too (Kuemmerle, 1997).

Parallel Development and the NIH-Syndrome

Because the R&D centres work towards different customers, there is little competition between them. There have been tendencies to parallel development and the NIH-syndrome between Bonn and Sunndalsøra, in relation to the overlapping fields of competencies within casting. However the NIH-syndrome is not regarded a significant problem in Hydro's R&D organisation.

“Parallel development is partly a problem, there are some areas within casting, and also alloy development, where Bonn and Sunndalsøra’s competences are overlapping. On these areas, we should cooperate more closely” Helge Jansen, head of R&D

Competition for Resources

There have been tendencies to an unhealthy competition for central financing between the R&D sites. Multisite projects, and innovation projects are often initiated and financed from the central R&D management. Some centres have strategically taken on responsibility for such projects to get the extra funding, but still prioritised the projects they performed for their business partners. The result is that project performance on the multisite projects has been much poorer than intended.

5.3.6 Summing Up: Lack of a Common Culture Hinders Organisational Flexibility

There is no clear and defined common culture in mid and downstream R&D. The culture at each centre is highly influenced by the culture within the business sector they serve. Cultural differences and differing work approaches, along with close customer ties, silo structures and silo mentality, represents obstacles hindering a common R&D culture from arising. The culture in Hydro’s R&D organisation is fragmented, and each R&D centre is significantly influenced by the culture at its clients’ sites. Without a defined common culture and set of beliefs, collaboration across organisational boundaries becomes a more difficult and complex process (Jelinek & Schoonhoven, 1990). Little cross-sectoral collaboration will affect the internal social capital negatively, in that the silo mentality is reinforced, and informal internal networks become limited. The flexibility of the organisation suffers (Ireland et. al., 2003).

5.4. Collaboration and Competences

5.4.1 Limited Collaboration Across Boundaries

Different Orientations and Different Cultures

There is little cooperation and communication between the business sectors in Hydro. Many of them have little in common as their processes differ substantially. However some business areas are more vertically organised in relation to each other, which makes collaboration between them more relevant. There is potential for increasing the amount of collaboration and also to improve the quality of it.

Although a close relationship to customers is positive, the partition between the R&D centres in many ways represents a negative feature for the R&D organisation. The R&D centres are financially dependent on their customers, and have only to a little extent a saying in the research agenda and R&D strategy. This makes them prioritise customer-specific projects over innovative multisite projects, resulting in a low rate of collaboration between R&D centres. Much research activity within the field of aluminium can be applicable for more than one business area, however as long as the centres do not communicate and share knowledge, such synergies are difficult to discover. There are several latent synergies in the R&D organisation, and closer relationships between R&D centres can help bring them out.

Project Pull from Clients Leads to Client-Specific Projects

Multisite projects in the R&D organisation are, and have historically been limited in number. The fact that there is little cooperation between the R&D sites does not mean that the R&D staffs are unwilling to cooperate. The project portfolios at each centre are managed in a way that makes it natural that they work purposefully to serve their customer. The R&D projects are most often defined by the R&D centre in collaboration with the business sector they serve; their business partner. The business partners communicate their needs and wishes to their dedicated R&D centre. As it is the business partners who finance the R&D centres' activities, they exercise a significant influence on the research agenda. Few projects are initiated and pushed from the R&D side. A more active technology push from R&D centres may enhance cooperation with the business partners. The possibility for utilising technology developed in one R&D site for one business area in another business area should be exploited further, leaving a space for more proactive technology push and transversal leveraging of technologies from other R&D centres.

Difficult Collaboration

The geographic dispersion of the R&D centres, and the tight customer ties, represent a challenge for effective coordination, management and control of the R&D activities in the organisation (Kuemmerle, 1997). The focus on distinct business areas limits conceived opportunities for cooperation between sites; the customers belong to different sectors and have different needs and requirements. The R&D sites have been segmented based on business sector, technology and focus on product development versus process improvement. In addition, the autonomy of each R&D centre has traditionally been high. These features have resulted in a silo structure and not least, a silo mentality among R&D staff. The silo mentality exists both at R&D site level, and at lower levels internally within each R&D centre. Several of the interviewees suspected that even people within each R&D centre did not communicate and far less collaborate on R&D projects.

Dougherty and Hardy stated in 1996, that organisational structures and processes were seldom designed for cross-sectional collaboration and organisation-wide problem solving in large and mature organisations. Unfortunately, this seems to be the case with Hydro too. When organisational units do not communicate or cooperate, institutional leadership is likely to arise (Selsnick, 1957). Institutional leadership will have a reinforcing effect on the lack of collaboration, as it often leads to incongruence between the organisational units. The partitioned silo structure in Hydro's R&D organisation may imply that institutionalised leadership is present in the organisation. The structural and functional features, which hinder and complicate collaboration between the sites, reduce the value of Hydro's organisational capital resources (Barney, 1991).

5.4.2 Low Turnover Rates

Employee Loyalty

Hydro employees tend to be very loyal to the organisation, and often stay within it for a number of years, if not their whole career. The trueness and loyalty to the organisation represents both strength and weakness. It is an advantage for the organisation that people stick with it over a long period of time, because they ensure competence stability. However, it is not healthy for the organisational learning (March, 1991), the corporate culture, innovation or organisational flexibility that people stay in the same positions over a long period of time. People, who move around in the organisation and take on new jobs and responsibilities, represent great value for the organisation. These people know

different parts of the organisation well, and are more likely to see where there are potential synergies between divisions.

Impact on Organisational Learning

Low turnover rates can be detrimental for organisational learning (March, 1991). It can affect the amount of exploration activities negatively, and put a limit to the total amount of accumulated knowledge in the organisation or the organisational department (March, 1991). The work force may become static, and incentives for bringing new knowledge in to the organisation are often reduced when knowledge equilibrium between the organisation and its members is established (March, 1991). In order to enhance the mutual learning of the organisation and the individuals within it, new people should be allowed in to the organisational departments in order to ensure new knowledge streaming in to them, expanding the organisational code (March, 1991).

Specialisation can make people change-reluctant and in all less flexible. Employee turnover within the R&D sites and for each position is important to ensure a dynamic and creative culture, and to ensure that new knowledge streams into the organisation (March, 1991). Also, turnover of employees facilitates the internal social capital in that R&D staff is moved around within the R&D organisation and the Hydro organisation as a whole.

Impact on Organisational Culture

Efficient management of turnover helps ensuring succession planning and maintains a creative culture and positive attitude towards innovation and change. Long lasting specialisation can impact flexibility and acceptance of change in a negative manner (Teece, 2000), and may reinforce the silo mentality within the organisation.

5.4.3 Inadequate Internal Network

The silo structures and mentality at the R&D centres isolate the centres from each other. When people are only interested in their own work and not informed on what is happening at the other R&D sites, then incentives for contacting people at other sites become reduced. Lack of communication and collaboration across sites leads to insufficient internal networks within R&D, in turn reinforcing the lack of collaboration. Turnover and personnel exchange in R&D are limited in amount. The lack of collaboration makes resources less available across boundaries, in turn inhibiting innovation projects and potentially leading to parallel development (Ireland et. al, 2003). Limited information flow may be expensive for the organisation in terms of opportunity-costs (Teece, 2000).

5.4.4 Summing Up: Little Collaboration Means Limited Exploitation of Resources

Projects run at the respective R&D centres are most often client-specific and leave little space for collaboration between the R&D centres. The structural and cultural differences, along with the silo mentality prevailing in the organisation complicate collaboration across boundaries, and there is in general little incentive in the organisation to initiate joint projects between the R&D sites. Internal social capital is limited, and there are no facilitated processes for enhancing the informal networks within the organisation. As a result, the organisation becomes rigid.

5.5. Innovation Challenges

“What we are not particularly good at is to create good, long-term, innovative projects; to make step-change. We are struggling at this point!” Helge Jansen, Head of R&D

5.5.1 Innovation Focus is not anchored at Lower Levels of the Organisation

Hydro claims in their marketing and business strategy that they value innovation and strive to be creative and innovative in order to become more sustainable and gain competitive advantage. Corporate management is heavily encouraging step change projects, and focuses on innovation when setting the strategic agenda. However, the results of my interviews reveal that this focus is not translated into action and practice within the R&D body.

Corporate management consists of the leaders of each of Hydro's business sectors, and although they encourage commitment to and priority of step change innovation projects, it is also them, who often put a stop to the few step change projects, which are suggested, due to the economics and risks involved. The leaders of each of Hydro's business sectors are seated in corporate management. This contradiction between strategy and action can cause negative ripple effects downwards in the organisation, in the way that it causes mistrust to corporate management's dedication to innovation. Such mistrust affects the creative cultures negatively, and may decrease the personal motivation among employees (Dougherty & Hardy, 1996).

Ripping off from Innovation Projects

The central project portfolio is supposed to be a motivator and a driver for initiating multisite innovation projects, however the central projects are given a low priority at all centres, compared to their customer-specific projects. It has occurred that centres have taken on responsibility for centrally financed projects just to get hold of the financial resources, and given those projects a low prioritising compared to their client-specific projects. The centrally financed projects are long-term and oriented towards step change innovation, however when the earmarked resources for these projects are ripped off, then innovation does not stand a chance in the organisation.

“(...) some centres have tried to be tactical, an try to get hold of as many as the central projects as possible, just to get hold of the financial means. This competition is unhealthy.” Helge Jansen, Head of R&D

5.5.2 KPIs and Capital Market Day Lead to Short Term Focus

Incentive systems in Hydro may cause unnecessary competition between people, impacting the performance and efficiency negatively. Corporate management and the upper levels of the R&D organisation are very visionary and oriented towards step change innovation, however this visionary mindset is not anchored at lower levels in the organisation because of the strict performance measurement – both at business levels and at personal levels. All of Hydro's business sectors are measured by sets of Key Performance Indicators (KPIs). The KPIs mainly focus on short-term profit - stealing emphasis away from long-term performance and step change projects.

"It is not strange, that when a middle manager has the opportunity of earning two or three monthly salaries, and has a certain number of people available, and a certain amount of money to achieve the results to get the bonus, he thinks short-term" Helge Jansen, Head of R&D

Bonuses are based on achievement of the set goals for the KPIs, and based on parameters like profitability, productivity, reclamations and customer satisfaction. Hydro has established two KPIs for long-term projects in order to make the KPI programme more oriented towards innovation, however they can hardly stand the fight against numerous short term focused KPIs. Such measurement systems lead to risk-averse behaviour among middle managers (Burgelman, 1983), and Dougherty & Hardy (1996) argue, that organisations employing them inhibit innovation champions by punishing them for stepping out of their formally described positions. The KPI system is not designed for long-term goals.

Capital market day is arranged twice a year, where Hydro presents results and objectives for the future. Capital market day also focuses on short-term objectives and performance.

"The focus at capital market day is very concerned with fourth quarter of the present year, rather than being oriented towards where we are in 2020" Helge Jansen, Head of R&D

Based on this, one can conclude that the KPI system of today and the capital market day discourage innovation, and act as pure innovation inhibitors. The research organisation has an exploitative focus, and is oriented towards improving operations and activities, project milestones and budgets. This exploitative approach hampers visionary and creative ideas from flourish, and the organisation misses out on new knowledge (Alvarez & Busenitz, 2001).

5.5.3 Restraining Customer Dedication

The R&D centres are dedicated to – and dependent of – their respective customers. The internal customers, also referred to as business partners, finance R&D's operations, and in that respect, they exercise a lot of power. R&D projects are presented to the customer every autumn, together with suggestions for budgets, which are then granted after some negotiations. The customers are business-driven and very focused on costs.

The strong dedication towards distinct business sectors and the close customer relationships work against innovation in the organisation. The customers are extremely focused on profitability and performance, and expect from their respective R&D centres that they help them achieve enhanced performance through their work. As long as the main source of R&D financing is their customers, the R&D centres will focus on serving them and prioritise client satisfaction over innovation rate.

Christensen and Bower (1996; cited in Hill & Rothaermel, 2003) explain that established incumbent firms may lead the development of new technologies, which are suited for their existing customers and value networks. However when it comes to technology for which a market has yet to emerge, impetus is seldom granted within established organisations. The model Hydro employs reinforces this mechanism, as the business partners are self-centred and focused on their own, existing operations. The quotation below illustrates the incongruence between the innovation strategy and the organisation's business model.

“Corporate management encourage step change innovation. However that does not hold water, because innovation is about having a long-term viewpoint, taking on high risks and commercialising and implementing something, which will yield high value. (...) We are too business-driven for innovation to become a reality. It is difficult to get financing for innovation projects as long as first priority is to serve the customer, who is our main provider of financing” Kjersti Myhre, RTD

5.5.4 Potential Core Rigidities

Close customer-relationships help identify customer needs and new demands because the researchers are out in the field at regular basis. However the integration with the internal customers draws the R&D centres and researchers into Hydro's daily business, resulting in a short-term focus, and lower priority of long-term innovation projects. Incremental innovations are safe, profitable and short term – and therefore what the client wants. Incremental innovations in process improvement appear to be core competencies and focus in the R&D organisation. As long as the organisation operates in stable competitive

environments, these core competencies are of high value. However, when faced with competition from a radical innovation and the challenges of market upheaval, they may quickly turn in to core rigidities for the organisation (Ireland et. al., 2003). Years of incremental innovations and refining processes and procedures make it more difficult for the organisation to develop new competences quickly (Dietrickx & Cool, 1989, cited in Alvarez & Busenitz, 2001).

When not combined with an explorative orientation, these exploitative core competences represent blinker capabilities for Hydro (March, 1991; Ireland et. al., 2003). Structures and strategies in exploitation-oriented organisations reinforce existing practices, and can, according to Hlavacek and Thompson (1973), become "hostile to creativity" (cited in Burgelman, 1983). This in turn is a contribution to the shaping of the organisational members' attitudes and beliefs; and may lead to a change-reluctant organisational mass. Deep-rooted processes and a heavy short-term business approach may become core rigidities when Hydro is faced with a radical change in the market. In addition Hydro's budgets are set annually, meaning that all projects, which are to be executed, are planned up to one year in advance. This is inhibiting for explorative activities, as there is little room for changing the budgets or plans during the year. This feature makes the organisation further inflexible, and serves as evidence that an entrepreneurial culture is not present in Hydro (Leifer et. al., 2001).

5.5.5 Lack of Creative Culture

The R&D body is where innovation projects should be conceived, and when the research organisation has not developed an innovative, creative culture and approach to new problems, then the organisation as a whole will experience difficulties in being innovative too (Ireland et. al., 2003). As head of Hydro's R&D organisation states:

"The top level managers in Hydro are very clear on the message that long-term technological development and step-change is important. Many managers who are positioned two and three levels lower than top management, share this focus. But then, there is a layer in between, which is more business-driven; they are very focused on short term goals and creating value at present" Helge Jansen, Head of R&D

Hydro's strategic orientation towards innovation is not translated into practice in the organisation. The organisational culture does not seem to value innovation, being driven and shaped by the cultures within the business sectors. The R&D organisation has not succeeded in creating an innovation-friendly atmosphere, and hence autonomous strategic behaviour for innovation may not be legitimate in the organisation (Dougherty & Hardy, 1996).

5.5.6 Innovation Award Lacks Respect

The Innovation Award is an annual prize within each business area. New products, processes, and other categories are nominated, and the best contributions receive prizes. The award has been established to stimulate innovation, best practice sharing and motivation in the company. The innovation Award does not seem to be respected and taken seriously by Hydro employees, and in this score, it does not have any effect on their motivation or actions for innovation.

"I do not think that Innovation Award functions as a motive power, it seems a bit artificial. If you compare Innovation Award and New Ideas, I will absolutely say that New Ideas is far more important" Ole Daaland, PTTC

5.5.7 New Ideas

"New Ideas is a pretty good initiative for innovation, however it could have been implemented in a better system" Helge Jansen, Head of R&D

The reason why potential innovation projects so often stagnate is not necessarily the availability of money, but rather the prioritising of means and resources along with risk averseness. The New Ideas programme is established to encourage and promote innovative ideas in the R&D organisation. The programme possesses a pool of MNOK 5, which can be distributed on creative projects, which random employees come up with. Everyone who has an idea can apply for financial means of up to NOK 150 000 to develop the idea further and check whether it is worth to pursue at higher levels. The money is to cover equipment and salary for the hours spent on the project. Every submitted idea is evaluated by a technical committee and the evaluation time is short. The distance between the technical committee and the idea contributors is short. When the "preliminary work" is completed, the idea owner can try to sell the project in as a real Hydro project. New Ideas represent a structure for making financial resources available for innovation projects, and in this manner, the programme encourages autonomous strategic behaviour and innovation championship (Jelinek & Shoonhoven, 1990; Day, 1994; Dougherty & Hardy, 1996).

5.5.8 What Happens After New Ideas?

Lack of Follow-Up

When the preliminary work with a New Idea is completed, no one in the organisation is dedicated the responsibility to take the project further – it is up to the idea owner to become an innovation champion (Day, 1994).

“The exploitation of New Ideas is poor, because no one follows up, that promising projects are put into effect” Kjersti Myhre, RTD

There are two possible ways of taking a New Ideas project further after the preliminary work has been carried out. The first one is to try to sell the project in to the R&D management, to become a central project. Central projects are long term, strategic and innovative projects, and may well be value chain projects. The other way of bringing a New Ideas project further, is to sell it in to the business partner to whom the project may yield the most value. If the business partner sees a business potential in the project, then they may be willing to finance it. The choice of paths after New Ideas depends on the nature of the project. If it is a value chain project, or a high-risk innovation project, then it is most likely to appeal to the central R&D management rather than one specific business partner. Projects, which concern one business sector more than others, are more likely to gain support from the specific business partner rather than the R&D management as a whole.

There are no structures or procedures for following up the New Ideas projects. It is up to the owner of the idea, to choose whether he or she wants to keep fighting for the idea and try to convince middle and top managers, that the project can become a success if commercialised. In practice, Hydro relies on innovation champions to carry on with the promising projects, like so many other large and mature organisations (Dougherty & Hardy, 1996). Dougherty and Hardy (1996) strongly advice against this, as it is not a sustainable solution for innovation.

Annual Setting of Budgets Leads to Missed Opportunities

The drawback with the two outlined ways of taking New Ideas projects further is that budgets are set on an annual basis, and it is difficult to get any funding for a project in the middle of the year. Suggestions and ideas for central projects must be sent in during summer time, and the R&D committee is then responsible for prioritising and selecting the projects. The R&D committee includes representatives from the entire value chain. There is no room for changing budgets or implementing extra funding for unforeseen innovation projects during the year, as it is a norm in Hydro, to be very loyal to the rules and regulations. These worked-in norms make resources unavailable for innovation projects, which can be expensive in term of opportunity costs.

“The trueness to the system, and these conservative, rigid processes are terribly inhibiting for new projects” Kjersti Myhre, RTD

Central R&D is currently in the process of creating new routines for project selection and financing, involving that they will strive to be open for supporting

innovation projects all year around. This decision has been adopted, however not yet implemented.

For business sector-specific projects, the routines are not yet in a change process. Potential business sector projects must be suggested to the relevant business partner, and then it is included in their annual prioritising and selection process of projects. This process is very inhibiting for many New Ideas projects, because budgets are locked up for one year, and innovation projects are often about making hay while the sun shines. Long waiting period for financing may have a discouraging effect on the people involved, or the window of opportunity may just be closed when the financing finally gets there.

5.5.9 Insufficient Technology Watch and Project Follow-Up

Hydro engage in limited technology watch activities, resulting in a home-base-exploiting approach (Kuemmerle 1997). All of the centres are focused on serving their clients and business partners, and fulfilling their needs. R&D seeks primarily to enhance and exploit existing resources in the organisation and are not offensive when it comes to screening the environment for new knowledge and opportunities.

Hydro's technology watch activities include customer meetings, patent searches, participation at technology fairs and conferences, literature searches and joint projects with external affiliates such as universities. RTD at Sunndalsøra and RDB in Bonn are affiliated to universities, meaning that they, to a greater extent than ECC and PTTC, are engaged in potential home-base-augmenting activities. Technology watch activities are however suppressed compared to other R&D activities at all centres, and routines for technology watch are lacking in the R&D organisation. This is much because the R&D centres are very oriented towards their clients' operations; they focus on serving their clients, and external competition with other actors in the aluminium industry is given less priority.

"Everything is so short-term and cost-focused, that we have lost the ability to raise our heads and try see what is happening in our markets (...). We are driven by our own internal processes, and not by what is happening out there. Top management want us to think long-term and focus on innovation, however we do not feel that we have the opportunity to be innovative, because the everyday operations are so tight and short term." Kjersti Myhre, RTD

Technology watch activities are tightly related to the concept of absorptive capacity (Cohen & Levinthal, 1990; Teece et. al., 1997; Zahra & George, 2000; Ireland et. al., 2003). External social capital is important here, as absorptive capacity involves the firm's ability to scan the industrial environment for market

changes, new technologies, new market trends and behaviours of competitors (Teece et. al., 1997). Processes for scanning and evaluating the competitive environment and prioritise R&D activities and new technologies internally are crucial here (Teece et. al., 1997). Lack of technology watch means poor absorptive capacity, which yields inflexibility and difficulties with adapting to, and developing competitive advantage in environments characterised by rapid change (Zahra and George, 2002).

Poor Follow-up on Projects

Many research projects in Hydro have been run over many years, without having demonstrated progress and value to the organisation. The organisation lacks routines for shutting down projects, which are not delivering as expected and represent resource drains.

“Several projects are run over ten years; budgets from the previous year is simply “recycled” and reused.” Kjersti Myhre, RTD

Project follow-up is also related to realised absorptive capacity; which is defined as the procedures and structures for seizing opportunities (Zahra & George, 2000). Structures for rapid decision-making and the setting of boundaries for the business scope help the firm to pursue the right opportunities and stay focused (Teece, 2000). Hydro's lack of routines for closing down unprofitable projects gives evidence that the realised absorptive capacity of the organisation is in poor shape. Routines for progress evaluation and closing of low pay-off projects are not established in the organisation, affecting the absorptive capacity and leading to a waste of resources.

5.5.10 A Need for Involving the Business Partners

There is no position in the R&D organisation today, concentrating on innovation activities only. It is believed by top management, that there is no point in striving to achieve innovation without involving the respective business partners, and that innovation cannot be one person's responsibility alone. An initiative has however been set, to come up with people from each business areas as well as from each R&D centre, who can work creatively and push for innovation processes.

“It does not matter how many ideas we come up with, as long as we are not able to sell them in to the people who are going to produce them, and bring them to market” Helge Jansen, Head of R&D

Without support from the business partners, there will be no real focus on radical innovation in Hydro, because of the clients' heavy short-term approach and their financial power of R&D.

5.5.11 Summing Up: Lack of Pull and Push for Innovation

"The business partners must – together with us – take responsibility for innovation within their business sector" Helge Jansen, Head of R&D

Step change projects are encouraged from Hydro's top-level management, however lower levels in the organisation are driven by short term goals, KPI measurements and results for capital market day. At these levels, the attitude towards innovation is "nice to have" rather than "need to have". Additionally, Hydro's budgets are set on an annual basis, putting a limit for long-term projects, which may require longer development time than a year. As long as it is the R&D centres' clients who are responsible for financing R&D projects it will be next to impossible to change focus from incremental innovations only, to include step change innovation. The clients' cultures and work approaches are extremely business driven, and their focus is short term and oriented towards incremental improvements of products and operations.

The New Ideas programme and Innovation Award represent structures for innovation projects, however these are not permeating the R&D agenda and focus in practice. Processes for innovation generation are not established in the organisation. There is a gap between the New Ideas programme and the initiation of real innovation projects, as New Ideas lack follow-up. The silo mentality and silo structure in Hydro make resources immobile, and prevent them from flowing to the projects, which need them (Kanter, 1983; Jelinek & Schoonhoven, 1990).

Innovation activities should be more emphasised and focused upon at all levels in the R&D organisation, and also among the business partners. KPIs and reward systems should be adjusted so that they facilitate and encourage innovation rather than inhibiting it.

5.6. Summing Up: A Weak R&D Organisation

5.6.1 A Fragmented Organisation

Hydro's R&D organisation is fragmented. Structurally, it has been shaped by contingencies, and is engraved by the fact, that there have been little or no efforts to integrate the distinct centres into one uniform organisation, and to bring their operations together. Upstream R&D and Building Systems' R&D are not included in the central R&D organisation, for no good reason other than contingencies and a cling towards the way it has always been. The formal arrangement and structure of each R&D centre studied in this assignment vary. Roles and responsibilities differ, and there are no identical arrangement of positions and position titles. This may cause confusion when employees from different sites communicate and collaborate; it becomes difficult for them to know how to place each other, and what to expect from each other, and to know what the responsibilities of the other person are.

The R&D organisation's place in the Hydro organisation can appear somewhat diffuse, and there is a great potential for improvement. An untidy structure in management may well cause negative ripple effects downwards in the organisation, and have a discouraging impact on researchers. A more sorted out relationship between the R&D organisation and Hydro's corporate management will make the lines clearer, and signals downwards in the organisation will become tidier. Today's R&D management functions well, much because of the close relationship between the Head of R&D Helge Jansen and the Group Chief Executive Svein Richard Brandtzæg. The day one of them is to be replaced, the organisation cannot expect to lean on such a relationship any longer, and a tidy and clear organisation will be of great advantage in order for an eventual replacement to work out smoothly.

The relationships between centres in mid and downstream R&D are not close. At times, there have been some tendencies towards unhealthy competition for financial resources. It has been observed, that there has been competition the central projects, just in order to ensure the financial means, and with no intention of focusing upon them. This attitude reflects a weak R&D organisation and disrespect to the central project portfolio. Competition for financial means indicates that the R&D centres are self-centred, and that there is no common and unifying culture in the R&D organisation.

5.6.2 Culture Follows Structure

The R&D body of Hydro employs a silo structure, where the R&D centres are weakly tied to each other and the body as a whole lacks flexibility. The

orientation towards business partners, and the system where it is the business partners who, to a high degree defines and shapes the research objectives and agendas of the R&D sites, reinforces the lack of R&D integration.

The R&D centres are currently so attached to their respective business partners, that the culture at each centre is more alike the culture at the customer's sites than it is alike the other centres in the R&D organisation. The central R&D organisation lacks a common culture and a long-term perspective. The business sector's short-term approach and focus on process improvement and incremental innovations colour the culture and mindsets at the R&D sites, leading to missed opportunities for innovation.

5.6.3 Unrealised Synergies and Weak Dynamic Capabilities

The structure and composition of the R&D organisation put some constraints on the effectiveness of the management and leadership of the business. The four R&D centres are managed centrally "on the paper" however the potential of this central management remain unexploited.

Hydro's R&D organisation constitute much of the total resource base in Hydro, and is involved in the maintenance and administration of the remaining parts of the resource base. This indicates that much of Hydro's total set of dynamic capabilities is rooted in the R&D organisation. However, the dynamic capabilities of Hydro's R&D organisation appear to be low quality, because of too little collaboration across the R&D centres. The lack of communication and the partition between the centres reinforce the silo mentality and inhibits full exploitation of the resource base. When people in the organisation do not know what kind of competence is present at the other sites, and when they are completely focused on their own projects directed to their own client, then it goes without saying that they will not collaborate with each other. At least not as long as the structure and culture remain the way it is today. Knowledge transfer is an important part of dynamic capabilities and absorptive capacity. Little personal communication makes knowledge resources immobile, and hinders them from being exploited at all sites although potentially relevant.

The lack of project follow-up and technology watch activities witness that Hydro's absorptive capacity is poor. This is a classical mistake for large and mature organisations, and often a consequence of stable operations through many years (Dougherty & Hardy, 1996). In the case of significant and rapid change in the external environment, organisations which do not have well-developed absorptive capacity will fail to identify the threats and opportunities of the change, and their time-lagged and hobbling response will be detrimental for their competitive advantage (De Wit & Meyer, 1998).

6. Proposal and Discussion

6.1 Proposal and Discussion

6.1.1 Taking the Ongoing Process One Step Further

There is an ongoing process today, where a group of 5-10 people across the R&D centres and business areas are to be dedicated an innovative responsibility in Hydro. Hydro's R&D management are about to challenge people to join this process by announcing innovation as a responsibility - not a job. The thought is to offer 80 hours of theoretical education in creativity, and then a training period for 6 to 8 months before the chosen ones return to their positions in Hydro, with extended responsibilities and a slightly different workday. The "innovation team" will include representatives from each business sector, and every R&D centre.

"These people are supposed to become our ambassadors for new thinking and innovation, and help people in Hydro to think structured about new processes and themes." Helge Jansen, Head of R&D

Establishing such an "innovation team" is an important first step in order to bring about an active innovation process in Hydro. Hydro needs an arena, a platform for innovation, and I believe that this approach is a large step in the right direction. However, the platform for innovation should be further refined. My proposal for restructuring and change involves taking this process on step further.

6.1.2 Proposal

Based on my findings, I have come up with a proposal for how to improve the current R&D organisation of Hydro. It should be kept in mind, that my knowledge of Hydro is limited, and the time perspective of this assignment has confined the scope and depth of my suggestions. My proposal is not too detailed, as I have attempted to draw the main lines, and set a course of action rather than specifying the methods and succession for doing it.

My proposal involves three main changes, and I will shortly present them in the following sections. Then, I will shortly provide some rough guidelines for the execution of the restructuring, before I will describe the effects and potential upsides of carrying them out. Challenges in relation to the execution of the restructuring will then be pointed at. The conclusion brings up how the proposal for change may yield value to Hydro.

(1) A United R&D Organisation at Corporate Level

The current organisation of Hydro's R&D is diffuse, fragmented and unclear, and it is difficult to outsiders to understand the system. This causes confusion

downwards in the organisation, and especially for potential innovation champions, there is no clear way to go in order to carry out an innovation project.

For Hydro's entire organisation – and the R&D organisation independently - to become a more lucid and tidy organisation, I recommend that all R&D units and activities are gathered under one umbrella; a central R&D organisation. The management team for the central R&D organisation should be made up of representatives from every R&D centre. This means, that up- mid- and downstream R&D centres have one central R&D management to respond to, and the R&D is lifted organisation to corporate level. The figure below illustrates the proposed structure.

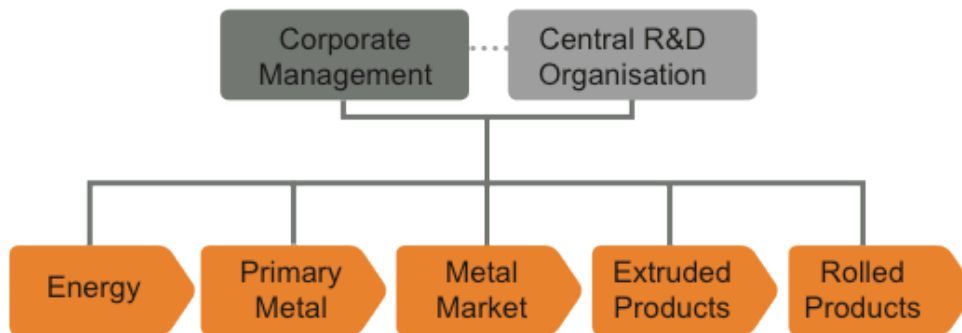


Figure 4 Proposal for a new arrangement of Hydro's R&D activities

This structural change entails that the Head of R&D is dedicated a seat in corporate management; consisting of leaders of the business sectors and the Group Chief Executive. R&D is one of Hydro's core competencies, and it is not unreasonable, that the Head of R&D has a saying on the running of the corporation. The Head of R&D is to report directly to the Group Chief Executive, and have close relations and regular meetings with the rest of the corporate management.

(2) Financial Empowerment of R&D

Today's organisation of R&D yield that the business sectors are in practice setting the R&D agenda and the strategic objectives of the organisation. The fact that there is little or no cooperation across business sectors in Hydro makes their strategies somewhat differing, and it is not ensured by anyone, that the business sectors are working towards the same direction, or that they utilise each other's competence for what it is worth. It is unfavourable, that the organisation is segmented into completely distinct business sectors, when the aluminium industry is moving towards integration. A more integrated industry may require more integrated offers, and the business sectors could potentially

gain a lot by approaching their customers collectively, and share customer information.

As stated in the Findings and Analysis section, there are only three people, in addition to the Group Chief Executive, who have positions which are aligned across the complete organisation of Hydro. The three people sitting across the Hydro organisation, are all employed by R&D, indicating the R&D plays a central role for development of a common set of strategic goals and objectives for the entire organisation. By gathering the entire R&D organisation and lifting it to corporate level, this important organisational task has the opportunity to grow stronger. However, as long as each centre is completely financially dependent of their customer within their specific business area, R&D will never take on this important role. Financial empowerment means strategic empowerment for R&D, and the freedom to focus more on step change projects. The intimate customer relationships must of course be attended to and preserved, as R&D projects still need to start in the field and pull from the business sectors is important. However if the R&D organisation gets the opportunity to influence their strategic agenda and prioritise projects more independently, the context for a creative workplace environment and initiation of more step change projects is likely to be much improved. Financial empowerment will release the R&D centres from their customers' clutches and give them freedom and opportunity to collaborate more with other R&D centres.

(3) Establishment of an "Innovation Hub"

My third proposal for change is to establish an "innovation hub" (Leifer et. al., 2001). The innovation hub should be organised under R&D, and report to the head of R&D. Key people in the hub should be recruited from each of the R&D centres and each of the business sectors. Like the R&D management, the hub should be situated across all of the R&D centres and business sectors, and have close ties to all of them. The hub is meant to function as an adhesive, bringing people from the distinct business sectors and R&D centre together through new interesting projects, and also through workshops, conferences and newsletters.

The tasks of the hub are simple; to hunt, gather, screen, select and prioritise new innovation ideas. They should also be involved in the process of selling in the potential projects to internal customers if they are not to be centrally financed, and in setting the right people on the projects. The hub may also be responsible for establishing cross-sectional processes for marketing, implementation and service to the clients. If R&D is lifted to corporate level, then they will have more resources available, and the hub will benefit from this.

The hub should take on responsibility for educating and encouraging innovation champions within the organisation. Although the organisation should not depend upon innovation champions to emerge, they represent an important motive power for establishing innovation projects (Dougherty & Hardy, 1996). The rise of innovation champions requires that the organisational culture is entrepreneurial, and prone to innovation (Ireland et. al., 2003). It is a question of the hen and the egg; what comes first, the innovation champion or the entrepreneurial culture? It becomes an iterative and reinforcing process, where the culture becomes more entrepreneurial when there are more innovation champions there, and more innovation champions will appear when the culture becomes entrepreneurial.

The internal customers are extremely business-driven and short term oriented. Innovation cannot happen in the R&D organisation alone, as it is part of the definition that innovation is something that is implemented and that yields value to someone. It follows, that for the R&D organisation to be able to promote innovation and creative activities, the business partners must be open to implementation of new and creative projects, and be willing to take on higher risks than they have been until now. An empowered R&D organisation lead by an innovation hub can make this happen.

6.1.3 Execution of the Restructuring

The proposed restructuring will have no effect what so ever if it is not thoroughly executed and followed up. The entire organisation of Hydro will be affected in some way, and the totality must be informed about the changes before they are implemented. Campaigns should be executed in order to make people understand the objectives of the changes, how they are to be carried out, and in what ways they will affect them as individuals. The attitudes and cultures at each R&D site, and also among business sectors, should be attended to by involving them in the process and be open with regard to what the changes will mean in their everyday operations.

A Programme for Integration

It is important that the “new” R&D organisation is totally renewed in order to inhibit suspicion among the newly integrated R&D sites and the “old” sites in the R&D organisation. Programmes for integration of the R&D organisation, and creation of a new R&D culture and identity should be initiated at an early stage, maybe even before the actual restructuring is put through. A uniform R&D identity needs to be created, which is most easily done by creating upheaval in the entire organisation and shaping a new identity based on common values and objectives. This action will also help tearing down the current barriers between the R&D centres, which inhibit realisation of synergy effects today. It must be

communicated to every unit in the R&D organisation how important R&D is in its entirety, and how they create value to the business partners and to Hydro as a whole. The potential upside of increased collaboration must be thoroughly illustrated, so that every R&D employee sees the use of communicating with people from other sites. A context for creating a creative culture must be set by the change process. The process of restructuring should be turned into something positive, tearing down old barriers within the old R&D organisation and eliminating suspicion and fear between the sites. Success requires that management is able to “get the people aboard”.

The R&D organisation should be brought together in its entirety at an early stage. A kick-off arrangement, where all R&D employees are given the chance to meet each other face to face, and where the strategic objectives for the restructuring are explained, will provide a good start. In order to create long-lasting ties between the R&D centres the kickoff should be followed up by regular meetings and seminars, under the hub's directions (Matsushita; Kuemmerle, 1997). Each R&D employee must feel appreciated and valued, and that his or her work represents high strategic importance for the organisation. On such a kick-off, each R&D centre can also be allowed to present themselves, their operations, and what they stand for. The detailed plan for the new system should be communicated in order to eliminate any discomfort and suspicion to the process. A prominent kickoff may also have a motivational effect in that R&D staff feel valuable and important for the organisation, and wish to keep up the good work.

Creating a Creative Culture

Gathering the R&D organisation and lifting it to corporate level, is expected to have positive effects for all of the R&D divisions. First of all, uniting every R&D unit in the organisation provides the opportunity of creating a uniform R&D identity and culture, which seem to be lacking in today's organisation. The process of integrating every R&D unit, and creating a new central R&D organisation is not insuperable, although there are some challenges related to it.

Every R&D site in the mid and downstream R&D organisation has developed their own characteristic culture – clearly coloured by their relationships to the business sectors they are serving. An R&D-specific culture is lacking. The psychological context in which people work, impacts their ability and urge to be creative and entrepreneurial (Drazin & Schoonhoven, 1996) and a common creative and entrepreneurial culture needs to be in place before one can realistically talk about chasing radical innovation. The R&D culture need not be homogenous, as the culture at each site is already so influenced by their customer relationships. However an R&D-specific culture should be the

foundation on which the centre-specific cultures can be built. Such a common core culture will eventually contribute to a positive set of attitudes towards other centres in R&D, and to internal collaboration and sharing of knowledge.

An entrepreneurial culture is a creative and bold culture where new ideas are expected and welcomed, uncertainty is accepted, risk-taking is encouraged, failure is tolerated, learning is facilitated and innovations are championed (Leifer et. al., 2001; Ireland et. al., 2003). If R&D succeeds in creating their own entrepreneurial and creative core culture, then they may also make an impact on the cultures of their customers. Both institutions would benefit from such a two-way influence of cultures. The innovation hub is supposed to be a motivational factor for creativity for the clients as well as for R&D staff, and a clear symbol of Hydro's dedication to innovation, which is important in order to be able to create an entrepreneurial culture (McDermott and O'Connor, 2002). Cultural exchange and creation of an entrepreneurial culture along with innovation encouragement from the hub will contribute to shaping the mindsets of Hydro employees to become more entrepreneurial (Leifer et. al., 2001). Influencing the organisational culture to become creative and entrepreneurial is an efficient way for corporate management to promote innovation and step change in the organisation's practices and daily operations (Leifer et. al., 2001). A common and creative culture will also make the organisation more flexible and prone to change (Teece, 2007) as it makes it simpler to anchor R&D strategies at lower levels in the organisation.

Incorporating New Ideas

The New Ideas programme has come a long way in encouraging people to dear think creatively and report their innovative ideas and pursue them. Nevertheless, New Ideas is somewhat defective yet, and my findings suggest that the programme should be better systemised in order to become more efficient and bring about results. There is a gap between the preliminary work from New Ideas to the becoming of a real Hydro project. The innovation hub could take on the responsibility for bridging this gap. I suggest that the New Ideas programme is included into the hub's responsibilities. It becomes the hub's responsibility to re-evaluate the preliminary works and decide, whether the projects are worth carrying on with. Where the New Ideas programme stops, the real job of the hub starts. Real-options logic should be applied for the continuous re-evaluation process. The job of screening ideas and evaluating their business potential is an extremely important job which carries an essential responsibility, to select the projects which are to become commercially successful, and to turn down the projects that are expected to be low pay-off. It is also the responsibility of the hub, to put a stop to projects, which do not deliver as expected.

Recruitment for the Hub

Employees in the hubs have the chance to build strong networks internally and externally, which become useful in the process of commercialising new ideas. Internal recruitment for the innovation hub is advisable, as it is an advantage that the hub employs people who know the organisation and its operations, and who possess wide internal networks. People with experience from – and maybe even with current jobs within – each business sector and R&D centre should be employed at the innovation hub, which should report directly to the head of R&D. The recruited hub staff should be educated and trained in technology transfer and innovation. Their networks within and outside the organisation should continuously be expanded, and this should be facilitated by the organisation. The hub staff needs to have solid internal networks in order to be able to efficiently screen new opportunities and map out where to find the necessary competence to carry the idea out, and who to talk to, to find out whether the idea really has a business potential. Facilitating this network should be considered part of the organisation's knowledge and competence management efforts. Hub staff should be attending internal gatherings and conferences within every business sector, where they should also come with contributions, presenting the hub and its objectives to make it known in the organisation. In addition the hub must be marketed internally in order to lower the threshold for taking advantage of it.

Marketing the Hub

The hub will be a visible evidence of Hydro's dedication and commitment to step change innovation. It must be accessible to every part of Hydro's organisation, and the formal distances should be short. Everyone who has an idea is to be welcomed by the hub. It is important in this instance that the hub is kept free for bureaucracy. The hub's work approach should be characterised by a great deal of empowerment and simple and efficient decision making processes.

Campaigns should be initiated, to exhibit the innovation hub and familiarise the organisation with it. Barriers for taking advantage of the hub should be as low as possible from the very beginning in order for the concept to become a success. The connection to the New Ideas programme represents an advantage here. By recruiting internally, several people in the organisation will have a direct or indirect personal relationship to someone who is employed by the hub, which also helps lowering the threshold. The innovation hub should be presented at the kickoff for the restructuring, together with the other structural changes. However, marketing of the hub should not stop there; representatives from the hub should continuously make an appearance while hunting and gathering ideas from different parts of the organisation. Newsletters, reports and brochures

should also be distributed across the organisation, so that everyone is reminded that the hub exists; and updated on its activities and achievements.

Internal Structure Alignment

The organisational structure in Hydro's R&D body is diversified and the four R&D sites in mid- and downstream R&D organisation share few characteristics. Rather, they are organised in fundamentally different ways; further complicating collaboration across centre borders. Adjustment and alignment of the structures in each R&D centre will possibly remove some structural barriers for cooperation and communication. Benchmarks on job descriptions and titles should be introduced at all centres, so that competencies, positions and people can be more easily associated properly. It follows naturally, that systems for information management are standardised and implemented across the total R&D organisation.

A more aligned organisational structure will potentially ease processes for performance management, because the R&D sites becomes more comparable. A programme for structure alignment should be implemented throughout the R&D organisation. The programme should contain guidelines for making uniform processes for decision making, improved procedures for establishing and sharing of best practice and uniform KPI sets. The vision and mission should also be more thoroughly implemented in the mind of every employee, permeating the organisation. The structure should remain flat at all R&D sites, as well as internally in the hub, to ensure smooth information flows, and efficient decision-making (Teece, 2000).

Cultivating Fields of Competence

Although no one wants to say it out loud, there seems to be consensus, that the R&D organisation can realise synergies by cultivating the fields of expertise and competences so that overlapping fields between Hydro's R&D centres are eliminated. This is congruent with Teece's (2007) idea of co-specialisation. Although Teece formulates the idea for firms, to team up with other firms offering complementary products or services, it is highly relevant for an R&D organisation such as Hydro's as well. If each centre is dedicated one or more fields of expertise, then they can team up with the other centres possessing complementary competences and assets and create something together with them, which will generate rents for both parties as well as for the client. Such an arrangement will eventually enhance collaboration between the R&D sites, as it makes them depend more on each other's competences. Cultivated fields of competence and expertise along with flexible organisational boundaries represent an optimal structure for optimising operation and ensuring dynamic capabilities and flexibility (Teece, 2000). The researchers at all centres should

be viewed as a pool, from which interdisciplinary project teams can be assembled.

Establishment of Common Process Models

The business sectors as well as the R&D centres work distinctly, and there are very few examples of them cooperating. There is reason to believe that a common process model for project initiation, execution and implementation will shorten the distance between the business sectors and R&D centres, bringing forth opportunities for cooperation and integration. Project leaders' responsibilities should be more defined. The efficiency of project processes can also be enhanced by establishing standards and best practices in project screening, selection, prioritisation, execution, external collaboration and also, project close-down (Zahra & George, 2000). If these processes become more uniform throughout the organisation and across R&D sites, then they will become more worked-in in the daily operations; facilitating cross-sectoral collaboration.

Institutionalisation of Personnel Exchange

A programme for active personnel exchange within R&D should be established and it can be part of the hub's responsibility to monitor and follow up the programme. More exchange of personnel is expected to have a positive effect on the R&D culture and identity, because it ties the centres together by personal relationships. This may again have positive effects on the amount of cross-sectional collaboration. Exchange from R&D to the operative plants is also valuable, and should be institutionalised as well. External exchange may enhance the absorptive capacity of R&D, bringing new knowledge and new impulses to the R&D organisation. Exchange of R&D personnel make the connections and relations between them stronger. A strong social capital leads to more efficient sharing, transformation and transfer of knowledge. The richest communication channel is based of face-to-face contact between researchers at all levels. Time must be invested in personal meetings, both between researchers on different sites, but also between researchers and local affiliated universities and suppliers (Kuemmerle, 1997).

Search for Value Opportunities

The hub is responsible for external technology watch and the search for external opportunities. However innovation opportunities can be found internally within the organisation as well. Especially, each section in the value chain, and the links between them should be investigated more thoroughly and searched for value opportunities. Such activities may result in multisite R&D projects focused on making the organisation as a whole more consistent and effective. Multisite projects also help develop the internal social capital within the R&D body,

facilitating further collaboration and more smooth information flows and communication.

6.1.4 Effects of the Proposed Restructuring

More interaction between business sectors and R&D centres increases the chance of discovering latent synergy effects in the organisation, and enhances the probability of succeeding in their realisation. More interaction means more sharing of knowledge and information, and more knowledge about the operations, projects and needs at other centres. A central R&D organisation, comprising every R&D centre in the Hydro organisation will bring the centres closer together, and may facilitate the development of an R&D culture. New strategies will more easily be anchored at lower levels in the organisation when there is one central management, and one consistent culture in R&D.

Serving Internal Clients in a Body

The R&D organisation is an important part of Hydro's unique resource base, and by bringing it together its value may be further enhanced. A more united R&D organisation means a more united resource base and can lead to better exploitation of the resources in the organisation.

The restructuring is meant tear down old internal barriers and lay the foundation for a unifying R&D culture and more collaboration between the R&D centres. The organisation will move from being a polycentric decentralised model to becoming an integrated R&D network of several co-specialised R&D centres. The centres are expected to borrow expertise and competence from each other, and will serve their customers more or less in a body where possible. An integrated R&D organisation along with a higher degree of integration of the business sectors will make Hydro more flexible.

Tearing Down Ancient Barriers

Empowering the R&D organisation will make integration easier achievable, forming one uniform organisation of distinct, equal R&D centres. By weakening the dependency of the business partners, internal barriers in R&D can more easily be demolished, as the strong customer orientation made the perceived distance between Hydro's R&D centres and their operations longer.

Financial and strategic empowerment of R&D will also lead to increased collaboration between R&D managers and the managers of the business sectors, as they will need to coordinate their agendas. If larger amounts of R&D financial resources are to be granted by central R&D management, then the central management and business partners will have to communicate and agree upon which projects should be prioritised. This will also boost communication and

collaboration between customers across business sectors, potentially leading to further realisation of synergies for Hydro. More collaboration will lower the barriers and vice versa, and when silo structures are eliminated, silo mentality will also disappear in time.

More Collaboration

Some interdependency between R&D centres and their customers is healthy in order to ensure efficient cooperation. However, this interdependency should be more a result of agreement and unanimity at top levels, than economic dependency at lower levels. The business partners and their respective R&D centres should come to an agreement for budgets and project prioritising in cooperation, like they do today. My proposal involves that the central R&D budget be increased, and like today focused on innovation and value chain projects. The R&D centres are expected to collaborate more as a result of a uniform R&D culture and identity, more centrally financed projects and establishment of common process and project models and structure alignment. More collaboration between the R&D sites will lead to a more efficient use and exploitation of resources for R&D and resources, which is a result of R&D (Dougherty & Hardy, 1996). More cross-functional collaboration also leads to enhanced value of the social capital, leading to more flexible connections between the R&D centres (Gassmann & Zedtwitz, 1999).

The hub represents a transversal innovation group, and may cause positive ripple effects in the R&D organisation on other areas than innovation as well – as it brings the R&D centres together, and represents a common arena for the business sectors. Business partners have a lot to gain by cooperating in their interface toward markets and customers.

Routines for Absorptive Capacity

The structure where the R&D centres are dedicated to, and financed by their business sectors leads to a lower prioritising on technology watch activities. There are currently no established routines for technology watch in the organisation. The hub is to be dedicated the responsibility of discovering and seizing new opportunities; hence its responsibilities include technology watch activities. In this respect, the hub directly enhances Hydro's absorptive capacity.

Organisational change is expensive, and processes for determining which transformations are worth going through, and which ones are likely to be low pay-off, are important. Closing down projects which are not honouring their expectation is also vital for organisations wanting to utilise their resources efficiently. These processes are important parts of the absorptive capacity of the firm, and also part of the hub's responsibilities.

Enhanced Flexibility

A more presbyopic organisational structure can make the organisation more flexible and efficient, because internal untidiness, competition and animosity may slow down processes. A clear structure simplifies the processes of reconfiguring and transforming the resource base; and personnel exchange and department turnover is likely to increase. This can potentially lead to more significant internal social capital, in that informal and formal internal networks are created and expanded. Increased turnover and personnel exchange enhances organisational learning, and makes knowledge and competencies more accessible in the organisation. Deliberately facilitating the development and expansion of formal and informal internal networks is a way of managing competence. A unifying organisational culture will also affect the behaviours and attitudes of the employees, making them more predictable and simple to manage in a situation of unforeseen change (Trice & Beyer, 1993). Elimination of internal barriers for collaboration reinforces the uniform culture, and enhances the flexibility both in terms of organisational structural flexibility and the flexibility of the work force in terms of mentality and attitudes.

Shorter Distances

A tidy organisational structure and a uniform basis of culture in R&D make it easier to get support for new ideas upwards in the organisation. The distance to top management becomes shorter, and the threshold for taking advantage of personal networks and asking for help from other places in the organisation is likely to be lowered. The hub represents a strategic and structural asset encouraging step change innovation and simultaneously bringing the business sectors and R&D centres together. It provides an arena where representatives from every business sector meet.

Focus on Step-Change

Lifting R&D to corporate level ensures that R&D – and step change innovation - is at the agenda at top organisational level. The annual setting of strategy and objectives along with KPIs, quarterly reviews and capital market day hinder middle managers from thinking long term. If one wishes to move the objective for R&D towards innovation and new-thinking, then the financial dependence on business partners should be set aside. The financial dependence makes it difficult to initiate step change projects as long as the customers are as conservative and business-driven as they are today. When the R&D organisation becomes more financially detached from its customers, it has the opportunity to think long term and focus on step change projects. Empowering the R&D organisation may lead to an increased focus on innovation. It must be monitored, that the resources made available for innovation projects are used for their earmarked purpose. The well-functioning collaboration between R&D and its

customers must be preserved however R&D should also have a saying in the setting of the research agenda.

6.1.5 Challenges Regarding the Restructuring

Attitudes towards Change

There will always be some reluctance to change in any large and stable organisation. Hydro is no exception. My findings suggest that R&D employees in Hydro have become comfortable in their positions. There are some differences between the sites, some are more used to organisational change, and hence more flexible than others. The two largest centres have not executed any radical changes the latest years, and there is reason to believe that employees there will not welcome change warmly.

The proposed changes are radical in the sense that they bring about fundamental changes within top management in Hydro and R&D. Politics are strongly involved, as there will be a question about how financial budgets are to be set, and who will have the power to influence the R&D agenda by granting financial resources. Corporate management must respond to one more person, and give up much of the power they practise over their respective R&D sites if the proposal is adopted. Additionally, the leaders of the upstream R&D division and Building Systems' R&D must report to the head of R&D rather than directly to corporate management. Dissatisfaction is likely to arise, as people generally thrive at their high positions and are not positive to be relegated in the organisational hierarchy.

There may also be resistance internally in R&D at researcher level. Any change can be perceived as scary, especially for employees who have sat in their safe positions for a long time. The integration of the upstream R&D centre and also of Building Systems' R&D will represent a radical change in the organisation.

Changed Power Distribution

Any change brings with it a redistribution of power, and it is important that the change process is thoroughly followed up in order to avert any counteract attempts to the change. The business partners are expected to react negatively on the proposed scheme for restructuring. Empowerment of R&D means taking power away from them and giving it to R&D, resulting in less influence on Hydro's strategies. Business partners are likely to fear, that their relationships to the R&D centres will be disrupted by the restructuring. They may also be suspicious that the service they get from R&D will become poorer less immediate when R&D becomes a more independent entity.

Negative Autonomous Strategic Behaviour

As mentioned, the restructuring means a fundamental upheaval of existing power distribution and roles regarding research questions and strategies. A successful completion of the restructuring requires that top level managers who, until now have been privileged to be in charge of R&D money, are willing to waive some power to the central R&D management. Being in charge of the money means being positioned to influence and shape the R&D strategy and agenda for the organisation, and setting a course of action. Top-level managers who oppose to the restructuring represent a threat to a successful integration. Negative autonomous strategic behaviour (Burgelman, 1983) among managers is more dangerous than among employees at lower levels, because managers have the opportunity and power to influence the people reporting to them, and may this way cause negative ripple effects downwards in the organisation. This may evolve to become a form for "organised strategic behaviour", and the culture and attitudes within a whole division can be influenced to become negative to the new system. This would be very harmful to the organisation as a whole, and to its performance. Any sabotaging or counteracting towards the system will affect the culture and identity of the new R&D organisation negatively, especially in a vulnerable start-up phase (Kuemmerle, 1997). New forms of competition and suspicion between the centres - and between the centres and their business partners - can become a threat to the operations of R&D (Selsnick, 1957).

Any negative autonomous strategic behaviour must be countered by establishing a strong R&D culture, and at the same time protect the strong ties between R&D centres and their customers. The managers at the customers' plants as well as in R&D must be convinced, that the restructuring is meant to be at their advantage. The resistance of the business sectors should be met by selling in the positive aspects for them, explaining that any innovation success will turn into a major advantage for them as well. More focus on step change innovation may bring about significant upsides for the customers once successful. After all, R&D is there to create value to the rest of the organisation. If cases are encountered, with negative strategic behaviour among any Hydro managers, it should be considered, whether they should be shifted.

6.1.6 Getting the People Aboard – a Critical Success Factor

Presupposed that the proposal for restructuring is adopted by Hydro's corporate management, there are a few factors, which are crucial for the restructuring to bear fruits. Without involving the work force of the entire R&D organisation, and also from within the different business sectors, the restructuring will be of no avail. If the R&D management succeeds in facilitating and shaping a creative and unifying culture and R&D identity, then the most important step is taken for creating a fertile context for dynamic capabilities to grow forth. Solid processes

for vertical and lateral cross-functional cooperation will expand formal and informal networks, and enhance the social capital and absorptive capacity of the organisation. When a unifying R&D culture is established, the behaviour of the workforce becomes more predictable, and the culture can be relied upon as a form for government system. A strong unifying culture can make R&D employees more self-managed and autocratic; their decisions and behaviours are influenced by the culture. Relying on organisational culture as a coordination system is expected to energise the organisational members, and put less emphasis on measurement and reward; in turn facilitating a long-term approach.

6.2 Conclusion: Actions for a Long-Term Perspective

6.2.1 Moving Towards an Integrated Network

Many multinational organisations have shifted their R&D organisational models from a polycentric decentralised structures or hubs to integrated networks (Gassmann & Zedtwitz, 1999). As previously mentioned, the proposal for change in this assignment will lead Hydro's R&D organisation towards an integrated network model if adopted. The motivation for suggesting this is that such a model may help Hydro identify and realise latent synergies within the R&D organisation (Gassmann & Zedtwitz, 1999). The orientation towards different and distinct business partners, along with the prioritising of client service over pure research is inhibiting for collaboration across the network and reinforces the silo mentality in the current organisation.

The R&D organisation of Hydro's mid and downstream operations is far from a uniform body. The four R&D centres are loosely and randomly tied together, and collaboration between them is not initiated or facilitated from top-level management. Different organisational structures, different leadership styles and different organisational cultures create further inefficiencies and difficulties for collaboration between the centres. An execution of my proposal will move the R&D organisation toward the integrated network model. This will be positive when it comes to leveraging competences, knowledge and resources within the R&D body, because higher integration will make resources available and applicable to all research centres. When R&D sites depend on each other, collaborate, and share information and knowledge, unrealised synergy effects between them become easier to reveal and realise. Vertical and lateral cross-functional collaboration represents a mean for R&D coordination, and the more cross-functional collaboration, the more integrated the R&D network becomes. These features also enhance the quality of the learning processes and make the organisation more flexible (Gassmann & Zedtwitz, 1999). The figure below illustrates how an integrated network model will facilitate the flow of resources between the R&D centres in order to serve customers along the entire value chain in a body.

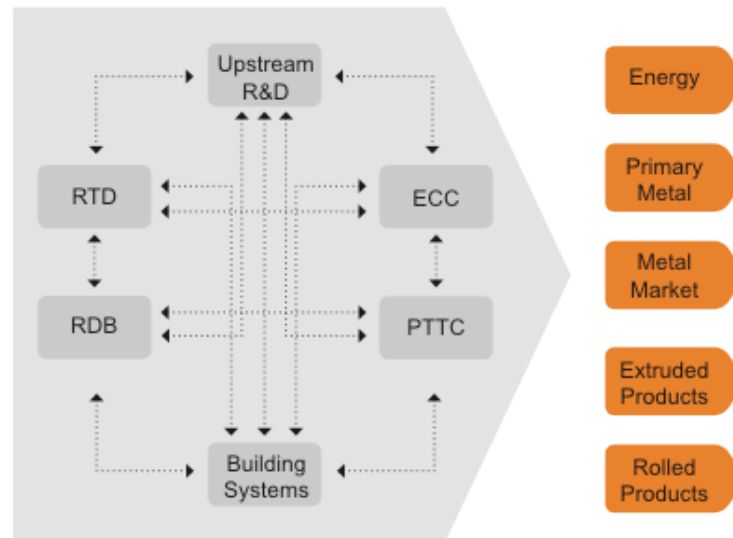


Figure 5 Proposal for an integrated network model in Hydro R&D

The innovation hub, with a strong tie to the R&D management team, will serve as the competence centre; or the technology steering committee in the integrated R&D network. It is important to differentiate the meanings of technology steering committee in relation to the integrated network, and “steering committee” in relation to the R&D centres’ customers, from each other. In relation to the integrated R&D network it means the group of senior managers who manage the R&D network, and ideally reports to the CEO of the corporation. The steering committee in connection to the internal customers of Hydro’s R&D centres involves representatives from the clients, who monitor the progress in the R&D projects. The hub monitors external changes and defines long-term strategies for development of the central R&D organisation. Short-term development will be set by each R&D centre in collaboration with their business partners.

Kuemmerle (1997) argues that as competition in global markets increase the imperatives for establishing integrated global R&D networks will become more apparent. Companies embracing a global approach to R&D will be better suited to meet the demands and challenges of the new market dynamic. They need managers who understand their role as global coordinators and who have the knowledge to be able to tap the full potential of the networks.

6.2.2 Coordination vs. Control

Coordinating a large and expanding R&D network is a challenging task, and managers of the network must be global coordinators, not local administrators. Their responsibilities include setting the research agendas and creating and

maintaining direct relations between sites. Regular central meetings and seminars for informing R&D employees about the corporate state of capabilities and technical knowledge is one way of creating such ties (Matsushita; Kuemmerle, 1997). Such seminars may also contribute to updating employees of the R&D organisation on technology trends in current and future markets. Internal gatherings and R&D workshops bring the people together, and provides an arena where researchers can get to know each other informally. Such features influence the organisational culture positively, and once a common and unifying R&D culture is established, coordination activities become easier as the behaviours of the work force become more predictable.

Efficient and well-functioning channels for information flow in both directions are essential mechanisms for managing an integrated R&D network efficiently (Gassmann & Zedtwitz, 1999). Despite geographical distances the research community should work to create a cohesive research agenda.

6.2.3 Value Creation by Restructuring

The problem definition for this master thesis concerns how the R&D body of Hydro should be arranged in order to create the most value to the company. The research objectives aim to identify actions, which will realise potential synergies, and what changes can be made in order to make Hydro's R&D organisation more oriented towards step change innovation.

The proposed restructuring will generate value to Hydro in three forms if executed properly. The three forms of value include (1) realised synergies and enhanced R&D performance, (2) the potential and opportunity to create step change innovation and (3) improved dynamic capabilities, absorptive capacity and enhanced flexibility. These three features are strongly interrelated, and will make Hydro better equipped in the face of a radical change in the market.

(1) Synergy Realisation

Financial empowerment of R&D will lead to strategic empowerment, allowing R&D to define their projects to a greater extent and to create multisite value chain projects. Together with cultivation of fields of expertise and the development of a common R&D-specific culture and identity, this will lower the barriers for communication between the R&D sites, and eventually lead to more collaboration. Cultivated fields of expertise and co-specialisation will lead to a need for more collaboration, which will work out smoothly if the organisation succeeds in establishing a common creative culture for the entire R&D organisation. Co-specialisation may also realise synergy effects in that competence overlaps will be eliminated, organisational learning enhanced (March, 1991) and processes for knowledge transformation and transfer will be improved (Teece, 2000; Nonaka & Takeuchi, 1995). More collaboration may well

lead to a more efficient running of the R&D organisation, but also for Hydro as a whole, because R&D results can be implemented in more than one part of the organisation and generate value or cost savings there too.

(2) Making the Fine Balance

A central R&D organisation and a place in corporate management for the Head of R&D will detach each R&D centre somewhat from their customers, allowing them to bring in a more long-term perspective to their operations. R&D organisations are there to explore, seek new opportunities and create value in new and innovative ways. However R&D can also be about refining processes, and making incremental improvements to existing products and technologies. Hydro's current R&D operations are strongly oriented towards exploitation of existing knowledge and technologies (March, 1991). The business partners have defined this indirectly but very clearly, by focusing on short-term goals and cost cutting. Too much focus on exploitation is a classical mistake among mature organisations in mature industries (Dougherty & Hardy, 1996).

R&D empowerment, establishment of an entrepreneurial R&D culture and a presbyopic organisational structure may help Hydro refind the balance between exploration and exploitation (March, 1991) and include radical innovation in their research strategy and agenda. This will enable Hydro's R&D to seek radical innovation and at the same time continue to provide incremental improvements on clients' demands; leading the organisation to become ambidextrous.

(3) Restructuring for Enhanced Dynamic Capabilities

Teece (1997) stresses that the management of capabilities and bundles of functional, organisational and technological skills are important for the dynamic capabilities of the firm. In Hydro's case, technological skills are well-developed both within and outside the R&D organisation. The organisational and functional skills, on the other hand, are more diffuse. It is this my proposal seeks to straighten out by tidying up the structural relations as well as tearing down old functional barriers, and creating a whole new identity for the R&D organisation.

My proposal seeks to influence the organisation's work force by making the organisational structure clearer and influencing the organisational culture to become unifying and creative. These features will provide a foundation on which solid dynamic capabilities and a flexible work force can be built (Teece, 2000; Drazin & Schoonhoven, 1996; Leifer et. al. 2001). The work force need to become more dynamic and prone to change as step change innovation means welcoming and applying new methods, work approaches and including new categories of resources in to the resource base (Christensen, 1997; Hill & Rotharemel, 2003).

6.2.4 Making the Decision

The most vital success factor for an eventual organisational restructuring is to make the decision - and stick to it. The objectives and manner of execution should be clearly communicated to every member of the organisation, and any negative response should be attended to in order to prevent an organised negative autonomous behaviour. A lenient procedure for bringing on a radical restructuring will be of no use. As Kjersti Myhre says;

“The success of an eventual restructuring depends on what Svein Richard says; how clear he is, and how faithful he is to the decision. People in Hydro are very true to decisions, however the decisions need to be crystal clear” **Kjersti Myhre, RTD**

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