Cluster 2.0: Collaboration Makes Innovation Happen

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Abstract

This bachelor thesis describes the product development of Cluster 2.0, a website developed to test a new theory regarding innovation. Cluster 2.0 combines the gathering of information about stakeholders in the satellite navigation industry, with a social network. The different stages of the development process will be explored, and most importantly the theory and background information that led to certain design choices will be explained.

Contents

1 Introduction

Innovation is generally seen as the dynamo of economic growth and employment [1] (Stokes, 1997). Therefore it is logical that companies in various industries all over the world set increasing budgets for their research and development divisions. Over the years, Silicon Valley developed itself to one of the most innovative hotspots of our planet. Obviously it is important to understand the actual process leading to this amount of innovation. A lot of research has been done to find all the factors that play a role in this process. This has lead to numerous theories about innovation.

This thesis will mainly focus on the development process of a website, called Cluster 2.0. This product can be used as a tool to test a new extension to existing innovation system theories, researched by the INNOFIT research group [2]. For our case the Galileo project was used, Europe's first global satellite navigation system. Because the Galileo project is a relatively new project, with potential to develop in a huge and diverse market, it is perfect to use to test the new theory on.

Before diving into the development process itself, a theoretical framework is presented. This is necessary to fully understand all the various concepts and background information, that have been used as a foundation for Cluster 2.0. This framework has been divided into two parts, each leading to a different problem statement.

In the third chapter a possible solution is presented, that can eliminate both of these problems, by providing a unique platform. In chapter 4 and chapter 5, certain important steps that were taken to produce Cluster 2.0 from scratch are presented. This is done so one can truly understand all the choices of our systematic approach, that have been made throughout the development.

Because Cluster 2.0 is a combination of two platforms, each aimed at different user groups, the sixth chapter will describe how each platform can be used. As the development was a highly iterative and user-centered process, this bachelor thesis will conclude using the actual results of the user feedback and several possible future challenges.

2 Theoretical Framework

Before proceeding to the development of Cluster 2.0 it is necessary to understand the domain of our research. For that reason, a theoretical framework will explain the background information and different concepts that will be used as pillars for our further research.

2.1 Innovation

The actual concept of innovation has been studied in a variety of contexts and has many different definitions in current and previous literature.

> *Innovation is generally understood as the successful introduction of a new thing or method. Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services.* [3]

Because of the many factors involved in innovation and the different causes of origin, innovation as such is hard to define [4]. However, there is one factor that is mentioned in almost every definition: *newness* [5]; a new way of doing something.

What does this concept of newness exactly refer to? Schumpert categorized five different types of newness as follows [6]:

- introduction of a new product or a qualitative change in an existing product
- process innovation new to an industry
- the opening of a new market
- development of new sources of supply for raw materials or other inputs
- changes in industrial organization

When understanding this relatively basic concept of innovation, one might ask himself the next logical question: *Why is innovation important?*

Technology is changing fast. New products from new competitors are being developed continuously. In this fast changing environment, product lifetimes have shortened, and the need to replace products sooner has grown substantially. It is becoming harder and harder for companies to differentiate themselves. Especially when competing against lower cost countries, there is a continual pressure to devise new and better products, processes and services faster. It is clear that on a corporate level, innovation is becoming more and more important for companies, as it is widely recognized as a key ingredient of productivity, in term determining the *continuity* of a company or organization.

The continuity and success of multiple companies can lead to both economic growth and the decrease of unemployment rates in a region. If government agencies would stimulate innovation proactively, it would lead to better economic performances on a nationwide level. Generally speaking, the more innovations are developed, the more increase we can see in the production of goods and the wealth of a nation [7].

2.2 Innovation Theory

Because of the importance of innovation, a great amount of research has been done on how to increase this level of innovation from both an economic and a managerial point of view. What factors and variables are a part of this innovation formula? How can government agencies for example, ignite this spark of innovation on purpose?

One of the first theories has been attributed to the early works of Joseph Schumpeter. Schumpeter introduced the entrepreneur himself as the main cause of innovation in a company. In his book [8] he describes how entrepreneurs like Thomas Edison, Henry Ford, Graf Zeppelin and Anthony Fokker were at the source of innovation driven firms. So to make innovation happen, we would need more entrepreneurs, and to get entrepreneurs, we need to stronger support them [9].

Schumpeter later changes his thoughts on innovation: it is no longer the entrepreneur that creates the inventions, but the efficiency of paid managers that improves the innovation process. To make innovation happen, innovation departments are required with plenty of resources and a more disciplined process. Throughout the years, the way of thinking about how to make innovation happen, evolved rapidly. From innovation by adoption of new ideas in society, to using innovation as a strategic means to differentiate in mature markets.

Over time innovation policies turned towards breakthrough innovation through strategic pooling of available resources. This concept aims to achieve innovation through collaboration in networks: innovation through strategic cooperation in *innovation systems*.

2.2.1 Innovation Systems

Innovation systems are used as a framework to understand innovation. There is no consensus on the exact definition of an innovation system. While the concept is still emerging, the innovation system stresses that the *flow of technology and information* among people, enterprises and institutions is key to an innovative process. It contains the *interaction* between the actors who are needed in order to turn an idea into a process, product or service on the market [10].

One of the stimuli for strategic cooperation and interaction between actors, is the situation in which enterprises, research institutes and service providers gather geographically. This regional phenomenon is also known as a *cluster*. In an area where a lot of companies and institutes are gathered, it is much more likely for key people to interact with each other. This increase in interaction indirectly enhances the possibilities of an increase in innovation.

Innovation system theory is used to describe the factors and components that explain innovation. New components are still being developed and integrated into the traditional innovation system. One of the new components is the concept of clusters.

2.2.2 Business Clusters

Clusters are geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialized inputs such as components, machinery and services, and providers of specialized infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies, or common inputs. Finally, many clusters include governmental and other institutions – such as universities, standards-setting agencies, think tanks, vocational training providers, and trade associations, that provide – specialized training, education, information, research and technical support [11].

Michael Porter explains in his "Clusters and the New Economics of Competition", how these business clusters can affect competition. According to Porter, modern competition depends on the productivity of a company. Productivity can be influenced by many variables. One of these variables is *how* the company competes. The sophistication with which companies compete in a particular location, is strongly influenced by the quality of the local business environment. Clusters affect competition in three broad ways:

1. by increasing the productivity of companies based in the area
2. by driving the direction and pace of innovation, which underpins future growth
3. by stimulating the formation of new businesses, which expands and strengthens the cluster itself

A cluster allows each member to benefit as if it had greater scale, without requiring it to sacrifice its flexibility. So being part of a cluster, allows companies to:

- operate more productively in sourcing inputs
- access information, technology and needed institutions
- coordinate with related companies
- measure and motivate improvement

Porter then continues and makes the link with innovation. In addition to enhancing productivity, clusters play a vital role in a company's ongoing ability to innovate. Some of the same characteristics that enhance current productivity have an even more dramatic effect on innovation and productivity growth. There are numerous reasons why being part of a cluster, can lead to more innovation. To sum up a few of these reasons:

- Sophisticated buyers are often part of a cluster, so companies inside clusters have a better window on the market than isolated competitors do.
- Clusters provide the capacity and the flexibility to act rapidly; companies within clusters can often source what they need to implement innovation, more quickly than competitors.
- Suppliers and partners can and do get closely involved in the innovation process, thus ensuring a better match with customer's requirements.
- Companies within a cluster can experiment at lower cost and can delay large commitments until they are more assured that a given innovation will pan out.
- Peer pressure, pride, and the desire to look good in the community spur executives to outdo one another.

For all these reasons, it is expected that clusters will remain centers of innovation for decades. When discussing clusters and the link to innovation, it is logical to take a look at an example of a cluster. One of the most successful high-tech clusters on our current planet is *Silicon Valley*.

2.3 Silicon Valley

> *During recent years the San Francisco Bay Area developed rather suddenly into one of the major centers of electronics research and industry in the United States. To those who knew the background it seemed a natural evolution in a region that has been the scene of radio and electronics pioneering since early in the Century.*
> – Frederick Terman [12].

Silicon Valley is widely known as the center of technology and innovation in the world. Despite the development of other high-tech economic centers throughout the United States, Silicon Valley continues to be the leading high-tech region. The income generated by Silicon Valley accounts for six percent of the gross national product (GNP) of the United States of America.

The rise of Silicon Valley gained worldwide attention because it seemed to offer the possibility, that a region with no prior industrial history could make a direct leap to a leading-edge industrial economy, given the right set of circumstances, without the time and effort required to pass through the intermediate stages of development [13]. How could so much growth occur in so short time? This phenomenon fascinated many, and led to government agencies wanting to create the next Silicon Valley in their own backyard [14]. Silicon Valley had become the Holy Grail of economic development.

Using traditional innovation system theory, many tried to explain the success of Silicon Valley. At first this actually seemed to provide an accurate framework for the highly successful cluster. It was common believe that the success was due to the abundance of resources, and all the fortunate conditions in the area, like the elite education system [15].

Using innovation system theory among other research, attempts have been made to duplicate these resources and conditions. Despite satisfying all requirements and resources, there has not yet been a cluster as successful as Silicon Valley.

2.3.1 Expanding Traditional Innovation System Theory

The Route 128 region around Boston is an example of a cluster that failed to be as successful as Silicon Valley. According to a paper by Martin Kenney and Urs von Burg [16] the most common explanations for the divergent performances of the Silicon Valley and Route 128 economies, were:

- differing cultures
- inter-firm relations
- internal organizational style

AnnaLee Saxenian suggests in her "Comment on Kenney and von Burg, Technology, Entrepreneurship and Path Dependence: Industrial Clustering in Silicon Valley and Route 128" [17] that there are other reasons for the success of Silicon Valley, and Route 128 not being as successful:

> *Silicon Valley's regional advantage lies not in its early entry onto a prolific technological pathway, but in an institutional environment that supports continuous innovation and collective learning – one that by its very nature undermines technological trajectories or path dependency. In the post-war period, the region's engineers rejected the management models and practices of mainstream corporate America in their efforts to preserve the flexibility and innovative dynamism of their early entrepreneurial successes. The institutions and social structures they created combine intense inter-firm communication and learning with a continually deepening social division of labor. As a result growth in Silicon Valley today occurs more through the conceptual advanced and innovations that derive from specialization, experimentation and recombination than from the scale economics associated with progress along a predetermined technological paradigm.*

One key aspect mentioned here is the *intense inter-firm communication and learning*. INNOFIT expanded the innovation system theory, with the concept of *networking*. Companies in Silicon Valley participate a lot in networking through different methods, leading to an exchange in information and opening up possibilities for collaboration. This translated itself into a new component that can be added to existing innovation system theory:

Networking leads to innovation.

2.4 Case: GALILEO

One of the main pillars of European transport policy is to stimulate the innovation of technology. On 26 May 2003, the European Union and the European Space agency agreed upon a programme, called Galileo. The Galileo project is a European initiative for a state-of-the-art global navigation satellite system. It is the first satellite positioning and navigation system that is specifically designed for civil purposes, unlike the system in the United States, which is primarily intended for military usage.

To test the new innovation system theory, a case was needed obviously. INNOFIT chose the Galileo project to test the new theory on. Before explaining why this specific project was chosen, let's first briefly discuss some specifications about the project itself.

2.4.1 Specifications

There has been 3.4 billion euros invested in the project so far. To fully deploy the Galileo system, 30 satellites have to be launched into outer space and the associated ground infrastructure has to be installed. On 30 November 2007 the 27 European Union transportation ministers involved, reached an agreement that the system should be fully operational by 2013.

Predictions have been made, that the market for equipment and services will be worth around 200 billion euros per year when the system is deployed. Over 100.000 new jobs are expected in all kinds of industries like transport, environmental management and recreation.

The Galileo project currently has three clusters associated with the satellite navigation industry:

- Munich, Bavaria
- Leiden, South-Holland
- Prague, Czech Republic

2.4.2 The CASTLE Project

CASTLE is a project, which has the goal to form a transnational cluster uniting the three European regional clusters engaged in aerospace technologies, with a sector-specific focus on satellite navigation technology applications while open to new partners. This goal has been split into six specific objectives:

1. To identify and describe the existing structures, carry out an evaluation and form a networking platform.

2. To induce an exchange of best practice based on the collected information of a SWOT analysis.

3. To identify the business and market trends within and beyond the three partner clusters.

4. To initiate joint business strategies and identify resulting opportunities.

5. To propose specific support policy and co-ordination actions, as well as measures to be taken at the regional and transnational levels to increase the efficiency and impact of innovation policies at the macro, meso and micro-economical stages.

6. To disseminate and exploit the knowledge generated through the setting up of an intranet platform as well as through meetings and the continuous flow of information.

The project aims to support the three existing cluster structures to enable them to become more competitive and to develop as European leaders in innovative and creative applications covering new and known fields of SatNav.

Expected project results include the mobilization of existing SatNav clusters in Europe to collaborate and exploit synergies, to better understand the success factors and weaknesses of clusters, the launch of joint projects and business strategies between new and old cluster partners and the extraction of policy lessons and recommendations for new member states' key players.

One of the important findings from the CASTLE project was the following:

All the clusters show a weakness in market orientation.

2.4.3 Motivation

The Galileo project is perfect to test the new theory. There are plenty of resources in the different clusters and it is going to stimulate a completely new market and industry in Europe. Because of the novelty of the project itself, it is ideal to test the theory, hopefully stimulating the networking while the clusters are developing and growing. In the coming years, more and more resources will be added to the clusters, like universities, educational centers and technical centers. By monitoring the market, and stimulating the networking, we can test this fresh innovation system theory in a proper way. Combining existing business cluster advantages with the advantages of networking – like an exchange in knowledge and collaboration between prospective partners – will hopefully lead to a visible increase of innovative concepts and thus innovation as a whole.

2.5 Combining Knowledge

To test our theory while monitoring the market, the following was proposed as a basis for my bachelor project and further research:

1. Design a mapping system for the emerging Galileo SatNav industry clusters.
2. Combine this with a social networking platform for SatNav professionals and firms.

The use of a mapping system, will provide a way of seeing how the European SatNav market will develop and evolve. If the system could monitor the growth of currently associated clusters, by collecting all relevant data about companies and other stakeholders in these clusters, this would eliminate the *weakness in market orientation* of these clusters, which was one of the findings of CASTLE. Combined with a social networking platform, this provides us with a solid and concrete opportunity to test the new innovation system theory.

3 Developing Cluster 2.0

> *If a builder build a house for someone, and does not construct it properly, and the house which he built falls in and kills its owner, then that builder shall be put to death.*
>
> – Article 229 of the Code of Hammurabi (1780 BC)

The path from concept to reality is a difficult one; the creative urge needs to be made subservient to the need to support the user. That is why I chose a very systematic approach to the development, using both modern software engineering techniques and widely used human-computer interaction disciplines, that will be explored thoroughly in the following sections.

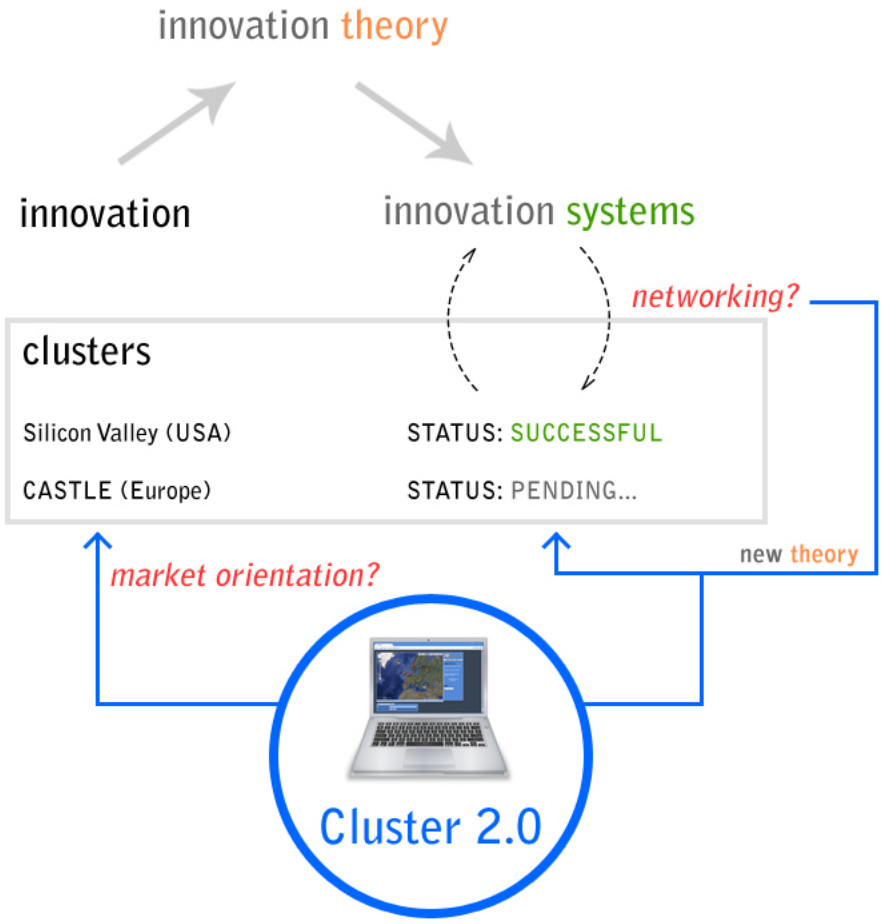

Figure 1: Cluster 2.0 as a tool to test a new theory, while tracking an emerging market.

3.1 Domain Analysis

Before starting to solve any problem, one should first put a certain amount of effort in understanding the particular problem and its background information. Using the previously introduced theoretical framework, we have complied in getting a vivid impression of this project's domain. This will provide us with certain benefits like faster development, a better system and anticipation of extensions to the system.

The goal is to develop a website, which will be named Cluster 2.0, that displays all the clusters of the SatNav industry and the stakeholders within these clusters on a map. Users can search for these stakeholders and get more information about them in a rapid and user-friendly way. Users can also add their company or institute to the map, which will allow them to join the social network.

The user group for Cluster 2.0 is quite diversified. From stakeholders that want to add themselves to the map so they can join the network and communicate with others, to curious individuals or company representatives that simply want to browse for certain information. Our most important user group however will be the stakeholder. The reason for the latter is that for our platform to be successful, stakeholders need to be stimulated to participate on our website. Participation means adding themselves to the map and being proactive on the network. Therefore the focus should be especially on the needs of the stakeholder. An important question that we kept in mind throughout the development of Cluster 2.0 was:

How can the user-friendliness and accessibility of Cluster 2.0 be optimized to appeal to potential and current stakeholders?

One of the advantages of testing a new innovation system theory, in a unique way on a yet to be developed platform, is the lack of competitors. Because of the uniqueness, and the under-developed market, Cluster 2.0 has many opportunities to excel. With some extra effort, a generic version of this product could be created, instead of a custom product focused on the European SatNav industry.

3.2 Defining the Problem

Cluster 2.0 is based on the concepts developed by the INNOFIT research group. The website will gather and share information about all the stakeholders within the SatNav industry. It will do so by providing stakeholders with the ability to add their information to the map. By adding themselves, they get the opportunity to join the social network.

The website can be split into two platforms: a social networking platform and an information platform. The information platform will be the part that uses the mapping system for stakeholders, which will be realized by using Google Maps [20]. The social networking

platform will use an external social network, customized to our requirements. This will be done by creating our own social network on the Ning [21] website. The integration with the social network website will make Cluster 2.0 become a platform to:

- release and share information
- search for prospective partners and competitors
- communicate and connect with other stakeholders
- explore new opportunities and possibilities
- create and participate in events

3.3 The Starting Point

When starting to work on a project, the starting point can vary considerably. Different types of projects can be distinguished, based on whether or not *software* exists at the outset, and whether or not *requirements* exist at the outset. Before starting the actual development of Cluster 2.0 I had to evaluate the starting point of our project. The four broad categories of starting point are illustrated in Figure 2.

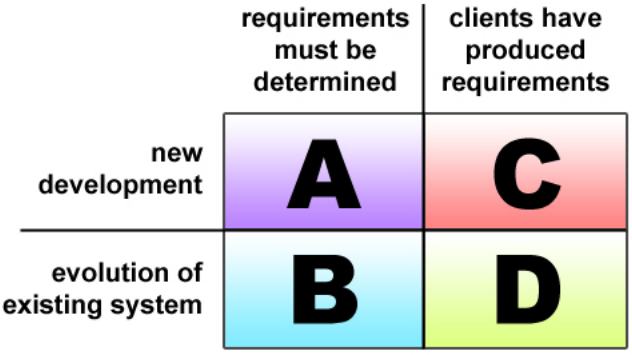

Figure 2: Starting points for software projects.

Because there was no existing system, on which I could build and evolve, everything had to be developed from scratch. Also, the requirements of the project had not been pre-specified, so these had to be determined manually. Thus using Figure 2, the Cluster 2.0 project could be categorized as a *Category-A* project [19].

3.4 Developing Requirements

Definition: a *requirement* is a statement describing either 1) an aspect of what the proposed system must do, or 2) a constraint on the system's development. In either case, it must contribute in some way towards adequately solving the customer's problem; the set of requirements as a whole represents a negotiated agreement among all stakeholders.

3.4.1 Functional Requirements

Functional requirements describe what the system should do; in other words, they describe the *services* provided for the users and for other systems.

1. When using the map displayed on the website, a user can do the following things (conditions under which input and output can occur):

- See all the stakeholders and clusters on the map, visualized by specific icons. Some stakeholders that are grouped together in a cluster, are not visible, until a user zooms in to the desired level. This is done to prevent crowding of icons. A replacing icon visualizes the cluster. The icons of stakeholders and clusters are both clickable.
- Drag the map to an area of interest, by clicking on the map and releasing when at the area of interest.
- Zoom to the desired level. Zooming can be done by using the provided buttons on the map, or by using the scroll wheel or mouse wheel. The level of zoom can possibly influence the amount of points on the map, that represent stakeholders and/or clusters.
- Change the type of map that is showed to the user. This is done by selecting one of four different map types, which are part of the popular Google Maps system. Default is the satellite map view. The map types are:
    - Map: the default road map view.
    - Satellite: Google Earth satellite images.
    - Hybrid: a mixture of normal and satellite views.
    - Terrain: a physical map based on terrain information.

- Get more information about stakeholders and/or clusters by clicking the icon representing them. When clicking these icons, a small box will pop-up with some information. The amount of information displayed, depends on the amount of information that the stakeholder wanted to share with you. Usually it will consist of some basic information like the company name, address and some contact information. Sometimes this information will contain an url. When an url is clicked, it will open in a new window, so the Cluster 2.0 window stays open in its current state. When a user clicks on another point of interest, while the pop-up box of a previous point of interest is still open, the current pop-up will close and a new pop-up will open.

2. The user can search for a specific stakeholder or multiple stakeholders in one of the following ways (conditions under which input and output can occur):

- By entering a name or keyword in the search box. After pressing the search button, the Cluster 2.0 back-end will search the database for companies with that name, or companies that have the keyword in their information or description. Results will be shown to the user in a listed form.

- By filtering all the stakeholders within a cluster. To do this, a user can click on the drop-down list, where all the clusters are listed. After clicking on the corresponding cluster, all the stakeholders within this cluster will be shown to the user in a listed form.

- By clicking on an item in the result list. This result list will only be visible, if a user did a search previously. After clicking on one of these items, the map will move to the corresponding point and open the pop-up box with more information about that specific stakeholder.

3. The user can add himself to the map and become part of the social network (conditions under which input and output can occur):

- After a user clicks on the large visible button with the label `[Add yourself to the map!]`, an input box will be shown to the user. This input box allows a user to enter an address and click the `[next]` button. If the address does not exist, the user will be informed of this event. If the address exists, the map will automatically center on it, and zoom to a user-friendly level. Now another input box will allow a user to enter the following information:

  - company name

  - website

  - contact person

  - e-mail address

  - telephone

- skype id

After entering this information, and clicking on the `[next]` button, the user now has the ability to enter:

- which, if any, *cluster* the stakeholder is part of
- what industry represents the activities of the stakeholder best
- additional information about the products and/or services provided

If a user finishes this last step, and clicks the `[next]` button, a message will be shown to inform the user that the database now is adding all the information. Also a message will be shown that the user should check the e-mail inbox of the e-mail address provided, to find an invitation for the social network. This message will be shown for five seconds, after which the website refreshes the map automatically, having added the new stakeholder.

4 Design Methodologies

The goal of design methods is to gain key insights or unique essential truths resulting in more holistic solutions in order to achieve better experiences for users with products, services, environments and systems they rely upon. Insight, in this case, is clear and deep investigation of a situation through design methods, thereby grasping the inner nature of things intuitively [22]. In the following sections, some interaction design basics used regarding prototyping and evaluation will be explored.

4.1 Iteration And Prototyping

Human situations are complex and designers are not infallible, therefore it is likely that our first design will not be perfect. For this reason almost all interaction design includes some form of iteration of ideas. In our case this started with paper designs being demonstrated and evaluated. Any of these design can be evaluated to see whether they are acceptable and where there is room for improvement. The design can then be modified to correct any false assumptions that were revealed in the evaluation and testing. This is the essence of *iterative design*, a purposeful design process which tries to overcome the inherent problems of incomplete requirements specification by cycling through several designs, incrementally improving upon the final product with each pass [23]. Iterative design is described by the use of prototypes, incomplete versions of the software being developed, that simulate or animate some but not all features of the intended system [24].

There are many variants of prototyping. For Cluster 2.0, *rapid prototyping* or throwaway prototyping was used. Rapid Prototyping involved creating a working model of various parts of the system at a very early stage, after a relatively short investigation. The method used in building it is usually quite informal, the most important factor being the speed with which the model is provided. The model then becomes the starting point from which users can re-examine their expectations and clarify their requirements. When this has been achieved, the prototype model is 'thrown away', and the system is formally developed based on the identified requirements [25].

The most obvious reason for using rapid prototyping is that it can be done quickly. If users can get quick feedback on their requirements, they may be able to refine them early in the development of the software. Making changes early in the development life-cycle is extremely cost effective since there is nothing at that point to redo. Another strength of rapid prototyping is the ability to construct interfaces that the users can test. The user interface is what the user sees as the system, and by seeing it in front of them, it is much easier to grasp how the system will work.

4.1.1 Examples

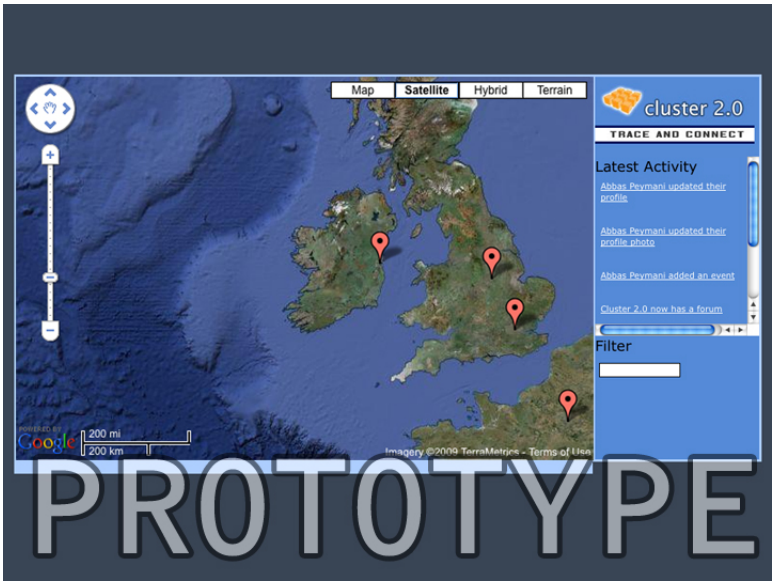

Figure 3: One of the first prototypes, early on in the development process.

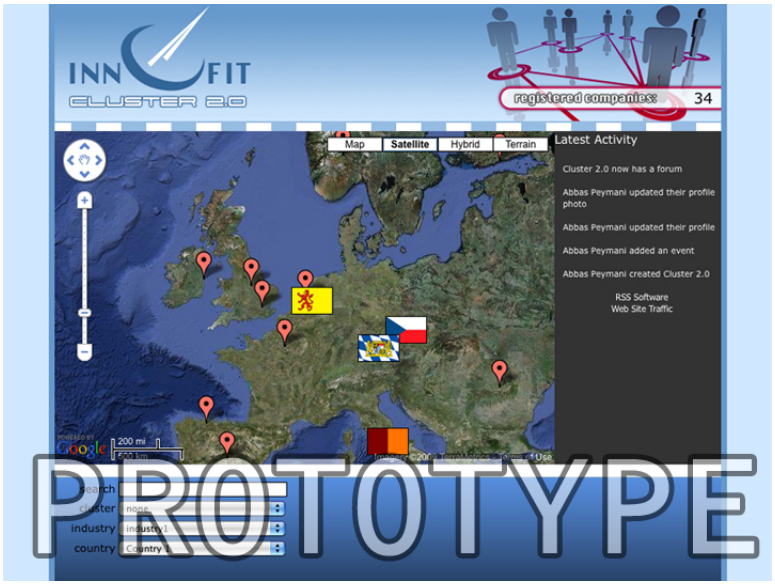

Figure 4: One of the later prototypes, after a lot more progress had been made.

4.2 User Evaluation

In the previous sections, processes to support the design and development of Cluster 2.0 have been discussed. However, even when using all the various techniques and research, the design still needs to be assessed and the website has to be tested, to ensure that it actually behaves as expected. Does Cluster 2.0 meet all of the pre-determined requirements? This is the role of *evaluation*.

Evaluation has three main goals:

1. Assess the extent and accessibility of the system's functionality. Does the functionality accord with the users' requirements?
2. Assess the users' experience of the interaction.
3. Identify any specific problems with the system. Identifying trouble-spots which can be rectified.

There are many ways to evaluate software. Some of these methods rely on the designer and developer to evaluate the system, other methods focus on user participation. For Cluster 2.0 I wanted to use multiple methods of evaluation, both by myself as a developer and the users themselves. This will lead to a good amount of feedback that can be used to further improve Cluster 2.0.

4.2.1 Cognitive Walkthrough

Cognitive walkthrough involves one or a group of evaluators inspecting a user interface by going through a set of tasks and evaluate its understandability and ease of learning. The main focus of the cognitive walkthrough is to establish how easy a system is to learn: *learning through exploration*. To do a walkthrough, four things are needed:

1. A specification or prototype of the system.
2. A description of the task the user is to perform on the system.
3. For each task, there must be a description of how the user is expected to complete the task.
4. An indication of who the users are and what kind of experience and knowledge the evaluators can assume about them.

With all the required information, one can proceed with carrying out the tasks that have to be performed on the website. For each of these tasks, the evaluator should try to answer the following four questions:

1. Will the users try to achieve the right effect?
2. Will the user notice that the correct action is available?
3. Will the user associate the correct action with the effect to be achieved?
4. If the correct action is performed, will the user see that progress is being made toward solution of the task?

4.2.2 User Participation

Another way of evaluation relies on asking the user about the interface directly. This embodies the philosophy that states that the best way to find out how a system meets user requirements is to *ask the user*. The advantage of this method is that the users' viewpoint is retrieved directly, and it may reveal issues that would not have been considered by the designer.

Interviewing users about their experience with our website, provided a direct and structured way of gathering information. After every few prototypes, users were interviewed to get their feedback, and then that feedback was used to optimize and improve the following iterations. The user-centered feedback was such a helpful and important tool, that I decided to dedicate a chapter to the results.

5 Using Cluster 2.0

As mentioned before, Cluster 2.0 combines two platforms, an information platform and a social networking platform, into one website. For the social networking platform, an external website is used, that allows us to create our own social network with some basic features. The information platform is obviously a completely internal concept. For that reason, the usage of the two main functions of the information platform, will be explored in detail.

5.1 Information Platform

The information platform of Cluster 2.0 serves three different purposes. It allows our user group to:

- trace an emerging industry real-time
- search for partners and competitors
- get informed about what is going on in the community behind the platform

The real-time tracing of how the satellite navigation industry emerges, develops and flourishes, can be done by marking the geographical location of stakeholders on the map that is shown on the website. The marking is done automatically when stakeholders add themselves to the map and provide some basic information.

Because of this basic information, that is registered in a database, certain operations on all of this collected data can now be carried out. Besides using the data in further research, it can be used to provide our user group with search and filter possibilities. Users can find competitors, service providers, suppliers and any other stakeholders by searching for a specific name or keyword, or filtering the results based on geographical properties – like country name or associated cluster.

The main page will update a feed, containing:

- actual news and events regarding the SatNav industry
- events that are happening real-time, or in the future
- new stakeholders joining the platform and/or social network

All of this information is transferred automatically from the social network. So when visiting the site, you get aware of all the latest news and events, which will hopefully trigger the users' curiosity, and stimulate the user to take part in this new community.

5.2 Networking Platform

The networking platform of Cluster 2.0 is obviously very important, for it is the core tool to test the new innovation system theory. It serves multiple purposes, and allows users to:

- connect and communicate
- organize social events
- discuss and comment on the forums
- invite other users to join the network

Through the networking platform, and the various tools associated with the latter – like a chat function, the ability to send e-mails and private messages, possibilities to go to social events together – users can connect and communicate with other stakeholders. This is crucial for our project and could lead to *intense inter-firm communication and learning*, which in turn can lead to more innovation on long term base.

Besides attending social events that have been organized by others, users can also organize social events themselves. An added benefit is that the person that organizes the event, can exactly stipulate which people get an invitation. These people in term can reply to the invitation, providing feedback to the organizer of the event about who *is* attending, who *is not* attending and who *might* attend.

The forum is an inevitable tool, and necessary to stimulate group discussions. It provides users the ability to share information and experience with other group members, or to discuss and comment on specific topics like policy and common pitfalls that stakeholders should avoid.

One very important aspect of the network, is the ability to expand itself. To reach this goal of *organic growth*, all the users on the network have the ability to invite other people. If these potential members choose to join the network, they in term have the same ability to invite others and vice versa.

Of course these are all some very basic functions that have been included in the social network. In the future more functions could be added to support the need and flexibility of the user. All these different tools and functions, evolve around the following fundamental concept:

Learn from each other through communication and networking.

6 User Feedback

After each batch of prototypes, a lot of feedback was received. Obviously it is impossible to discuss all the feedback received. To show the variety of feedback that was received, a selection has been made of some feedback that led to both big and small changes in the design.

One of the first comments on Cluster 2.0, was regarding the limited possibilities for the user to search the database. The only way to search was to use keywords, that would get matched against company names and description. The solution that was used, was to expand Cluster 2.0 with a filter system, so users could filter results based on properties like cluster or industry. These *search filters* provide an accurate way to rapidly find the stakeholder(s) that the user is interested in.

When adding your company to the network, a user first has to enter an address. If the address is valid, the Google Maps application will center the map at that point and add a marker to that point, pinpointing the exact location corresponding with the address. Google Maps is a revolutionary application, but it can be slightly off when pinpointing the exact location. Therefore Cluster 2.0 now has the ability added to manually change the location of the marker after entering an address. Something so small that the function probably would not have been added, if specific evaluation methods had not been used.

The *social network feed* was another concept developed after one of the first prototypes. This concept focusses on how to make Cluster 2.0 more appealing and stimulating to potential stakeholders. For the platform to be successful, it is a necessity to sparkle the interest of site visitors to register themselves by adding themselves to the map. Someone that would visit the site, should not only get informed about the social network, but also feel an urge to become part of the community. Exploring principles from both sociology and psychology disciplines [26], there are several important reasons why people join groups:

- security
- to enhance self-esteem
- to share information and/or gain knowledge
- affiliation
- social needs
- to achieve certain goals or objectives

If a person anticipates the fulfillment of any of the stated objectives, he or she will be much more likely to proactively try and join a group or community. By expanding Cluster 2.0 with a feed of the social network, users might find themselves becoming curious about the community and the associated advantages that joining the network could result in.

7 Web 2.0

In the previous section, several objectives were stated that can stimulate a user to participate in Cluster 2.0. To further fulfill these objectives and to optimize user stimulation, one of the last prototypes was expanded with *Web 2.0* technology. Web 2.0 refers to web development and web design that facilitates interactive information sharing, interoperability, user-centered design and collaboration on the World Wide Web. In contrast to non-interactive websites where users are limited to the passive viewing of information that is provided to them, Cluster 2.0 allows users to interact with other users and even change certain content pages [27]. To achieve this, several external concepts have been used and carefully integrated:

- RSS
- Wordpress
- Twitter
- MediaWiki
- LinkedIn

RSS simply provides the user with a feed, containing the same information as the social network feed that is displayed on the main page. This allows users to rapidly keep themselves informed about what is going on in the network, even when not using the Cluster 2.0 website. The feed can be configured in several external applications, to show the latest events on blogs or even mobile phones. Furthermore the Wordpress blog allows users to read the latest news and announcements, and comment on these accordingly. These two methods provide an efficient way of broadcasting information rapidly through

Everybody is familiar with Wikipedia and its revolutionary system to provide users with information that has been added by other users. One of the reasons why people join groups was to *share information and/or gain knowledge*. Therefore a wiki platform would be perfect to use for Cluster 2.0. MediaWiki is a free software wiki package, that is also used on the original Wikipedia website. One of the key aspects here is that users themselves can add and edit the pages on the platform.

To enhance certain social needs and the feeling of affiliation, both Twitter and LinkedIn are used. Twitter is a free social networking and micro-blogging service that enables its users to send and read messages known as tweets. This allows everyone that is interested to see what is going on in the community. LinkedIn is a business-oriented social networking site mainly used for professional networking. On the LinkedIn website, a group is created for all the Cluster 2.0 stakeholders.

8 Conclusion and Future Work

In this bachelor thesis a theoretical framework has been presented that concisely stated all the background information and research leading to the development of Cluster 2.0. Taking this background information and research into account, combined with principles of various disciplines – like software engineering and human-computer interaction – the development of Cluster 2.0 has been explained thoroughly. Even though the current product could be used to test the innovation system theory that was developed by INNOFIT, it can be further adjusted and enhanced to be able to serve as a fully functional and professional product.

The Dutch Minister of Education, Dr. Plasterk, recently announced that all research funded by public money should be freely accessible. For many years, Dutch scientific organizations have been trying to stimulate *open access*: free access to all scientific information. Currently our society is striving to evolve towards this open access, especially if the research is funded through their money. If society demands such a thing, it is obviously an important issue. The core values that are brought out into the open through open access are linked to the notions of collaboration and socialization in Web 2.0 [28]. Therefore by connecting and expanding the Cluster 2.0 platform with several Web 2.0 techniques, a small step has been made to conform to the concept of open access. Future work could evolve on this concept and integrate the newest Web 2.0 technologies into our platform. The website is currently linked to a wiki platform, which in this early stage does not have any content yet. It could be very beneficial for both stakeholders and the public if the wiki platform for example would get some basic content, after which the platform could expand by itself, after initial interest has been aroused.

Currently the design mainly serves a functional purpose. To fully exploit all the advantages of a product like Cluster 2.0, it would be best to have a professional design that is both functional and aesthetically pleasurable. When professionally designing for usability, there are certain criteria that can be taken into account – like how information should be positioned and presented to the user [29] – that could dramatically improve the conscious and subconscious user experience of Cluster 2.0. Future work could focus on using certain design techniques and proven research tools from various disciplines, like human-computer interaction, and applying the results to the platform.

For the social network currently an external website is used. This has various limitations from both a business and a developers point of view. It is strongly recommended to develop a custom social network for Cluster 2.0, fulfilling all the required and necessary needs, and flexibility to collaborate with the information platform. The Cluster 2.0 community should not be dependent on an external website, like it currently is. For the mapping system it is pretty safe to depend on the Google Maps service. Google is one of the biggest companies in the world, and a lot of other companies depend on their Google Maps system. If the mapping system would ever go down, for any of a number of reasons, the community would not suffer from this substantially. Besides being completely unnecessary, it is also highly unrealistic

to develop our own web mapping service application. Therefore future work could focus on developing a very simple but effective social network, that allows Cluster 2.0 itself to serve as a communication platform instead of depending on an external organization. This could be done by developing a very basic system where users can register an account, update profiles and send messages to other users, and then expanding it with more tools like event management and a forum.

One of the most important things for a project of this calibre to be successful, is both the quantity and quality of the user feedback received. Different evaluation methods on a larger scale could be used in the future to greatly enhance various features and aspects of Cluster 2.0. An example would be to use questionnaires as a research instrument for the evaluation. The platform itself also has multiple databases filled with data. A system could be developed that uses data mining techniques to find and extract certain patterns in this data. The results can be used to improve the platform, enhance our knowledge about the industry or find interesting new patterns.

It is clear that there is a lot that can be done in the near future to increase the technology used, to stimulate communication and to expand Cluster 2.0 with more and more functionality. One thing that prospective researchers should keep in mind however is the assessment between the functionality and the resulting increase or decrease in usefulness. There are different methods to present your user group any new concept. An interesting example that I would like to briefly mention is the SAVE ENERGY Project. This is an organization that aims to transform the energy consumption behavior of public building users by applying ICT-based solutions [30]. Their website can be visited at `http://www.ict4saveenergy.eu/`. Instead of developing a system from scratch, they provide the user with links to external websites. These external websites are a mix of popular widely used tools and platforms like Flickr, Wordpress and MediaWiki. For Cluster 2.0 we developed our own system from scratch, yet combined it with a decent amount of external services. It will be interesting to see which methods will provide to be the most successful in the future.

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