Master of Arts Thesis

# Prospect*Ba*

## Platform for Collaborative Exploration of Product Innovation Opportunities

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## Platform for Collaborative Exploration of Product Innovation Opportunities

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# Abstract

This paper presents the design research based development of the ProspectBa platform, consisting of method and related tools for identifying future product innovation opportunities in an unfamiliar domain. The ProspectBa platform is a resource for exploring future business areas. It is also a solution to the common issue of distributed cognition in cross-organization innovation networks. The diverse body of knowledge about a domain, produced with the platform, has versatile application in the Front-End of product innovation and serves in the renewal of core capabilities. The three main platform components are the Prospect Mapping method, the Prospect Map system model and tool, and the online ProspectBa Studio blog. The Prospect Mapping method combines systematic design methods with a systems approach and scenario building for designing alternative systems of solutions to potential future needs in a domain. The Prospect Map system model defines design parameters and variables for creating a domain system image used in prospecting future needs and composing design briefs. The system model functions as a shared conceptualization of the domain; in this capacity it supports an emergent common understanding of opportunities among platform users. Common understanding is further supported by the systematic externalization of domain parameters and variables to the Prospect Map tool. The ProspectBa Studio blog augments the Prospect Map tool, enabling archiving, annotating and sharing its contents online. The adaptive design-based Prospect Mapping process produces meta-foresight about the impact of trends, macro-foresight about the impact of future concepts and micro-foresight about how to exploit identified opportunities. These outcomes are founded on the domain system image, which systematizes the monitoring of their relevance and simplifies new knowledge-creation. Ultimately, the platform is a potential unifying solution to the heterogeneous Front-End of product innovation.

Keywords: blogs, concept design, design frameworks, distributed cognition, Front-End, ontology, product and service innovation, R&D networks, scenario building, System Logics, systematic design methods, systems thinking, visioning concepts,

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# 1 Introduction

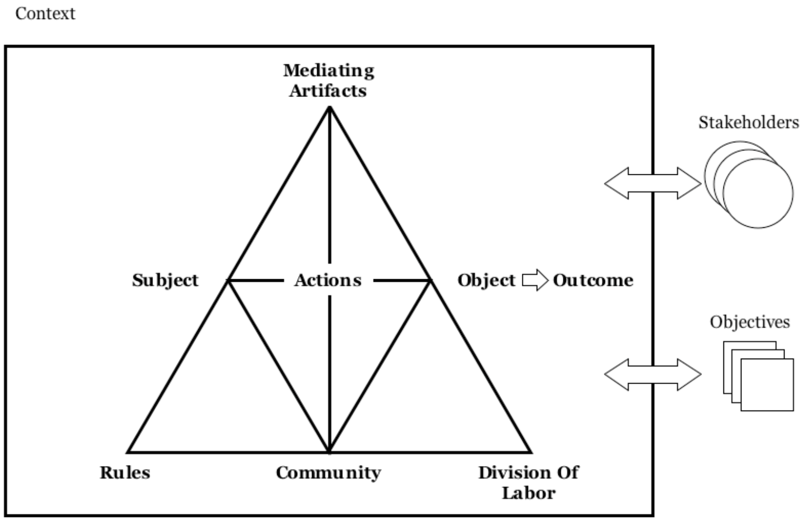
Knowing what is the right thing, at the right time and place for the right customer is probably the biggest challenge of product innovation in today's global economy and saturated markets. This is especially true for the Information Technology and Telecommunications Industry (ICT) characterized by rapid speed to market of products, decreasing regulation, and rapid obsolescence of new products. In the industry the continuous migration to new systems in search of growth and market dominance is conditioned on the systematic exploration of socio-technological opportunities and the maximizing of R&D diversity and complexity.

This Master of Arts thesis addresses three themes arising from the need to seek new business growth through innovation. The first theme is the development of new methods for collaboratively identifying future product innovation opportunities. The second is supporting distributed innovation networks in their search for those opportunities. The third theme has to do with the application of new knowledge about the opportunities in various product innovation contexts.

## 1.1 Background to Research Problems

The thesis continues the development of design-based methods and tools that I first started at Satama Interactive, as part of the Prospect Kosmos collaboration between Satama and Nokia Design. The collaboration took place during a period from Fall 2004 to Spring 2005. An Activity System model is used next to describe the Prospect Kosmos activity and the origins of the design research problems the thesis deals with.

According to Hasan (2002) the Activity System model from Cultural-Historical Activity Theory can be used as a general model and analysis framework for any type of activity. The theory considers activity as a system that has structure, its own internal transitions and transformations and its own development. These are reflected in the Activity System model. Human activity in the Activity System model is considered a dialectic relationship between Subject (person) and Object (purpose), mediated by Instruments, Tools (language, ideas, methods and models) and Community that sets the rules and roles within which the Subject acts. The model's components are Context, Stakeholders, Objectives, Object, Subjects, Outcomes, Tools/Instruments, Community, Rules and Division of Labor (Engeström 1999). The Prospect Kosmos activity components, relevant for describing the origins of the thesis research problems are presented next.




**1.1. General Activity System model. Image adapted from Iivari & Linger (1999).**

*Context*: The Prospect Kosmos collaboration was established to investigate major domains that neither company had been involved with previously, for future business growth opportunities. The collaboration was motivated by the potential synergy between Satama Interactive and Nokia in the creation of future Product Service Systems. Satama Interactive is the leading Finnish provider of self-service solutions, integrated marketing campaigns and future service concepts for digital channels. It has offices in three countries and a global customer base. Nokia, the world's leading mobile communications company has been Satama's key client since Satama was established in 1997. Nokia's mission is "Life goes mobile" which is reflected in its offering of mobility enabling technologies, products and services for the domains of Mobility, Home, Enterprise and Media. Together the two companies have the capabilities to create world-class next generation digital products and services. The relationship between the two companies has deepened over the years and recently Satama has been involved in the early phases of Nokia's mobile device product development. Prospect Kosmos was a logical step in further deepening this relationship.

The Activity System context for Prospect Kosmos can be divided into industry and organizational levels. The high-level industry context is the highly innovative and competitive ICT industry. The industry is characterized by technology platforms, high investment in R&D and migration from one information system to another. Migration related challenges are presented in section 2.1. On the organization level, the activity belonged to the Front-End of product innovation and more specifically, experimentation with new innovations. The aim of experimentation is to envision the future, identify new innovation opportunities and through them ensure that the company is able to respond to changes in its operating environment.

Prospect Kosmos had *Stakeholders* in both the Satama and Nokia organizations. At both companies the stakeholders were responsible for strategy planning and future investments. At Nokia they included Design and Technology Managers from the Technology Platform organization. At Satama, the Stakeholders were members of the company's Management Team.

Prospect Kosmos had "means" and "ends" related *Objectives*. "Means" related objectives consisted of managing the collaboration, and empowering it by developing methods, tools and a network to support the mission or "ends" of the activity. The "ends" or mission was:

> *Prospect Kosmos designs and maintains knowledge spaces describing business opportunities 10 years in the future related to specific domains, for the purpose of facilitating future product and service development decision making, design, implementation as well as tracking of future trends.*

Prospect Kosmos aimed to create diverse knowledge about new domains and future trends to benefit the Front-End of product innovation. The targeted benefits for designers included the identification of common needs across domains; provision of domain related pre-design material to inform future domain concept design; and the formation of domain related expert networks. For developers Prospect Kosmos aimed to provide insight and foresight supporting the development of technology roadmaps. The targeted benefits for Product Managers consisted of ideas on how to improve existing products; ideas for new products; information about trends and recommendations for timing domain interventions. The aimed benefit for Business Managers was the provision of insight and foresight to help assess the explored domain's strategic future value. Essentially, the full body of knowledge produced by Prospect Kosmos would help define what is the right thing, at the right time, for the right person in the right domain. The first domain that was explored was pets.

The multidisciplinary *Community* for the activity consisted of stakeholders, the activity core team, domain contributors (pet owners and activist interviewed as part of the work), and other parties from Nokia and Satama.

The Kosmos core team had six *Subjects*: three from Nokia, two from Satama and one industrial design student. The team members were experienced in designing product and service concepts and conducting end-user research in the Front-End but had not previously designed for the explored domain. External experts were involved in various stages of the activity to ensure that domain expertise would be incorporated into the knowledge produced about the domain.

The activity consisted of domain related design research, methodology development and collaboration specific *Actions*. The first months of the activity focused on researching methods and tools for exploring future innovation opportunities. Shneiderman's (1998) Genex (Generator of Excellence) was identified as a potential high-level framework for the collaboration. Genex consists of four steps: Collect, Relate, Create and Donate. Based on this framework, but without having specified how to create foresight, the team began collecting data about pets. From the analysis and structuring of the collected data emerged the idea for the Domain Map tool, which then led to the Domain Mapping method. Pet product and service concepts were brainstormed based on the Domain Mapping method. The team ran out of time before it could envision future domain changes.

*Mediating Artifacts* in the activity were software, devices, the Internet, workshops and the Domain Mapping method. PCs were used for online research, image editing, note taking and authoring of presentations. Digital cameras and mobile phones were used to take photos of pet owners during periods of observational research. The Domain Mapping method was used in the later part of the collaboration. In Domain Mapping the explored domain was modeled in terms of Actors, Needs, Solutions, Domain Trends and Global Trends. These were considered to be essential factors for designing domain related concepts. Instances of these domain factors were defined from collected domain data and then documented with Post-It notes onto the Domain Map. Concept design briefs were composed and design themes were identified from the collection of design factors. For the stakeholders the Domain Map served as an indicator of how the work was progressing.

The activity produced means and ends related *Objects*. Means related objects were the Domain Map and Domain Mapping method. Ends related objects were the collection of domain design factors documented to the Domain Map, high-level product and service concepts, as well as the naming of domain design themes.

The activity produced means and ends related *Outcomes*. A major means related outcome was the Domain Mapping method to guide the collection and structuring of domain data for concept design. The decision to further develop the method has led to this thesis work. Other means related outcomes consisted of design workshops, knowledge sharing events at Satama and the deepening of trust between two companies. The activity produced knowledge about high-level product and service concepts for the near future and domain design factors. It failed to identify future domain opportunities. It also failed to establish domain related innovation networks. In this regard, the activity did not meet all of its objectives.

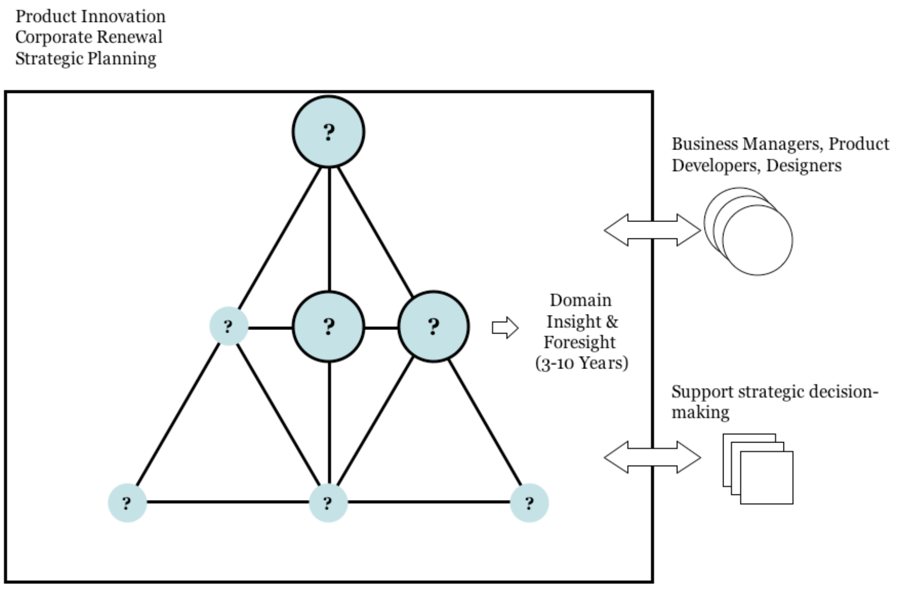
The Prospect Kosmos collaboration is exemplary of the contemporary trend in innovation networking of cross-organizational exploration for new business areas and renewal of core capabilities. The problems it faced in terms of developing methodology, supporting collaboration and empowering the application of the new knowledge are highly relevant to ICT innovation in general. This thesis takes the Domain Mapping method as a starting point to solving these problems.

## 1.2 Design Research Problems and Objectives

The thesis aims to develop a holistic solution to the following product innovation Front-End problems:

1. Identifying future innovation opportunities in a chosen domain;
2. Supporting emergent common understanding of future domain opportunities in a diverse innovation network;
3. Empowering the application of domain insight and foresight in the product development organization.

The first problem involves developing methodology for exploring spaces of possibilities and learning about future problems in a domain. The second problem is about supporting innovation collaboration by providing tools for distributed cognition, or the formation of common understanding in a diverse innovation network. Ultimately, it is about enabling the network to function as a complex adaptive system. The third problem concerns the body of knowledge created by domain exploration and deals with how to apply it effectively and monitor its relevance. The overall goal is to develop a reusable and extendible platform of methods and tools that solves all three problems. From an Activity System perspective, the goal is to define Mediating Artifacts, Actions and Objects for potential innovation experimentation Activity Systems in the Front-End.




**1.2. Thesis objectives presented with the Activity System model. Image adapted from Iivari & Linger (1999).**

The thesis also envisions how the platform of methods and tools could be adapted as a resource to different product development contexts and ultimately, be productized. From an academic perspective, the goal is to inform and inspire the development of design-based innovation methods and open innovation collaboration.

## 1.3 Personal Motivation

My original objective was to design a software application concept for Domain Mapping. However, upon starting the work, it became apparent that developing a method was a more pressing design research problem. Therefore, most of this work deals with method development but some software application and interaction design considerations have been made as well.

While application design as a thesis subject is more common at the Media Lab than the development of design methods, the later is more representative of my professional development and current interests as a designer. Since 1995, when I started out as a Multimedia Designer, the focus of my work has progressively moved from the”surface” or visible part of digital services and applications to the design of service concepts, definition of design offerings and the development of design tools. In Spring 1999, I began working at Satama Interactive designing web service concepts. Over the past few years the time horizon for the service concepts has moved further and further into the future. This progression from the user interface to concept design and finally, to future service innovations culminated in the Prospect Kosmos collaboration. From this perspective, this thesis is a milestone in my development from a user interface designer to a (future) problem solver using design methods and skills. The thesis combines concept design with the big picture of ICT innovation. I feel it is an excellent way to conclude my studies at the Media Lab.

## 1.4 Thesis Structure

This thesis consists of:

1. Written part presenting the background, theoretical framework, design research process, description and analysis of the ProspectBa design solution;
2. Prototype of the ProspectBa Studio blog application containing pet domain data. (The prototype can be accessed at http://www.jokkokorhonen.com/thesis/ProspectMapper/);
3. Prospect Map tool artifact containing pet domain design parameters and variables.

The written part of the thesis is divided into three thematic parts. The first theme deals with requirements and approaches to the design of the ProspectBa platform. It clarifies the methodology, collaboration and knowledge application problems the thesis aims to solve. The second theme is the design research process and ProspectBa platform design solution. The third theme explores the validity and comprehensiveness of the ProspectBa platform design solution to the research problems. It considers its possible applications and then envisions future work.

The first thematic part consists of Chapters 1 and 2. It provides background to the research problems. Chapter 2 opens with a section on ICT innovation roles and challenges. The section shows why the Front-End of product innovation is heterogeneous, and sets the context for knowledge application problem. Exploring spaces of possibilities and identifying future user needs are enumerated as key methodological challenges in migration driven innovation. Problems related to managing distributed cognition and organizing work in diverse innovation networks are also examined. The next section in the chapter turns to knowledge work theories to clarify the problem of multidisciplinary collaboration. The SECI model for organizational knowledge creation and Body of Knowledge classification are examined among others. Subsequently, systematic design and foresight methods are covered as potential solutions to the methodology problem. The System Logics framework is identified as a key solution to exploring innovation opportunities. The review of methods ends in the evaluation of Methods Toolbox and Visioiva Tuotekonseptointi, two concept design methods, which incorporate systems thinking and scenario building. The chapter concludes with theoretical frameworks to the thesis problems.

Chapter 3 moves on to the second thematic part dealing with the design research process and solutions. First, the Horizon project, which prefaced the Prospect Kosmos collaboration, is outlined to show how concept design has been the unifying language between Nokia and Satama. The origins and uses of the Domain Mapping method and Domain Map tool follow. The rest of the chapter recounts the different development phases of the design solution. It begins with an evaluation of the Domain Mapping method and ends with a simulation of the Prospect Mapping process.

Chapter 4 presents the ProspectBa 1.0 platform concept and its components, as the design solution to the research problems. First, the Prospect Map system model and artifact are described. Next, a walk-through of the ProspectBa Studio blog concept and features is taken. The Prospect Mapping process definition follows. A detailed phase-by-phase and step-by-step description is given of how the targeted domain is modeled to learn about present problems, how they are subsequently projected and then how the results are used to define future System Logics or approaches to customer needs and systems of solutions in the domain.

The third thematic part dealing with benefits, uses and improvements consists of Chapter 5. The chapter starts of by showing how the platform answers the methodology, collaboration and knowledge application problems of the thesis. In the discussion section, the ProspectBa platform is considered from a knowledge creation perspective. It is compared to the Methods Toolbox and Visioiva Tuotekonseptointi and deemed to display complex adaptive system characteristics. Next, potential application areas for the platform are envisioned, first in terms of different Activity Systems that can be based on it and then in terms of how to create new business with it. Finally, issues with ProspectBa 1.0 are pointed out before future work is presented.

Chapter 6 makes conclusions about the design research process, the outcomes and application potential of the ProspectBa platform. It also considers how the design research process could have been done differently. A summary of the thesis contributions ends the paper.

# 2 Identifying Future Innovation Opportunities

*Design predicts the future when it anticipates experience* - Augusto Morello

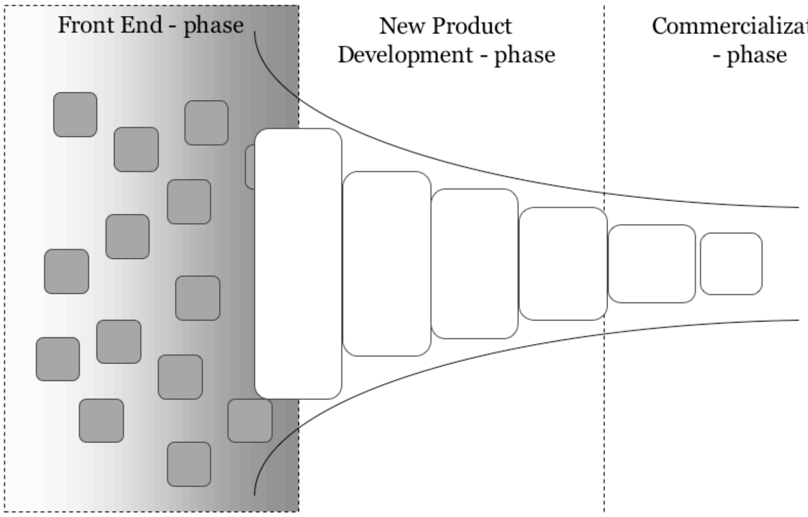
Chapter 2 begins by looking at the roles and challenges of ICT innovation, which form the background to the research problems. Knowledge theories are examined to learn about the fundamental reasons for the problems, especially collaborative problems. Systematic design and scenario building methods are presented as potential solutions to identifying and modeling future domain problems. Subsequently, attention is drawn to two methods combining systems thinking and scenario building, which enable defining future opportunities. Finally, the chapter concludes with a theoretical framework to the three research problems.

## 2.1 ICT Innovation Roles and Challenges

Prospect Kosmos is representative of ICT Front-End product innovation led experimentation. Product innovation in connection with new domains and beyond the core competencies of a company is a form of experimentation supporting the renewal of core capabilities. Moreover, experimentation is required in the approaches to identifying new opportunities and managing their relevance. It is also needed in organizing distributed innovation networks. This section examines each of these forms of "experimentation." It begins with the product innovation process and its importance for renewing core capabilities and then clarifies the methodological and collaboration related problems in exploring new opportunities.

### 2.1.1 Front-End of Product Innovation

According to Poskela et al. (2004) product innovation can be divided into three phases: *Front-End*, *New Product Development* and *Commercialization*. For an organization to fully benefit from innovation all three phases need to function seamlessly as a "pipeline" from inventions to commercial products (Poskela et al. 2004).




**2.1. Product innovation process. Image adapted from Poskela et al. (2004).**

In the *Front-End* phase, markets are monitored in order to identify a desirable position for the company and placement of its products. The objective is the discovery of new opportunities for product innovation. It is a proactive and experimental activity in the sense that it tries to find opportunities before they occur. Foresight plays an important role in trying to anticipate changes and see the world differently than is presently done by the company.

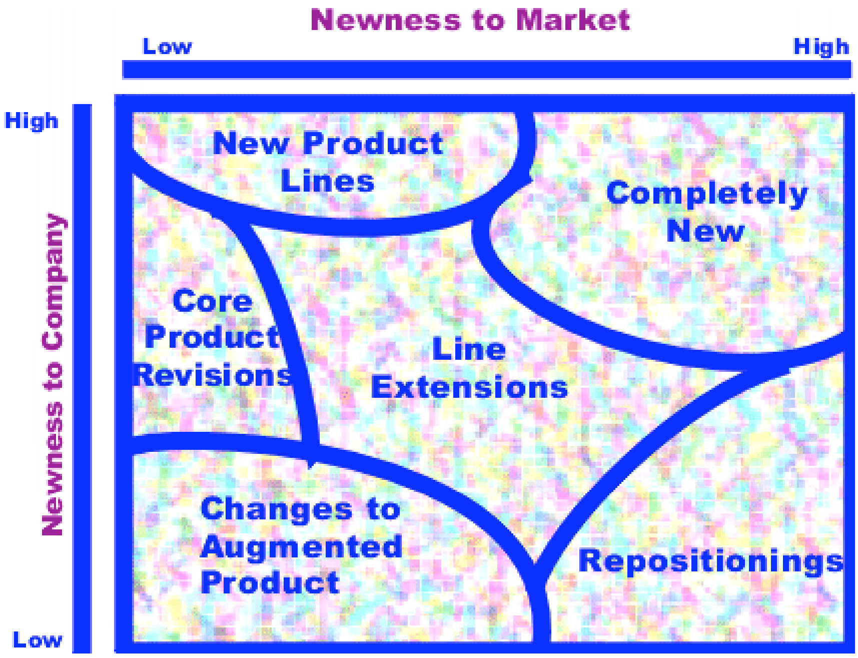
The purpose of the *New Product Development* (NPD) phase is to achieve the desired position identified in the Front-End through the formulation of a value proposition and implementation of a product concept. This involves the exploration of how to realize the opportunity within the boundaries and capabilities of the company. The goal is to develop selected new product concepts into final products as effectively and efficiently as possible.

The *Commercialization* phase aims to successfully introduce new offerings to markets. Distribution and marketing related factors affect the success of this phase.

***Heterogeneity of Front-End Processes***

The Front-End presents the best opportunity for an organization to improve its overall innovation capability because it is the least understood and least managed of the three phases (Poskela et al. 2004). Perttula (2004) claims numerous approaches for bringing more control and measurability to the Front-End have been proposed and tried. However, no single one has emerged as being universally better than the others (Perttula 2004, Poskela et al. 2004). This is because Front-End processes are by nature heterogeneous. The inherent factors influencing the heterogeneity of Front-End processes are product type, platform and design strategy, organizational culture and ultimately, the soundness of the organization's foundation for innovating (Perttula 2004). Together these factors make standardizing the Front-End impractical and subsequently, more difficult to integrate to the New Product Development phase.

According to Perttula (2004) the first factor affecting Front-End processes is the different starting points for product development. The starting points vary from an identified opportunity or need to a problem with an existing product. They result in different types of product innovations, which can be categorized according to degree of newness to market and incremental-ness or newness to company.




**2.2. New product types. Image source: http://www.mywiseowl.com/articles/New_product_development**

These product dimensions impact the requirements for the innovation process. New-to-market products have higher risk and uncertainty than incremental products about customer acceptance, technological feasibility and manufacturing associated with them. The need for a more thorough validation of the product related risks results in a different process and project team for new-to-market products than incremental products in the Front-End phase.

Product platforms and their roadmaps are the second factor. They are key ingredients to new product design strategy and thereby also influence Front-End processes. The linkage between product family type and platform roadmap impacts the type of design strategy employed in NPD. For example, in the case of product families and incremental products, existing product architecture is an input and constraint in the innovation process. For a listing of types of product families and useful design strategies see Perttula (2004).

The third factor affecting the variety of Front-End processes is the degree to which the organization is able to couple creativity and business discipline. While creativity is needed to generate ideas, business discipline is needed to make the ideas real. If creativity is not focused and supported by processes or expedient culture of the company, many ideas will be wasted. Therefore, the two have to be coupled. However, finding the right mix between creativity and business is challenging. It is a matter of finding the right balance between rigid formal procedures and flexibility to nourish innovativeness. This balance is often found indirectly through organizational culture.

The fourth factor, which ties the first three together, is the organization's foundation for innovating. The foundational elements of product strategy, technology management and portfolio management need to be in place before a Front-End process can be defined.

When considering the merits of Front-End processes Perttula (2004) concludes that processes should be combined or tailored to suit operations and culture. Kim and Wilemon (2002) claim formal processes seem to work best for incremental innovations by optimizing efficiency. Benner & Tushman (2002) believe a less structured approach leads to more innovative results. Perttula's (2004) recommended approach to managing the Front-End is to place emphasis on idea generation and concept design rather than on strict process. This is because product concepts are able to "bridge" different Front-End projects and the Front-End with the NPD phases.

### 2.1.2 Creative Destruction

The Front-End phase is the most critical and challenging phase of developing new and innovative products. Many different characterizations of the Front-End have been made (Poskela et al. 2004). The picture that emerges from these characterizations is one of experimentation and chaotic phenomena. In this capacity the Front-End and the product development process it is part of, serve the renewal of a company's core capabilities.

The core capabilities of a company defined by Leonard-Barton (1995) are (1) Employee knowledge and skills; (2) physical technical systems; (3) managerial systems (such as education, rewards, and incentives); (4) values and norms (that determine what kind of activities are tolerated and encouraged). These four capabilities are how companies differentiate themselves from others. They evolve overtime through the company's way of doing business and its culture. As long as the operating environment stays the same the core capabilities continue to drive the company's success. But they may also become barriers to its success. If the operating environment changes and the company is not able to adapt, then its core capabilities have become its core rigidities. Therefore companies need to engage in *creative destruction* or *disruptive research*. According to Leonard-

Barton (1995) creative destruction diverges from the company's core capabilities and involves formal and informal experimentation with product innovations. The logical place for it is the Front-End where tolerance for uncertainty is valued and the unreasonable is considered for the sake of maximizing learning and increasing organizational know-how.

### 2.1.3 Approaches to ICT Product Innovation

*Innovations* are products, services, solutions or processes that have no logical antecedent and are value-creating to a core audience (White 2005). Product innovation, the focus of this work, can be considered from two temporal dimensions: before and after market introduction of the product. Product innovation before the product reaches the market deals with invention and development of new technology. The overall objective is a new proposition to the market with differentiated value against other competitors. Product innovation after market introduction deals with new uses consumers have invented for the product that affect its diffusion. In ICT innovation, the context from which this thesis originates, both product innovation dimensions, before and after market introduction are intertwined and need to be considered together.

According to Gerstheimer and Lupp (2005) the ICT industry is driven by four interconnected forces: technology push, market requirements and needs (migration pull), clear demands from market (market pull) and latent market needs (latent pull migrations). As a result of these forces, the industry is in constant migration from one information system to another. The aim of migration is "new or improved application possibilities and services, improvements to specific performance characteristics, quality and/or efficiency and achieving a market edge by introducing a new system" (Dömer 1998; p.68-70). Innovation in this context is the systematic transformation of the overall socio-technological system, and the development of services and applications that achieve use value and economic digital sustainability (Gerstheimer & Lupp 2005). However, in migrating industries product innovation opportunities cannot be clearly identified because the boundaries of the product environment are constantly shifting. Therefore, innovating services and applications given a migration point of technological change and the status quo of existing systems takes a farsighted and user-oriented approach. It involves exploring future spaces of possibilities connected with new technologies and latent future needs of consumers at the migration point of new systems.

***Exploring (Future) Spaces of Possibilities***

The focus in product innovation has shifted from finding optimum solutions (specific product innovations) to exploring spaces of possibilities for application of new technologies and creation of added value beyond products (Gerstheimer & Lupp 2005).

Identifying opportunities related to new technologies requires exploring the technological limitations and possibilities that influence product design. An understanding of these can be gained only through a systemic and systematic approach involving users. In the approach the possibilities and limitations of the new technology as seen from the end-user's point of view are identified as function blocks and organized into a system. Combinations of function blocks are explored to arrive at new concepts representing new possibilities associated with the technology. The new concepts are evaluated with users to learn what are the most desirable possibilities of the technology.

A similar systematic exploratory approach is needed to uncover opportunities for adding value beyond the product. Today, the scope of value creation associated with a product has been widened to include secondary functions such as packaging, brand name, service characteristics like guarantee, insurance, distribution channel, after sales and maintenance. Moreover, it can be widened even further to encompass the product's lifecycle, and ways of amplifying design, delivery, manufacturing, maintenance and recycling (Ortiz, 2004). This type of exploration requires a holistic understanding of the whole system in which the product will live.

***Identifying Future Needs and Problems***

In ICT innovation, focused on creating next generation systems from new and existing technologies, defining the innovation problem is more challenging than solving it. The future needs of user groups and their everyday application context, at the migration point for a new system need to be identified.

Identifying future needs is a "wicked problem": it has no clear goal, nor clear criteria for testing its solution. Rittel and Webber explain that with wicked problems "one cannot understand the problem without knowing about its context; one cannot meaningfully search for information without the orientation of a solution concept; one cannot first understand, then solve" (Cross, 1984; p.102). "Taming" a wicked problem so it can be solved with conventional problem solving methods essentially means interpreting or structuring the problem by probing the problem context with potential solutions. Hence, with wicked problems defining the problem is itself the actual aim.

Gerstheimer and Lupp (2005) advocate Jonas's analysis-projection design method, which uses ideas of systemic development to solve the problem of future user needs. The *systemic development* approach involves adequate modeling and the ease of self-chosen paths of change (Willke, 1994). Jonas's method combines systems thinking and scenario building to design both the problem and the solutions to it. In the method the role of systems thinking is to make the complexity and context of the problem manageable without destroying its systemic character; while, scenario building helps create plausible paths to the future and the possible. The method produces "stocks" of alternative futures describing possible user needs and "stocks" of solutions to them. The method is described in detail in section 2.3.4. The method follows Simon's prescribed approach to developing migrating systems. According to Simon (1994) "systematically constructing alternative environment and use scenarios and analyzing and anticipating the digital needs of tomorrow from a design perspective represent important elements in developing migration expertise on the road to the strategic development of services and applications that are valued by users".

In conclusion, systems thinking, scenario building and systematically exhausting options are of the essence when exploring spaces of possibilities and future needs. These approaches are also followed in the design solutions proposed by this work.

### 2.1.4 Challenges in Innovation Collaboration

In the report Shape Shifting in R&D, Gorbis et al. (2002) from the Institute For The Future claim the past decade has seen an explosion in the forms of R&D with innovation networks becoming the norm. The evolution of R&D forms has gone from early domination of individual inventors at the end of 19th century to large scale corporate and government labs, forming homogenous networks, up until the late '80s. Today, R&D happens outside of organization boundaries, in diverse innovation networks, that bring together internal and external resources to solve problems or pursue common passions. Diverse networks are preferable to homogenous networks because they support cross-fertilization of disciplines, functions and ideas improving the chances for innovations. However, diverse networks are less efficient at communicating ideas and coming to a common understanding. This section examines how innovation networks can be supported in coping with the volume and dispersion of knowledge and why the innovation process should function as a complex system.

***Supporting Distributed Cognition with Shared Conceptualization***

The systemic nature of migration driven innovation and its socio-technological scope make the Front-End of product innovation a complex knowledge intensive activity demanding different specializations. Companies have tackled the complexity of innovating by opening up their innovation process to involve external parties. As a result universities, open and collaborative research labs, corporate venturing and proprietary strategic research projects have joined the corporate innovation process. The result has been an explosion of different forms of innovation networks (Gorbis et al. 2002). The benefit of innovation networks is that research can be carried out concurrently in different venues to produce enhanced results and accelerated technology transfer. Moreover, when different perspectives are brought to the same problem tacit aspects of the problem can be uncovered: the problem and solution are enriched by multiple expertise and skills (Tormey et al. 2004). However, with diverse innovation networks comes the challenge of managing *distributed cognition*, or the coming together of people with heterogeneous skills to share knowledge, skills, expertise and insights.

In Fisher's (2002) opinion managing distributed cognition requires capabilities for synthesizing disparate perspectives to a problem and dealing with vast amounts of information. It requires a shared conceptualization of the innovation problem. *Shared* means “not private to some individual, but accepted by a group”, and *conceptualization* “emphasizes the abstract model of some phenomenon in the world by having identified the relevant concepts of that phenomenon” (Studer, Benjamis et al. 1998). According to Studer & Benjamis et al. (1998) ontologies are an explicit formal specification of a shared conceptualization. Ontologies describe concepts and relations assumed to be always true independent from a particular domain by a community of humans and/or agents that commit to that view of the world (Guarino, 1997). According to Tormey et al. (2004) the use of ontologies enables exploration of the knowledge space with information systems. It supports knowledge capturing, structuring and sorting, distribution and using. Moreover, it facilitates the development of software tools for supporting distributed innovation.

The role of tools, based on a shared conceptualization or ontology of the innovation problem space, is to enable the mapping of heterogeneous modeled knowledge in the heterogeneous network to homogenous system knowledge (Tormey et al. 2004). In other words, the tools are incorporated with or help form an agreed set of meanings about the innovation problem. The agreed meaning (shared conceptualization) enables semantically dispersed information from across the extended innovation organization to be synthesized. As a result specialists from different domains are able to understand each other and identify relevant sources of information for their work. Ultimately, tools based on a shared conceptualization enable organizing innovation for diversity and complexity.

***Transforming the Innovation Process into a Complex System***

The key to future success in product innovation is in better information management rather than processes (Holman et al. 2003). Companies that have been able to reduce the time needed to launch new products while raising their sales of new products and their market share have done so by improving the quality, timing and synthesis of product and process information through out the development cycle. These companies have managed to create an innovation process that is able to constantly make sense of new information and adapt to it. According to Holman et al. (2003) the key to information driven processes is in organizing diverse teams around the same information flows. When new information enters the conception process it gets analyzed by all parties involved ensuring a holistic and systemic understanding of the information’s impact on the product under development. As a result, simultaneous workflows involving all stakeholder departments can be established in response to it. Holman’s approach is a step towards organizing the innovation process as a complex adaptive system.

In his book *In the Bubble*, John Thackara (2005) offers for “deliberation“ observations on seven design frameworks: From blueprint and plan to sense and respond; from high concept to deep context; From top-down design to seeding edge effects; From blank sheets of paper to smart recombination; From science fiction to social fiction; From designing for people to designing with us; From design as project to design as service. Essentially, the frameworks speak of how to design and how to collaborate in a space of flows (the characterization he gives to today's world). According to Thackara design in an ultra-networked world should be about the continuous definition of a system's rules rather than its outcomes. Before designing one should understand why a system is in one state before making an intervention to nudge it into another state. The approach that this leads to can be called "sense and respond": a process of continuous observation, measurement and feedback. Thackara argues that succeeding requires combining people, skills and knowledge from within and outside of the targeted system. It means collaborative design needs to find ways to share a vision of the system among all its actors and stakeholders as the system evolves. The message is clear: design problems today need to be seen as complex adaptive systems, which can be solved only by following the principles of such systems.

A complex system is nonlinear and dynamic and can be described as a group of independent parts interacting together to function as a collective whole (Sardar, and Abrams 2001). Product innovation activity organized as a complex system would follow the complexity principles of emergence, self-organization and evolution. It would be able to adapt and evolve constantly in face of complexity, and through these actions create new order and coherence that result in better innovations and insight.

## 2.2 Knowledge Work Perspective to Product Innovation

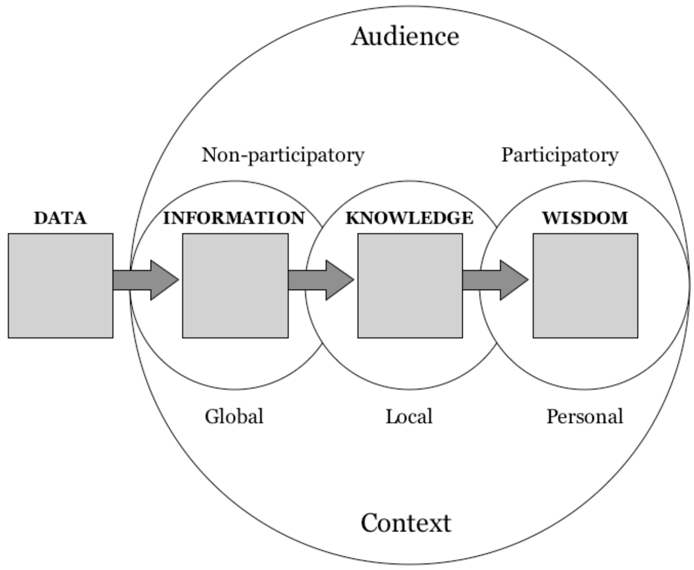
Nonaka and Takeuchi (1995) consider new product development as a primary source of new knowledge in an organization. According to Davenport (1998) knowledge is a fluid mix of framed experiences, values, contextual information, and expert insight that provide a framework for evaluating and incorporating new experience and information. Levy considers knowledge from an organizational point-of-view and say it is "a dynamic organization of memory that as a cognitive process can be supported and augmented by technology and social organizations" (Judelman 2004). Consequently, a knowledge perspective to the innovation challenges described in the previous section, could elucidate their origins and provide insights into how to solve them. The following sections present knowledge creation theories and approaches that clarify the collaboration and knowledge application problems the thesis deals with.

### 2.2.1 Creating Knowledge

Next, two perspectives to how knowledge is created, the data-information-knowledge model and SECI model, are reviewed.

### *Data-Information-Knowledge*

Judelman (2004) considers Knowledge Work (KW) to be the targeting, communication, application and subsequent creation of knowledge. Shedroff's (1994) data-information-knowledge (DIK) theory helps make sense of what essentially happens in knowledge work. According to the theory knowledge emerges from information by its contextualization, application and social exchange. This is preceded by the transformation of data into information by either the discovery of relationships in data or by putting application rules to information. The transformational process is cyclical with each step requiring an increasing degree of context and personal integration.



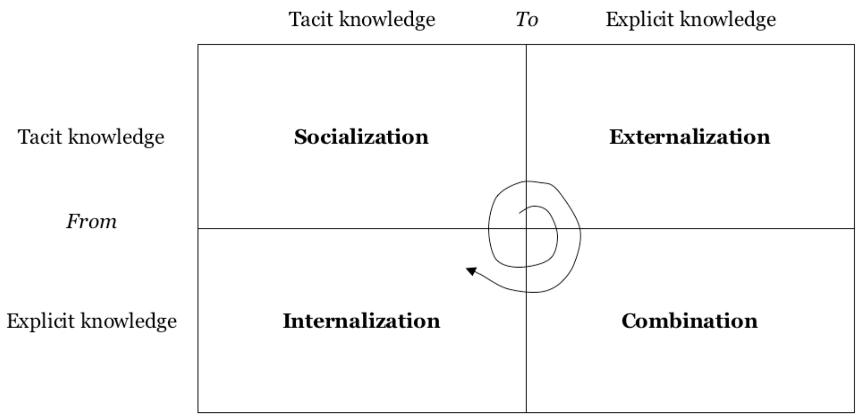

**2.3. The Understanding Spectrum. Image adapted from Shedroff (1994).**

The way the process brings more structure, context and meaning as it progresses becomes apparent from Judelman's (2004) description of the continuum elements. Data is quantifiable, disordered and raw. It consists of numbers, statistics or facts that have been accumulated but not ordered. Information is data that has been processed, structured or patterned. Information takes the form of visualizations, reports and instructions. Another distinction between it and data is that it is somewhat more ambiguous than data, subject to interpretation. Knowledge on the other hand, is applied, personally verified or discussed information. It cannot exist without a specific context and a personal desire, i.e. the purpose for using information. Knowledge takes the form of actions, stories or processes. In sum, through the continuum, data becomes more personally applicable and context specific.

***SECI Model for Organizational Knowledge***

The SECI model for organization knowledge creation and dissipation is a cyclical four-stage process where tacit knowledge is transformed to explicit knowledge and back to tacit knowledge (Nonaka & Takeuchi, 1995). According to the model knowledge takes on different representational forms corresponding to the nature of the knowledge and how it is used.

The model is based on the premise that knowledge in its initial state is in *tacit* form, meaning its not easily visible or expressible. Tacit knowledge is created through *Socialization* where workers exchange knowledge through conversation. Tacit knowledge is transformed into explicit knowledge through *Externalization*. “Explicit knowledge can be expressed in words or numbers, and easily communicated and shared in the form of hard data, scientific formulae, codified procedures, or universal principles” (Nonaka & Takeuchi, 1995). The next transformation is the creation of new explicit knowledge through the act of *Combination*. Finally, new explicit knowledge is integrated into the daily operations of the company as part of *Internalization.* In the final step the new explicit knowledge becomes tacit knowledge in the form of shared mental models and know-how. From here the cycle begins a new.




**2.4. SECI model of knowledge-creation. Image adapted from Nonaka & Takeuchi 1995).**

The SECI model clarifies how new knowledge is created in product development. Initially, product developers come up with new product ideas as part of their work. They share these ideas with their colleagues through conversations (Socialization). Some of the ideas gain broader support and the next step becomes to further elaborate and document them (Externalization). Subsequently, the ideas are developed into concepts and prototypes are designed by combining explicit knowledge, in the form of technology and best practices (Combination). The concrete and often functioning prototypes make it easier for others to understand the initial idea (Internalization). Comprehension of the product idea results in it becoming integrated into the product development activity and ultimately can result its development for the market.

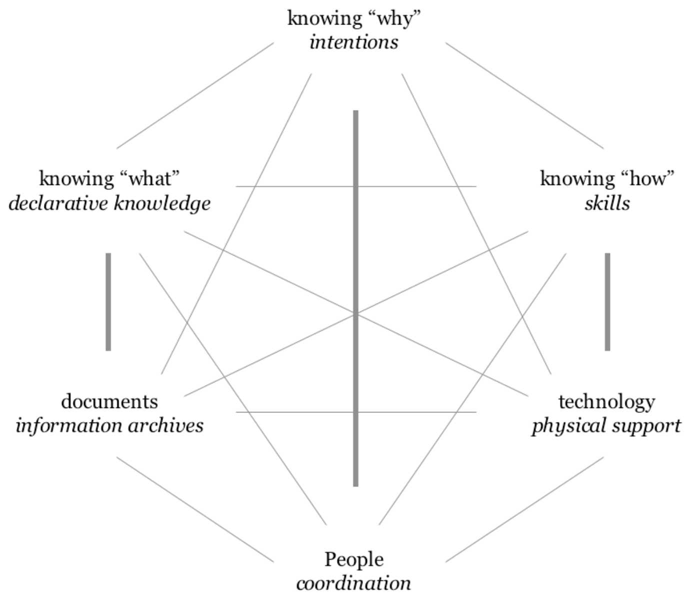
### 2.2.2 Organizing Knowledge Work

Product innovation always takes place in a setting of people, supporting technologies and different types of knowledge. These dimensions of the setting influence how knowledge work and ultimately, the innovation process can be organized and managed.

***Knowledge Spaces***

Judelman (2004) identifies three different interrelated types of knowledge or inner cognition that form the basis for human activity. Each is supported by a different set of technologies. The first is *declarative knowledge* or Knowing *what*. This type of knowledge is supported by documents, however; declarative knowledge does not take the form of documents. In other words documents are a container but not a representation of knowledge. The second is Knowing *why*. It addresses the notion of reason or meaning of some phenomenon. Societal institutions usually create and coordinate this type of knowledge. The third type of knowledge is *procedural knowledge*, or knowing how to perform an activity or task. This requires communication or material technologies in order to be successfully executed as an action. When these different types of knowledge and the supporting documents, social networks and technologies, are considered together as system, they form a *knowledge space*.

A knowledge space is the underlying context for knowledge work. It is another way of conceptualizing the environment for product innovation. In this regard, each innovation organization needs to prioritize and arrange knowledge, people, documents and technologies into a knowledge space. How this is done is a central research question in this work.




**2.5. Knowledge space. Image adapted from Judelman (2004).**

From the knowledge space perspective the challenge of supporting distributed cognition, described in section 2.1.2 is two fold. It arises from participants not having the same sense of what and how. It is also the result of participants not having adequate technology to manage and make sense out of the diverse information used in the activity.

***Bodies of Knowledge***

Iivari and Linger (1999) claim that organizing collaborative knowledge work has been difficult because a theoretical model for classifying knowledge used in the activity has been lacking. They have proposed the Situated Activity Theory as a solution to this problem. It is a theoretical model of collaboration that allows existing practice to be profiled, reflected upon and changed based on a Bodies of Knowledge classification. The model is founded on the idea that all knowledge work deals with representations rather than directly with objects of work.

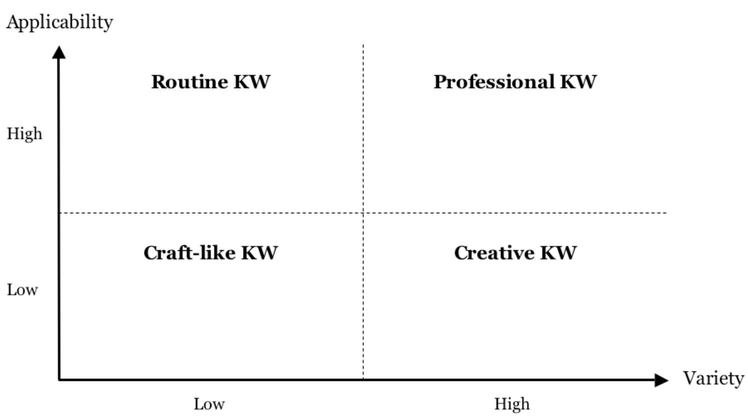
According to Iivari and Linger (1999) knowledge work has the following characteristics:

- It is based on a body of knowledge;
- Entails working on representations (data) of the objects of work;
- Stipulates typically a deep understanding of the objects of work, and;
- The outputs of which entail knowledge as their essential ingredients.

Representations are essential constituents of the common information and workspace in collaborative work. The role of representations becomes concrete through the concept of Body of Knowledge (BoK). Body of Knowledge refers to the different types of representations used in a particular type of knowledge work and it is central to the definition of knowledge work and a key to organizing it. A BoK may consist of facts, rules, techniques, case histories, stories, theories, hypothesis, philosophies, and metaphors. The applicability of a BoK to the object of work (the goal) is defined in terms of concreteness and generality. Low concreteness in a BoK requires using judgment and experience based interpretations so that its application becomes easier. Generality refers to the range of different cases and situations a BoK can be applied in. Low generality implies the BoK is outside the scope of the situation. To improve its applicability the generality of the BoK needs to be increased.

The challenge of distributed cognition in diverse innovation networks arises from low concreteness and low generality. Distributed cognition becomes an issue when the collaborators cannot perceive commonalities between the different BoK present in the network. To overcome it requires the specialists becoming acquainted with each other's BoK. The first step in solving this problem is to analyze the BoK present. Iivari and Linger have proposed a Bodies of Knowledge classification based on the dimensions of application (concreteness) and variety (generality) for profiling knowledge work. The four BoK that form the classification are:

1. *Professional KW* deals with theories, approaches and strategies that have high applicability and high variety. They are applied, adapted and judged as part of the knowledge application process.
2. *Creativity KW* is about using intuition, imagination and improvisation, for applying philosophies, visions and metaphors, with high variety and low applicability, to create knowledge.
3. *Craft KW* consists of cases and patterns, with low applicability and low variety, which are applied through recognition, comparison and imitation.
4. *Routine KW* deals with techniques and facts, with high applicability and low variety, which are applied through routines and automation.




**2.6. Classification of KW. Image adapted from Iivari & Linger (1999).**

The implications of the BoK classification for knowledge work from the perspective of Activity Theory are that instances of Activity Systems can be created to deal with specific types of collaborations, characterized by their own BoK. The different BoK act as the basis for instantiating Activity Systems and help in organizing the collaborative knowledge work to overcome problems of concreteness and generality. In this regard, BoK profiling of an innovation network helps when developing tools for distributed cognition.

***Ba as Knowledge Creation Platform***

*Ba* is a Japanese philosophical term denoting space and time including the space for interpersonal relations. Nonaka, Konno and Toyama (2001) have introduced the idea of *ba* to knowledge creation and have defined it as a platform where knowledge is created, shared and exploited. *Ba* can be a physical, mental or virtual space or any combination of these. It can be a shared space and time for a project team (face-to-face to virtual), a space for informal dialogues, a space to share experiences with customers, a space for inter-divisional cooperation or a space shared by virtual companies. The underlying idea is that each space influences knowledge creation.

Nonaka has explored what types of *ba* are most suitable for each step of the SECI knowledge creation process. Socialization or the conversion of tacit knowledge to tacit knowledge is supported by *Originating ba* in the form of situations for face-to-face sharing of experiences. Externalization or the conversion of tacit knowledge to explicit knowledge is supported by *Dialoguing ba*. It takes the form of situations for fostering dialogue and crystallizing individual thoughts into collectively shared concepts. Combination, or the explicit-to-explicit knowledge conversion is supported by *Systematizing ba* in the form of information technology and on-line networks. Internalization or the conversion of explicit knowledge back to tacit knowledge can be supported by *Exercising ba*, which can consist of repetitive exercises or the application of knowledge to real-life and simulated situations.

From the perspective of this thesis, the *ba* concept, as a setting for knowledge creation is a good metaphor to guide the design of the solutions to the methodology, collaboration and knowledge application problems. As Nonaka has shown, the *ba* concept can be combined with the SECI model to design settings and activities in support of knowledge creation. Finally, the idea that a *ba* can take on any combination of physical, mental or virtual forms inspires to envision models, protocols, as well as physical and software tools as solutions to the research problems.

## 2.3 Design and Foresight Methods

Section 2.1 presented ICT innovation as the design of future-oriented complex systems but also, as an activity, a complex system to organize and manage. The following section deals with design and foresight methods that have been developed to cope with the innovation challenges of systematically exploring spaces of possibilities and identifying future user problems.

### 2.3.1 Systemic and Systematic Design Methods

In his book Developments in Design Methodology, Cross (1984) presents numerous systemic and systematic design methods that have been developed for specific stages of the design process. Several of these will be examined next, but first, the design process to which they apply will be described.

***Design Process***

According to Cross (1984) the three stages of the design process are Analysis, Synthesis, and Evaluation. In the Analysis stage the objectives of design, the inputs and constraints and the design problem are identified and prioritized. This involves exploring and analyzing the factors that have to be taken into account as well as identifying sub-problems. Based on the externalization of inputs and their analysis success criteria can be set for the required design solutions. In the Synthesis stage, best possible systemic solutions to identified sub-problems are sought systematically. In this stage the design idea goes through many levels, progressing from very general considerations at the start through to specific details nearer to completion. Typically, alternative designs are created as part of it. Finally, a "creative" leap is needed to arrive at a comprehensive design solution. In the Evaluation stage, the alternative designs, sub-solutions or the whole solution, depending on the level that has been reached in the process, are evaluated systematically against success criteria. The purpose is to find the best alternative design. From here the process cycles again until a satisfactory result is reached.

***Merits and Application of Systematic Design Methods***

The fundamental idea behind systematic methods is to separate creative thinking and logical analysis, both needed in design. Systematic design methods support this separation by providing tools for externalizing design inputs and analyzing them. The purpose of separating creative thinking and logical analysis is to reduce the amount of design error, re-design and delay in a design project and to enable more imaginative and advanced designs.

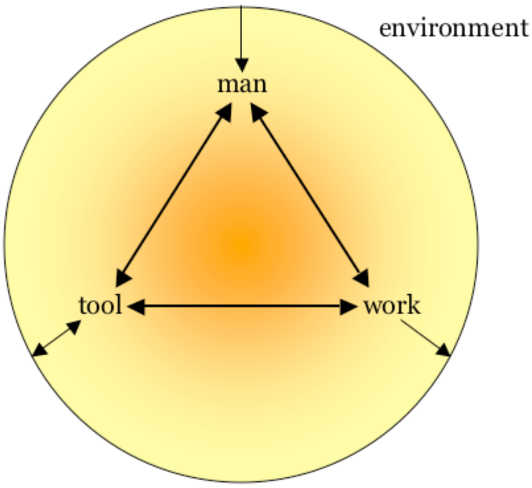
Cross (1984) claims that by externalizing design inputs it is possible to keep separate records for ideas, solutions, information and requirements; store random inputs for possible later use; systematically explore interactions between problem factors; delay the choice of final solution until problem is fully understood; and combine partial solutions into whole ones. Ultimately, externalization leaves the designer's mind free for creative ideas, random thoughts and intuitive thinking. It also supports the formation of a common context and reduces the amount of domain expertise needed by designers at the outset of the process. This is because externalization and documentation of design decisions, makes it possible for external domain experts to routinely evaluate them. Consequently, it reduces the amount of time needed by designers to acquire domain expertise before they can begin work.

According to Jones (1984) systematic design methods can be applied to design when the following conditions exist: large quantities of design information are available, or can be usefully obtained; the design team has well-defined responsibilities, can concentrate on the development, and is free of routine design work; and/or considerable departures from existing designs are called for. The methods are particularly applicable to "wicked problems" because "systematic design does not seek a single solution but aims at finding a range of solutions and making it clear in what ways each fits, or does not fit, the specification" (Jones, 1984). However, the systematic exploration of alternative solutions at different levels of design can be immensely time and resource consuming. Therefore, systematic methods are appropriate to use only when one or more of the following conditions exists: when the consequences of being wrong are grave; when the probability of being wrong is high due to lack of prior experience; and/or when the number of interacting variables is so great that the break-even point of man-hour cost versus machine-hour cost is passed. Many of these conditions are true in ICT innovation, which makes systematic design methods highly attractive for innovating in the Front-End.

***Man-Work-Tool-Environment System***

By nature, designers are seekers of connections. They excel at making new previously unconnected connections between bits of information. Archer (1984) has proposed the man-work-tool-environment system, for the analysis stage of design, to support the seeking of connections between design inputs, namely user needs, the object of the activity and its context. The "dialog" the system enables between inputs is essential to understanding the design problem and formulating a design brief.

The man-tool-work-environment system enables exploring the relationships between the interacting factors affecting design and elucidates the socio-technical system the product will be a part of. From a user perspective it describes the overall experience the product affords. The




**2.7. Man-Tool-Work-Environment system. Image adapted from Archer (1984).**

The following interactions can be considered with the system:

1. Environment acts on man
2. Man performs work
3. Works reacts on man
4. Man operates tool
5. Tool reacts on man
6. Tool performs work
7. Work reacts on tool
8. Work acts on environment
9. Environment acts on tool
10. Tool has side effects on environment
11. Environment acts on man

The above interactions of the system can be condensed into three human factors (motivation, ergonomics, aesthetics) and three technical factors (function, mechanism, structure) for design. These factors represent the use context (human factors) and technology implementation (technical factors) of product and service concepts.

The system is more indicative of the type thinking needed in ICT innovating than a ready-made tool for it. For instance, it does not include a framework for classifying needs arising from work and the environment. It does however illustrate the type of systemic exploration that should be conducted to understand the socio-technological systems innovations become part of and influence.

***System Logics***

The *System Logics* design-based-analysis framework, focuses on user needs and provides a means of structuring and relating them for product or service innovation. According to

Patnaik (2004) the concept of System Logics refers to a company's philosophy of what customer's needs are and how it can organize its offerings to meet those needs. The system connects a hierarchy of needs of customers with the design of product features, products and product families. In this capacity the system is a prescriptive framework for how to develop deep product service experiences and roadmap solutions.

System Logics consists of four levels of needs Common Needs, Context Needs, Activity Needs and Qualifier Needs. The needs go from more general and universal needs to specific needs related to a task. They vary in their level of abstraction depending on how connected they are to an immediate situation. *Common Needs,* the most general needs, are the needs of nearly everyone. They include needs such as to socialize, to be loved and to feel good. People try to have these needs met by an immediate activity or context need. *Context Needs* are needs of people of the same age, profession, and religion. In other words they are the needs of those who belong to the same overall domain. The needs originate from the situations in which people live, work or operate and motivate people to engage in domain activities. *Activity Needs* are needs of people in the same context who want to do the same things. They are born from the types of activities a person wants to perform. Usually people describe these needs in terms of existing products or solutions. For example, a person who is expressing the need for food might say: "I need some McDonalds". Finally, *Qualifier Needs*, the most specific needs, are needs of people in the same context who want to do the same things in the same way. These needs arise usually from "problems" with existing solutions. People are most aware of these types of needs. Industrial designers usually try to solve these needs by improving existing solutions.

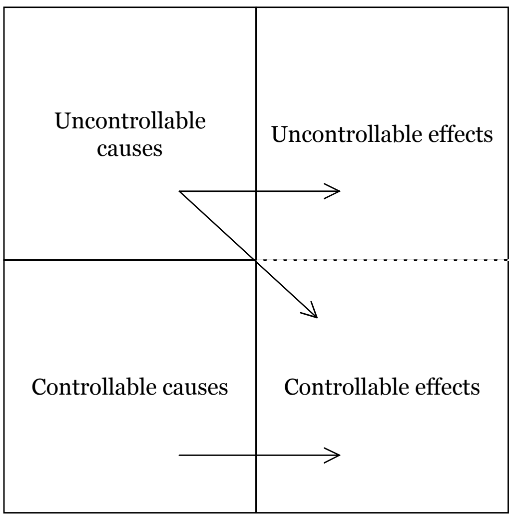
The framework can be applied to translate needs discovered in any domain into different level product innovation opportunities. For example, addressing Qualifier Needs focuses on improving existing product features. Targeting Activity Needs leads to designing new products. Using Context Needs as the starting point for design broadens the scope to creating new offerings that provide complementary effects with existing offerings. In other words, addressing Context Needs makes product families the focus of design. Finally, Common Needs can be used to indicate areas for long-term strategic action or changes in strategy. Together the needs form a system for creating systems of solutions that work together, bounded by a unified approach to meeting needs. Market leaders, like Starbucks and Lego are excellent examples of how a System Logics approach to innovating systems of solutions as opposed to single products can bring long-term success.

The System Logics framework has other strategically important applications in product development context. It can be applied to explore the fit of new products into existing offerings. New extensions to existing product lines should satisfy the same Common and Context Needs as current products. From a more proactive perspective, System Logics can be used to roadmap existing products: each new generation should strive to satisfy Common and Context Needs. In all, the Systems Logics framework is a highly valuable tool in informing strategic and tactical decision-making.

***Designing with Parameters and Variables***

Design problems consist of many interacting factors that can be decomposed into a hierarchy of sub-problems. Decomposing is a useful practice in the analysis stage of design, however in the synthesis stage, designers have to aim for comprehensive solutions rather than piecemeal composites of sub-solutions. The danger in piecemeal composites is that potential external factors influencing the whole solution are not considered. To help designers see the "whole" design problem as they are designing, Levin (1984) has proposed characterizing the system properties of the problem in terms of causes and effects.

The "controllable causes" constitute the design itself, which produces "controllable effects". However, there are "uncontrollable effects" as well that fall outside the influence of the design process. They are the result of uncontrollable effects. The causes and effects can be clarified by using urban design as an example. In urban design the design of the built environment is under the designer's control. The physical layout of the town is a set of controllable causes that will have certain controllable effects. All other causes of the controllable effects such as economic and social forces, or individual motivations are not. These uncontrollable causes will have uncontrollable effects that may impact the desired controllable effects. In sum, the city is the overall system governed by the causes and effects.




**2.8. Framework of causes and effects. Image adapted from Levin (1984).**

According to Levin (1984), to manage the uncertainties associated with the design problem, designers need to choose controllable causes and adjust them is such a way that, under the circumstances defined by uncontrollable causes, desired controllable effects are obtained. To help designers do achieve this "future proofing" of solutions, he proposes an eleven-step set of operations based on parameters and variables. In the context of the operations *design parameters* are measures of "controllable causes". *Dependent variables* are measures of "controllable effects" and *independent variables* are the measures of "uncontrollable causes and effects." The basic idea behind the operations can be clarified with an algebraic equation such as $y = 3x+2$ or $y=mx+c$. In this equation $y$ is the controllable effect the designer is aiming for. The parameters $m$ and $c$ are the design parameters the designer has control over. He must choose them so that whatever value the independent variable $x$ takes the end result $y$ is still within acceptable limits.

In conclusion, the approach advocates the prediction of uncontrollable future factors and their relationships on the overall desired goals of design, before definition of the design problem and its decomposition into sub-problems. It is from such a systemic and forward-looking view of the problem that the iterative design process should unfold. As design decisions are made, their consistency with the goals and uncontrollable future factors need to be assessed. In the end, the designer is able to predict how the design will fare in conditions presented by uncontrollable future factors.

### 2.3.2 Creating Foresight

Foresight is the ability to envision possible future problems or obstacles. In the context of product innovation foresight is the analysis of socio-technical perspectives that helps organizations shape their images of the future. Next, a review of the different forms and applications of foresight serves as an introduction to projective scenario methods, which are examined in more detail.

***Types and Uses for Foresight***

Fox (2005) considers foresight as an organizational capability and identifies three kinds: meta-foresight, macro-foresight and micro-foresight. Meta-foresight is the capability to see the underlying trends in technologies, products and markets and understand their impact on business. Macro-foresight is the capability to see concepts that would lead to the successful exploitation or adaptation of underlying trends. Examples of such concepts are new products or business models. The last kind of foresight, called micro-foresight, is the capability to see how a successful future position can be attained from a present situation.

There are four ways according to Slaughter (1996) how foresight can be used by organizations: (1) *Consequence Assessment*: assessing the implications of present actions, decisions, etc. (2) *Early Warning and Coincidence*: detecting and avoiding problems before they occur; (3) *Proactive Strategy Formulation*: considering the present implications of possible future events; (4) *Narrative Scenarios*: envisioning aspects of possible or desired futures.

In the Front-End of innovation having meta-foresight and macro-foresight capabilities are a must. Innovating new products and more importantly renewing the core capabilities of the company cannot take place without the ability to envision possible and desirable futures in terms of desirable products and services. Therefore, scenario building or the creation of alternative stories about the future is a key innovating activity.

***Scenarios - Projection***

Jonas (2003) distinguishes three typical approaches to understanding the future:

1. *Deterministic*: The scientific point of view that believes the future can be predicted and humans have no way of influencing it.
2. *Teleologic:* The strategic planning point of view that identifies a desirable future and then organizes activities to make the future happen.
3. *Projective/Prospective:* The learning and design approach, that acknowledges the lack of perfect knowledge and the influence of uncertainty and deals with them creatively by exploring a whole range of possible future states of the system. With this approach one creates a "stock of futures" to be prepared, to be more sensitive regarding indicators that might announce the emergence of this future or the other.

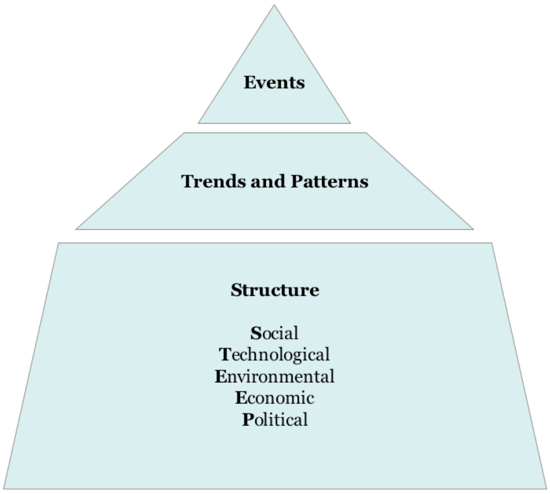
Scenario building is a projective/prospective approach to envisioning the future. According to Porter (1985) *scenarios* are “an internally consistent view of what the future might turn out to be – not a forecast, but one possible future outcome”. Godet and Roubelat (1996) define scenarios as “description of a future situation and the course of events that allows one to move forward from the original situation to the future situation”. They identify two kinds of scenarios (1) *Exploratory*, starting from past and present trends and leading to a likely future and (2) *Anticipatory or normative*, built on the basis of different visions of the future; they may be either desired or, on the contrary, feared. A scenario is not a prediction, it is not deterministic, nor a telelogic strategy, but rather a hypothesis designed to highlight the risks and opportunities involved in specific strategic issues of an organization. Scenarios can be also be used as a tool for creating a shared conceptualization about the future and related problems for a group of people.

***Driving Forces***

Scenarios are typically based on two or three *driving forces*. Like the independent variables in Levin’s parameter and variable based systematic design method, driving forces are internal or external system variables. According to Jonas (2003) driving forces have a high impact on the system and at the same time, show high uncertainty in their future behavior. Simply, driving forces change the pattern of events seen in the world (van der Heijden 1996). Examples of current driving forces are aging populations in the Western World and the rising cost of energy. Typically, driving forces form interrelated webs that evolve over time, with new forces being added and existing ones being replaced or combined.

Driving forces can be grouped into either external environmental forces or internal organizational actions. The key to using driving forces in scenarios, takes knowing which of them, are relevant. Relevant driving forces from the point of the organization developing the scenarios are those forces that the organization does not know or cannot control and whose likelihood of realization is extremely difficult to determine. The degree to which both types of driving forces, environmental and organizational, are considered as part of the scenarios determines the applicability of the scenarios. First generation skeletal scenarios are designed to provide an understanding of the business environment by highlighting connections in the system and identifying major driving forces. In these scenarios only environmental driving forces are considered. Second generation scenarios connect environmental driving forces with internal organizational actions. Herein lies the key to competitive advantage from scenarios: being able to recognize and understand the impact of driving forces on the business environment.

Van der Heijden (1996) suggests an “iceberg” metaphor to help identify and use driving forces to create scenarios. External driving forces can be identified only when the broader “STEEP” structures for the domain or business environment are understood. Scenario data can be categorized using the iceberg as a metaphor, into visible Events, and hidden Trends and Patterns, and Structures that form the foundation for the visible part. Events are the visible events in the business environment. Trends and patterns refer to the identified causal relationships for the business events. They are the independent variables influencing the event via the structure. Structure refers to the underlying logic that when impacted by trends, causes events in the environment to appear. Structures are combinations of broad Social, Technological, Environmental, Economic and Political (STEEP) related factors. Understanding structure requires looking for relationships between trends. Once the structure and the causal relationship to events are understood it is possible to project future behavior on the structures and recognize what will happen in the future.




**2.9. Iceberg metaphor. Image adapted from van der Heijden (1996).**

### 2.3.3 Product Concepts as a Front-End Resource

Perttula and Sääskilahti (1999) define product concepts as internal or external marketing material that should reflect a change with a product portfolio. Concepts encapsulate customer needs and functions in the form of an application description where the technology, working principles and form are outlined. According to Keinonen and Jääskö (2004), concepts always have two sides to them: use context and technological implementation. Both sides influence the concept's existence and are determinants of its success on the market.

***Benefits of Concepts in the Front-End***

Orihata and Watanabe (2000) consider concept innovation or creating product concepts a prerequisite for product innovation. Similarly, Perttula and Sääskilahti (1999) claim concepts should be considered as a Front-End resource. The basis in the value of concepts in the Front-End lies in their versatility as a tool for decision-making and requirements capture but also in risk management, idea pooling, reputation building, and as sources of new features and testing material. A further benefit of product concepts in the Front-End is that they can be treated and monitored as a portfolio of options (Perttula & Sääskilahti, 1999).

Perttula and Sääskilahti (1999) offer a categorization of concepts based on when they are required (by the market) and the degree of associated technological uncertainty that can be used to manage concepts as a portfolio of options. The dimensions of the categories are positively correlated: the longer the time-horizon for when the concept is required, the less predictable or feasible is its technological implementation. The categorizatio consists of four types of concepts: visioning, emerging, defining and solving. V*isioning concepts* belong 10 years into the future and have a high technological uncertainty. *Emerging concepts* belong 5-10 years in the future and are based on proven technology.

D*efining concepts* are required 2-5 years in the future and their technology is well understood. Finally, *solving concepts* are based on available technology and are required 0-2 years into the future. The above categorization assumes one market for which the concepts are created. It can be extended with the third dimension of Markets.

***Visioning Concepts***

According to Kokkonen et al. (2005) visioning concepts support strategic planning because they are illustrations of what future products could look like for the company if a certain strategy is pursued. They incorporate foresight about the company's know-how and the development of the domain to which they belong. Typically many visioning concepts are created to illustrate not one but many alternative futures. These futures are described in detail by scenarios that must be created in advance of the concepts. Consequently, designing visioning concepts forces the company to think about the development of technology, markets and organization beyond its own typical three to five year cycles.

### 2.3.4 Methods Combining Systems Thinking and Scenario Planning

How do we want to live? This is the question, designers exploring tomorrow's needs and envisioning future products and services are faced with. Answering the question through design requires incorporating projection or scenario building into the analysis-synthesis-evaluation design process. Methods Toolbox and Visioiva Tuotekonseptointi are two methods that do exactly this: they combine systems thinking and scenario building to enable the exploration of future possibilities. Next, these two methodologies will be examined in terms of how they address the methodology, collaboration and application problems of this thesis.

***Methodological Toolbox for Design Project-Oriented Systems Thinking and Scenario Building***

Jonas (2003) has assembled the *methodological toolbox* to help designers take a more active and responsible role in discourse of social futures. The toolbox, containing systems thinking, scenario building and process management methods, is founded on the belief interventions, in the form of innovative products and services, can only be successful as far as the structural conditions of the system or problem area, its perceptive and behavioral possibilities are respected.

Jonas prescribes an analysis-projection-synthesis process to answer the two central questions in future-oriented design: what is the (future) problem and how could the future environment look like in which solutions have to prove their viability?
In the process a systems approach is required to learn what the problem is that needs to be solved. The objective of the systems approach is to present the problem context as a closed entity trying to preserve its self-organization. The implication of this view is that purposeful external control of the system is impossible (Jonas 2003). The process begins

with a structural analysis of the general problem context leading to its modeling in terms of internal variables that can be influenced by design and external variables that cannot. Levin has proposed a similar approach (see 2.3.1). Jonas recommends using an adaptation of the VESTER-approach (Vester, 1993), developed in the field of city-and regional planning that provides seven living systems related questions, to orient the definition of internal variables for the system. External variables are driving forces of the system, which can be identified by conducting a PESTE analysis of the problem context. Next, using cross-impact analysis the relations between variables and their roles in the system is defined. The purpose of the analysis is to understand how the variables interact with each other. Jonas stresses to avoid developing a mechanistic system image by defining causal relationships between variables because too much system destroys the systemic quality: precise modeling is both undesirable and unrealistic. Through the analysis the feedback cycles and stabilizing effects of the variables on each other are determined. Variables can have active/independent, reactive/dependent, buffering, neutral or critical roles in the system. A variable's system role is not based on its inherent nature but results from its relations to the other components of the network. Intervention into the system in the form of new products and services should be based on the understanding of how these roles influence each other. This aspect of the method follows the idea of the systemic structure "under the surface" that drives change, originally presented as the Iceberg metaphor (see section 2.3.2). In the end, the systems approach produces an understanding of the systemic structure of the problem context and its complexity and hints at promising points of interventions.

The analysis phase is followed by the projection phase in which possible changes in the systemic image of the problem context are explored through scenario building. Possible futures are generated with relevant external variables that have a high impact on the system image and at the same time show high uncertainty in their future behavior. External variables with active and critical roles in the systemic image can be used as driving forces. Typically, two or three driving forces are used in one scenario. By changing their states different scenarios can be created from the same set of driving forces.

Once the scenarios have been fleshed out, product and service concepts are designed that act as solutions to tension areas between the system (problem context) and its possible environments (futures). SWOT analysis can be used to focus the design of system related solutions. Other tools can be used as well to guide design in relation to the system. Each solution should be reviewed against each of the scenarios. This can be done systemically using a matrix of decision options. The end-result is a "stock of futures" and options or solutions for how to deal with those futures.

Jonas insists that the method should not be considered as a step-by-step guide for implementation of future oriented design projects but rather as a methodological toolbox, a flexible project-oriented collection of elements from the areas of systems thinking and scenario building. The method can be criticized for being too structured to lead to creative results and for requiring too much effort to arrive at concepts. However, as Jonas argues without it concepts cannot be integrated in consistent argumentative networks, which cover the whole range from global contexts to material products.

The method is usable individually or in a group, but no explicit support is provided for using it in distributed groups. In a review of method problems Jonas points out that an external moderator is needed to facilitate common understanding of both the method and the systemic image of the problem context. He attributes the lack of shared vision experienced by team members trying the method to the vague definition of the problem context. The method does not present a formal, agreed set of meanings about how to model the context but rather proposes to use Vester's seven living systems related questions to orient the modeling. Other problems related to using the method collaboratively are the lack of systematic tools for checking the robustness of the concepts against the scenarios and the laboriousness of the method itself.

In terms of supporting the reuse of the created knowledge, the method does produce a set of options, in the form of service concepts related to possible futures. The concepts, which are the main deliverables, can be considered as specific company competences for specific future contexts.

| | **Methods Toolbox** | **Visioiva Tuotekonseptointi** | **Design solutions** |
|---|---|---|---|
| 1. Identifying future innovation opportunities | Enables designing and rationalizing future product and service concepts reflecting environment 10-15 years in the future;<br><br>Process: Analysis (systems thinking) –Projection (scenario building) – Synthesis (concept design);<br><br>Uses systemic image of problem context for projection.<br>Systemic image is based adaptation of Vester's 7 questions related to living systems and consists of internal and external variables;<br><br>Systemic image projected with driving forces;<br><br>Outcomes: concept options for different scenarios; | | |

| | | | |
|---|---|---|---|
| | Method (toolbox) can be used flexibly. | | |
| 2. Supporting emergent common understanding among collaborators | Team of designers required for the work;<br><br>Vague structure for systemic image does not support shared conceptualization;<br><br>Workshops play a major role in creating common context;<br><br>Does not provide tools for distributed work; | | |
| 3. Supporting application of new knowledge in organization | Creates solution options to future contexts;<br><br>Understanding of new knowledge based on concepts. | | |

**Table 1. Comparison of Methods Toolbox and research questions.**

### *Visioiva Tuotekonseptointi*

The second of these methods has been developed by a multidisciplinary group of Finnish experts in the fields of Industrial Design, Futurology and Engineering as part of a TEKES sponsored project (Kokkonen et al. 2005). The method, Visioiva Tuotekonseptointi, aims to combine futures research into product concepting. The overall objective is to create foresight supporting strategic decision-making and the timing of R&D activities related to a theme.

Visioiva Tuotekonseptointi is based on a top-down approach where scenarios of the global environment are used to inform theme related scenarios, from which opportunities are identified. The process has five stages: (1) identification of change factors; (2) scenario building; (3) identification of product needs (a) and (b); (4) generation of product concepts; and (5) timing of R&D – activities and operations. In the first stage futurologists using prior scenarios, PESTE analysis among others, identify change factors or driving forces for four levels of environments: global operational, "block", (continent), state (country) and "branch" (industry) environment. At each level both strong and weak driving forces for each PESTE category (political, economical, social, technological, environmental) are defined. The driving forces and their possible states are documented to Future Tables. Alternative scenarios paths through the four environment levels are created by linking driving forces at level and in each PESTE category and by varying their internal states. The paths form outlines for scenarios. Typically, 4-6 scenarios are created in this way. They differ in terms of whether they are market, technology or society driven, to reflect different levels of future risks and flexibility for the company. The aim is not to create precise visions of the future but detailed enough narratives to guide visioning concept design.

In stage three, theme level scenarios for each of the higher-level scenarios are created. Again, the PESTE structure is used categorize identified theme related driving forces. The values for the driving forces are selected based on the higher-level driving forces to ensure, the scenarios are consistent with them. The theme level driving forces serve are inputs for the visioning concepts.

In stage four, a series of workshops are organized to brainstorm and develop concept ideas for the theme. The participants should be ones who created the scenarios to ensure, the understanding of the scenarios remains consistent. At the beginning of the stage, the company should decide to what degree the company's present core competencies in terms of technology and its overall business and market approach should guide the ideation. It influences how radically new ideas are created. Each scenario is systematically explored for opportunities with the given guidelines. In the process ideas are iterative refined until concept ideas are generated for each scenario. The numerous ideas are then categorized in terms of their timing, and relevance to the existing product families of the company. Subsequently, the ideas are developed into "outlines" of visioning concepts. Through evaluation a small set of concept ideas are selected for further development involving visualization and 3D modeling. The detailed visioning concepts are subsequently tested in the alternative scenarios and they are finally evaluated in terms of their technical feasibility and market potential.

The fifth stage, the timing of R&D activities and operations has been left out of scope in the methodology development. According to authors the timing and impact of the new knowledge about opportunities needs to be resolved by each specific company, in their own way. The decision by the authors not the define this last stage is indicative of the heterogeneity of Front-End processes within and across companies, which makes recommendations on how to apply new knowledge difficult to make.

The method aims for a combination of multidisciplinary expertise to solve the problem of future opportunities. It brings together futurologists, industrial designers and engineers to generate visioning concepts. The method prescribes workshops as a way to bring the participants together to discuss and design based on the scenarios. The collaborator's shared conceptualization of future opportunities is based on the scenarios and is passed on in the visioning concepts, which are the primary deliverables of the work. According to the authors, companies lacking the required competences need to establish innovation networks that are able to supply the skills and knowledge needed in the method. The authors point out that using innovation networks, consisting of members who are not familiar with the company may lead unrepresentative scenarios and poor results from company’s point-of-view. This potential problem is not addressed further I the method: it does not provide tools to support distributed use.

| | Methods Toolbox | Visioiva Tuotekonseptointi | Design solutions |
|---|---|---|---|
| 1. Identifying future innovation opportunities | Enables designing and rationalizing future product and service concepts reflecting environment 10-15 years in the future;<br><br>Process: Analysis (systems thinking) –Projection (scenario building) – Synthesis (concept design);<br><br>Uses systemic image of problem context for projection.<br>Systemic image is based adaptation of Vester’s 7 questions related to living systems and consists of internal and external variables;<br><br>Systemic image projected with driving forces;<br><br>Outcomes: concept options for different scenarios;<br><br>Method (toolbox) can be used flexibly. | Enables identifying product and service opportunities 10-20 years in the future. Visioning concepts produced in the process support strategic decision-making and timing of R&D;<br><br>Process: Global Scenarios (Analysis-Projection) – Theme scenarios (Analysis-Projection) – visioning concepts (Synthesis);<br><br>Uses Future Tables structured according to PESTE and consisting of driving force variables to generate scenarios;<br><br>Outcomes: Future Tables; visioning concepts for different scenarios;<br><br>Method to be applied in full. | |
| 2. Supporting emergent common understanding among collaborators | Team of designers required for the work;<br><br>Vague structure for systemic image does not support shared conceptualization;<br><br>Workshops play a major role in creating common context;<br><br>Does not provide tools for distributed work; | Multidisciplinary team required for the work;<br><br>Future Tables function as common context for work;<br><br>Visioning concepts used to communicate insight and foresight;<br><br>Workshops play a major role in creating common context;<br><br>Does not provide tools for distributed work; | |
| 3. Supporting application of new knowledge in organization | Creates solution options to future contexts;<br><br>Understanding of new knowledge based on concepts. | Visioning concepts support strategic decision-making;<br><br>Does not address how to deal with timing and implications of results on R&D. | |

**Table 2. Comparison of Methods Toolbox and Visioiva Tuotekonseptointi and research questions.**

## 2.4 Theoretical Framework for Design Solutions

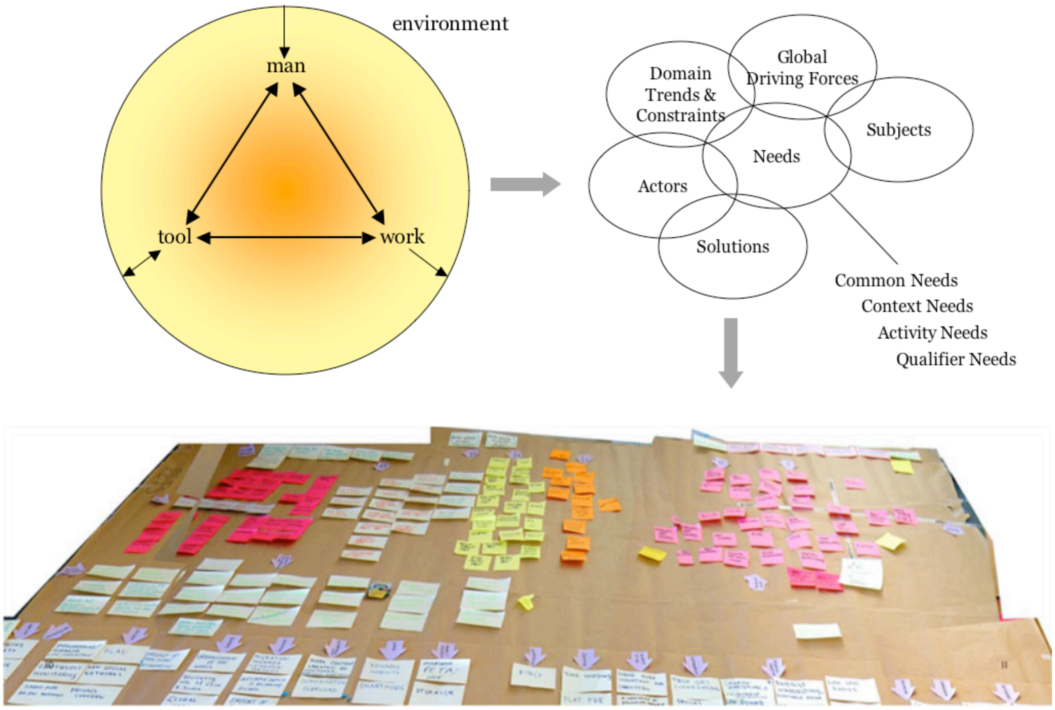
Chapter 2 has presented related work, theories and methods that inform and inspire the design of Mediating Artifacts (methods and tools), Actions (tasks and process), and Objects (deliverables) for cross-organizational exploration of future product innovation opportunities in a chosen domain. The chapter began by looking at the role and processes of the fuzzy Front-End phase in product innovation. It contextualized the problem of applying knowledge across the Front-End and in the next phase of New Product Development. Exploring spaces of possibilities and defining future needs were pointed out as key methodological challenges, while supporting distributed cognition in diverse innovation networks and adapting to new information, were named as key collaboration challenges. This work aims to provide solutions to these challenges. Next in the chapter, knowledge theories and models were considered for insight about the fundamental reasons behind the challenges of multidisciplinary collaboration and application of knowledge. The issue of different bodies of knowledge clashing in multidisciplinary work was raised. The *ba* concept was introduced as a potential metaphor for conceptualizing the objective of this thesis as the design of diverse, yet complementary knowledge creation settings. Systemic and systematic design methods as well as scenario building methods were presented as potential approaches to the challenges of exploring spaces of possibilities and identifying future user needs. Product concepts were described as a useful Front-End resource for communicating and managing knowledge about innovation opportunities. Finally, two methods for defining future opportunities were examined to determine whether they provide answers to the methodology, collaboration and knowledge application problems the thesis deals with. Theoretical framework inspired by the reviewed literature, to solving the methodology, collaboration and knowledge application problems is proposed in the following section.

***Methodology Framework***

The methodology problem that this thesis aims to answer is: How can future innovation opportunities be identified in any chosen domain? First, its important to point out that the rationale for identifying future innovation opportunities is to support strategic decision-making and indirectly, the renewal of core capabilities. According to the reviewed literature, solving this problem entails creating alternative scenarios of future user needs and solutions to these needs. The focus for future innovation, i.e. the innovation opportunity, emerges through this reflective and prospecting process. While the Methods Toolbox and Visioiva Tuotekonseptointi methods enable creation of alternative scenarios, reflecting future needs and problems, and lead to design of concepts, they both lack a prescriptive framework for systematically translating opportunities into specific types of innovations and systems of solutions. Such a capability would improve the applicability of the knowledge in strategic decision-making. This capability is the differentiating factor in this theoretical framework to identifying future innovation opportunities.

According to Patnaik (2004) System Logics descriptions involving Common and Context Needs are descriptions of innovation strategies because they represent high-level approaches to what are the customer's needs are in a domain, and systems of solutions to them. Defining opportunities in terms of System Logics is a more holistic and informative approach than defining them through visioning concepts. First of all, System Logics descriptions encompass (visioning) concepts but additionally, they present the rationale for the concepts. The framework enables translating different levels of needs into different innovation strategies, from new features to product families. Subsequently, System Logics descriptions are more applicable to strategic decision-making and can be used more flexibly than concepts alone in the Front-End. For these reasons the System Logics framework provides a good foundation for any methodology used to identify future product innovation opportunities.

Defining future System Logics in connection to a chosen domain unfolds into a process of identifying future needs and problems in the domain and subsequently, designing concepts to solve them. According to Jonas (2003) knowing what is the future problem requires "designing" the problem by combining systems thinking and scenario building. It requires first the construction of a systemic image of the problem context. This is necessary because only by considering the problem context or domain as a system with internal stabilizing behavior in reaction to external influences, can successful future interventions be made into it with product and service innovations (Jonas, 2003). In Jonas's method, the problem system image is composed from internal and external variables. In the theoretical framework described here, the system image of the chosen domain should incorporate the System Logics hierarchy of needs. Moreover, to facilitate design of solutions to the needs, it should also consist of factors describing the overall context and experience of these needs. Archer's (1984) man-tool-work-environment system can be used to explore interactions between factors affecting product design. Through the interactions the overall socio-technical environment the designed product will live in can be clarified. From this perspective, Archer's model is a good starting point for defining the remaining components of the need-centric domain system image. According to Gerstheimer and Lupp (2005) the system image used in ICT innovation to learn about future needs should reflect the status quo socio-technological system and therefore, it needs to consist of factors such as user needs, technological possibilities, as well as legal and commercial considerations.




**2.10. Theoretical methodology framework. Image by author.**

From the perspective of Levin (1984)'s method, the components of the system image based on which concepts are designed fall into two general groups: design parameters or controllable causes and variables or uncontrollable causes and effects. According to Cross (1984) by externalizing design inputs, in this case the parameters and variables, it becomes possible to systematically explore interaction between factors, keep separate records for ideas, solutions, information and requirements and delay choice of final solution until problem is fully understood. Moreover, by interrelating the parameters and variables it is possible to create the domain system image. As a result of interrelating parameters and variables, patterns describing needs and their context emerge in the domain system image. These patterns represent domain problems, which serve as briefs or inputs for concept design. The patterns or briefs can also be systematically composed from the externalized parameters and variables. The type of innovation opportunity described by a brief can be controlled through the levels of needs included in the brief. For example, briefs describing product family opportunities must include Context Needs, while opportunities for new features are described with only Qualifier Needs.

From the perspective of scenario building and Van der Heijden's (1996) Iceberg metaphor, the system image consisting of parameters and variables, is a structure that reveals the relationships between trends and present "events" or opportunities in the domain. The present opportunities can be transformed into future opportunities by projecting future trends (or causes) to the system image and its patterns. The future opportunities describe approaches to future customer needs, for which visioning concepts can be designed. The future briefs and solutions together define future System Logics. This approach enables systematically generating alternative System Logics by systematically creating alternative briefs from the system image parameters and variables and subsequently projecting these using alternative driving forces to the future. Visioning concepts illustrating future opportunities can be subsequently designed based on the future briefs. Following Perttula's and Sääskilahti's (2004) proposal of treating and monitoring concepts as a portfolio of options, the resulting future briefs and visioning concepts, which together represent future domain System Logics, can be treated as a portfolio of domain options.

***Approach to the Collaboration Problem***

The collaboration problem the thesis aims to solve is: How can emergent common understanding of the domain (problem area) opportunities be supported in a diverse innovation network? The problem has essentially two aspects to it: generally supporting the formation of common context among specialists from different fields and more specifically, supporting distributed cognition or the coming together of people in a distributed network with heterogeneous skills to share knowledge, skills, expertise and insights. The fundamental challenge in multidisciplinary collaboration according Iivari and Linger (1999) is that the bodies of knowledge of each collaborator appear to the others as having low concreteness or applicability and low generality or variety. To overcome this problem a shared conceptualization among the collaborators of the work, they are engaged in, is needed. According to the reviewed literature a shared conceptualization is an agreed set of meanings about some phenomena. Tormey et al. (2004) have proposed the use of ontologies to formally establish shared conceptualization in a distributed design environment. According to Tormey et al. (2004) the use of ontologies supports the mapping of heterogeneous modeled knowledge to homogenous system knowledge. Moreover, to overcome the problem of distributed cognition Fischer (2002) has called for tools based on a shared conceptualization of the innovation problem, that enable synthesizing disparate perspectives to a problem and to deal with vast amounts of information. In the case of identifying future innovation opportunities in a chosen domain, the collaborators need to have an agreed set of meanings about how view a domain (in general) and describe its opportunities. They also need tools for externalizing and sharing their common understanding.

The theoretical framework to the methodology problem also solves the problems of shared conceptualization and externalization of design inputs. From the perspective of the collaborators, the domain system image composed of interrelated parameters and variables, functions as a shared conceptualization of the innovation problem area. The system model behind the system image, is a framework that simplifies and unifies domain related data collection, analysis, synthesis and evaluation. Hence, collaborators regardless of their area of specialty are able to use the domain system image as a framework for filtering and translating their insights for other collaborators. Information systems and other tools for knowledge capturing, structuring and sorting needed to create and use the domain system image can be designed based on the shared conceptualization. Such tools could support externalization of the system image and its distributed use. The externalization of design inputs, prescribed by the theoretical framework, further supports the formation of common context among participants in the design process. Because they are externalized, the system image and designs can be flexibly subjected to internal and external evaluations, which ultimately, ensures that the emergent common understanding is of the domain and its opportunities is adequately accurate.

***Approach to the Knowledge Application Problem***

The third problem the thesis tackles is: How can application of domain insight and foresight by the product development organization be supported? Essentially, this problem has to do with both the body of knowledge the insight and foresight consists of as well as the context for its application. In this case, the application context for the new knowledge is the Front-End and the overall product development organization. Poskela et al. (2004) and Perttula (2004) have shown that Front-End processes are chaotic and heterogeneous and numerous attempts to unify them have failed. Currently, product concepts are regarded as the most successful unifying resource in the Front-End. They are used to convey innovation ideas across the product development organization, to pool ideas, build reputation, and as sources of new features and testing material. Moreover, Perttula and Sääskilahti (2004) have proposed that concepts should be treated and monitored as a portfolio of options in the Front-End. While concepts are a good resource, as a body of knowledge they do not necessarily have high generality, which is also needed in addition to high concreteness or applicability when considering the application of new knowledge. From the perspective of this thesis, ideally the insight and foresight produced in the methodology approach should have both, high applicability and high variety, in order to support strategic decision-making and the renewal of core capabilities.

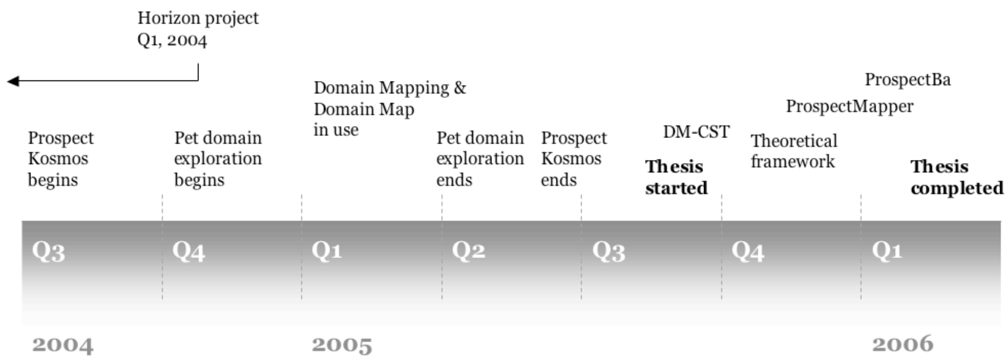
Supporting the application of insight and foresight about future innovation opportunities in a domain requires bridging Front-End processes and the Front-End with the later product innovation phases. It requires treating and monitoring the opportunities as a portfolio of options. It also means the resulting body of knowledge needs to have high applicability and variety. The proposed theoretical methodological framework satisfies both of these criteria. It produces a variety of knowledge having different applicability and variety in strategic decision-making and renewal of core capabilities. As a result of the systemic and systematic method, the knowledge is structured and related to each other on the lowest conceptual level in terms of design parameters and variables. Since, all knowledge produced in the approach is based on the same "building blocks" it is possible to duplicate and combine the knowledge. This also facilitates comparisons between knowledge produced through the method. Additionally, the design of concepts as “illustrations” of opportunities adds to the comprehensibility of the knowledge and its application in product development. In sum, insight and foresight “packaged” in this way means it can be exploited as pre-design material at a later time, reducing the time spent collecting information about a domain if and when the company decides to produce products and services for the domain. Consequently, the body of knowledge produced can be said to have high applicability and high variety. To further improve the applicability of the new knowledge, its relevance and timing can be determined systematically by monitoring the realization of the driving forces it is conditioned upon. If changes occur in the domain, the domain portfolio can be updated using the domain system image framework.

The rest of this thesis deals with implementing these theoretical solutions to the methodology, collaboration and knowledge application problems.

# 3 Design Research Process

*With wicked problems the problem and solution co-evolve during the design process.*

The design research process in search of solutions to the research problems began already before this thesis in the Horizon project at Satama Interactive. The development of the method and tools for identifying future innovation opportunities was started in the Prospect Kosmos collaboration at the beginning of 2005. The first half of chapter 3 describes how the Domain Mapping method and Domain Map tool were developed. They are the starting points to the thesis. The second half of the chapter explains the design research process, started in late September 2005 that first led to the theoretical framework and finally, to the hybrid ProspectBa platform, the design solution to the research problems.




**3.1. Timeline of design research process. Image by author.**

## 3.1 Prospect Kosmos Pet Domain Exploration

The idea to create a method and tools for exploring future opportunities came initially from the Horizon project. It was an internal project at Satama Interactive, in which a multidisciplinary team developed approaches to envisioning future domain opportunities.

### 3.1.1 From Horizon project to Prospect Kosmos

During early Spring 2004 Satama approached Nokia Design offering its design services in support of new product development. In response to the offer, Nokia wanted to know if Satama could help answer the two questions: What will be the interesting domains 3-10 years into the future? Why are they interesting? Nokia defined a domain as something that involves 10-100 million people, is not likely to disappear anytime soon and is not currently saturated with products and services. Related to the questions the following critical issues were raised: timing of ideas, combining virtual and physical, and selling ideas internally to stakeholders. These issues we translated into the following questions as part of Satama's response to Nokia:

1. When is the best time to act on existing product and service ideas? And in which domains are the ideas most relevant? Will there be new domains?
2. In which current domains, that are new to Nokia, can the user experience be innovated by bringing the virtual and physical closer together?
3. How should the new domains and related ideas be sold in the Nokia organisation?

The outcome of this exchange was an agreement to collaborate in creating insight and foresight about new domains. The collaboration was named Prospect Kosmos.

A kick-off for the Prospect Kosmos collaboration was held at the end of September 2004. A core team of six members, two from Satama, three from Nokia and an Industrial Design student from Lahden Muotoilu Instituutti, was formed to do the work. My role was to lead the team during the exploration of the first domain, and develop methodologies for the work.

**3.2. Prospect Kosmos core team. Team members from from left to right, starting at the top: Jokko Korhonen, Mikko Jäppinen, Jari Ijäs, Timo Vitikainen, Pentti Ahlgren, Esa Nousiainen. Photos by author.**

One of the first things I did as team leader was to collect method and tools that I thought would be useful for the work. These included the Genex process, System Logics framework and a list of web resources useful for collecting domain data. I created a

Power Point presentation of the methods called *Conceptual methods, frameworks and software tools* and shared it with the team. The presentation and methods were structured according to Shneiderman's (2000) Genex process that has the steps Collect, Relate, Create and Donate. I also appropriated Judelman's (2004) principles for visualization as the Prospect Kosmos work principles. The principles and my interpretation of them were the following:

1. *Map* - Discover relationships, associations and rules between domain related needs and concepts and future trends.
2. *Optimize* - Provide the right amount and kind of information for describing opportunities, future trends and phenomena.
3. *Stabilize* - Form a foundation for concept design by naming the meta-structures, rules and associations that are unlikely to change drastically in the domain.
4. *Digitalize* - Push the potential of the digital medium to handle complexity in understanding domains relationships with future trends and phenomena by using databases for storing and meta-data for structuring.

### 3.1.2 From Initial Workshop to the First Domain Map

In January 2005 I organized a core team brainstorm on Pets and the future trends. The brainstorm produced lots of data and opinions about pets and pet owners as well as ideas about how domain foresight could be created. The domain data was documented with Post-It notes. Following the brainstorm I was left with the task of organizing the results, i.e. the Post-It notes. To help with the clustering the Post-Its my colleague Mikko Jäppinen and I came up with the idea for the Domain Map.

**3.3. Initial workshop. Photo by author.**

The Domain Map was a large brown paper spread over four tables that contained all the Post-It notes from the workshop. The Post-Its were clustered into the categories of Actors, Needs, Solutions, Domain Trends and Phenomena and Global Trends. The categories formed three bands across the brown-paper, with Actors, Needs and Solutions on the top band, Domain Trends and Phenomena on the middle band and Global Trends on the bottom one. The structuring represented a zooming in or out of the domain depending on whether you started scanning the contents of the map from the bottom or the top of the map. This hierarchy also represented a systemic view of the domain.

**3.4. Domain Map. Photo by author.**

Later, I decided to incorporate a set of domain related questions on to the map to guide the further collection and mapping of data. I came up with the following list of questions, which I felt were crucial to answer in order to develop a sense of the domain;

- What makes an animal or thing a pet?
- How are pets chosen?
- What animal needs influence owning a pet the most?
- Which currently basic needs relating to pets are likely not to change in 10 years?
- How are Pets and Wellness domains inter-related?
- From what other domains is the money used in Pets taken out of?
- How can information be embedded or linked to animals?
- What are the guidelines for pet-centric design?

- What pet related existing products and services can be enriched replaced, automated…?
- What existing pet related products, services and businesses will be made *redundant*, will need to be *redesigned* or *restructured* as a result of the ongoing services revolution
- What is the Pet industry researching?
- What common user experience qualities do Pets and mobile phones share?

The questions were written up on Post-Its and added to the map.

### 3.1.3 From Domain Map to Domain Mapping Process

Data from the first Kosmos workshop in January was used to create the first version of the Domain Map. In several design sessions thereafter more data was added to the map. The contents of the map were evaluated in several sessions with stakeholders and pet owners. This resulted in the iteration of data items and their positions on the map. The overall structure of data categories remained unchanged.

The Domain Map was used for concept design on several occasions. To test the legibility and usefulness of the Domain Map for ideation of products and services I decided that external designers should try using it. Two concept designers from Nokia were invited to come and brainstorm pet product and service concepts with the help of the Domain Map. The Domain Map approach to modeling the domain in terms of actors, people, needs, trends, phenomena, solutions seemed logical to the designers. They started by scanning and copying data items from the map which they though were interesting starting points for design.

Interestingly, both of the designers used the Domain Map differently. One decided to solve her personal needs as a dog-owner. She recognized her dog care related needs from the map and she chose them as her design brief. The other designer synthesized a design theme from numerous data items describing needs. Essentially both designers were able to create domain problems using the map and without consulting external sources. While both of the constructed problems dealt with the wellbeing of dogs they differed in terms of scope. From this experience we learned that the Domain Map could be used as an "open" brief for concept design.


**3.5. Prospect Kosmos observatory. Photo by author.**

Another use for the Domain Map was also tested. A member of the core team who had designed a product concept for dog-owners based on the ideas and needs identified in earlier workshops used the Domain Map to rationalize and contextualize the concept. He did the reverse of what the Nokia designers did. Instead of constructing a brief from which to begin working, he constructed a rationalization for his concept. This showed that the Domain Map could be used at the beginning of the design process as well as a tool for evaluating and contextualizing the results at the end. A further learning was that the Domain Map provided a common conceptualization of the domain based on which concepts created outside the context of Prospect Kosmos could be interpreted together by the team.

To summarize the approaches to concept design using the Domain Map were:

1. *Recall* - using the Domain Map to recall (personal) problems related to the domain;
2. *Composition* – using the Domain Map to compose domain design themes;
3. *Contextualizing* - using Domain Map to understand or rationalize domain solutions or observations.

The idea for the Domain Mapping method came from exploring the uses of the Domain Map. However, the process of creating and using the Domain Map was not defined in detail or tested during the Prospect Kosmos collaboration. The Domain Map and the idea for the Domain Mapping method were considered key outcomes of the collaboration and as potential sources of future work.

## 3.2 Design Research Process for ProspectBa

The second phase in the design research process began at the end of September 2005 when my employer, Satama, asked if I was interested to continue the development of Domain Mapping method as my MA thesis for the Media Lab. I gratefully accepted the offer and hence, began the design research process described next.

### 3.2.1 Findings from Domain Mapping of Pets Domain

I began the work by evaluating the Domain Mapping method and Domain Map tool. I also started to collect relevant literature.

***Wish-list of Domain Map Related Operations***

The Domain Mapping evaluation produced a list of requirements for the next version. Most of the requirements dealt with overcoming the physical limitations of the Domain Map. The requirements were the following:

- To support collaborative work it should be possible to: create a personal version of the map to work on; and annotate map elements with personal ratings and comments.
- To create a domain system image with the map it should be possible to: define and represent relationships between map elements; edit the relationships; track their behavior over time; view the connections between elements and concepts; simulate changes to the interrelations and see the outcomes of the changes on the map in real-time.
- The following filtering related operations are also highly desirable: referencing the original sources of map elements; creating multi-faceted views to the map; reviewing map history; and sorting map elements by contributor.

Some of these operations could have been performed with the Domain Map in its present state. For example, it would have been possible to develop a notation for representing relationship between data items. The notation would enable adding the relationships as meta-data directly to the Post-Its on the map. Keeping track of changes in the relationships could have been done by replacing Post-Its with new ones and archiving the old ones. The map's version history could have been tracked with photographs. However, I believed that to satisfy all of the above requirements the map had to transformed into a database based information system.

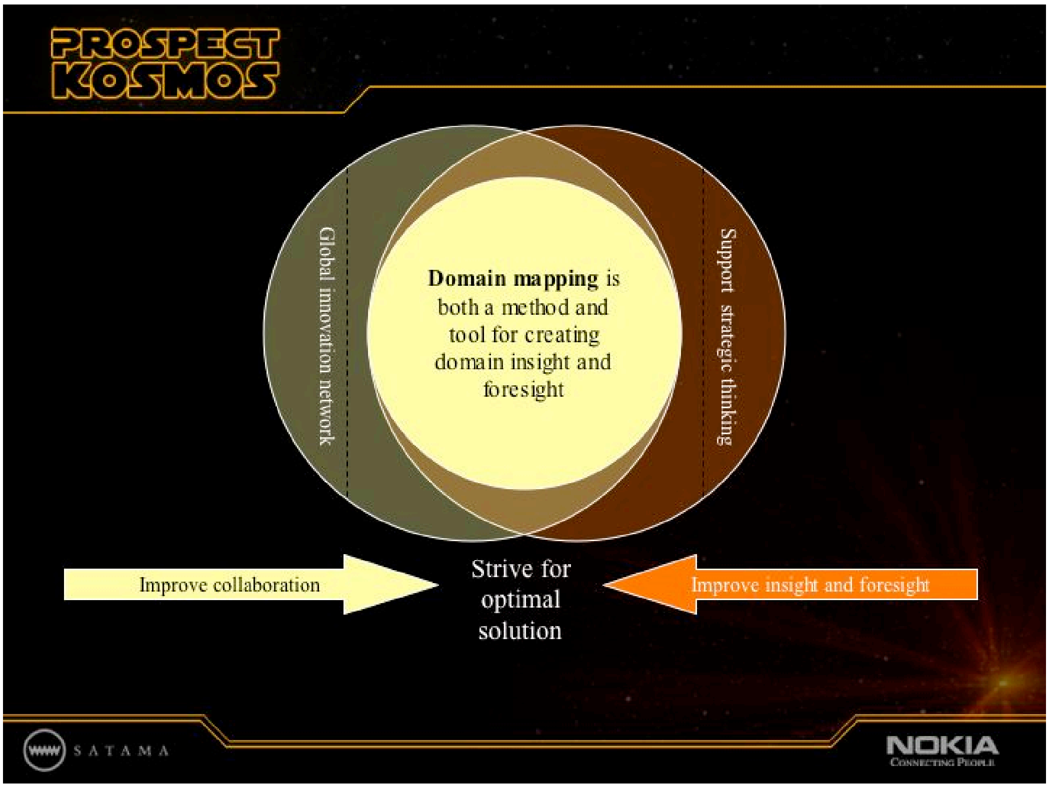
***Insights on Best Practices***

In the evaluation I also noted down the best practices associated with the map and its good qualities. One of these was the map's physical representation. The color-coding scheme that was used to identify the different types of design factors on the map, made locating specific elements easy. Moreover, the large size of the map and the fact that it contained all the domain design factors identified during the domain exploration made it an excellent collaboration tool. Based on these insights I concluded that the Domain Map was a versatile design tool for structuring domain data, composing briefs and themes and rationalizing design decisions. I decided that any future method for using the map should not reduce its capacity as a creative tool.

Before moving on in the design process I wrote down a list of attribute keywords to guide the next iteration of the Domain Mapping method. The attributes were *Multi-disciplinary*, *Distributed*, *Consumer-centric*, *Systematic*, *Emergent*, *Forward thinking*, *Empowering*, *Reusable,* and *Systemic*. Later in the work, these attributes helped me find relevant literature.

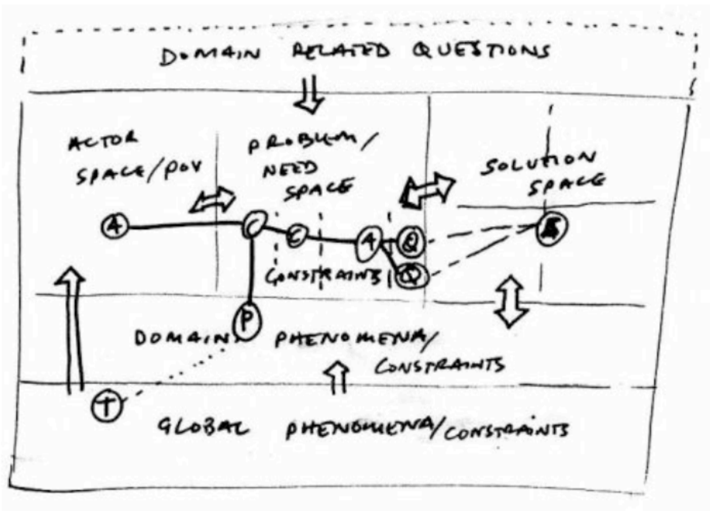
### 3.2.2 Getting Started and Setting the Initial Scope

The scope I set initially for the thesis consisted of developing the Domain Mapping method and designing a software tool for it. The general questions that I felt the thesis needed to answer were: How should the Domain Mapping process be managed? Can a generic structure be given to options spaces in domains? How should domain knowledge be packaged to facilitate design of envisioning concepts?



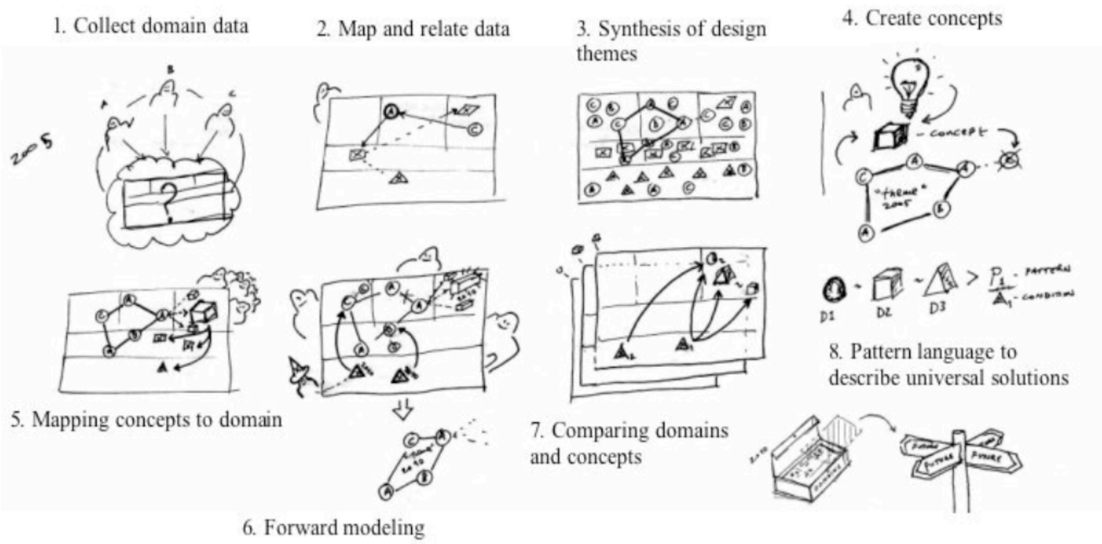

**3.6. Overview of Domain Mapping method. Slide by author.**

First I briefly defined what Domain Mapping was. Then I documented the structure of the Domain Map. The map consisted of an Actor space, a Problem/Need space, a Solution space, Domain Phenomena/Constraints and Global Phenomena/Constraints space as well as a space for domain related questions that guided the populating of the map.



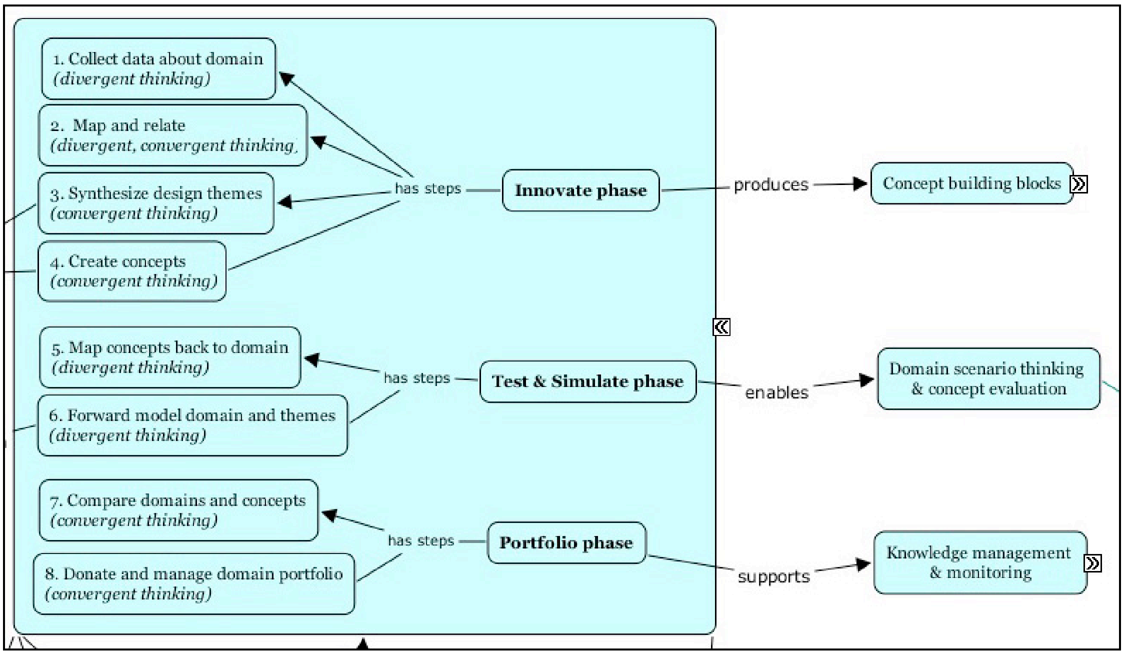

**3.7 Sketch of the Domain Map. Image by author.**

Next, I made an initial attempt at defining the full Domain Mapping process from (present) modeling of the domain to forward modeling it. I created a sketch of the process depicting the central role of the Domain Map. The process had eight steps that were divided into the three phases: Innovate, Test & Simulate and Portfolio.



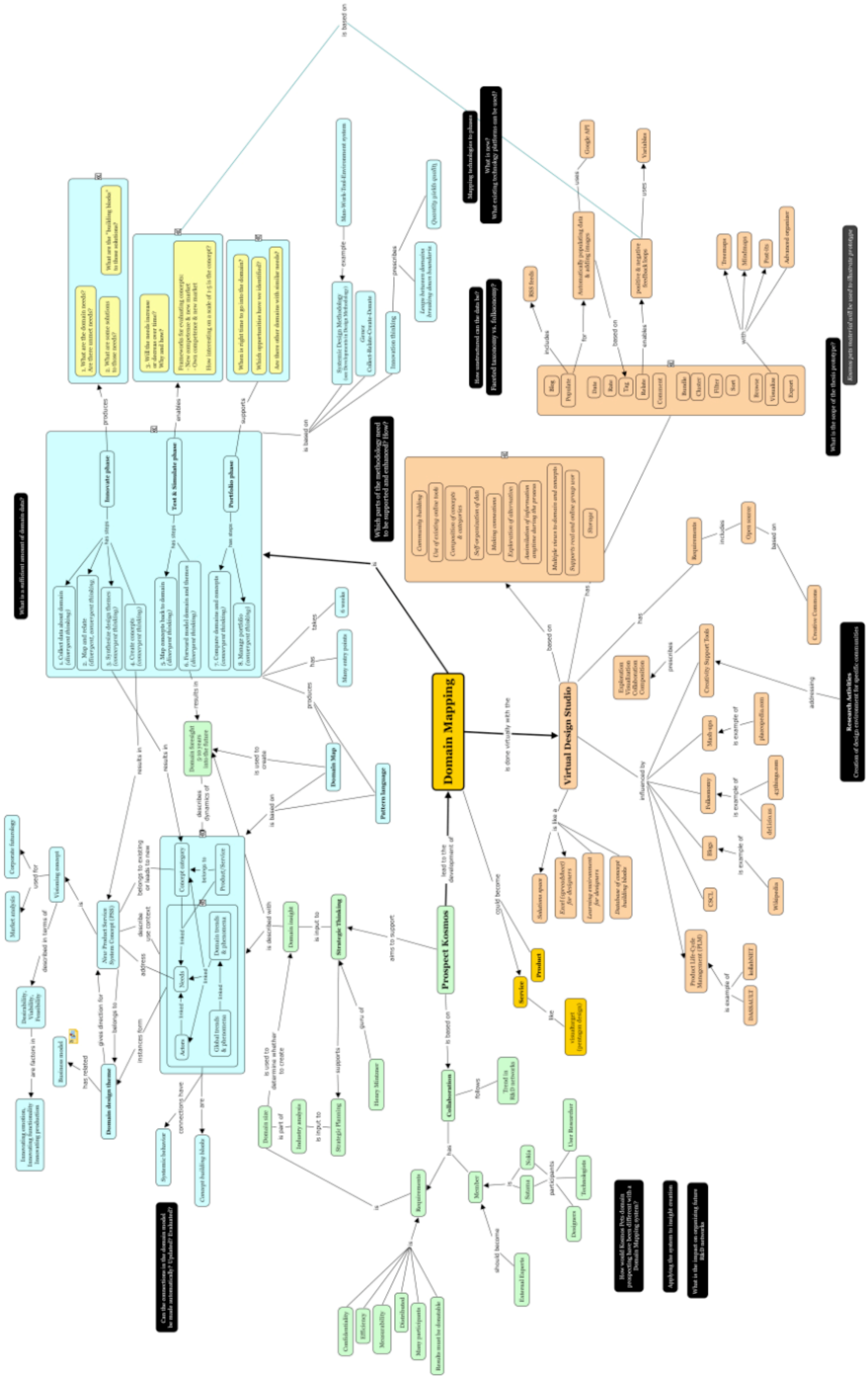

**3.8 Overview sketch of the Domain Mapping process. Image by author.**

The Innovate phase consisted of collecting data, mapping the data and defining interrelations between mapped data, synthesizing design themes from the map and then creating product service system concepts using the themes. The Test and Simulate phase aimed to evaluate the impact of the concepts on the domain and next to generate a forward model of the domain with the help of futurologists. The themes and concepts based on the present day version should be re-designed to reflect domain changes in the future. The Portfolio phase involved comparing explored domains and resulting concepts. The phase aimed to develop a sense of opportunities and their timings both inside a domain and among a set of potential domains. Finally, the last step of the process was to develop a pattern language that would make the description of domain problems and solutions consistent across domains.




**3.9. Concept map of the Domain Mapping process. Image by auhor.**

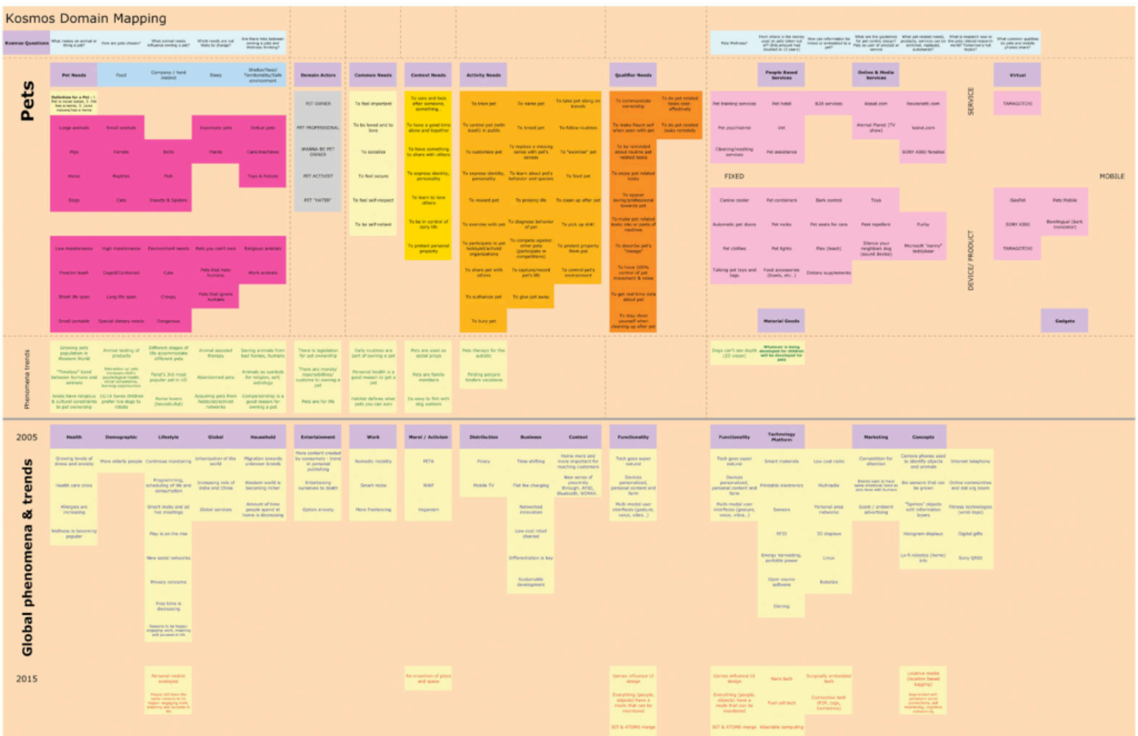
I created a concept map of the thesis to get a better sense of its scope. I also used the concept map to communication the thesis topics and scope to others. In this capacity it proved to be a valuable tool. The map depicted three overall thesis themes: Prospect Kosmos as the background to the thesis (green items), the Domain Mapping method and Domain Map tool (blue items) and the initial approach and features of the DM-CST software tool (orange items). With the concept map I was able to indicate how these three areas related to each other and formulate more questions for the thesis to answer.




**3.10. Concept map showing thesis scope. Image by author.**

The questions I aimed to answer were presented on the concept map in black boxes. The main question had two parts to it: Which parts of the methodology need to be supported and enhanced, and how?" I was also interested in if connections between data items on the Domain Map could be defined and evaluated automatically. The focus of both research questions was the software tool that I felt Domain Mapping needed before it could be used for effective distributed domain exploration. I decided to call the software tool "DM-CST", short for Domain Mapping Creativity Support Tool. The software tool's role in the process and its name were inspired by the new field of Creativity Support Tools (CST). I envisaged the software to be an online design studio consisting of a virtual Domain Map and blog for storing raw data and commenting the progress of the work.

My next step was to document and store the contents of the Domain Map in digital format for later use. I had been considering the DM-CST software tool as a "Excel (spreadsheet application) for designers" and this influenced me to choose Microsoft Excel as the documentation tool. I was further motivated to use Excel because it allowed me to simulate the spatial layout and color coding of Post-Its on the physical Domain Map. A third factor influencing my choice was the idea of programming the Excel to generate random design briefs.



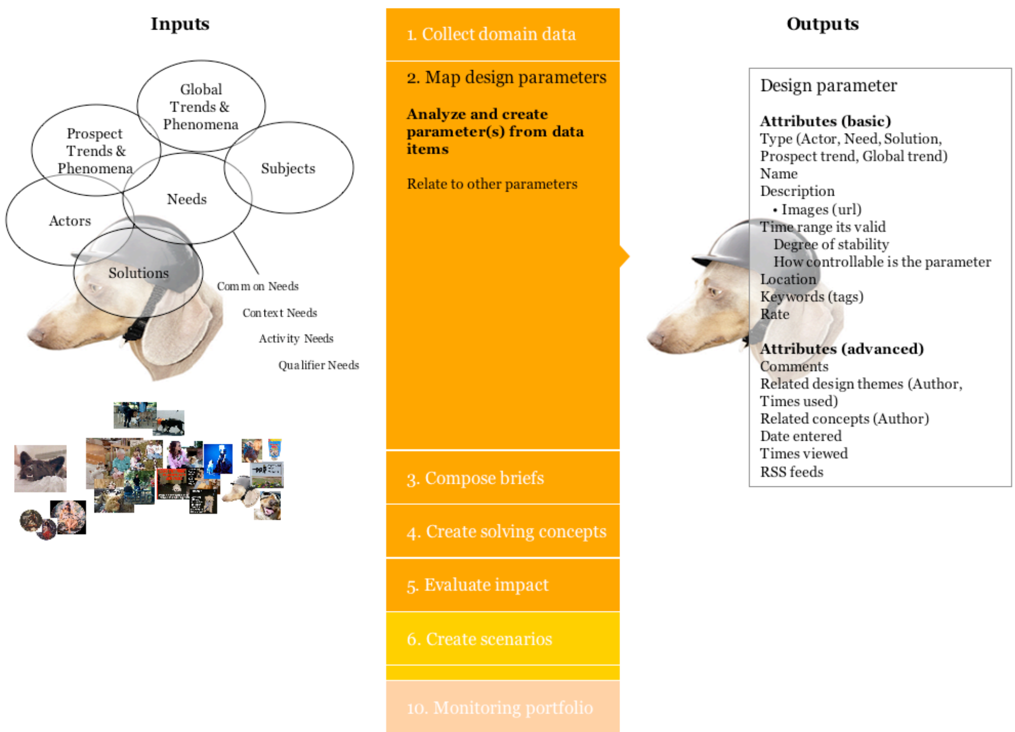

**3.11. Domain Map elements documented with Excel. Image by author.**

I tried to copy the appearance of the physical Domain Map as closely as possible. However, in some cases I changed the wording of the map elements. I added the People category to the Excel map that in my opinion had been missing from the Domain Map. The People category contained the different pet related people or potential target end-users for product and service concepts such as pet-owners. My plan of programming the resulting spreadsheet did not materialize.

It was at this point that I began referring to the Domain Map elements as parameters and variables. Parameters were the domain design factors that could be used in concept design and variables those factors that had an impact on design but could not be influenced directly by it. I categorized Actors, People, Needs and Solutions as design parameters and Domain Trends/Phenomena and Global Trends/Phenomena as variables.

### 3.2.3 2nd Iteration of the Domain Map and Domain Mapping

The next iteration of the Domain Mapping method came when I defined the step-by-step inputs and outputs of the Domain Mapping process. To help document the detailed Domain Mapping task flow I designed a Power Point template for showing the inputs and outputs of each key task. The template had three areas, a left hand area for presenting the inputs, the center for showing the process phase and task description and the right hand area for presenting the output. In the process of describing the task flow I ended up adding more detailed tasks and changing the overall process. I also changed the last phase from Portfolio to Monitor.




**3.12. Step in the Domain Mapping process. Image by author.**

At this point my objective was still to design the DM-CST software tool. The design drivers that I defined for the tool were collaborate, explore, visualize, compose, widgets and Web 2.0. I envisioned DM-CST replacing the physical Domain Map and enabling virtual collaboration between Domain Mapping process participants.

The DM-CST application consisted of three sub-tools (feature sets): blog, parameter space and portfolio. The blog was for collecting and commenting data. The parameter space was the virtual Domain Map containing parameters and variables. The parameter space tool would support different approaches to exploring the parameter space. The parameters and variables would self-organization into clusters based on similarity. Users would be able to compose personas, briefs and themes out of the domain parameters and variables. Different visualizations could be rendered of the parameter space to support specific tasks during the process. Collaboration between users would be supported with different task management and communication features incorporated in the parameter space too. The portfolio sub-tool was for storing and monitoring design outputs such as concepts and briefs.

The technical architecture would be based on Web 2.0 paradigms. The open APIs of web services like Google and del.icio.us could be used for augmenting functionality of the application. Tagging would be used as the secondary way of categorizing data. Functionalities would be presented to the users in the form of widgets or self-contained little applications. The widget architecture would make it easier to add functionalities over time in future versions of the application.

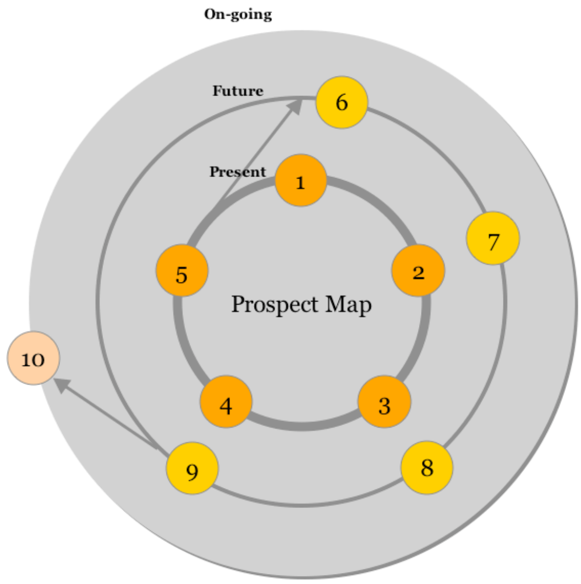
Having gotten a better sense of the DM-CST application and of the method itself I realized that the thesis scope, namely defining the method as well as designing and prototyping the software tool, was too broad. It presented too many research questions to be answered by one work. After this realization I narrowed the thesis scope to the development of the Domain Mapping method.

### 3.2.4 ProspectMapper - Hybrid Platform

With a narrower scope placing more emphasis on the Post-It based method I began the third iteration of the thesis design solutions. At this point, I began using the theoretical methodology framework described in section 2.4. I renamed Domain Mapping to *ProspectMapper* to reinforce the change in both the objectives of the work but also the growing difference between what I was developing and the original Domain Mapping method.

In the subsequent iteration of the method I ended up once more renaming the phases and adding more tasks to the process. The Innovate phase was renamed Solving and the Test & Simulate phase to Visioning. With the new names I wanted to clarify the progression from present day solving concepts to future visioning concepts. I renamed the third phase Monitoring to reflect its core activity, which was to monitor the results over time and ascertaining attractiveness and timing of the concepts.

| I. Solving | | | | | II. Visioning | | | | III. Monitoring |
|---|---|---|---|---|---|---|---|---|---|
| 1. Collect data | 2. Create design parameters | 3. Compose briefs | 4. Create Solving Concepts | 5. Evaluate impact | 6. Create scenarios | 7. Identify future problems | 8. Create Visioning Concepts | 9. Assess opportunity | 10. Monitoring and managing portfolio |




**3.13. ProspectMapper process. Image by author.**

Next, I iterated the Domain Map tool. I changed the People element to Actors and the Actors element to Subjects. With this change I wanted to reinforce the idea that people have needs because they own or deal with pets, or in other words Actors (people) have needs resulting or because of Subjects (pets). Although, the change was done to reflect the pet domain, I felt the new names and the relationships they implied would work in other domains as well. For example, in the spiritual domain subjects would be different faiths, which actors have the need for but which also generate needs for the actors.

The biggest conceptual change was to transform the table like Domain Map representation into a systemic model, showing interactions between the elements of the map. The model I designed for the Prospect Map (new name for Domain Map) was inspired by Archer's (1984) man-tool-work-environment system model described in section 2.3.1. The new representation communicated the original idea of the interaction between the elements in the domain. It clarified the relationships between Actors and Subjects. Moreover, by placing the Concept element at the center of the model, I wanted to show that the focus of the process was to design new concepts. The change to the system model representation led to the need to define relationships between the elements. While the physical map had not changed, it needed to reflect the system model, so I developed a written notation used that could be used to describe relationships an element had with other elements on the map.

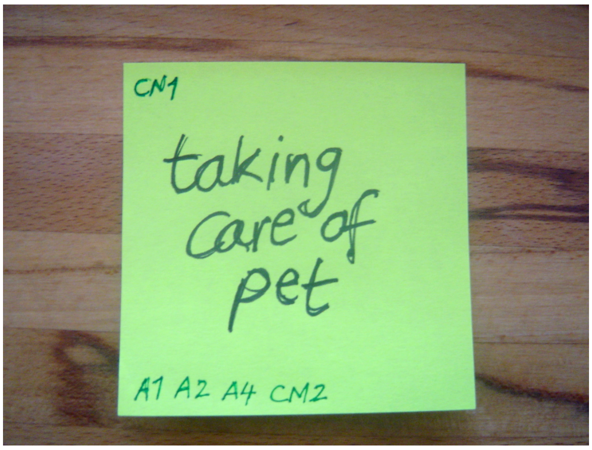
The need to document the interrelations along with the earlier need to archive and distribute the contents of the Domain Map motivated me to consider once more a software tool. This time I did not want to make the tool the focus of the work, but rather use it to augment the Prospect Map tool. This led to the idea of a "hybrid" platform, where a virtual tool supports the method and use of physical tool. Since, my goal was to develop a practical methodology that could be used by others straight "out-of-the-box", the software tool also had to satisfy the same criteria. Weblogging software seemed like a good choice for archiving and filtering the Prospect Map elements. A weblog makes creating, publishing and tracking text based web content relatively easy. This ease of use coupled with inherent community enablers like commenting and linking to posts along with RSS syndication have made weblogs an extremely popular form of web content.

A weblog or blog has a public side from which visitors are able to consume the blog's content and a publishing side where the content is authored. The user interfaces to both sides are conventional and relatively uniform in all blogs, which makes it easy to read a blog and keep a blog. On the public side, content is listed in reverse chronological order on the main page of the blog. Clicking a post title in the list opens the full post on a new page. Usually, the author allows the visitor to comment the post. Moreover, the visitor can subscribe to a RSS (Real Simple Syndication) feed from the blog, which makes tracking new posts extremely easy. On the publishing side, a form based user interface is used to write and format content. The appearance of content is managed with CSS styles. Blogs enable categoring posts and setting rules for archiving. The author can moderate comments and track other linking blogs.

Typically, when someone wants to blog, they subscribe to a blog hosting service. Blogger.com and Typepad.com are examples of such services. However, there are numerous blog systems or platforms that can be downloaded for free and installed on a personal server. Since, a hosted blog cannot be tailored to the same extent as a personally hosted blog I decided to install and run a blog myself. I needed to tailor a blog system to that it could be used to Prospect Map elements and their relationships.

I chose the WordPress personal publishing system because I had previously worked with it. After downloading the WordPress (v.1.5.2) software package from http://wordpress.com/ I installed it to my personal web domain http://www.jokkokorhonen.com/thesis/. I realized that I also needed to add tagging functionality to the blog in order to be able to document interrelations between elements. Therefore, I searched the WordPress Plug-in DB (http://wp-plugins.net/) for a plug-in that would enable to add metadata to categorized blog entries. Out of a number of tagging plug-ins I settled on UltimateTagWarrior (v.2.9.2.1) (http://www.neato.co.nz/manyfaces/wordpress-plugins/ultimate-tag-warrior). With the plug-in installed and activated I was able to enter a Prospect Map element as a blog post, categorize it according to year and category (Actor, Subject…) and then add keywords to identify related elements.

Next, I tested the use of the hybrid platform using data collected in the Prospect Kosmos. The first step was to re-construct the Prospect Map, this time with meta-data enhanced elements. I reassigned a new color-coding scheme to the Post-Its representing elements. Following the new color scheme I created new Post-Its out of the old ones. I gave each Post-It a unique id. The id was composed of the category identified letter or two and a category specific serial number. For example, "pet owner" Actor design parameter was given the id A1 (first element in the Actor category). Also as I recreated each Domain Map Post-It I thought about how it related to the others. I tagged the Post-It with the ids of related elements.




**3.14. Parameter Post-It. Photo by author.**

I also wanted to describe the nature of these relationships and for this I developed another simple notation. I began using the second metadata notation on global variables to show how they were influencing domain parameters. I thought that identifying and communicating the type of relationship between a global variable or driving forces and a domain parameter was necessary for scenario building. The notation for describing relationship types was as follows:

| | |
|---|---|
| -> | cause |
| <- | effect |
| (+) | positive feedback loop |
| (-) | negative feedback loop |
| (*) | concept |

However, soon after starting to use the notation I stopped because it was too laborious. Ensuring that the relationship types were described consistently on all related elements was tedious work. Moreover, in many cases there was not enough room on the Post-It for marking both the ids of related items and the types of relationships that existed between them.

Once I had recreated all previous parameters and variables of the pet Domain Map using the new color scheme and notation, I mapped them to a blank sheet of paper. Then I entered the elements to the tailored WordPress blog. Subsequently, I proceeded to simulate the workflow, which I had defined earlier, with the physical map using Post-Its and the blog. Through this trial and error approach I was able to define the remaining steps of the process.

### 3.2.5 Prospect*Ba*

The fourth and final iteration started with the discovery of the *ba* concept. As I explain in section 2.2.3, I regard the *ba* concept as a fitting metaphor for the hybrid platform. I decided to rename the design solution from ProspectMapper to ProspectBa.

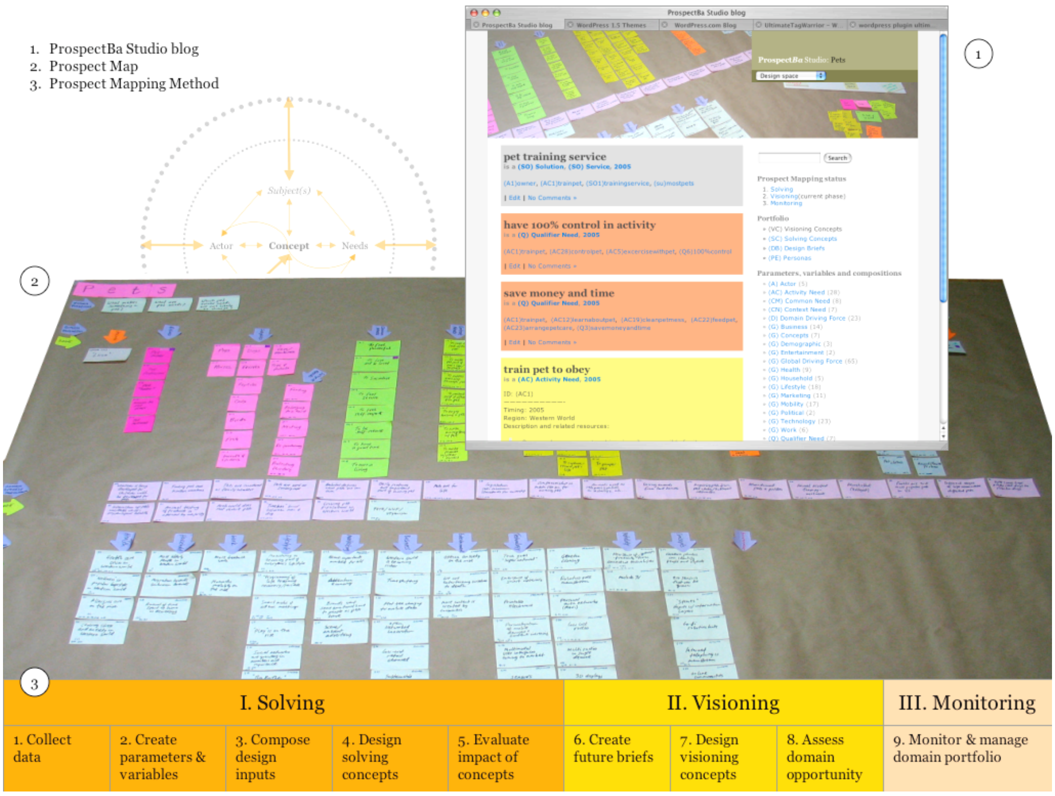
My motivation for the final iteration was to facilitate the adoption, use and reuse of the method. In the last iteration I focused on improving the efficiency of the method. I renamed the steps in the process once more to clarify their roles and objectives. I reduced the overall number of steps by combining several of them. I also continued to iterate the WordPress blog's functionality and appearance to better suit the method.

The next chapter presents the design solution outcome form this reflective design research process. My findings on the benefits and issues with the platform are presented in chapter 5.

# 4 ProspectBa 1.0

"*Design connections between you and new people, knowledge and disciplines. Design a new way to collaborate and do projects. Whatever you choose to do, don't do it alone. We are all designers now.*" John Thackara (In the Bubble, p.226)

ProspectBa 1.0 is a platform for collaboratively creating, sharing, and exploiting knowledge about future product innovation opportunities in a chosen domain. The platform consists of the Prospect Mapping method, the Prospect Map system model and tool, and the ProspectBa Studio blog. As a platform it is re-usable, extendible, and enables the transfer of meaning from one domain exploration to another.




**4.1. Overview of ProspectBa platform components. Image by auhor.**

The ProspectBa platform is used to create knowledge about future System Logics i.e. approaches to customer needs and systems of solutions for them in a domain. The knowledge serves in strategic decision-making and the renewal of a company's core capabilities. The Prospect Mapping method, at the core of the platform, is used to create a domain system image. The system image helps in identifying domain problems and projecting their future dynamics with driving forces. The projected domain problems serve as briefs for visioning concepts. The briefs and concepts together illustrate domain opportunities, i.e. System Logics. The domain system image consists of interrelated design parameters and variables defined by the Prospect Map system model. The parameters and variables form a design language for collaborators. It supports a common emergent understanding of domain opportunities during the Prospect Mapping process. The emergent and evolutionary nature of the process facilitates forming flexible innovation networks to do the work. Moreover, the evolutionary nature combined with the systematical externalization of all design inputs and outputs during process, as well as the monitoring of discovered opportunities as a portfolio of options, supports the application of the domain knowledge in product innovation.

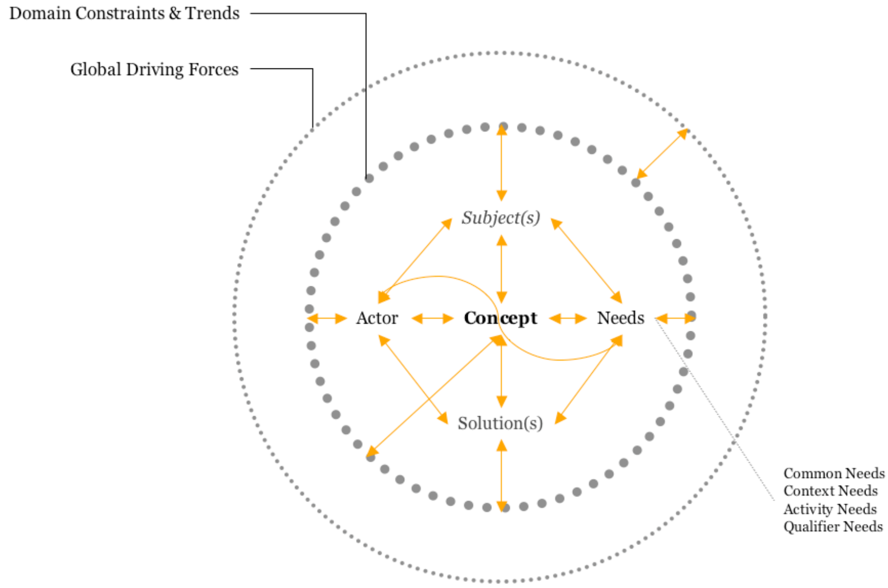
From the ba concept point-of-view, the ProspectBa platform is a combination of physical, mental, virtual and social settings for knowledge work. The physical setting consists of the Prospect Map tool for externalizing domain knowledge and the physical spaces used by the innovation network for collaborative work. The Prospect Map system model frames the mental setting or common understanding in the innovation network. The mental setting guides the Prospect Mapping activity by acting as a common framework for bringing together specialists from different fields. The innovation network engaged in the Prospect Mapping activity is the social setting for knowledge creation. Finally, the ProspectBa Studio blog is a collaborative virtual setting for composing, exploring and visualizing Prospect Map elements and compositions. It is also a social setting for discussing and commenting among the participants as well as learning about each other.

## 4.1 Prospect Map

There are two aspects to the Prospect Map: the system model for creating a domain system image and the tool resulting from externalized domain parameters and variables.

### 4.1.1 (Prospect Map) System Model

The system model is a lens through which a domain can be seen as a complex system with structure and emergent behavior. There are two overall categories of elements in the model: parameters and variables. The subcategories of parameters are Actor, Subject, Need, and Solution. The subcategories of variables are Domain Constraint//Trend and Global Driving Force. Together they are the lowest level conceptual elements in the system model. They are interrelated to reflect the phenomena and trends in the real domain. The domain system image emerges from the interrelated parameters and variables. It frames the domain for exploration and helps identify present domain problem areas and their origins. These problems are modeled with the system image parameters and variables. The system image and problem compositions are used to simulate domain dynamics.




**4.2. Prospect Map system model. Image by author.**

### *Parameters and Variables*

The domain system model consists of parameters and variables. They are used to create the domain system image and act as building blocks for composing contextual system patterns representing domain problems.

Actors, Subjects, Needs and Solutions are *design parameters*. They are controllable causes of desired controllable effects in the domain. The design process has power of choice over them: designers can choose which users or subjects to design for, what needs to satisfy, what solutions to support and what kinds of solutions to design.

Solutions and Domain Constraints/Trends are *dependent variables*. They are controllable effects in the domain and constitute of the factors that designers try to create or change through the design process.

Domain Constraints/Trends and Global Driving Forces are *independent variables*. They are external uncontrollable causes of uncontrollable effects in the domain. Designer cannot control or influence, but must still consider them when designing concepts because they influence the parameters. Changes in independent variables may result in changes in parameters and their interrelations. From the perspective of the system image independent variables are the catalysts of domain dynamics.

| **Prospect Map Design Parameters, Dependent Variables and Independent Variables** |
|---|
| Actor (A) |
| Needs |
|     Common (CM) |
|     Context (CN) |
|     Activity (AC) |
|     Qualifier (Q) |
| Subject (SU) |
|     Needs (optional) (SN) |
| Solution (SO) |
|     Product |
|     Service |
|     Solving Concept (SC) |
|     Visioning Concept (VC) |
| (Internal) Domain Constraints and Trends (D) |
|     e.g, Legal, Traditions, Technology, etc… |
| (External) Global Driving Forces (G) |
|     e.g. Political, Social, Economic, Technological, Ecological, etc… |

**Table 3. Prospect Map system model parameters and variables.**

The *Actor* design parameter stands for a person who acts to satisfy their own Needs or those of Subjects. Actors differ in terms of the roles they have in the domain, which in turn originate from Needs or Domain Constraints/Trends. For example, in pet domain Pet Owners, Pet Professionals, Wanna-be Pet Owners, Pet Activists, and Pet Haters are Actors.

*Needs* are the most important design parameter in the system model. Needs originate from interaction between Actors and Subjects. Needs may result from a Domain Constraint/Trend's influence on an Actor or Subject. Patnaik's (2004) System Logics framework is used to categorize needs into a four level hierarchy that describes their connection to an immediate situation in the domain. *Common Needs (CM)* are needs of nearly everyone. They include needs such as to socialize, to be loved and to feel good. *Context Needs (CN)* are needs of people of the same age, profession, religion, etc… The origins of these needs are the situations in which people live, work or operate. *Activity Needs (AC)* are needs of people in the same context who want to do the same things.

They are born from the types of activities a person wants to perform. *Qualifier Needs (Q)* are the most specific needs. They are needs of people in the same context who want to do the same things in the same way. These needs arise usually from “problems” with existing solutions.  This hierarchical framework can be applied to translate needs discovered in any domain into different level product innovation opportunities. For example, basing a domain brief on a Common Need implies taking a specific product design strategy towards the domain. Or if a brief contains only Qualifier Needs it will lead the design of incremental concepts that are improvements of existing products. When a system of needs is coupled with a system of solutions the end result is *System Logics*. Defining potential future System Logics in the domain is the overall objective of Prospect Mapping.

The *Subject* design parameter stands for an animate or inanimate thing that an Actor interacts with. For example, the Subjects in the pet domain are the animals and other material and immaterial goods or objects that are considered as pets. The *Subject Need* design parameter refers to a need that motivates or drives a Subject’s behavior in the domain. These needs are often the root cause for Actor needs and satisfying them translates into domain activity or Activity Needs. In the pet domain most of Actor needs originate from (pet) Subject needs. Moreover, the domain may impose regulation, as in the case of pets that forces Actors to act upon Subject Needs.

There are two kinds of domain *Solutions*: existing market solutions and concepts created during Prospect Mapping. Existing market solutions are considered as potential inputs for concept design. Existing solutions are divided into Product (P) and Service (S) design parameters. They refer to solutions in the domain that satisfy present Actor and Subject needs. Their market diffusion can be attributed to specific Actors and Subjects as well as Domain Constraints/Trends. In this regard, existing products and services tell a lot about the domain.

Concepts are dependent variables: they are the end-result of design and also icons for specific System Logics (opportunities) in the domain. Solving Concepts (SC) and Visioning Concepts (VC) are created from the starting point of a domain brief composed of design parameters and variables. The brief is a description of a domain problem arising from Actor or Subject Needs and influenced by Domain Constraints/Trends and Global Driving Forces. The concepts are solutions to problem described by the brief. They can take on the form of a product, service or system combining both. Solving Concepts (SC) solve present day problems, while Visioning Concept (VC) solve future problems at the migration point set for the work. For example, in the pet domain, a pet leash is a Product and a pet hotel is a Service. Both are Solutions that satisfy specific Actor needs.

*Domain Constraint/Trend* (D) can be either a dependent or an independent variable. In either case Domain Constraint/Trend stands for a cultural, regulatory (legal), commercial, spiritual, historical phenomena or trend that is inherent to the domain and has an impact on Actors, Subjects and/or Solutions. When design can control the presence and influence of a Domain Constraint/Trend it is considered to a dependent variable. When design cannot control it, or if it is not influenced by other domain parameters or variables, it is considered an independent variable. In the former case, the objective of design may be to increase or decrease the presence and influence of the Domain Constraint/Trend. In the later case, the Domain Constraint/Trend either enforces or inhibits the presence and influence of Solutions, Actors, Needs or Subjects in the domain. For example, in the pet domain the timeless bond between man and animal is a Domain Constraint/Trend.

The *Global Driving Force* (G) independent variable refers to a trend, phenomena or pattern of these in the global environment that has a high impact on the domain system image and at the same time, shows high uncertainty in its future behavior. Typically, driving forces form interrelated webs that evolve over time, with new forces being added and existing ones being replaced or combined. As an independent variable, design cannot control it. It however, has an enforcing or inhibiting influence on design parameters and dependent variables giving them behavior which is used in transforming present briefs into future briefs. For example, the aging of the Western World is a Global Driving Forces that enforces the need to own a pet for companionship as well as for therapeutic reasons.

### *Interactions*

The system model is used to resolve and define the interactions between parameters and variables. The total potential interactions that need to be resolved and defined according to the system model can be divided into present, projecting related and future ones.

The present interactions are:

Actor – Subject
Actor – Need
Actor – Solution
Solution – Need
Solution – Subject
Concept – Actor
Concept – Need
Concept – Subject
Concept – Solution
Domain Constraint/Trend – Actor
Domain Constraint/Trend – Subject
Domain Constraint/Trend – Need
Domain Constraint/Trend – Solution
Domain Constraint/Trend – Concept
Global Driving Force – Actor
Global Driving Force – Subject
Global Driving Force – Need

Global Driving Force – Solution
Global Driving Force – Concept
Global Driving Force – Domain Constraint/Trend
Actor - Actor
Need - Need
Solution - Solution
Subject – Subject
Concept - Concept
Domain Constraint/Trend - Domain Constraint/Trend
Global Driving Force - Global Driving Force

Projection related interactions:

*Future* Global Driving Force – Actor = *Future* Actor
*Future* Global Driving Force – Subject = *Future* Subject
*Future* Global Driving Force – Need = *Future* Need
*Future* Global Driving Force – Solution = *Future* Solution
*Future* Global Driving Force – Concept = *Future* Concept
*Future* Global Driving Force – Domain Constraint/Trend = *Future* Domain Constraint/Trend

Future interactions:

*Future* Actor – *Future* Subject
*Future* Actor – *Future* Need
*Future* Actor – *Future* Solution
*Future* Solution – *Future* Need
*Future* Solution – *Future* Subject
*Future* Concept – *Future* Actor
*Future* Concept – *Future* Need
*Future* Concept – *Future* Subject
*Future* Concept – *Future* Solution
*Future* Domain Constraint/Trend – *Future* Actor
*Future* Domain Constraint/Trend – *Future* Subject
*Future* Domain Constraint/Trend – *Future* Need
*Future* Domain Constraint/Trend – *Future* Solution
*Future* Domain Constraint/Trend – *Future* Concept
*Future* Global Driving Force – *Future* Actor
*Future* Global Driving Force – *Future* Subject
*Future* Global Driving Force – *Future* Need
*Future* Global Driving Force – *Future* Solution
*Future* Global Driving Force – *Future* Concept
*Future* Global Driving Force – *Future* Domain Constraint/Trend
*Future* Actor - *Future* Actor
*Future* Need - *Future* Need
*Future* Solution - *Future* Solution
*Future* Subject - *Future* Subject
*Future* Domain Constraint/Trend - *Future* Domain Constraint/Trend
*Future* Global Driving Force - *Future* Global Driving Force

Because it is a connectionist system the number of interactions that need to be considered grows exponentially with each new parameters or variable added to the system image. Therefore, it is necessary to limit the system image both in terms of the number of parameters and variables used as well as how comprehensively the mutual relationships are defined.

Domain system image complexity is determined by the number of parameters and variables and how interconnected they are. Knowing what is the right level of complexity for comprehensively identifying opportunities is a wicked problem. The best (and only) way to solve this problem is by iteratively building and validating the system image for accuracy and comprehensiveness with the help of domain experts. The iterative process of arriving at the optimal system image is limited by time and space constraints. The time allocated for the Prospect Mapping limits the amount of data that can be collected and subsequently the number of domain parameters and variables that are created. It also limits how many iterations of the map can be made. The physical size of the Prospect Map acts as a natural limit to the system image size.

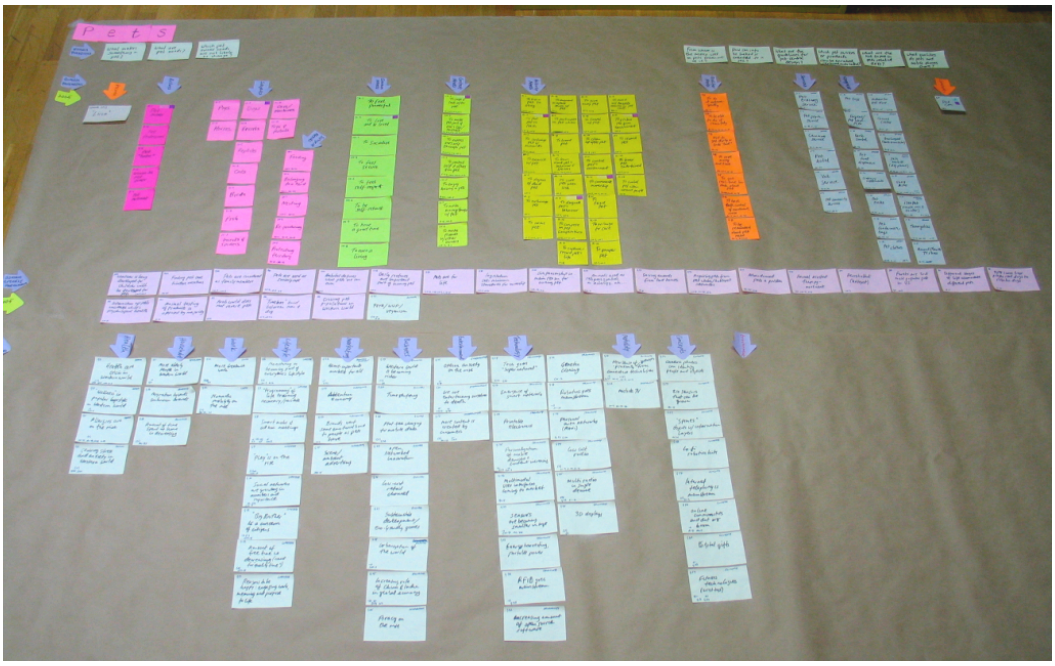
The number and types of relationships that need to be defined is limited by using a two level relationship hierarchy. First level relationships are defined “on the way in” when adding parameters and variables to the Prospect Map. These relationships are simple to identify and easy to define because of their binary nature. The first-level relationships describe ownership and cause-and-effect between parameters and variables. The end result is a comprehensive high-level system image of the present domain.

Second level relationships enable conducting what-if and if-then simulations of domain parameter and variable behavior. Enforces-inhibits relationships are defined “on the way out” when selecting parameters and variables for a design brief. They enable to envision how the problem or opportunity presented by the brief is transformed in the future under the conditions described by future driving forces, associated with the brief. These relationships are more subjective than first level relationships. Often their accuracy can be verified only from a historical perspective. In this way, second level relationships for the whole map are defined one brief at a time, on a need to use basis.

While the scope of a single Prospect Map may be limited, there is no limit to how many dispersed teams can work independently, yet synchronously to create separate Prospect Maps of the domain. In fact, such an approach is recommended because it ensures a breadth of perspectives to the domain. The Prospect Map makes the distributed approach of several different groups synchronously exploring the domain feasible. Diverse domain system images and portfolios based on the same Prospect Map structure and system model can be combined at the end of the Prospect Mapping process. This is a potential tactic for overcoming the scoping limitations and ensuring a sufficiently comprehensive and rich domain system image.

### 4.1.2 Prospect Map Tool

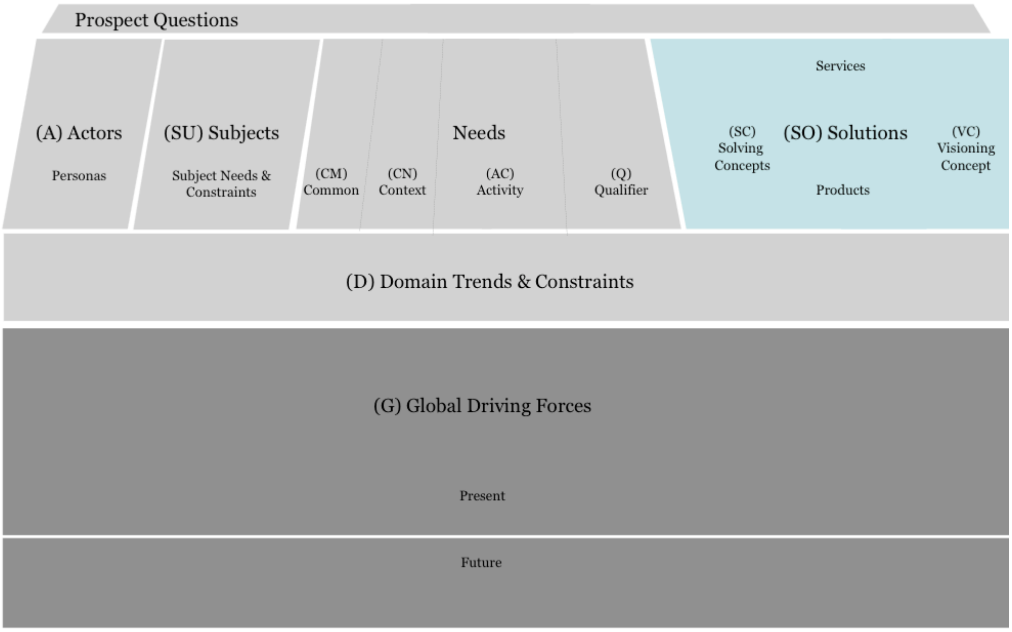
Prospect Map tool supports the systematic externalization and categorization of parameters and variables. The tool is the physical artifact consisting of parameters and variables documented with different colored Post-It notes that are posted onto a large sheet of paper. On the map the parameters and variables form options spaces of elements between which interactions can be resolved and defined. From these option spaces briefs can be systematically composed. Over the course of the Prospect Mapping process, the map evolves from an empty sheet of paper to one filled with Post-Its. In this regard, the map is a visual indicator of how the work is progressing.




**4.3. Prospect Map tool. Photo by author.**

The Prospect Map tool is divided into two overall areas, one for internal domain parameters and variables, and the other for external driving forces. The internal domain area frames the domain and structures it from the point of view of concept design and System Logics. It is divided into Actor, Subject, Subject Needs, Need (hierarchy), and Solution (Products and Services, Solving and Visioning Concepts) parameter categories and an area for Domain Constraints and Trends variables. An area up top may be reserved for domain questions to remind what key aspect of the domain need to be uncovered and displayed on the map.

The external area is for Global Driving Forces. Its contents accumulate over time independently of the domain parameters and variables but still as an integral part of the Prospect Map. Populating this area with independent variables is an important work stream in the Prospect Mapping process. The sub-categories for the Global Driving Forces area are emergent.




**4.4. Prospect Map tool structure. Image by author.**

In summary, the physical Domain Map is the tool for exploring spaces of possibilities. It serves as a collective memory, visual representation of domain knowledge produced in the process and a limiting factor to the number of parameters and variables included in the system image.

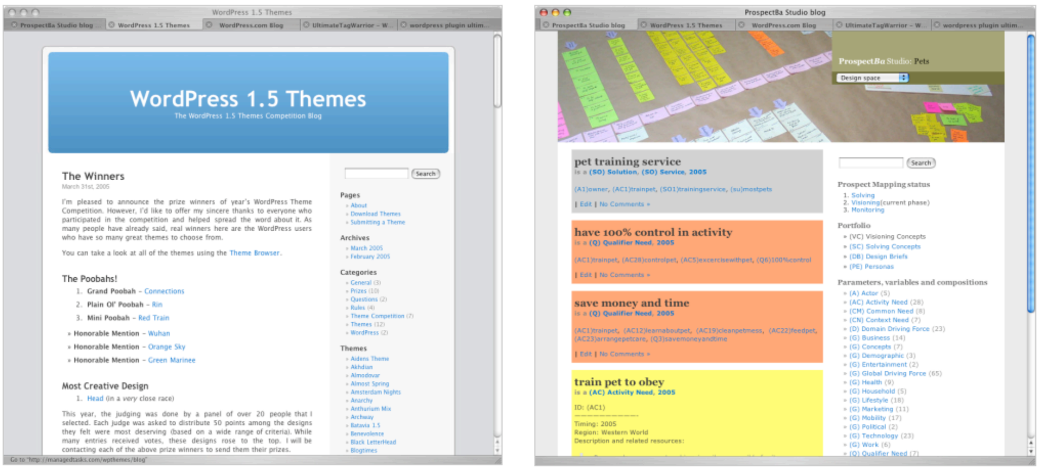
## 4.2 ProspectBa Studio blog

The ProspectBa Studio blog is a tailored WordPress personal publishing system weblog that augments the Prospect Map tool. It is a virtual setting accessible on a network for composing, exploring and visualizing Prospect Map elements and compositions as well as archiving them. The blog also supports distributed collaboration and lowers the threshold to participate in the Prospect Mapping process. A prototype of the PropsectBa Studio blog can be found online at http://www.jokkokorhonen.com/thesis/ProspectMapper/

### 4.2.1 Technical Implementation

The ProspectBa Studio blog is based on version 1.5.2 of the WordPress personal publishing system. The system is built on the PHP programming language and MySQL. PHP is a widely used general-purpose scripting language that is especially suited for Web development and can be embedded into HTML. MySQL is the world's most popular open-source database. Therefore, the technical set-up for the ProspectBa Studio blog requires a web server that supports PHP (version depends on WordPress system version) and offers a MySQL database for storing the blog contents.

The WordPress system is licensed under GPL (General Public Licence). The license is intended to guarantee the freedom to share and change free software. For more on the system and its background see the WordPress website (http://www.wordpress.com). With the freedom afforded by the license the appearance and functionality of the WordPress (v. 1.5.2) system have been modified to make it a suitable tool for Prospect Mapping. The default theme implemented with CSS (Cascading Stylesheets) that controls the appearance of blog pages has been changed to reflect the appearance of the Prospect Map tool. New PHP code has been added to blog templates, which defines the appearance of individual posts based on their categorization.




**4.5. Default WordPress (left) and ProspectBa Studio blog (right). Image by author.**

The WordPress system functionality has been enhanced with the UltimateTagWarrior plug-in. The plug-in has been used to document relationships between Prospect Map elements. It enables tagging posts with keywords, displaying tags as part of posts, displaying of related tags for a specific tag and provides different visualizations to describe tag usage. For more information about the plug-in please see the developer's website at http://www.neato.co.nz/ultimate-tag-warrior/.

### 4.2.2 Information Architecture

The ProspectBa Studio blog has six "public" sections: Design space, Element cloud, Process, Participants, Resources, and About. It uses the WordPress system's site administration "dashboard" for managing and modifying the sections and their contents.

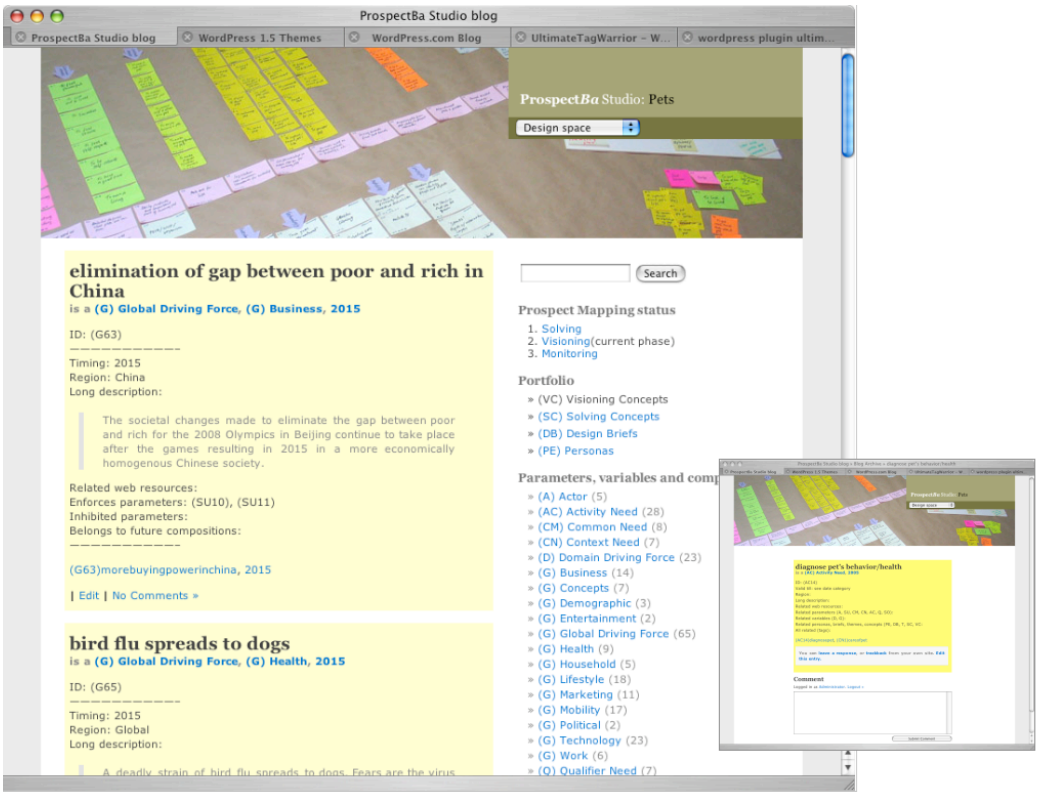
### *Design Space*

The *Design space* section contains the core functionality of the blog. The section offers features for exploring, visualizing and collaborating.

In the Design space section the Prospect Map elements and compositions entered to the blog can be explored in different ways. The blog's main page is the Design space main page. It lists in reverse chronological order the latest content. From here, individual posts or elements can be opened. The blog automatically generates element category archives based on categorized posts. These can be accessed from links in the main page sidebar. Free keyword search is another form of generative exploration. It returns a list of elements and compositions matching search criteria. Prospect Map version history can be tracked from the daily, weekly and monthly element archives. Moreover, the interrelations between elements can be navigated from the tags of associated elements listed at the bottom of an element.

The element posts in the Design space have been designed to look like the Post-It notes on the physical Prospect Map. Elements in both environments adhere to the same color scheme used for element categories. For example, the Actor category parameter in the blog and the physical Actor Post-It on the map share the same background color. Making the visual representations consistent between the physical and virtual elements facilitates switching between the environments. Subsequently, the experience of creating map elements with Post-It notes and using them to compose briefs is consistent in the physical and virtual environments.

Blogs support collaboration inherently. This is also the case with ProspectBa Studio blog whose primary function is to support temporally and spatially distributed Prospect Mapping. The blog serves as a collective memory for the participants. Collaboration and memory are enhanced by the possibility to comment individual Prospect Map elements. Moreover, commenting supports social awareness among collaborators. Collaborative filtering, which augments social awareness of each other's contributions, can be performed in the blog by searching for elements posted by specific participants.




4.6. Design space section. Image by author.

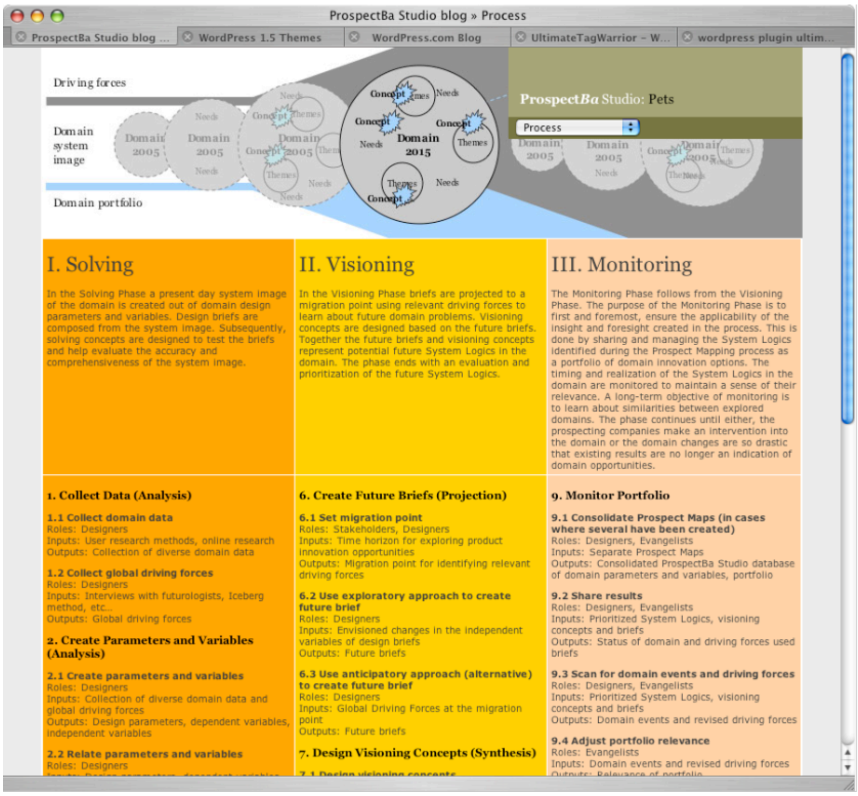
### *Element Cloud*

The element cloud section consists of a single page that visualizes the topology of Prospect Map element connectivity. The page contains a tag cloud generated by the UltimateTagWarrior plug-in that lists the all the tags or elements of the Prospect Map that have been entered to the blog. The most connected elements in other words, in other words the one that have been used to most to tag others, are shown in bigger and darker colored font.


**4.7 Element cloud page. Image by author.**

### *Process*

The *Process* section consists of a single page that gives an overview of the Prospect Mapping process. It lists the steps and tasks in each phase. Each task description enumerates the necessary participants, inputs and outputs. The current status of the process is indicated on the Design space main page, from where it is possible to link directly to the associated task description in the Process section.




**4.8. Process page. Image by author.**

### *Participants*

The *Participants* section contains the profiles of Prospect Mapping participant. The profiles contain background information and contact details to encourage communication between distributed collaborators. In this way the section supports social awareness and establish the foundation for forming common context among participants.

### *Resources*

The *Resources* page contains links to external online resources and tools that support Prospect Mapping. The page includes links to search engines and domain community sites, which are used to collect online domain data. It also contains links to online applications that support creative thinking and visualization.

### *About*

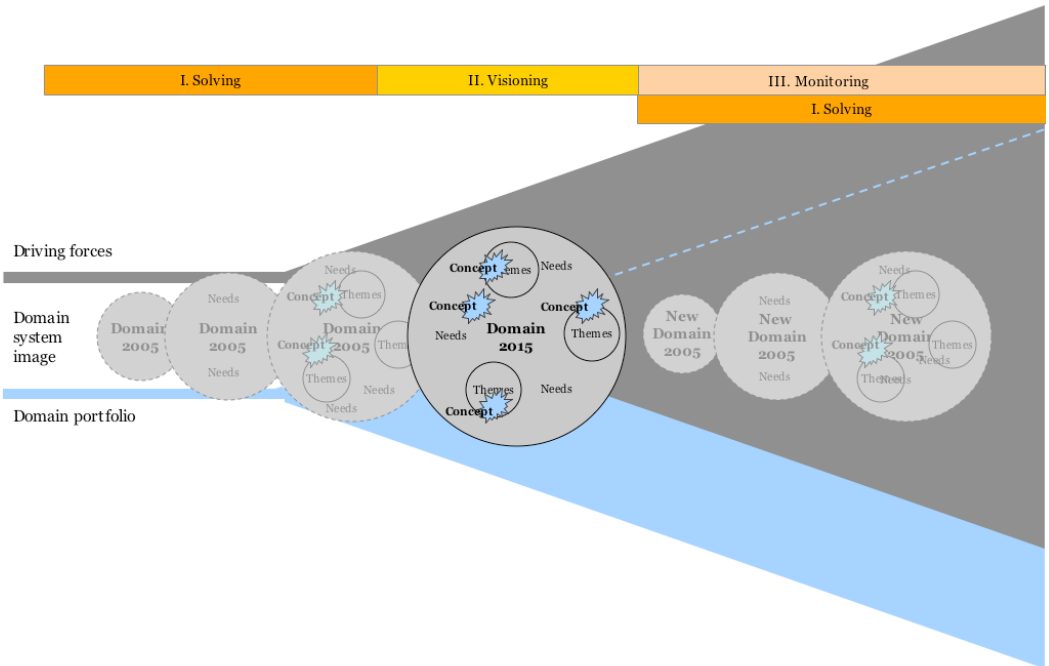
The *About* page provides an overview of the ProspectBa platform for first time users.

### *Site Admin*

From the perspective of regular ProspectBa Studio blog use, the most important feature sets in the *Site admin* section are Write and Manage. The Write feature set is used to post a new parameter, variable, design brief, persona and concept to blog's database. A specific structure or "templates" is used for each of these content types. The templates are described in the Appendix. Tags of related elements are also entered in the Write user interface. The tag notation is also described in the Appendix. The Manage feature set is used to edit and delete posts. Post categories are also created in the Manage section.

## 4.3 Prospect Mapping Process

The Prospect Mapping process is a form of design inquiry and learning that takes the participants on a journey through a domain starting with the present and ending in the future. Through the process answers are sought to questions such as: Who are the domain actors? Who are their subjects? What are their needs? How are they satisfied? What influences or characterizes the domain? What may cause major changes in it? What are those changes? What is their impact on people, needs and solutions? The objective of the journey is to design future System Logics or approaches to actor needs in the domain and systems of solutions to them. The process combines systems thinking, concept design and scenario building into a design-oriented process with the following nine steps: set-up, analysis, synthesis, evaluation, projection, analysis, synthesis, evaluation and ending with ongoing monitoring activity. The steps are combined into four phases: Set-up, Solving, Visioning, and Monitoring. Even with formal phases and steps, the process and its outcomes are emergent and evolutionary.




4.9. Overview of the Prospect Mapping process. Image by author.

The Set-up phase deals with arranging facilities, setting-up infrastructure, recruiting participants and kicking-off the activity. The set-up for the process should always be adapted according to the planned diversity, complexity, openness and duration of the activity.

In the Solving phase, domain data is collected and transformed into parameters and variables for creating a domain system image used in exploring domain problems and for composing concept design briefs. The parameters and variables are externalized to the Prospect Map tool where cause-and-effect and ownership relationships between them are defined. Next, personas and design briefs, or patterns formed by interconnected parameters and variables in the system image, are defined and extracted from the map. The briefs, based on the system model structure, describe contextual problems in the domain. Second level relationships of enforces-inhibits are resolved for the elements in the brief. This makes it possible to transform the brief into a future-oriented brief with relevant driving forces. Solving concepts are designed based on the present briefs. Finally, the concepts are evaluated with the help of domain experts to assess the domain system image's comprehensiveness and accuracy.

The Visioning phase begins with the transformation of present briefs into future briefs. There are two projection-based approaches for this. A brief can be transformed from within, by envisioning the future behavior of the independent variables it includes. Or it can be transformed by adding new future independent variables to it. In both cases second level relationships enable to simulate how all of the other brief's elements change as a result of the driving forces. In this way the brief becomes future-oriented. Consequently, it describes a future domain problem arising from the applied driving forces. Visioning concepts are designed based on the future briefs. The phase concludes with the definition of future System Logics and their evaluation.

The Monitoring phase continues after the Visioning phase. The System Logics definitions, briefs and concepts, created in the previous phases are treated as a portfolio of domain opportunities. The purpose of the Monitoring phase is to ascertain periodically, the attractiveness of this portfolio. It involves monitoring driving forces that the System Logics are conditioned upon as well as other unexpected events that impact the domain.

### 4.3.1 Set-up Phase

The purpose of the Set-up phase is to prepare the Prospect Mapping activity by choosing participants, organizing physical and online facilities and planning the work. The platform set-up depends on the requirements and objectives for the activity. Diversity, complexity, openness and duration are high-level factors influencing set-up. Diversity refers to the heterogeneity of the participants in terms of skills, geography and number. Complexity is determined by the exploration scope, familiarity of participants with the domain and how iterative and adaptive the process needs to be. Openness refers to how easily new participants are able to join, how widely the results are shared and the overall level of confidentiality set for the activity. Finally, duration or length of the activity including the Monitoring Phase affects the set-up as well. The impact of the above factors on the activity is explored in section 6.2.2. Next, the set-up for a Prospect Kosmos type of collaboration lasting several months, involving one core team, two organizations and targeting an unfamiliar domain is described in detail.

***Participants***

Participants can be divided into *insiders* who are responsible for creating the domain system image and designing concepts, and *outsiders* who support and evaluate the work.

Insiders:

> *Designers* – The term “Designers” is used broadly to refer to all the participants whose responsibility it is to collect, relate, create and donate domain insight and foresight. The work involves researching the domain, creating the system image, composing design inputs, projecting the design inputs and designing concepts. The types of specialists that could be selected for this work are designers (industrial, user experience, service, interaction, user interface, etc…), sociologists, anthropologist, technology developers (engineers) and business consultants. Ideally, domain experts are included in the core team. In a cross-organizational collaboration the specialists should come from the participating organizations. For Designer ProspectBa is the mental, physical, social and virtual space within which to create domain knowledge.
>
> *Evangelists* – Evangelists join the process in the Monitor Phase. Their responsibility is to share and monitor the portfolio of future domain options. Monitoring consists of following the driving forces that identified System Logics are conditioned on and flagging domain changes that may potentially have an impact on the portfolio’s attractiveness. Evangelists should come from the New Product Development organization, i.e. not from the Front-End. They should be highly connected people experts at brokering ideas and filtering them for specific audiences. For Evangelists ProspectBa provides a framework for determining the timing of opportunities.

Outsiders:

> *Contributors and Evaluators* – Contributors and Evaluators are domain experts and futurologists. They support the Prospect Mapping process, by providing information about the domain and the global environment. They also give feedback on the system image, design inputs and concepts. There can be several groups of Contributors and Evaluators that participate in a Prospect Mapping process. For these participants ProspectBa offers a comprehensible framework

for understanding how Designers perceive the domain and a language for giving feedback.

*Stakeholders* – Stakeholders are the business managers and directors, who will use the results of the work to make strategic decisions concerning the future of the company. In collaborations with universities, they may include research department heads or leading researchers. Stakeholders are often fund the activity. The value of ProspectBa for this group is that it provides insight and foresight for strategic decision-making.

*IT Support* – IT experts are needed to set up the ProspectBa Studio and administer user rights.

***Physical and Online Facilities***

ProspectBa has a physical dimension and a virtual dimension to it. The physical dimension is the space in which the physical Prospect Map resides. It is the place to which the participants convene from time to time to work with a physical Prospect Map. The ProspectBa Studio blog, is the virtual dimension of Prospect Mapping, that is used for storing and commenting Prospect Map contents, personas, briefs and concepts. The blog is accessed with a web browser.

Set-up for physical space:

- Open walled space (room)
- Large brown paper as the background for the Prospect Map
- Post-It notes of various colors for recoding parameters and variables
- Pens for writing and drawing
- Paper or cardboard boards for posting Post-Its

Set-up for ProspectBa Studio blog:

- Tailored WordPress personal publishing system (see section 4.2.)
- Web server providing PHP and MySQL

More than one blog is needed when more than one Prospect Map tool is created simultaneously and if the blog is not accessible by all participants. However, using more than one blog leads to synchronization issues.

***Work Flow***

The physical Prospect Map tool is the main mediating artifact in the Prospect Mapping process. It is the frame for the domain system image, keeping the process manageable in terms of the number of parameters and variables that are worked with. It provides a visual overview of the domain system image and is an indicator for how the work is progressing. Hence, in the hybrid Prospect Mapping process, all manipulations of the system image should be performed first with the Prospect Map tool and then archived or duplicated in the ProspectBa Studio blog.

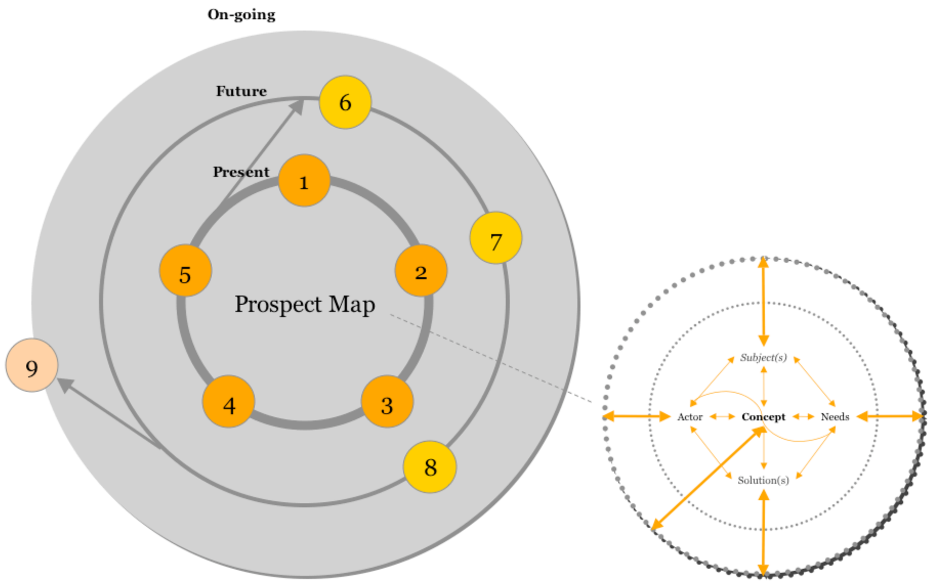
### *Kick-off Workshop*

The Prospect Mapping process is kicked-off with a workshop to all participating Designers, Evangelists, Evaluators and Contributors and Stakeholders are invited. The objectives of the workshop are to name the domain that will be explored, explain the Prospect Mapping method, show how to use the Prospect Map and ProspectBa Studio blog, define responsibilities for Designers, Evaluators and Contributors and set the work schedule. A project plan should be written up to summarize the aforementioned issues. If a domain has not been already been selected, one should be selected in the workshop. Guidelines for how to do this are not in the scope of this thesis; they could be the focus of future work.

## 4.3.2 I. Solving Phase

In the Solving phase a present day system image of the domain is created out of domain design parameters and variables. Design briefs are composed from the system image. Subsequently, solving concepts are designed to test the briefs and help evaluate the accuracy and comprehensiveness of the system image.

| I. Solving | | | | | II. Visioning | | | III. Monitoring |
|---|---|---|---|---|---|---|---|---|
| 1. Collect data | 2. Create parameters & variables | 3. Compose design inputs | 4. Design solving concepts | 5. Evaluate impact of concepts | 6. Create future briefs | 7. Design visioning concepts | 8. Assess domain opportunity | 9. Monitor & manage domain portfolio |




**4.10. Prospect Mapping process tasks. Image by author.**

### ***1. Collect Data (Analysis)***

| | |
|---|---|
| 1.1 | Collect domain data |
| 1.2 | Collect global driving forces |

#### *1.1 Collect domain data*

Roles: Designers
Inputs: User research methods, online research
Outputs: Collection of diverse domain data

The Prospect Mapping process begins with the core team "immersing" itself into the domain to learn and collect as much data about it as it can in a given time frame. The designers should research customers, products and services, marketing, industries and legislation in the domain. Conducting ethnographic interviews with domain experts, attending conferences and events, and purchasing domain goods and services are excellent sources of domain data.

When collecting domain data, its format is not important. Data can be in form of observations, reports, benchmarked solutions, interviews, and market reports. Data found on the Web should be entered into the ProspectBa Studio blog including the links to the original sources. Ideally, a summary of the non-electronic data is entered into the blog. In this way all raw data from which parameters and variables are created is archived in one place online.


**4.11. Pet domain data. Image by author.**

The amount of data that should be collected depends on how familiar the domain is to the core team as well as how much time is allocated for this step. Experienced designers have a good sense of how much data is sufficient. Data can be collected and integrated through out the process; this is one of the benefits of the Prospect Mapping methods.

*1.2 Collect global driving forces*

Roles: Designers
Inputs: Interviews with futurologists, Iceberg method, etc…
Outputs: Global driving forces

The identification of global driving forces also starts in this step. Section 2.3.3 presents methods for how to identify and categorize driving forces. As with parameters, the number of driving forces that should be collected is limited by time and space constraints. The number is also affected the number and proficiency of sources for driving forces. At the beginning of the process it’s difficult to tell if the driving forces are relevant to the domain. Again, the key is to do this iteratively.

***2. Create Parameters and Variables (Analysis)***

| |
|---|
| 2.1 Create parameters and variables |
| 2.2 Relate parameters and variables |

*2.1 Create parameters and variables*

Roles: Designers
Inputs: Collection of diverse domain data and global driving forces
Outputs: Design parameters, dependent variables, independent variables

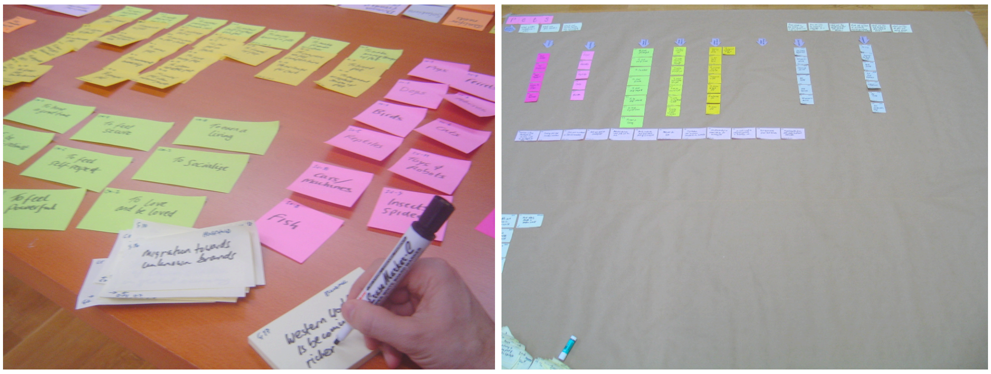
In this step the collected domain data is analyzed and structured with the Prospect Map system model to create design parameters and variables. The work should begin with Solution (products and services) and Activity Need (tasks people perform) parameters. They are usually the most prominent and self-explanatory phenomena in a domain and therefore easy to define for someone who is unfamiliar with the domain.

Benchmarking existing solutions makes it relatively easy to define Actor, Subject and Need parameters in the domain. Activity Needs are also a good starting point because they can be observed through ethnographic research, in which domain Actors are shadowed as they go about their daily lives. Identified Activity Needs can be abstracted into higher-level Context and Common Needs or detailed Qualifier Needs can be deducted for them.


**4.12. Color-code scheme for parameters and variables. Photo by author.**

Parameters and variables are documented with Post-It notes. A color-coding scheme should be used to visually distinguish the different categories. The same scheme should also be used in the ProspectBa Studio blog, where virtual versions of the Post-Its are stored. The element description, written on the Post-It and in the blog, should be legible.

Preferably the description is phrase, which outsiders are able to understand. Moreover, each parameter/variable should be given a unique identifier consisting of a category identifier and a serial number.



**4.13. Author creating parameters and variables. Photo by author.**

*2.2 Relate parameters and variables*

Roles: Designers
Inputs: Design parameters, dependent variables, independent variables
Outputs: First level relationships between parameters and variables

After a parameter/variable has been created the first level relationship of cause-and-effect or ownership that it has with others need to be recorded before it is added to the Prospect Map. Identifying relationships is a mechanical process where the parameter/variable is compared to others on the map. This can be also done in the blog where it is easier to browse the elements. The identified relationships are recorded as metadata onto the parameter/variable Post-It or blog entry by marking the identifiers of related parameters. The relationship type should be marked only in the blog. As new elements are added to the map, the metadata on the Post-Its and in the blog needs to be updated to reflect new relationships.

***3. Compose Design Inputs (Synthesis)***

3.1 Compose persona
3.2 Compose design brief
3.3 Evaluate composed design inputs

*3.1 Compose persona*

Roles: Designers
Inputs: Design parameters
Outputs: Persona sheets or boards

A persona is person description of a stereotypical domain target end-users for products and services. In Prospect Mapping, a persona is composed from an Actor parameter, related Subject(s), related Common Need(s), and related Context and Activity Needs. Composing a persona begins by selecting a Common Need or an Actor parameter and subsequently, all related Subject, Context Needs and Activity Needs.

Documenting a persona entails duplicating the selected parameter Post-Its and posting them onto a separate piece of paper or a board. In this way the persona composition can be referred to later. In the ProspectBa Studio, a persona is a new blog post that lists the parameters, which describe the persona.

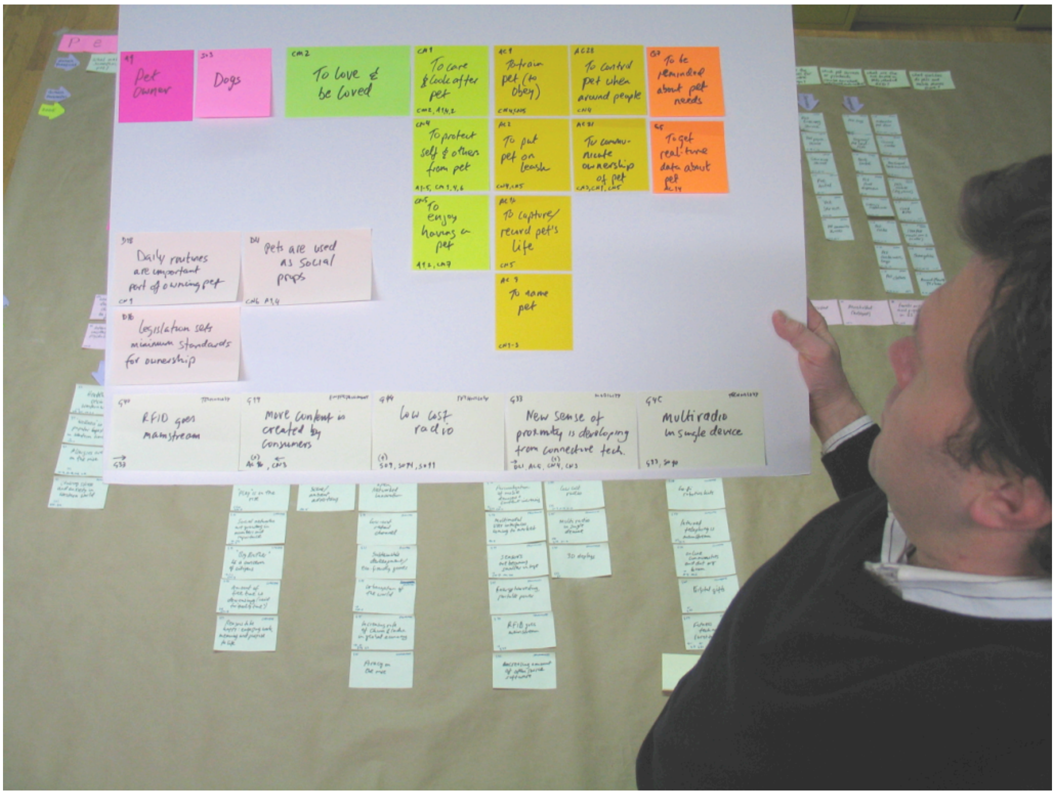
*3.2 Compose design brief*

> Roles: Designers
> Inputs: Design parameters, dependent variables and independent variables
> Outputs: Brief sheets or boards

A brief identifies a problem in the domain that can be solved with concept design. From the perspective of the domain system image, problems are system patterns describing contextual needs in the domain. A hypothetical problem or system pattern can also be composed from the Prospect Map elements to encourage out-of-box thinking. The extracted or composed problem pattern should consist of elements from each Prospect Map category. Hence, the brief duplicating the pattern and the system image share the same structure; in other words a brief is a fractal image of the system image.

A brief is composed in the same way as a persona, by selecting Actor and related Need parameters. Next, Solution parameters are added to the mix. The brief is completed with Domain Constraints/Trends and Global Driving Forces that enforce, inhibit or cause each of the selected parameters. In some cases, the relevant independent variables might be missing from the map and should be added to it. Identifying and documenting the second level relationships of enforces-inhibits that parameters have with variables makes it possible to project the brief into the future.

When composing a brief from the map elements, the selection of parameters is key because it determines the degree to which the brief reflects the real domain as well as the brief’s scope. A brief can reflect a known problem in the domain, but it can also reflect a hypothetical problem. Composing a known problem means selecting parameters and variables that are related to each other. Here consulting domain experts can be helpful. A more hypothetical brief consists of parameters and variables that are not all related to each other. In this sense the brief does not have a basis in “observed” domain reality. The purpose of such briefs is to get designers to abandon common notions and to make unexpected connections that may lead to new ways of thinking about the domain. The scope and reusability of a brief is determined by which Needs are included as part of it. Including a full hierarchy of needs starting with Common Needs and ending with related Qualifier Needs means the brief can be used recursively to design a system of solutions. When only Activity Needs and Qualifier Needs are included, the concept design focuses on single products or services.




**4.14. Design brief. Photo by author.**

Documenting a brief is done in the same way as with a persona, by duplicating map elements and posting them onto a separate piece of paper. The second level relationships for each element in the brief needs to be marked onto them as metadata. The same metadata should be added to the original elements still on the Prospect Map. In this way the second level relationships for the Prospect Map parameters and variables are defined one brief at a time.

*3.3 Evaluate composed design inputs*

> Roles: Contributors and Evaluators, Stakeholders
> Inputs: Briefs, personas
> Outputs: Prioritized briefs, personas

At this point Contributors and Evaluators should be invited to evaluate the personas and briefs. Based on their feedback these inputs can be prioritized and their relevance improved. Additionally, the feedback should be used to improve the overall Prospect Map system image.

### *4. Design Solving Concepts (Synthesis)*

| |
|---|
| 4.1 Design solving concepts<br>4.2 Document concepts<br>4.3 Use external concept to validate Prospect Map |

#### *4.1 Design solving concepts*

Roles: Designers
Inputs: Prioritized briefs and personas
Outputs: Solving concepts

Solving concepts have two functions. They are needed to define present day domain System Logics, which are combinations of needs (briefs) and solutions (concepts). Moreover, solving concepts are needed to evaluate briefs and the Prospect Map system image. It's important to note, that solving concepts should not be used to convince stakeholders of domain opportunities at this point in the process. The number of solving concepts that should be designed depends on the number and scope of briefs created in the previous step. Having said that, it is also possible to skip this step, since the ultimate objective is to define future System Logics, and solving concepts are not a pre-requisite to be able to do this.

There are several factors to consider when designing solving concepts. First, the effect of independent variables should be minimized. If a concept is not impacted by future driving forces, it can be said to be future proof. Such "classic" concepts are the most interesting from the perspective of product innovation because they address universal and fundamental needs in the domain that do not change over time. Second, the fit between concept and existing solutions should be noted. When the solving concept and an existing Solution answer the same Common and Context Needs they can be said to belong to the same product family. If they share the same Activity Needs they can be said to be competing with each other. A third and final guideline for concept design is that the concept descriptions should be left at an abstract level, in the form of text, high-level diagrams and sketches. The more abstract the concept description the more basic and flexible its appraisal can be. Moreover, designing and describing detailed concepts takes a lot or time and effort, which should not be expanded at this point.

#### *4.2 Document concepts*

Roles: Designers
Inputs: Solving concept ideas

Outputs: Solving concept boards

Text descriptions, sketches and diagrams are sufficient to document a concept. The documentation should make reference to the original brief and through it to the parameters and variables on the Prospect Map. By basing the concept on the design inputs composed from the Prospect Map the designer ensures that others in the core team are able to understand its background and determine its domain fit.

Documenting a concept is done by taking the brief board created in step 3.2 and adding to it the concept sketches and text description. The resulting concept board encapsulates the needs and the solution to them, forming a definition of System Logics in the domain. A similar combinatorial approach should be taken when documenting the concept into the ProspectBa Studio blog. Finally, a Solution parameter should be created out of the concept and mapped to the Solution area of the Prospect Map.


**4.15. Concept "board". Photo by author.**

*4.3 Use external concept to validate Prospect Map*

Roles: Designers
Inputs: External concepts

Outputs: Iterated Prospect Map

Solving concepts can also be designed independently and externally from the Prospect Mapping process, without using Prospect Map parameters and variables. In fact, at times designing concepts in this way is a means of objectively evaluating the comprehensiveness and accuracy of the Prospect Map system image. Moreover, concepts created outside the Prospect Mapping context are an alternative way of collecting domain data and defining domain parameters and variables.

### *5. Evaluate Impact of Concepts*

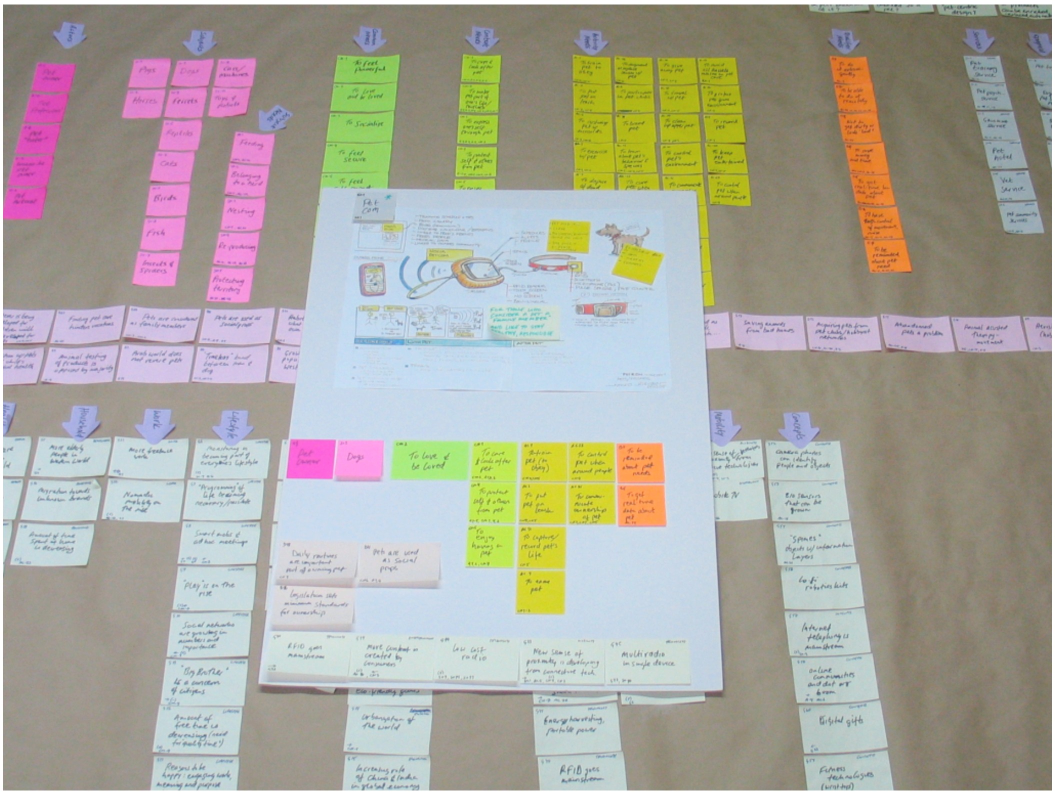
| 5.1 Evaluate concept's impact on domain |
|---|

*5.1 Evaluate concept's impact on domain*

Roles: Contributors and Evaluators, Designers
Inputs: Solving concepts, briefs, System Logics definitions
Outputs: Iterated Prospect Map, prioritized briefs and solving concepts

At this point in the process the Prospect Map system image, briefs and solving concepts need to be evaluated once more. This is important to do to ensure that they are adequately accurate and comprehensive for projecting into the future. Evaluators and Contributors are invited to come and help with this task.

Evaluators should be asked to follow agreed upon heuristics when evaluating because it facilitates comparing the results and unifies the evaluation scope. Different evaluation heuristics can be applied as long as they are used consistently. One approach is to examine the concept in terms of desirability, viability and feasibility. Desirability refers to how much domain Actors would like to use the concept. Viability refers to whether or not money can be made by selling or offering the concept as a service. The importance of needs addressed by the concept and the success of existing solutions it competes against are good indicators of viability. Finally, feasibility refers to how known the technology needed to implement the concept is. McLuhan's tetrad for understanding media is another potential evaluation approach. The tetrad asks the four questions: What does the concept borrow? What does it displace? What does it make possible? How is it perverted? It is a good way of assessing the uniqueness of the concept in relation to present domain products and services. Based on these evaluations briefs and concepts can be ranked in terms of desirability and originality. The evaluations also inform the team how representative the Prospect Map system image is of the actual domain. If Evaluators feel that the concepts are not relevant, more domain data should be collected and the system image should be iterated.



**4.16. Outcomes of the Solving phase. Photo by author.**

This step completes the Solving phase. It may be necessary to iterate the steps 1-4 either as one big cycle or make smaller iterations between subsequent steps to arrive at a satisfactory domain system image and a representative collection of personas, briefs and concepts.

### 4.3.3 II. Visioning Phase

In the Visioning phase briefs are projected to a migration point using relevant driving forces to learn about future domain problems. Visioning concepts are designed based on the future briefs. Together the future briefs and visioning concepts represent potential future System Logics in the domain. The phase ends with an evaluation and prioritization of the future System Logics.

#### *6. Create Future Briefs (Projection)*

| |
|---|
| 6.1 Set migration point |
| 6.2 Use exploratory approach to create future brief |
| 6.3 Use anticipatory approach (alternative) to create future brief |

*6.1 Set migration point*

Roles: Stakeholders, Designers
Inputs: Time horizon for exploring product innovation opportunities

Outputs: Migration point for identifying relevant driving forces

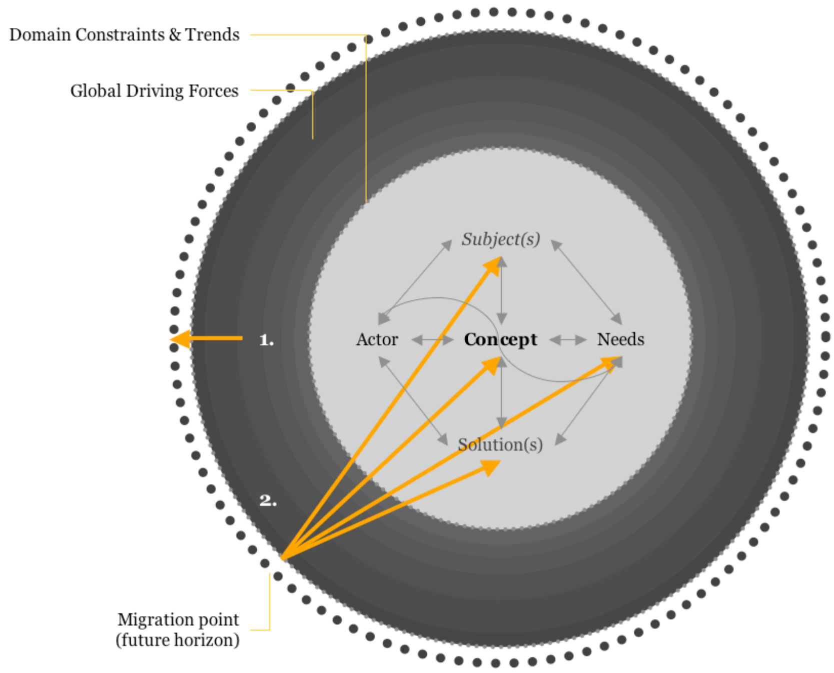
Creating future briefs requires conducting what-if and if-then simulations with the brief's elements. First, however, a time horizon for the simulated future changes needs to be set. The time horizon should be set beyond the typical product cycles of the company. From the perspective of Prospect Mapping, the time horizon becomes the "migration point" to which the briefs, are projected.

After the migration point has been set, there are two approaches to creating future briefs: *Exploratory* and *Anticipatory*. Both approaches are based on simulating the impact of future driving forces on parameters in present briefs.

*6.2 Use exploratory approach to create future brief*

Roles: Designers
Inputs: Envisioned changes in independent variables included in the brief
Outputs: Future brief

In the *Exploratory* approach, a design brief composed in step 3, is projected into the future by changing it from within. First the Domain Constraints/Trends and Global Driving Forces in the brief are projected to the migration point by extrapolating past and present trends associated with or represented by them. Next, the impact of the changed variables is assessed and then reflected to the parameters that they either enforce or inhibit. These second level relationships were defined in step 3. As a result of the impact the affected parameters may need to be replaced, or new ones may need to be added to brief. In this way the present problem described by the brief is transformed into a future problem description. The metadata on the remaining parameters and variables should be updated to reflect new first and second level relationships between the changed independent variables and any new parameters.



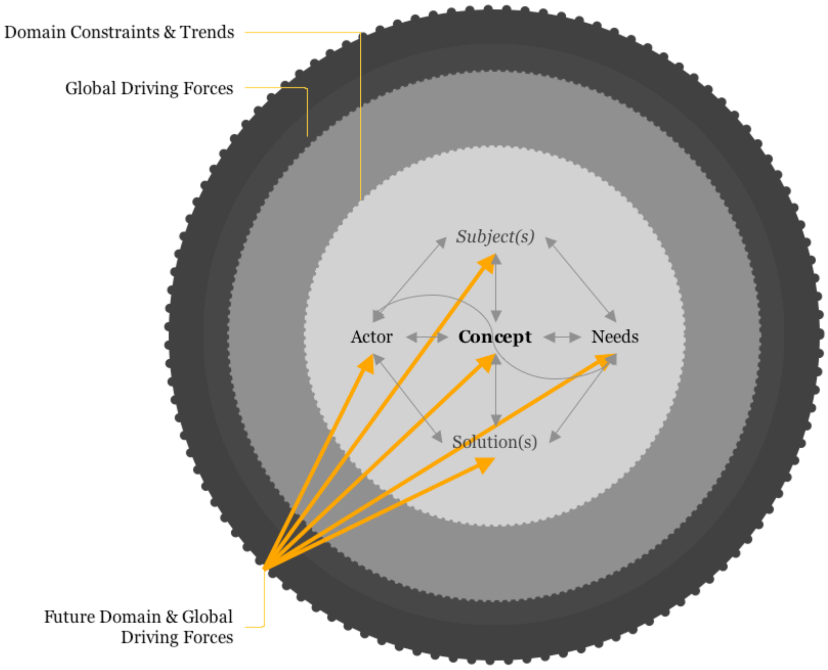

**4.17. Exploratory approach. Image by author.**

*6.3 Use anticipatory approach to create future brief*

Roles: Designers
Inputs: Global Driving Forces at the migration point
Outputs: Future brief

In the *Anticipatory* approach new Global Driving Forces influencing the domain at the migration point are identified or imagined. Their impact on present briefs is envisioned by assessing if they enforce, or inhibit the parameters in the briefs.

The main difference between the approaches is that the Anticipatory approach assumes new driving forces, not present in the current system image, will influence the domain in the future. The approach is particularly suitable if domain specific or universal scenarios describing the domain at the migration point are available or can be commissioned from futurologists. The Anticipatory approach also enables creating new future briefs from scratch. Taking the identified new driving forces as the starting point, related parameters can be selected from the Prospect Map to form a future design brief.




**4.18. Anticipatory approach. Image by author.**

In both approaches, changes made to briefs should be also made to the Prospect Map and ProspectBa Studio blog posts. In this way the domain system image becomes future-oriented one future brief at a time.

### *7. Design Visioning Concepts (Synthesis)*

| |
|---|
| 7.1 Design visioning concepts<br>7.2 Document concepts<br>7.3 Define future System Logics |

#### *7.1 Design visioning concepts*

Roles: Designers
Inputs: Future briefs
Outputs: Visioning concepts

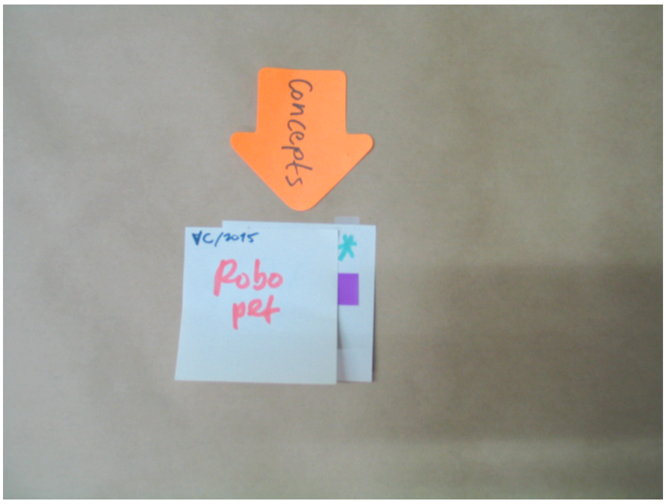
Identifying potential future System Logics in the domain requires designing visioning concepts. The role of visioning concepts is to solve the future problems identified with future briefs. The future brief and visioning concept, illustrate future customer needs in the domain that could be targeted and how those needs are met with product (service) innovations.


**4.19. Future brief. Photo by author.**

### *7.2 Document concepts*

Roles: Designers
Inputs: Visioning concept ideas
Outputs: Visioning concept boards

Visioning concepts are representative of all that has been learned about the domain along the Prospect Mapping "journey". Therefore, visioning concepts should be designed and documented in more detail than solving concepts. The documentation should include a reference to the future brief that informs and inspires the concept, so that outsiders can at a later time return to the rationale behind it.




**4.20. Visioning concept mapped to Prospect Map. Photo by author.**

*7.3 Define future System Logics*

Roles: Designers
Inputs: Future briefs and related visioning concepts
Outputs: Future System Logics

Finally, having produced future briefs and related visioning concepts, future System Logics can be defined. A future brief and the visioning concepts, if there are more than one, that have been designed based on it, are combined into one “document”. This document describes what are the future needs in the domain and the systems of solutions to them.


**4.21. Future System Logics definition. Photo by author.**

***8. Assess Opportunity (Evaluation)***

| |
|---|
| 8.1 Evaluate System Logics |

*8.1 Evaluate System Logics*

Roles: Contributors and Evaluators, Designers
Inputs: Future briefs and related visioning concepts, future System Logics descriptions
Outputs: Prioritized System Logics, visioning concepts and briefs

Up till this point the Prospect Mapping process has yielded a wealth of knowledge about the domain in the form of parameters, variables, questions, personas, briefs, themes, solving concepts, visioning concepts and System Logics definitions. Along the way a number of decision have been made regarding what are important problems in the domain, how they should be solved and what factors will transform them in the future. The decisions have been made in stages and often relying on trial and error and feedback from domain experts. In this step, the experimental decision-making process concludes with the decision on what are the most potential product innovation opportunities or System Logics in the domain. It's important to remember that one possible conclusion is that the there are no potential future System Logics in the domain.

In general, potential System Logics (combinations of briefs and concepts) are comprehensive, desirable, deviant, and stable. The comprehensiveness of the System Logics approach can be assessed from the brief, which specifies domain needs and their levels. The System Logics is comprehensive if it includes all four levels of needs from Common to Qualifier. Deviation can be assessed by comparing existing solutions and concepts in terms of structure, functionality and needs. The System Logics is deviant if the approach to satisfy the needs is unique to the domain. Stability or how constant the System Logics remains in the future, can be assessed by comparing current briefs with future briefs and solving concepts with visioning concepts. It's stable if the approach to needs and how they are satisfied does not change significantly in spite of future changes in the domain. These comparisons give further insight into the magnitude of domain dynamics resulting from specific driving forces. Finally, Evaluators and Stakeholders should once again participate, this time to evaluate the desirability of visioning concepts. From these analyses and evaluations it should be possible to rank the different System Logics in terms of their potential. The results should be documented to the ProspectBa Studio blog. As a final task, feedback on the overall process and the results should be collected from Stakeholders, Evangelists, Evaluators and Contributors.

### 4.3.4 III. Monitoring Phase

The Monitoring phase follows the Visioning phase. The purpose of the Monitoring phase is to first and foremost, ensure the applicability of the insight and foresight created in the process. First, the results of the process are shared. Then the defined future System

Logics are treated as a portfolio of domain innovation options, which is regularly monitored to maintain a sense of their relevance. A long-term objective in monitoring is to learn about similarities between explored domains. The phase continues until either, the prospecting company makes an intervention into the domain or the domain changes so drastically that the defined future System Logics are no longer an indication of domain opportunities.

***9. Monitor Portfolio***

9.1 Consolidate Prospect Maps (in cases where several have been created)
9.2 Share results
9.3 Scan for domain events and driving forces
9.4 Adjust portfolio relevance
9.5 Scan for general opportunities

*9.1 Consolidate Prospect Maps*

Roles: Designers, Evangelists
Inputs: ProspectBa Studio blogs
Outputs: Consolidated ProspectBa Studio blog databases

In the case of several separate teams participating in the Prospect Mapping process, each creating its own Prospect Map, the first step in the Monitoring phase is to consolidate all the Prospect Maps and portfolios produced by the teams. This is done only with the databases of the different ProspectBa Studio blogs that have been used by each team (if different databases have been used by each team). It involves combining the databases into a single database containing all the outcomes of the process.

*9.2 Share results*

Roles: Designers, Evangelists
Inputs: Prioritized System Logics, visioning concepts and future briefs
Outputs: Awareness of results, use of the materials

Once potential future System Logics in the domain have been prioritized, Evangelists takeover and begin sharing the results with relevant parties. Evangelists should initially share the results with stakeholders. In this as well as all the sharing, the ProspectBa Studio blog plays an important role. From it outsiders are able to browse the parameters and variables, review the briefs and read about the concepts. In the portfolio section they are able to rate the System Logics, or combinations of briefs and concepts.

The applicability of the deliverables and results is high. All the materials function as domain related pre-design material for Concept and Industrial Designers. They can use the materials a sounding board for concepts they are currently working on. Product

Managers benefit the most from the System Logics descriptions, which enable them to envision how the identified opportunities fit with current roadmaps. From visioning concepts developers are able to envision what kinds of future changes might be needed to the technology platform. Directors use the material to make strategic-decisions about the company's involvement in the domain. They are interested in the System Logics as indicators of new strategies and in the system image and connected driving forces, which describe domain dynamics.

*9.3 Scan for domain events and driving forces*

Roles: Designers, Evangelists
Inputs: Prioritized System Logics, visioning concepts and briefs
Outputs: Domain events and revised driving forces

After sharing the System Logics with Stakeholders and other relevant parties, the activity shifts to the periodic monitoring of their timing and realization. The System Logics are conditioned on the existence and timing of a specific configuration of domain parameters and independent variables (driving forces) and concepts. If any of these components change, or the timing of the driving forces changes, the System Logics will mostly likely also change. Hence, the System Logics need to be monitored to learn if emergent changes in the domain or in driving forces enforce or inhibit them. Monitoring should focus primarily on the independent variables in the future brief, since they are the most uncertain component of the System Logics. Unexpected events in the domain should also be recorded as part of monitoring.

The first step in monitoring is to define keywords to describe the driving forces that are of interest. The keywords can then be used to search the Internet and other sources for any matching information. Setting-up automated routine searches for the keywords can be done relatively easily with current online news services and RSS (Real Simple Syndication) readers.

*9.4 Adjust portfolio relevance*

Roles: Evangelists
Inputs: Domain events and revised driving forces
Outputs: Relevance of portfolio

When changes in brief related independent variables are observed, they should be updated to the briefs and the Prospect Map. The impact of the revised driving forces on the related briefs should be determined and simulated following the same cross-impact analysis that was used to project the brief into the future. The revised driving forces may enforce the needs identified in the brief, raising the potential of the overall System

Logics that the brief is a part of. The opposite may also occur. In this way, the overall value domain portfolio of options (System Logics, design compositions and concepts) is revised to reflect the current environment.

### *9.5 Scan for general opportunities*

Roles: Designers, Evangelists
Inputs: Domain portfolios
Outputs: General solution patterns, solution language

The value of domain portfolios as a source of product innovation knowledge increases with each new explored domain. The uniform format and structure of the different domain System Logics defined with the ProspectBa platform makes it easy to compare System Logics, briefs, personas, themes, design drivers and concepts between domains. For example, the domain portfolios can be mined for similar System Logics. The comparison can happen on the level of needs or concept or both. If similar System Logics are found, this can be seen as an opportunity to develop product strategies that span domains and markets. Moreover, comparing the driving forces in domains makes it easier to ascertain their timing and the scope of their impact.

# 5 Discussion and Future Work

## 5.1 Recapitulating the Work

In the Front-End of product development exploring future innovation opportunities in unfamiliar domains is the ultimate form of experimentation. Seeking new opportunities beyond core competencies is necessary because at its best is can produce new ideas, new tools, and import new knowledge from outside the organization. According to Leonard-Barton (1995) experimentation ensures the current core-capabilities of the company will not turn into future rigidities, impeding capitalization of new opportunities arising from unanticipated transformations in the operating environment. The ProspectBa platform has been designed to support experimentation; more precisely, the collaborative exploration of future product (and service) innovation opportunities. Components of the platform are the Prospect Mapping design-oriented method, Prospect Map domain system model and tool, and the online ProspectBa Studio blog. Together they enable creating, sharing and reusing insight and foresight about future innovation opportunities in a domain. The platform solves three overall problems: the methodological problem of creating knowledge about future innovation opportunities; the design collaboration problem of supporting emergent common understanding of opportunities among collaborators; and the problem of applying the new knowledge in the product development organization. Ultimately, the platform is a step towards enabling the product innovation Front-End to function as a complex adaptive system.

### 5.1.1 Identifying Future Innovation Opportunities in a Domain

**Research question 1: How can future innovation opportunities be identified in any chosen domain?**

In the ICT industry, characterized by migration of systems, focus in product innovation has shifted from creating optimal solutions to scanning future opportunities. The opportunities arise from four forces: technology push, market requirements and needs, clear market demand or pull, and latent market demand. As a result, scanning for future opportunities requires exploring possibilities for applying old and new technology (technology push) and probing for future needs or problems (latent market demand). The ProspectBa platform supports both tasks. It tames the wicked problem of future needs by enabling the systematic exploration of future domain opportunities.

Systematic methods typically separate creative thinking and logical analysis by externalizing design inputs and providing analysis frameworks. In doing so they reduce design errors and enable more imaginative and advanced designs (Cross, 1984). In the

Prospect Mapping method, the Prospect Map system model is used to transform domain data into parameters and variables, which are subsequently, externalized to the physical Prospect Map and archived to the ProspectBa Studio blog. The Actor, Subject, Need and Solution parameters and Domain Constraints/Trends and Global Driving Forces variables are the lowest level problem factors in a domain. The need parameter in the system model is further divided into Common Needs, Context Needs, Activity Needs and Qualifier Needs following the System Logic framework. The framework connects needs with different levels of product innovations from new features, to product and product families consequently, facilitating the communication and categorization of these opportunities (Patnaik, 2004). In all the elements of the system model form the vocabulary for describing opportunities in the domain from the point-of-view of an actor, in terms of needs, related solutions and the overall context as well as their potential dynamics.

The first step in exploring opportunities in Prospect Mapping is to resolve and define mutual and contextual relations between the externalized parameters and variables on the Prospect Map. The interconnections, in terms of cause-and-effect and ownership, give additional meaning to each element, setting the conditions for the subsequent emergent and evolutionary exploration process. The interconnected parameters and variables form a domain system image, which evolves as new elements are added to it. Exploration of opportunities involves identifying and extracting patterns of related elements in the system image describing actor and subject needs and their context. Patterns can also be created from unrelated elements. In either case, the system image patterns are used as design briefs for concept design. By varying the combinations of elements in the briefs, including levels of needs, and their internal mutual relations, it's possible to systematically explore different level domain opportunities, either known or hypothetical, with different sensitivities to domain dynamics and the global environment.

The briefs are the basis for the prospecting/projecting approach taken by platform to taming the wicked problem of future domain opportunities. There two ways in which domain briefs can be projected to a future migration point. In the exploratory approach the brief's internal variables, Domain Constraints/Trends and Global Driving Forces, are transformed into future variables by extrapolating their own past or present trends into the future. Next, parameters in the brief are adjusted to reflect the future variables' impact on them. In the anticipatory approach, external future Global Driving Forces are envisioned and then added to the brief. After new mutual relations have been resolved the parameters and variables are adjusted. In both cases, the present brief is transformed into a future brief. By systematically varying the driving forces used for projecting the brief as well as their "impact" on its present parameters and variables, alternative future briefs can be generated effortlessly. Visioning concepts are designed based on the briefs. Finally, both future briefs and future concepts are evaluated with domain experts and stakeholders. In this way, foresight about innovation opportunities can be created with the ProspectBa platform.

### 5.1.2 Supporting Emergent Common Understanding of Innovation Opportunities in Innovation Networks

**Research question 2: How can emergent common understanding of domain opportunities be supported in a diverse innovation network?**

With the increasing complexity of innovating products and services for global saturated markets has come an explosion of R&D forms. Establishing innovation networks involving external parties ranging from academia, to independent labs and other industry players, has become an innovation best practice. The diversity of participants ensures a richness of perspectives to the innovation problem and creates a wealth of new knowledge for the company. However, it also brings the challenge of managing distributed cognition or bringing together of heterogeneous skills, tools and bodies of knowledge. Distributed cognition needs a common context, which enables participants to identify and synthesize relevant knowledge from domain and collaborate. In the ProspectBa platform distributed cognition is supported by the Prospect Map system model, which acts as a shared conceptualization of the domain and provides a language for describing opportunities. Moreover, the platform brings participants together in physical and virtual settings for knowledge creation and sharing further supporting the formation of common emergent understanding in the network.

Face-to-face encounters in workshops and evaluation sessions with domain experts, involving the physical Prospect Map, play an important role establishing a common context for the participants of the Prospect Mapping process. In these encounters the physical map artifact serves as a boundary object uniting participants. However, it is the system model of the map that is the catalyst for emergent common understanding among participants. The system model is an agreed set of meanings about how to view the explored domain as well as how to identify and define innovation opportunities. It is a way to understand the masses of data collected about a domain; a homogenous model on to which heterogeneous data can be mapped. The system model works as a shared conceptualization of domain opportunities because, it uses relevant concepts organized into a connectionist system to describe product innovation opportunities. It works like an ontology allowing the participants to speak the same language.

The system model connects Actor, Subject, Need and Solution parameters with Domain Constraints/Trends and Global Driving Forces variables to orient domain exploration to answer questions like: Who are the actors in the domain? What are their needs? Why do they have those needs? How are the needs solved? What causes, enforces or inhibits the needs? The focus of the work becomes exploring connections between customer needs and solutions, the domain context and broader global environment. The connections between needs and solutions are formally defined by the System Logics framework, which is embedded into the system model. Moreover, the system model enables domain insight and foresight to be externalized to the Prospect Map. Externalization augments the formation of common context in encounters and reduces the amount of domain expertise needed at the outset of the process. The team's latest understanding of the domain can be "read" from the Prospect Map, which means outsiders can be brought into the process flexibly, without having to spend lots of time orienting them.

The ProspectBa Studio blog further supports managing distributed cognition in the Prospect Mapping networks and lowers the hurdle to participate. Tailored on a blog or personal publishing platform, the ProspectBa Studio is a virtual knowledge creation setting. It is used to archive the contents of the Prospect Map, the portfolio of process results and any other insight and foresight created during the process. The blog augments the experience of the physical Prospect Map by enabling the annotation of map elements, briefs, personas and concepts. Moreover, it supports filtering the element option spaces based on category, author, date and time, rating, connections with other elements, number of connections and related design inputs. With the blog, participants are able to stay up-to-date on the work's progress and contribute to it regardless of time and place.

### 5.1.3 Applying Identified Innovation Opportunities in Product Development and Rest of the Company

**Research question 3: How can application of domain insight and foresight by the product development organization be supported?**

New knowledge about future domain opportunities should serve strategic decision-making, current product development or the renewal of core-capabilities. For it to have an impact, it needs to be shared, internalized by the organization and applied. This requires communicating the applicability and relevance of the knowledge. Moreover, it requires enabling the knowledge to be re-used for different purposes. Essentially, the problem of applying new knowledge has to do with the bridging the visionary Front-End phase with the efficiency and effectiveness driven New Product Development phase. The use of product concepts as a communication media and concept categorizations for describing timing as well as treating concepts as a portfolio of monitored options, have been proposed as solutions to the problem of transferring knowledge from the Front-End. The ProspectBa platform incorporates these ideas to support the application of identified innovation opportunities by the product development organization.

The Prospect Mapping method produces a wealth of knowledge in the form of design parameters and variables; present domain system image; present and future design briefs;

persona profiles; solving and visioning concepts; and System Logics descriptions of potential approaches to needs and systems of solutions. The resulting body of knowledge has high applicability and high variety, consisting of different kinds of insight and foresight with different applications in product innovation.

The Prospect Mapping method produces all three kinds of foresight identified by Fox (2005). It produces meta-foresight about the impact of driving forces on domain opportunities. The meta-foresight takes the form of future design briefs. It consists of macro-foresight about the impact of concepts on the domain, both in the present and in the future. Moreover, from the Prospect Map system image and briefs it is possible to understand the rationale behind concepts and their impact on the domain. This is a form of micro-foresight, i.e. the ability to see how the desired situation portrayed by the concepts can be attained.

The Body of Knowledge (BoK) classification proposed by Iivari and Linger (1999) is useful for analyzing the different types of knowledge created with the platform and how they can be applied by the product development organization. According to the classification knowledge varies in terms of concreteness (applicability) and generality (variety). From the BoK perspective, design parameters and variables have low concreteness and low generality. As single elements they cannot be applied, outside of the Prospect Mapping process. However, in the process they are the "building blocks" for composing higher-level design inputs. They are also used to monitor changes in the portfolio of domain innovation options.

Solving and visioning concepts have high generality and low concreteness. Concepts are a form of common language in the product development organization, instantly familiar as a media for conveying new ideas, idea pooling, reputation building, and as sources of new features and testing material. They encapsulate needs and aspects of the domain environment in a product or service description, appealing to intuition and the imagination. Concepts are applied in the Prospect Mapping process to complete the System Logics descriptions of domain opportunities and are "icons" of these opportunities.

The domain system image and System Logics descriptions have high concreteness and high generality, which makes them ideal for adaptation, application and judgement. The system image and System Logics are applied to making strategic product innovation decisions during and after the process. The System Logics framework enables exploring how the identified opportunities, described in terms of the framework, fit into existing offerings (Patnaik, 2004). The system image enables updating the portfolio of domain opportunities after the process has ended. Based on it, second-generation scenarios can be created where internal driving forces are combined with external driving forces to envision business outcomes from specific strategies.  For example, by incorporating new company strategies into the domain portfolio of options as new internal driving forces, their impact on the opportunities can be assessed. In sum, the bodies of knowledge analysis shows that the knowledge produced using the platform, has high applicability and high variety which makes it highly valuable to the product development organization.

Re-using platform based knowledge about a domain can be encouraged by monitoring its relevance in face of domain and global changes. Monitoring, situated in the Monitoring Phase, focuses on following the development of Global Driving Forces that are part of the System Logics in the portfolio of identified domain innovation opportunities. To automate the activity, keywords can be assigned to the driving forces and then tracked with software search agents on the Internet and in organization's extra- and intranets. The responsibility of monitoring is delegated to an Evangelist, who is ideally a product manager from the New Product Development organization. This further improves the diffusion of the Prospect Mapping knowledge in the organization.

## 5.2 Discussion

### 5.2.1 A Knowledge Perspective to ProspectBa

Nonaka's and Takeuchi's (1995) SECI model of organizational knowledge creation shows how the Prospect Map system model as a shared conceptualization supports a common emergent understanding of the domain and its opportunities among the participants. From the SECI model point-of-view the Prospect Mapping process goes through two iterative cycles of collaborative knowledge creation. At the beginning of the Solving Phase domain data or tacit domain knowledge is collected through interviews and research (Socialization). The tacit knowledge is externalized to the Prospect Map, when parameters and variables are created from it. As an externalization, the Prospect Map facilitates sharing domain insights within the team as well as with external domain experts. It also makes possible the creation of new knowledge through defining relationships between elements of the map and composing design briefs and personas from them. (Combining) More combining of knowledge occurs when solving concepts are designed based on the briefs and personas. The participants internalize the new knowledge represented by the solving concepts through reviews and discussions about them. Additionally, they create new tacit knowledge about the concepts and the briefs. Mapping the concepts back to the Prospect Map externalizes the new tacit knowledge. When the process moves onto the Visioning Phase, it begins again with socialization or creation of tacit knowledge, this time about driving forces that may have an impact on the domain. Subsequently, the driving forces are externalized to the Prospect Map. They are combined with briefs to create new knowledge in the form of future briefs. Once, again concepts (visioning) help the core team, domain experts and stakeholders internalize the new knowledge. And the cycle continues.

The above analysis validates the SECI model as a model of knowledge creation and clarifies the role of each step in the process in the creation of new knowledge about the explored domain. It also reinforces the idea of the ProspectBa platform consists of different *ba*s or settings for knowledge creation. The face-to-face encounters and workshops in the process are *Originating ba*. Typically, they occur around the Prospect Map. Populating the Prospect Map with parameters and variables, composing design inputs and concepts are forms of *Dialoguing ba*. The design briefs and concepts as well as the ProspectBa Studio blog, as a knowledge archive and annotation tool, can be considered to be *Systematizing ba*. Monitoring the portfolio of domain options and applying the new knowledge in later stages of product innovation can be considered as instances of *Excercising ba*.

### 5.2.2 Towards a Complex Adaptive System of Product Innovation

The ProspectBa platform applies complex adaptive system principles in its methodology and process, which makes it a suitable contemporary product innovation framework. The complex adaptive system principles of emergence, self-organization and evolution are inherent in the Prospect Map system model driven methodology and the design-based Prospect Mapping process.

The process of identifying opportunities begins with low-level "building blocks" of parameters and variables, from which briefs or patterns are constructed and given behavior. After exploring different combinations of elements, promising briefs are arrived at. Using the behavior of the prioritized briefs, they are projected to the future and subsequently, are used to design visioning concepts, which again are evaluated and iterated. Through this reflective process, the designer and the system image, both evolve. The system image becomes a more accurate reflection of the domain's underlying structure and behavior, and the designer's own experience of the domain grows. Evolutionary processes are characterized by emergence, and this is also the case with the Prospect Mapping process. It follows Thackara's (2005) blueprint of "sense and respond". The process constantly adjusts to the feedback from domain experts. The domain system image is also emerging: when a new element is added, the repercussions ripple through the whole system but also potentially to the level of design briefs, personas and concepts.

Because the domain system image is emergent and evolutionary, the process for creating it can be dynamic. It can be adjusted to the flows of information and the level of access to domain experts. At any point in the process, new information can be flexibly added to the Prospect Map domain system image to improve its accuracy or comprehensiveness. Similarly, people can be added to the process flexibly: outsiders are able to join the process without disrupting it and can begin to contribute to it quickly. In summary, an innovation network using the PropsectBa platform is able to integrate new information into its work at any step of the process, understand its impact and adjust its own composition of know-how, according to the emerging demands of the exploration.

### 5.2.3 Comparing Methods Toolbox, Visioiva Tuotekonseptointi and ProspectBa

In section 2.3.4, Jonas' (2003) Methods Toolbox and Kokkonen et al.'s (2005) Visioiva Tuotekonseptointi methods were presented as two approaches to creating knowledge about future opportunities for product and service innovation. The ProspectBa platform has been designed for this purpose as well. It has similarities and differences, which are worth pointing out, both to inform method selection in the Front-End and to elucidate potential future development paths for the ProspectBa platform.

The main similarity between the three methods is that they enable designing future concepts in connection to a problem area, theme or domain. Each method sees product concepts in the same way: as media for communicating to various stakeholders a solution to an identified problem and its context. The three methods use the concept of scenario thinking as a means of envisioning alternative futures. They share a reflective approach in which the problem and solution co-evolve.

The philosophies behind the methods differ. Jonas's philosophy is that interventions in systems can be conducted only after an understanding of the system as a closed entity with self-organizing behavior has been established. His rationale for developing the Methods Toolbox has been to provide designers with the means to see the problem context as a system and create plausible future paths in support of system interventions. The philosophy behind Visioiva Tuotekonseptointi is the use of visioning concepts as resources for strategic decision-making. The motivation for the method is the empowering of multidisciplinary collaboration in a scenario-centric design process. A "between the lines" motivation is to show the value of the Industrial Design discipline in strategic thinking. The ProspectBa philosophy is to provide a holistic framework for distributed collaborative creation of need-based insight and foresight for strategic decision-making and renewal of core capabilities. The motivation has been to empower future Prospect Kosmos types of innovation activities. The platform has been developed specifically to support future collaboration between Satama Interactive and Nokia but has wider applications as well.

The main methodological differences from the point-of-view of the thesis research questions are summarized in the table below:

| | **Methods Toolbox** | **Visioiva Tuotekonseptointi** | **ProspectBa** |
|---|---|---|---|
| 1. Identifying future innovation opportunities | Enables designing and rationalizing future product and service concepts reflecting environment 10-15 | Enables identifying product and service opportunities 10-20 years in the future. Visioning concepts produced | Enables defining future System Logics for a domain (typically 3-10 years in the future). |

| | | | |
|---|---|---|---|
| | years in the future;<br><br>Process: Analysis (systems thinking) –Projection (scenario building) – Synthesis (concept design);<br><br>Uses systemic image of problem context for projection.<br>Systemic image is based adaptation of Vester's 7 questions related to living systems and consists of internal and external variables;<br><br>Systemic image projected with driving forces;<br><br>Outcomes: concept options for different scenarios;<br><br>Method (toolbox) can be used flexibly. | in the process support strategic decision-making and timing of R&D;<br><br>Process: Global Scenarios (Analysis-Projection) – Theme scenarios (Analysis-Projection) – visioning concepts (Synthesis);<br><br>Uses Future Tables structured according to PESTE and consisting of driving force variables to generate scenarios;<br><br>Outcomes: Future Tables; visioning concepts for different scenarios;<br><br>Method to be applied in full. | Insight and foresight produced in process support strategic decision-making and renewal of core capabilities;<br><br>Process: Present domain design briefs and solving concepts (based on domain system image) – evaluation - future briefs and visioning concepts – monitoring of portfolio of options (Analysis-Synthesis- Evaluation-Projection-Analysis-Evaluation - Monitoring);<br><br>Uses domain system image for projection.<br>System image based on Prospect Map system model and consists of parameters and variables (incorporates System Logics framework);<br><br>Outcomes: domain design parameters and variables, domain system image, present and future briefs, personas, solving and visioning concepts and System Logics.<br><br>Method and tools can be used flexibly. |
| 2. Supporting emergent common understanding among collaborators | Team of designers required for the work;<br><br>Vague structure for systemic image does not support shared conceptualization;<br><br>Workshops play a major role in creating common context;<br><br>Does not provide tools for distributed work; | Multidisciplinary team required for the work;<br><br>Future Tables function as common context for work;<br><br>Visioning concepts used to communicate insight and foresight;<br><br>Workshops play a major role in creating common context;<br><br>Does not provide tools for distributed work; | Multidisciplinary team required for the work.<br>Domain experts involved in the process;<br><br>Prospect Map system model functions as a shared conceptualization of how to view domain and describe opportunities;<br><br>Externalization of system image briefs and concepts supports creation of common context;<br><br>Solving and visioning concepts are used to communicate insight and foresight;<br><br>Workshops play a major role in creating common context; |

| | | | |
|---|---|---|---|
| | | | ProspectBa Studio blog lowers hurdle to participate and supports formation of common context; |
| 3. Supporting application of new knowledge in organization | Creates solution options to future contexts;<br><br>Understanding of new knowledge based on concepts. | Visioning concepts support strategic decision-making;<br><br>Does not address how to deal with timing and implications of results on R&D. | Diverse body of knowledge has high applicability and variety supporting bringing of Front-End processes and later phases of product innovation, strategic decision-making and renewal of core capabilities;<br><br>Provides method for monitoring relevance of knowledge. |

**Table 4. Comparison of Methods Toolbox, Visioiva Tuotekonseptointi, ProspectBa and research questions.**

## 5.3 Applications of ProspectBa

The ProspectBa platform is adaptive and integrative and therefore, can be used flexibly in different forms of innovation opportunity exploration work conducted by heterogeneous types of innovation networks. The platform is an opportunity for design consultancies to offer design-based innovation exploration as an ongoing service or to develop intelligence services based on the insight and foresight produced with it. This section examines these and other potential applications for the ProspectBa platform.

### 5.3.1 ProspectBa as a Unifying Front-End resource

According to Perttula (2004) numerous attempts to bring more control and measurability to the Front-End have failed because Front-End processes are inherently heterogeneous. Currently, product concepts are considered as a unifying resource in the Front-End and between later product innovation phases. The ProspectBa platform enables identifying future innovation opportunities and produces concepts, which makes it a potential Front-End resource. However, it has the potential to become a universal Front-End resource for product innovation experimentation because of its systematic and systemic approach, the wealth of insight and foresight it creates and most importantly, its integrative and adaptive qualities. The systematic method and the body of knowledge the platform produces have already been discussed in previous sections. Next, the adaptive and integrative qualities of the platform will be clarified.

The platform adapts to the four factors that make Front-End processes heterogeneous and difficult to unify. The first factors affecting heterogeneity is the diversity of product innovations. The Prospect Mapping process enables identifying and defining the range of innovations from, new-to-market to new-to-company. New-to-market innovations can be explored by simulating the impact of internal company (technological) driving forces on discovered domain opportunities. New-to-company innovations can be explored by designing System Logics (approaches to needs and systems of solutions) that are new to both the domain and the company.

The second factor influencing Front-End processes is platform strategies. With ProspectBa, the company's platform strategies can be incorporated into the Prospect Mapping process. They can be translated them into the system model language of parameters and variables. The company's technology and product roadmaps (reflecting platform strategies) can be described in terms of System Logics and internal (technological) driving forces. Subsequently, the strategies can be reflected in the domain system image with Need parameters and Global Driving Force variable. Subsequently, these influence the exploration of opportunities. Consequently, the discovered opportunities reflect platform strategies.

The third Front-End factor accommodated by the ProspectBa platform is organizational culture. Organizational culture stands for the balance between creativity and business discipline in the company and its activities. The platform adjusts to different organizational cultures. For example, the Prospect Mapping process can be managed as a formal innovation project or left to emerge as a self-organizing activity in the Front-End where it is used as a resource (see section 5.3.2). In either case, the produced insight and foresight are homogeneously structured facilitating sharing and re-use.

Finally, the platform can be used to reinforce or discover the company's foundation for innovation: it both informs and adapts to product strategy, technology and portfolio management. For these reasons, the ProspectBa platform is a potential universal unifying approach to the chaotic and experimental Front-End.

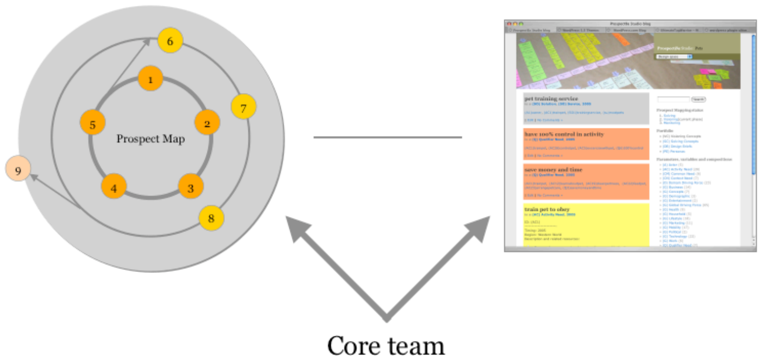
### 5.3.2 ProspectBa Activity Systems

Chapter 4 presented the Prospect Mapping process in detail and explained how the Prospect Map and ProspectBa Studio blog are used in it. This section zooms out from the process and tools to examine three potential ProspectBa mediated Activity Systems, for exploring innovation opportunities in unfamiliar domains.

Different types of ProspectBa Activity Systems can be envisioned by varying the diversity, complexity, openness and duration of the domain exploration to which the platform is applied. From an Activity System perspective, diversity is an attribute of the Subject and Community components; complexity is an attribute of the Object, Outcome and Objective components; and openness is defined with the Rules component. Duration is an attribute of the Action in the Activity System. Next, three potential Activity Systems characterized by different levels of diversity, complexity, openness and duration are considered to demonstrate the adaptability, scalability and value of the ProspectBa platform.

### *Activity System A – Internal Domain Exploration Project*

Activity System A is a low diversity, low complexity, periodic activity that is not open to externals. It is a domain exploration project organized as part of the Front-End of product development at an ICT company. The activity core team consists of five Designers from the product development organization, who work with a single physical Prospect Map supported by a single ProspectBa Studio blog. The project results are kept confidential, and shared only with stakeholders inside the company.




**5.1. ProspectBa Activity System A. Image by author.**

*Context* for the activity is the product development organization, which is concerned with developing new unique propositions for the market as well as experimentation for the renewal of core capabilities.

*Stakeholders* are members of the product development organization as well as overall company management.

*Objectives* are to create insight and foresight about future product innovation opportunities in a domain based on which strategic decisions can be made. A secondary objective is to develop domain specific innovation networks.

*Rules* govern the participants of the activity and limit them to be members of the company's product development organization. Moreover, the results of the activity are company confidential.

*Community* consists of a Stakeholders, Designers, Contributors and Evaluators for the activity. The networks Designers are able to forge with Contributors and Evaluators are crucial since, they are the primary source of diversity in the activity.

*Subjects* for the activity are the five Designers selected from the product development organization (see participant profile in section 4.1).

*Division of Labor* is based on the Prospect Mapping process. Designers are responsible for the tasks prescribed by the process and try to involve Contributors and Evaluators at key stages. The work among Designers can initially be divided into domain and foresight related streams. Stakeholders are responsible for allocating resources to the activity and evaluating the results. The job of Evangelists is to raise awareness of the results in the organization and monitor their relevance and timing.

The bodies of knowledge (BoK) classification related to knowledge work (WK) (see section 2.2.2) can be used to describe in more detail the type of work each participant does. Designers have the biggest and most varied workload in the process. They are responsible for the design of concepts, projection of briefs (Creative KW); creation of parameters/variables, defining relationships between them, composition of briefs and personas (Craft KW); documenting compositions and designs to Prospect Map to ProspectBa Studio blog (Routine KW); and to some degree evaluation of briefs and concepts (Professional KW). Contributors and Evaluators are responsible for collection and sharing of data (Routine KW) and evaluation of Prospect Map system image, compositions and concepts (Professional KW). Stakeholders carry the overall responsibility for the work. They primarily evaluate the results and apply them to strategic decisions (Professional KW). Evangelists are responsible for following driving forces and domain events and assessing their high-level impact on portfolio (Routine and Craft KW).

*Mediating Artifacts* in the activity are the Prospect Map, ProspectBa Studio blog and the Prospect Mapping process. The single physical Prospect Map is used to externalize domain design inputs and to create a system image of the domain. It serves as an open brief from which the team can create present and future design briefs. It also serves as a common framework for the activity's Community. The ProspectBa Studio blog is used to archive, annotate, browse and search for Prospect Map contents and collected domain data. The Prospect Mapping process defines the task flow and tasks for the activity. With it the core team is able to explore domain possibilities systematically. Section 4.2 describes in detail how these components are used as part of the Activity System.

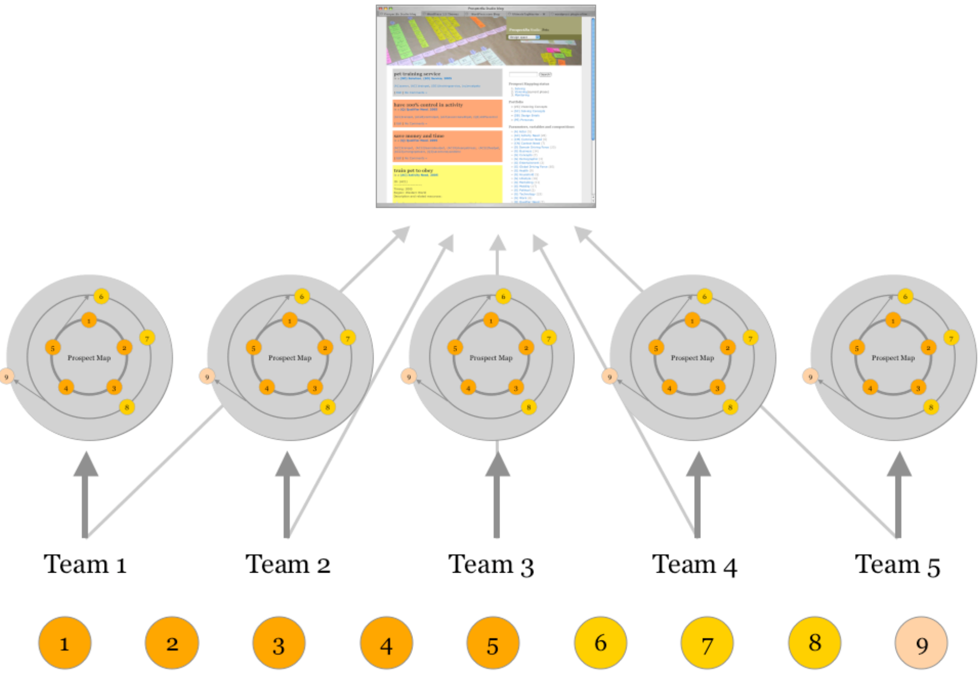
*Actions* can be divided into tasks, encounters and episodes. The Prospect Mapping process defines the majority of tasks and episodes or phases. The timing of transitions between tasks is based on the core team's own judgement of how the work has progressed as well as on the feedback from Evaluators and Contributors. Team members encounter each other in face-to-face workshops located in the physical space containing the physical Prospect Map. The team encounters Contributors and Evaluators in the field and in evaluation workshops. Encounters between core team and Stakeholders occur periodically in review meetings.

*Objects* produced in the activity are the physical Prospect Map of parameters and variables, the domain system image and the portfolio of domain innovation options that support domain related decision-making and serve as pre-design material. The activity also produces innovation networks with domain experts.

*Outcomes* can be divided into intended and unintended outcomes. Intended outcomes are a portfolio of domain innovation options and ongoing monitoring of these options. The overall intended outcome is to have enough insight and foresight needed to determine the strategic value of the domain. A further intended outcome is internal proficiency in domain related design. A potential unintended outcome resulting from the relatively small size of the team is failure to create sufficient domain insight and foresight.

### *Activity System B – Partnership*

Activity System B is a medium diversity, medium complexity, periodic activity that is open to selected organizations. It is representative of partnership based domain exploration. The fifteen members of the core team come from the different companies, where they form company specific Prospect Mapping teams. Each company team works with its own physical Prospect Map, but all share the same ProspectBa Studio blog. The results are shared widely inside the companies and their networks as well as with key domain players.




**5.2. ProspectBa Activity System B. Image by author.**

Activity System B consists of a central ProspectBa Activity System for the collaborative domain exploration between partners and individual ProspectBa Activity Systems at each participating company. The following is a description of the central Activity System.

*Context* for the activity is formed by the product development partnerships between several companies with complementary and overlapping competences. The explored domain is new to the participating companies. For each individual company the domain exploration serves as an opportunity to renew its own core capabilities.

Stakeholders come from the participating companies where they are managers (decision-makers) in their respective product development departments. Compared to Activity System A, Stakeholders take on a more activity role in steering the work, and ensuring that the core teams have the needed resources. There are internal activity Stakeholders at each company.

*Objectives* for the activity are to create insight and foresight about future product innovation opportunities in a chosen domain. Based on this knowledge the strategic value of the domain for the companies as a whole is defined. As a result, new strategic partnerships can be formed or existing ones deepened. A further objective is to appear as a unified consortium to domain players and forge common domain related innovation networks.

*Rules* for the activity are extremely important since it involves collaborating companies. Two approaches can be taken: pre-defined or emergent. In the pre-defined approach the overall activity is managed closely which means rules are defined for allocating resources, as well as for sharing and exploiting results. The division of labor and division of expenses among other aspects are defined before the activity commences.

In the emergent approach, the ProspectBa platform is used as a methods toolbox. Rules are defined as the work progresses. This leaves room for the individual styles and interests of each company to influence the activity. However, it also is riskier because the types and quality of Objects produced in the activity are difficult to predict.

*Subjects* for the Activity come from the participating organizations. In this case there are altogether fifteen Designers, five from each company who form company specific sub-teams. All Designers belong to the activity core team.

*Community* can grow to become quite large in this case. It consists of the Stakeholders, Designers in core teams, Contributors and Evaluators for the activity.

*Division of Labor* needs to be defined between Designers inside each company team and between the company teams at the core team level. It needs to be defined also between the core team and Stakeholders. Stakeholders need to agree on the division of labor between themselves. A core team leader needs to be appointed from one of the participating teams to manage the overall Prospect Mapping process. To ensure synergy, the work should be divided according to the competencies of each participating company. The opposite strategy of not following competencies in the division of labor can be employed to enhance learning, however this requires trust between participants. Each team follows the Prospect Mapping process using its own physical Prospect Map. Hence, the process and timing of tasks is the same for each team. All teams use the same ProspectBa Studio blog, which ensures results are shared between teams, and a common portfolio is created at the end of the process.

*Mediating Artifacts* for the activity are the Prospect Map, ProspectBa Studio blog and the Prospect Mapping process. All teams follow the Prospect Mapping process and aim to be in synch with each other. The process helps the teams to collaboratively explore the domain for future opportunities. The Prospect Map has a unifying and equalizing effect on the collaborative activity. While each team works on a separate physical Prospect Map, the Prospect Map systems model serves as a common framework for all participating teams, leading to a common emergent understanding of the overall domain and its opportunities. The systems model makes comparing and fusing different maps possible. Moreover, it acts as a common language that facilitates creating and sharing insights and foresight about the domain. In this regard, it supports distributed cognition. It also ensures that the teams act as a unified entity towards the domain. The separate Prospect Maps can be duplicates of each other (requires constant synchronization) or can reflect each team's own point-of-view and progress. The overall status and results of the work are visible in the shared ProspectBa Studio blog. The blog is a centralized information system for archiving, annotation and relating the contents of the separate Prospect Maps as well as the different compositions and concepts created by the teams.

*Actions* can be divided into tasks and encounters. The main task for the core team is to follow the Prospect Mapping process. The process defines the majority of the tasks and episodes or phases for all the sub-teams. The distributed set-up presents additional tasks related to managing the process and synthesizing the results from each team. The timing of transitions between tasks is based on the core team leader's judgement of how the work has progressed and on Evaluators, Contributors and Stakeholder feedback. The sub-teams encounter each other in workshops. The team encounters Contributors and Evaluators in the field and in evaluation workshops. Encounters between core team and Stakeholders occur periodically in review meetings.

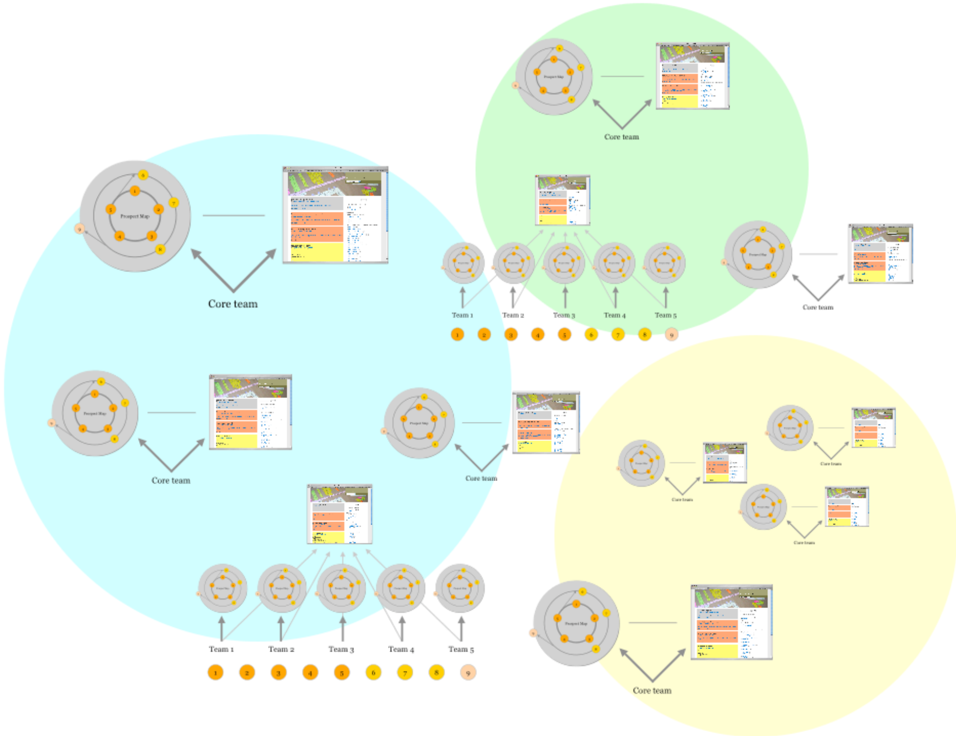
*Objects* of the activity are the Prospect Maps, domain system images, archive of parameters and variables, common and company specific portfolios of domain innovation options. The activity also produces innovation networks with domain experts.

*Outcomes*. The purpose of the activity is to provide sufficient insight and foresight for deciding as a collective, the strategic value of the domain. Intended outcomes are common and company specific portfolios of domain innovation options as well as ongoing collaborative monitoring of the common portfolio. Company specific portfolios should prioritize each company's own opportunities in the domain. The further intended outcome is internal and external publicity for the collaboration. Insights into each participating company as well as an evaluation of the value of the partnership are additional intended outcomes. A company specific intended outcome is internal proficiency in domain related design. Potential unintended outcomes can be disagreements between companies on intellectual property rights to concepts or roles in future domain related ventures.

***Activity System C – Open Source Intelligence***

Activity System C is a maximum diversity, maximum complexity, continuous activity that is completely open to all interested individuals and organizations. It is representative of an open source intelligence approach to innovation networking. A company develops the ProspectBa platform and then releases it to the public domain under the GNU Free Documentation License (GFDL) for anyone to use and modify. The activity, composed of an unknown number of independent domain exploration activities is self-organizing and emergent. However it can be steered by any interested party toward a desired outcome, which in this case is to encourage innovations in a specific domain, for the purpose of building a foundation for future domain interventions. Results from the different domain explorations can be shared under Creative Commons licenses.

Activity System C consists of an unknown and constantly changing number of independent Activity Systems using the ProspectBa platform for domain exploration and other activities. It is an example of open source intelligence started by the developer of the ProspectBa platform that aims to maximize the cross-fertilization of disciplines, functions and geographies for the purpose of preparing markets for future interventions. Activity System C is formed when the ProspectBa platform is released into to public domain where it is used as an innovation toolbox, adapted to unforeseen problems.




**5.3. ProspectBa Activity System C. Image by author.**

*Context* for the activity consists of an unknown number of global innovation networks, projects and other activities.

*Stakeholders* are members of the organization (company) that has developed the ProspectBa platform.

*Objectives* from the point-of-view of the company that has developed the platform are to encourage and steer open innovation based on the ProspectBa platform in a specific domain in order to prepare it for potential future interventions. In this regard, it is an attempt to innovate the overall domain so that it is receptive to the company's own innovations.

*Rules* in the form of open source licenses are set for the use of the platform and Objects produced with it. The ProspectBa platform is released under the GNU Free Documentation License (GFDL). Objects from the different domain explorations can be shared under the Creative Commons free licenses enabling others to leverage them.

*Subjects* are unknown, and ideally number in the thousands.

*Community* is more like an ecosystem where the platform developer, different communities of interests and service providers create and thrive on ProspectBa platform based activities. Communities of interest consisting of platform users, developers, and evangelists emerge over time. The communities of interest form decentralized free-scale networks in which ideas propagate through weak links. Services also emerge. Examples of potential services are consultants who assist others in the use of the platform, specialized search engines for locating platform results, companies providing back-ups of portfolios and monitoring of results. The overall community forms many decentralized networks that are connected by hubs of specialists.

*Division of Labor* in the community is emergent.

*Mediating Artifacts* are the Prospect Map, ProspectBa Studio blog and the Prospect Mapping process. The platform serves as a methodological toolbox, which is adapted on a case-by-case basis. However, as with the other Activity Systems the Prospect Map has the same unifying and equalizing effect on the collaborative activities. While different teams works on separate physical Prospect Maps and have their own ProspectBa Studio blogs, they are able to share insights and foresight thanks to the common framework provided by the platform. Moreover, incorporating the Creative Commons XML/RDF metadata format for describing the results into the ProspectBa Studio blog, makes finding the work of others easier. The framework will evolve to hold historical knowledge of how the community behaves and is organized.

*Actions* from the perspective of the company are to encourage the platform's diffusion through "marketing" and initially supporting early adopters. The company can also try to steer the use of the platform towards specific types of innovations by acting as thought leader it the Community.

*Objects* produced by the activity vary but originate from the same underlying structure.

*Outcomes* can be divided into intended and unintended ones. The overall intended outcome is to innovate the domain system by encouraging an explosion of domain related innovation. There will be many positive and negative unintended outcomes connected with the activity. For example, competitors could use the platform to innovate competing products. Or new versions of the platform could emerge that transform the Prospect Map system model, fragmenting the knowledge produced with the platform.

In summary, each of these three Activity Systems will evolve overtime as ways to transform the platform and activity to be more creative, effective and efficient are discovered and incorporated into its components.

### 5.3.3 Capitalizing on the ProspectBa platform

The three ProspectBa Activity Systems give an idea of the different ways the platform can be applied to support product innovation. This section envisions ways the platform could be productized and monetized. The four approaches presented next, are inspired by Thackara's (2005) claim that design should be sold as a service, based on a continuous sense and response approach rather than on a project basis. First, the platform could be developed into a software tool for the Front-End. Second, the Prospect Mapping process could be offered as an ongoing consulting service to product innovation organizations. Third, the platform could be used for to encourage domain related innovation in general by offering it as an open source, open idea platform to domain players. Fourth, if the use of the platform spreads, money could be made in knowledge spot markets that emerge around it.

***Software Tool for the Front-End***

*What?*

A capable actor develops the ProspectBa platform into a stand-alone web-based creativity support (software) tool for Prospect Mapping in the Front-End. The ProspectBa Studio application enables distributed and asynchronous Prospect Mapping, enhances the exploration of interrelations and patterns in the domain system image, automates the monitoring of driving forces, and serves as an online knowledge base. The application consists of four feature sets: collaboration, visualization, exploration and composition.

Collaboration features enable spatially, temporally and conceptually distributed collaboration and creativity within a Prospect Mapping innovation network. The features support social awareness, social memory and coordination of work in the innovation network.

Composition features enable the initiation-revision-evaluation of low and high-level conceptual elements in Prospect Mapping. Parameters and variables are defined with a form-based user interface, while the system image and briefs are composed through direct manipulation. Tagging of elements is also supported.

Exploration features consist of different ways to search and make sense of domain information and the domain system image. The scope of exploration extends from the application's database the hard-drive of PC the application is running on, the Web and other proprietary databases. The application supports generative exploration in the form of tag-based clustering and self-organization of parameters, variables and the overall system image. Cross-context exploration consists of comparing domain system images and portfolios as well as across versions of these.

Visualization features play an important role in the value proposition. They enable visualizing complexity, context and dynamics of the domain system image and briefs during the Prospect Mapping process and the "attractiveness" of the domain portfolio after the process ends.

The application could also be used as a knowledge management tool for non Prospect Mapping related knowledge at a design consultancy. For example, all client briefs and debriefs made back to clients could be stored in the ProspectBa Studio application, where they would be structured in a standard way, according to the Prospect Map system model. From the consistently structured debriefs, the big picture or system images of client domains could be pieced together. This is an ad-hoc approach to creating Prospect Maps of the domains the consultancy designs for.

*How?*
The ProspectBa Studio application would be developed through user-centric software development process. Web 2.0 paradigms and technologies should be used in the development. For example, the application should support tagging of content, open APIs and syndication features. Self-Organizing Map technology could also be used to facilitate the interrelating of system image elements.

*Who?*
The customers for the application are product development organizations and design consultancies. The application is marketed to these customers via a website, expert networks and at product innovation conferences. The application could be given away for free to selected customers to gain success stories that serve as marketing materials.

*How much?*
An up-front investment into software development and marketing is needed. Subsequently, costs come from developing new releases of the software, running the web store from which it can be downloaded and offering support to users. Revenues come from selling software licenses.

***Design Consultancy Service***

*What?*
A design consultancy offers product innovation services based on the ProspectBa 1.0 hybrid platform. The value proposition consists of offering up-to-date insight and foresight about a chosen domain and the managing of a portfolio of domain innovation options. The platform gives credibility to the design consultancy's product innovation offering.

*How?*
The design consultancy needs to set up infrastructure to run several Prospect Mapping projects at the same time. This includes physical space for the physical Prospect Maps and workshops. It includes IT infrastructure for running ProspectBa blogs and other supporting software tools. The consultancy has to establish domain related innovation networks and partnerships to ensure quality of inputs for the process. Capabilities for

creating physical product and interactive service digital prototypes would add value for the client, although they increase costs.

*Who?*

The customers for the service are product development organizations and large corporations in need of strategy consulting and strategic design services. Prospect Mapping should be offered as on going service rather than on a project-by-project basis.

*How much?*

The Prospect Mapping service generates yearly subscription or membership revenues. In this case using a time-based project revenue model does not make sense because of the work's emergent nature. Monitoring of options can be offered as a separate service. The costs for the service come from hiring and training designers and researchers, setting-up and managing infrastructure, product development of the platform, marketing the service and managing customer relationships.

***Open Source Innovation Initiative***

*What?*

A major ICT actor decides to establish open source innovation based on the ProspectBa platform in domains it is considering as future markets. The company packages the platform for universal use and then releases it to the public domain under the GNU Free Documentation License (GFDL) for anyone to apply and modify. It is interested in developing communities of interest around the domains in order to create critical mass in terms of ideas and players before entering those domains itself. The overall objective is to create an "innovation commons" where following Lawrence Lessig's paradigm new creations are built on previous creations and provide inspiration for future ones. The ability to freely use and refine those previous creations increases the possibilities for future creativity.

ThinkCycle.com is an example of this kind of an open innovation community platform on the Internet. Similarly, in the Prospect Kosmos collaboration, an overall objective was to develop the designforpets.com website where the results of the pet domain exploration would have been available to the public. By sharing results of Prospect Mapping Nokia and Satama would have sent a strong signal to pet domain players that they are curious about the opportunities in the domain. It would have been a means to generally probe the domain for interested partners and to get valuable feedback on initial ideas.

*How?*

Offering ProspectBa as an open innovation platform requires the capability to "package" the platform so that it can be adopted as effortlessly and flexibly as possible. It means setting up a website offering the platform package for downloading and additional support in its use. It also entails establishing partnerships or collaborations with those capable and interested parties who become proficient in using the platform.

*Who?*

The platform is distributed to the public (and specific) but targeted to specific communities of innovators and domain players.

*How much?*

The costs come from packaging the platform, distributing it and supporting its use. While this approach does not produce direct revenue flows or calculable profits it can potentially generate tremendous value for the company in terms of visibility in the domain, and in general as a though leader in innovation.

***Knowledge Spot Market Approach***

*What?*

According to Gorbis et al. (2002) knowledge spot markets bring together those who seek problem resolution and those with the solutions wherever they may be located geographically. They extend the pool of resources available to companies or individuals for solving problems. Two ProspectBa platform related knowledge spot market approaches can be taken.

In the first case, a capable actor begins continuously producing foresight with the platform about “trendy” domains. It then offers the meta-, macro- and micro foresight (see section 5.1.3) to different domain related knowledge spot markets on the Internet. If these do not exist it can create them. The second opportunity arises only after the platform has diffused to product development organizations and has gained a critical mass of users, who are continuously using it. In this case, there could be knowledge spot markets for domain data, domain parameters and variables or even domain system images. However, the biggest demand will mostly likely be for domain driving forces.

*How?*

The actor has to invest in infrastructure that enables it to use the platform and to package and sell the knowledge it produces. Additionally, establishing partnerships may be necessary to gain access to domain data and experts, needed to ensure the quality of the “product”.

*Who?*

The customers for the knowledge vary and are encountered in the knowledge spot markets (on the web).

*How much?*

The approach requires an up-front investment into creating ProspectBa platform based insight and foresight. Reoccurring costs come from using the platform. Revenues come from selling platform based insight and foresight on knowledge spot markets.

## 5.4 Future Work

When considering future work, it's important to note that ProspectBa platform was not fully tested in this thesis, i.e. a group of designers has not explored a domain with it. The materials that were used in the design research process originated from the Prospect Kosmos collaboration, where they were originally structure according to the Domain Map system model. Hence, a case study or two with the platform would bring much needed perspective and insight to the discussion of future directions. This section attempts to pinpoint potential issues with the platform and based on them offers improvement suggestions as well as points out interesting avenues for future research and development.

### 5.4.1 Issues in Working with the ProspectBa Platform

While the Prospect Mapping process enables systematic exploration of possible opportunities in a domain, it is potentially immensely time and resource consuming when the number and variety of Prospect Map elements grows large. On the other hand, if the elements are few and homogeneous, the exploration becomes limited. Therefore, the success of the Prospect Mapping process depends on capabilities for collecting domain data; generating and externalizing parameters and variables; processing and evaluating higher-level compositions and designs; as well as automatically tracking domain opportunities. Each of these activities presents challenges that are pointed out next.

The biggest challenge with Prospect Mapping is setting the scope for the domain system image. Scope affects the variety of identified opportunities. The tasks affecting scope are important to identify. Initially, access to the domain, data and experts as well as scenarios and futurologist is essential to ensure quantity and quality of inputs for the process. It requires networking and resources for immersing in the domain. When the amount of data, parameters and variables grows large, managing and exploring the domain system image becomes laborious. Motivating the team to keep the system image comprehensive in its internal connections as well as up-to-date becomes an issue. Limiting the scope of the Prospect Map is a necessity; it requires continuous feedback from domain experts as the system image is built. The scope is limited by the size of the physical Prospect Map. This may work against the exploration. The physical format of the Prospect Map based system image makes it difficult to keep track of the interconnections between elements, although the ProspectBa Studio blog in its current version helps somewhat with this. Identifying patterns and creating design briefs requires laborious exploration and more importantly, judgement to orient and limit the work so that is comprehensive and manageable.

Rules for evaluating and prioritizing briefs should be created on a domain-by-domain basis. Ad-hoc and flexible involvement of domain ´experts in the process, especially to systematically evaluate the system image, briefs and concepts is crucial. Again networks and incentives play an important part. The format for documenting solving and visioning concepts needs to be agreed early on in the process, and should be based on available resources and skills of participants. Determining the impact of driving forces on the briefs requires the most imagination and theorizing in the process. Experience of participants plays a big part in this phase of the process.

While the above issues can be overcome through more formalization of tasks and the development of specialized information management tools, care should be taken not to limit creativity in seeking and making connections between elements, composing and combining briefs as well as designing concepts.

### 5.4.2 Research Topics

Research topics can be divided into ones dealing with the system model, the workflow and collaboration and creativity of the process.

Two possible focus areas for system model related research are, the complexity or scope of the model, and its extendibility. Interesting complexity related questions to answer are: What is the optimal size of the domain system image? How does the number of parameters and variables influence the results? In the designing tools to manage manage scope related problems it would be interesting to learn: How AI technology could be applied to automate the creation of parameters and variables and resolve their mutual relations? If a software tool is created for the platform, the application of Self-Organizing Map (SOM) technology should be explored.

Research into extending the system model can branch out into the field of ontologies and their application in design or focus on adding depth to the system model beyond System Logics the framework. For example, could a business model ontology be incorporated into the domain system model to better inform about the business impact of opportunities? Additionally, it would be interesting develop a design pattern language based on the system model. Pattern languages are a means of capturing insight for future use. A pattern language could potentially have many uses in the ProspectBa context. It could be used to create general design drivers for a domain or to test new themes with existing solutions patterns. The pattern language would help in identifying solution patterns across domains. Domain patterns and design drivers could be donated to the public domain to encourage innovation in the domain. Furthermore, applying solution patterns to new domains becomes an interesting approach to innovating and can potentially lead to synergies in product development.

Workflow and collaboration related research, needs to address the issues of augmenting the physical Prospect Map and communication in the innovation network. The objective of augmenting could be to automate the archiving of map data or potentially, replace the Prospect Map tool with a mixed reality system. In a mixed reality version of the Prospect Map, phicons or physical icons, could replace Post-Its notes. Projections could be used to show in real-time meta-data about interconnections and ratings of elements. Such a concept would also require the development of a system for authoring phicons. Nokia's Near Field Technology should be explored as a potential solution to this approach. A less ambitious direction would be to develop a software application for Prospect Mapping. This raises interesting research topics like What are the optimal visualizations of the system image during the different steps of the process? What kinds of composition and comparison tools would make the work more efficient?

The objective of the platform is to enable participants to see the domain as a whole system, in terms of emergent or latent future opportunities. Reaching the objective is in large part dependent on intuition, imagination and improvisation or simply, creativity. Typically, formal processes seem to work best for incremental innovations by optimizing efficiency. The implication is that less structure leads to more innovative results. The key question regarding the use of the platform as a formal unifying Front-End resource is: Does it truly lead to new creative ideas or does it only amplify existing ones? Does the formal and structured Prospect Mapping process lead to innovative ideas? The development of a virtual design studio should focus on supporting creativity. The Creativity Support Tools field could offer guidance in this area.

# 6 Conclusion

In conclusion, I will look once more at how the proposed design solutions resolve the three research problems originating from the Prospect Kosmos collaboration. The main problem I set out to solve was the identification of future innovation opportunities in a chosen and potentially unfamiliar domain. The problems of supporting emergent understanding of opportunities in the innovation network and applying resulting domain knowledge in product innovation are derivatives of the main problem. They served as heuristics for evaluating the quality and comprehensiveness of the solution to the main problem.

The main problem has two parts to it: defining what an opportunity is in the domain and learning what the domain will be like in the future. I arrived a theoretical framework to these through my experiences in developing the Domain Mapping method and Domain Map tool and a review of existing literature. The theoretical framework implicitly acknowledges that identifying future innovation opportunities is a wicked problem. It involves first defining the problem from which the opportunity arises, however, defining the problem itself can only be done by attempting to solve it. Essentially, the framework prescribes designing future product and service concepts for the domain as the means to learn about opportunities. It considers systems thinking and scenario building as the key enablers for future oriented concept design. The framework borrows ideas such as externalizing design inputs and classifying them as parameters and variables, from systematic design methods. The specific design inputs to be used in the design are derived from the System Logics framework and the man-tool-work-environment model. These two are combined in the domain system model. The domain system model is used to generate design briefs and to envision future changes in the domain problems described by the briefs.

The above theoretical framework informed the design research approach which resulted in the ProspectBa platform design solution. The platform is evidence of the fact that the theoretical framework can be transformed into a method. Moreover, tools can be developed for it. Together the method and tools can be applied to the identification of future innovation opportunities in domains. The domains can be unfamiliar to the explorers because the method supports an emergent understanding of the domain opportunities as well as the flexible, on-demand involvement of domain experts as evaluators and contributors. In this regard the platform validates the theoretical thinking behind the framework. From the opposite perspective, the theoretical framework gives the ProspectBa platform credibility to be a potential unifying solution to Front-End innovation management.

The most valuable contribution of this thesis is the most valuable component of the ProspectBa platform: the Prospect Map system model. The system model is the root solution to the three design research problems. It incorporates all the essential aspects of the theoretical framework. The model consists of design inputs including the System Logics framework, forming a systems view of the domain and its global environment. The model frames a design inquiry process into future domain problems. The Prospect Mapping activity is inscribed into the model's structure. The steps in the process can be derived from the model's elements, the lines interconnecting them and the central placement of the Concept element. With the Prospect Map system model simplifies and unifies perspectives to the targeted domain. Yet it enables to describe adequate domain complexity, needed to take different design paths through it. The model is sufficiently systemic to describe present domain behavior, based on which future dynamics can be projected. From a collaboration perspective it acts as a shared conceptualization of the domain and its opportunities. From a knowledge perspective it is a means to generate new knowledge with high applicability and variety in product innovation and for strategic thinking. Additionally, new knowledge can be created out of existing knowledge using the model. In summary, the system model speaks to three themes. To the theme of identifying future innovation opportunities it says that to succeed you need to understand domain complexity, context and dynamics. To the theme of supporting distributed innovation it says ontologies may be an answer. Finally, to the theme of applying knowledge it says that the key to creating a body of knowledge with high applicability and variety is to use low-level conceptual building blocks.

In hindsight, the thesis could have placed more emphasis on developing and evaluating the Prospect Map system model. This could have been done at the expense of the Prospect Mapping process description. From the description of the process, one gets the feeling that it is probably too laborious to be used in its entirety in the fast paced Front-End of product innovation. Before, testing the process, it would be more valuable to test the applicability of the Prospect Map system model for modeling diverse domains. Future work should initially concentrate on addressing the issues of scope, applicability and extendibility associated with the system model. One promising direction for future work is the exploration of connections between the Propsect Map system model and the use of ontologies in distributed design environments.

Finally, this thesis has been one the biggest challenges I have ever personally undertaken. I feel that as a result I am a more proficient designer and thinker. I have learned to approach design problems systematically. I am now better equipped to see their systemic qualities. These lessons extend beyond the scope of professional design work, to my life in general. Because of the skills and knowledge I have acquired through this process the world around me appears more inspiring. I feel more creative, more attuned to seek new connections. I couldn't have hoped for a better result.

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# Appendix

## Prospect Mapping Task Flow

The following is a set of instructions on how to use the Prospect Map and ProspectBa Studio blog during key phases of the Prospect Mapping process.

### Solving Phase

#### *1. Collect Data (Analysis)*

| |
|---|
| **ProspectBa Studio**<br><br>Resources:<br>Search: http://www.google.com<br>Human Universals (Brown): http://www.depaul.edu/~mfiddler/hyphen/humunivers.htm<br>Google Montage<br>Scenario Thinking<br>Technorati<br>(Keyword filtering of news) |

#### *2. Create Parameters and Variables (Analysis)*

| |
|---|
| **Prospect Map**<br><br>*2.1 Create parameters and variables*<br><br>1. Write parameter/variable description on category color-coded Post-It;<br>2. Give parameter/variable an id;<br>3. Add ids of related parameters/variables;<br>4. Map Post-It to corresponding category area on Prospect Map.<br><br>**ProspectBa Studio**<br><br>*2.1 Create parameters and variables:*<br><br>1. In title field, write description of parameter;<br>2. In category list, checkmark the parameter's category;<br>3. In category list, checkmark appropriate year;<br>4. In the post field, fill in the information specified by the following template: |

- ID: (category identifier and serial number)
- Timing: (year)
- Region: (region of the world the parameter/variable belongs to)
- Description and related resources: (examples and links to sources of more information)
- Owns/owned by: (identified when parameter/variable is mapped)
- Has/belong to: (identified when parameter/variable is mapped)
- Enforces/enforced by: (identified when parameter/variable is selected for a brief)
- Inhibits/inhibited by: (identified when parameter/variable is selected for a brief)
- Causes/caused by: (identified when parameter/variable is selected for a brief)
- Solves/solved by: (identified when parameter/variable is selected for a brief)
- Part of compositions: (ids of personas, briefs and concepts parameter/variable is used in)

5. In tag field, abbreviate names of all related parameters;
6. Publish

### *3. Compose Design Inputs (Synthesis)*

**Prospect Map**

*3.1 Compose persona*

1. Select one Actor, one or several Subject, one Common Need, several but not all related Context Need, Activity Need and Qualifier Need parameters;
2. Duplicate chosen Post-It parameters following color scheme;
3. Create a separate persona profile by arranging the new Post-Its onto a separate board or sheet of paper;
4. Write persona name and id (PE#) on two Post-Its and add one to the map and the other to the persona profile;
5. Draw or use a photo as an additional identifier for the persona.
6. Update the Post-Its on the Prospect Map used in the persona profile with the Persona id to reflect the new relationship they have to a design input (composition)

*3.2 Compose design brief*

1. Start by selecting one Actor parameter and related Subject parameter(s);
2. Select related Common Need(s), Context Need(s), Activity Need(s), and Qualifier Need(s) if the objective is to design systems of solutions;
3. Select only one Activity Need and related Qualifier Need(s) if the objective is to design a single product or service;
4. Select Solution(s) related to chosen Needs (these either serve as components of future systems of solutions or competing products and services, depending on the brief's scope);
5. Identify and select related Domain Constraints/Trends and Global Driving Forces by asking for each chosen parameter what enforces, inhibits or causes it;

6. Add any missing Domain Constraints/Trends and Global Driving Forces to the map and brief;
7. Duplicate chosen Post-It parameters and variables following color scheme;
7. Create an external brief description by arranging the new Post-Its onto a separate board or sheet of paper;
8. Give brief an id (DB#).
8. Update the Post-Its on the Prospect Map used in the brief with the Design Brief id to reflect the new relationship they have to a design input (composition).

**ProspectBa Studio**

*3.1 Compose persona*

1. In title field, write persona name;
2. In category list, checkmark the Persona category;
3. In category list, checkmark appropriate year;
4. In the post field, fill in the information specified by the following template:

- ID:
- Name:
- Gender:
- Timing:
- Region:
- Actor type:
- Subject(s):
- Needs:
- Description and related resources:

5. Publish

*3.2 Create design brief*

1. In title field, write brief name;
2. In category list, checkmark the Design Brief category (the brief is automatically added to the Portfolio list);
3. In category list, checkmark appropriate year;
4. In the post field, fill in the information specified by the following template:

- ID:
- Timing:
- Region:
- Actor(s):
- Subject(s):
- Needs:
- Domain Constraints/Trends:
- Global Driving Forces:
- Related concepts:

5. Publish

### *4. Design Solving Concepts (Synthesis)*

**Prospect Map**

*4.2 Document concepts*

1. Write concept name on Solution category color-coded Post-It;
2. Give concept an id (SC#);
3. Add id of design brief (DB#);
4. Map Post-It to Solution category area on Prospect Map.

**ProspectBa Studio**

*4.2 Document concepts*

1. In title field, write concept name;
2. In category list, checkmark the Solving Concept category (the concept is automatically added to the Portfolio list);
3. In category list, checkmark appropriate year;
4. In the post field, fill in the information specified by the following template:

- ID:
- Name:
- Type:
- Timing:
- Region:
- Brief: (name and id of design brief)
- Description and related resources:
- Potential product family members: (Solutions with related Common Needs and Context Needs)
- Potential competitors: (Solutions with same Activity Needs and Qualifier Needs)
- Related compositions:

5. Publish.

### *5. Evaluate Impact of Concepts*

**Prospect Map**

*5.1 Evaluate concept's impact on domain*

1. Give an overview of Prospect Map to invited Evaluators and Stakeholders;
2. Present concept document (brief parameters and variables and concept description), explain how concept relates to other solutions in the Solution area of the Prospect Map, i.e. what other products and services belong to the same product family, which products or solutions does it compete against
3. Ask Evaluators to determine desirability, viability and feasibility;
4. Conduct further analysis using McLuhan's tetrad;
5. Collect and document all comments and feedback;
6. Adjust process and Prospect Map accordingly.

**ProspectBa Studio**

*5.1 Evaluate concept's impact on domain*

1. Ask Evaluators and Stakeholders to visit the ProspectBa Studio blog;
2. In the blog ask them to browse through the briefs and solving concepts and in the comment field add their evaluations (same frameworks can be used as with the physical Prospect Map;
3. Review the evaluations;
4. Adjust process and Prospect Map accordingly.

## Visioning Phase

### *6. Create Future Briefs (Projection)*

**Prospect Map**

For both approaches

1. Analyze the impact of the future Global Driving Force on brief;
2. Modify the brief document by adding new parameters and variables and/or taking away old ones;

Add future Global Driving Force to brief and Prospect Map;

1. Divide a Global Driving Force color-coded Post-It into three columns (make the middle column the widest, draw an arrow point up above left-hand column, draw arrow pointing down above right-hand column);
2. In middle column, write description of variable;
3. Add variable id and migration point year to the top of the Post-It;
4. In left column, write ids of parameters and variables in briefs that are enforced by it;
5. In right column, write ids of parameters and variables in briefs that are inhibited by it;

6. Place Post-It onto Global Driving Forces category area on the Prospect Map.

Modify parameter/variable:

1. Divide a parameter/variable color-coded Post-It into three columns (make the middle column the widest, draw “+” sign above left-hand column, draw “-“ sign above right-hand column);
2. In middle column, re-write description of parameter/variable to reflect impact;
3. Rewrite id and add migration point year to the top of the Post-It;
4. In left column, write id(s) of future Global Driving Force(s) that enforces it;
5. In right column, write id(s) of future Global Driving Force(s) that inhibits it;
6. Update Post-It to the brief;
7. Place Post-It on top of its present day version on the Prospect Map

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Update existing independent variable:

1. Open independent variable in Write mode;
2. In category list, checkmark migration year;
3. In post field, add new information above the earlier description:

- Timing:
- Region:
- Description and related resources:
- Enforces/enforced by: (Driving Force/Need relationships)
- Inhibits/inhibited by: (Driving Force/Need relationships)
- Causes/caused by: (Driving Force/Need relationships)
- Part of compositions:

4. In tag field modify the metadata
5. Publish

Update existing brief:

1. Open design brief in Write mode;
2. In category list, checkmark migration year;
3. In post field, add new information above the earlier description:

- Timing:
- Region:
- Actor(s):
- Subject(s):
- Needs:
- Domain Constraints/Trends:
- Global Driving Forces:
- Related concepts:

4. Publish

Sources for driving forces:

- IFTF – http://www.iftf.org
- Scenario Thinking -http://scenariothinking.org/wiki/index.php/Driving_Forces
- Trendwatching.com – http://www.trendwatching.com

### *7. Design Visioning Concepts (Synthesis)*

**Prospect Map**

*7.2 Document concepts*

1. Write concept name on Solution category color-coded Post-It;
2. Give concept an id (VC#);
3. Add id of design brief (DB#);
4. Map Post-It to Solution category area on Prospect Map.

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*7.2 Document concepts*

1. In title field, write concept name;
2. In category list, checkmark the Visioning Concept category (the concept is automatically added to the Portfolio list);
3. In category list, checkmark the migration year;
4. In the post field, fill in the information specified by the following template;

- ID:
- Name:
- Type:
- Timing:
- Region:
- Brief:
- Potential product family members: (Solutions with same CM and CN)
- Potential competitors: (Solutions with same AC)
- Related compositions:

5. Publish.

### *8. Assess Opportunity (Evaluation)*

**Prospect Map**

*8.1 Evaluate System Logics*

1. Rank briefs in terms of the levels of needs that they encapsulate: briefs starting with Common Needs should be ranked higher than ones starting with Contextual Needs;
2. Compare present and future briefs to determine deviance;
3. Note which driving forces change briefs the most;
4. Compare solving and visioning concepts (originating from same brief) for structural, use and need deviations;
5. Present visioning concepts to Evaluators and Stakeholders and collect feedback;
6. Make required adjustments to Prospect Map;
7. Rank System Logics in terms of potential and document ranking.

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*8.1 Evaluate System Logics*

1. Open brief and rate it;
2. Open concept description and rate it.

## Monitoring Phase

### *9. Monitor Portfolio*

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*9.3 Scan for domain events and driving forces*

1. Add keywords to