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Design Thinking in Developing a New DP Reference Sensor

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Abstract

The paper describes the development of a new DP reference sensor based on the implementation of a Design thinking process. Compared to traditional development processes based on a set of known requirements, Design thinking allows unknowns to be taken into account. This is useful when developing a product based on advanced and complex technology. To meet the challenge of what is unknown it is important to actively use ideation as a part of the process. An example of the outcome of ideation is using detector arrays rather than a single detector for the reflected laser beam. The Design thinking process has also been about connecting to the user community and the user environment. This has been done to avoid the "solution without a problem" syndrome. The user environment has been visited and observed by use of a multi perspective approach which has given valuable learning and insight. At some point it is necessary to enter into the disciplined phase of implementation and testing. This is the phase where the costs start to get substantial and risks carefully managed. Receiving the "Merket for god design" award in two categories, industrial design and interaction design, was an important encouragement but the final and most important judgement is going to be made by the users.

Introduction

The traditional design process of DP reference sensors is dominated by focusing on functionality, compliance with formal standards and meeting certain technical specifications. Less effort has usually been put into considering the complex user environment for these products, like installation, maintenance and operation. Technology and product quality are still crucial to achieve sufficient accuracy and reliability, but it is also important to really include human aspects in the product design process.

When developing a new, laser based DP reference sensor, we decided to invite industrial designers and interaction designers into the design process. This involvement gave both inspiration and valuable insight. We even sent interaction designers on board to analyse the user environment during real operations. This radically changed the product both with regard to functionality and design.

This paper describes our interpretation of design thinking in the context of developing a laser based DP reference sensor. It also discusses lessons learned for running this process and the impact on the final product.

Design thinking

The traditional, scientific design process usually follows the following development steps:

- Defining parameters of the problem
- Creating a solution
- Verifying that the solution meets the requirements
- Validation of the solution to check that the requirements are relevant

This - and similar processes - are still used with great success in many situations. However, this method is built on the assumption that "defining parameters of the problem" is possible. This is not always a true assumption.

In real life there might be a lot of uncertainty regarding what is technically feasible and what the real user need is. The result is usually the wrong solution to the wrong problem, and at an incredibly high cost.

Design thinking can be traced back to the late sixties and emerged as an alternative approach. Design thinking can be summarised as a method for developing active, practical solutions to problems using creativity as an element in the process.

In Design thinking it is important to:

- Explore both known and unknown aspects of the situation
- Discover hidden parameters
- Open alternative paths
- Iterate

As an alternative to the classical waterfall model, the Design thinking process can be illustrated as in Figure 1.

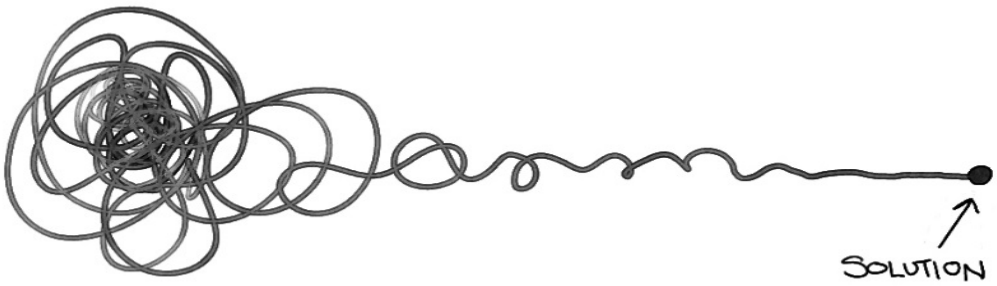

Figure 1: The Design thinking process

The apparently confusing phase in the beginning is important to explore possibilities and alternatives at an early stage. As alternatives are explored and excluded, the process zooms in and follows a more traditional path at the end.

Some elements are important in a Design thinking process:

- Defining an ambitious and inspiring goal
- Appropriate framing of the problem
- Making research to explore feasibility and technology options
- Ideating to find alternative solutions
- Rapid prototyping to get early feedback
- Choosing among alternatives
- Implementing solutions
- Learning as a part of the process
- Continuous search for improvements

These are elements that do not necessarily following each other in a particular order. Our ambitious and inspiring goal was:

“Make a really cool laser based DP reference sensor”

Technology

When the idea of developing a new, laser based reference sensor occurred, there basically were three observations used for making the decision to proceed:

- We already had developed DP reference systems based on other technologies (GNSS, microwaves and inertial), and could assume we knew the basics of designing such systems
- There were already laser based systems on the market, and we could assume that there was a market for such solutions
- We had in-house access to basic laser technology that could form the foundation for a product development

Our technology legacy was formed in the late eighties when we developed and marketed several laser based products for subsea applications:

- SPOTRANGE, laser guided ranging
- SPOTSCAN, 3D subsea imaging
- SPOTMAP, subsea laser radar for seabed mapping
- ROVPOS, subsea laser radar for ROV positioning

Even if the products reached their end-of-life at year 2000, the technology was maintained and still relevant. The technology is especially relevant because of vast improvements in signal processing capacity compared to what was available 15 - 25 years ago. We still had to explore the properties of the atmosphere and to look at alternative laser solutions appropriate for solving the basic problems of a laser based DP reference sensor.

Examples from this work is given in Figure 2. Before we selected the laser solution we tried to assess the characteristics of attenuation of electromagnetic waves in the atmosphere under different conditions and compared them with available laser technology. A traditional 905 nm laser was chosen in the end, but as the figure indicates, there are still a few interesting alternatives as the basic technology evolves.

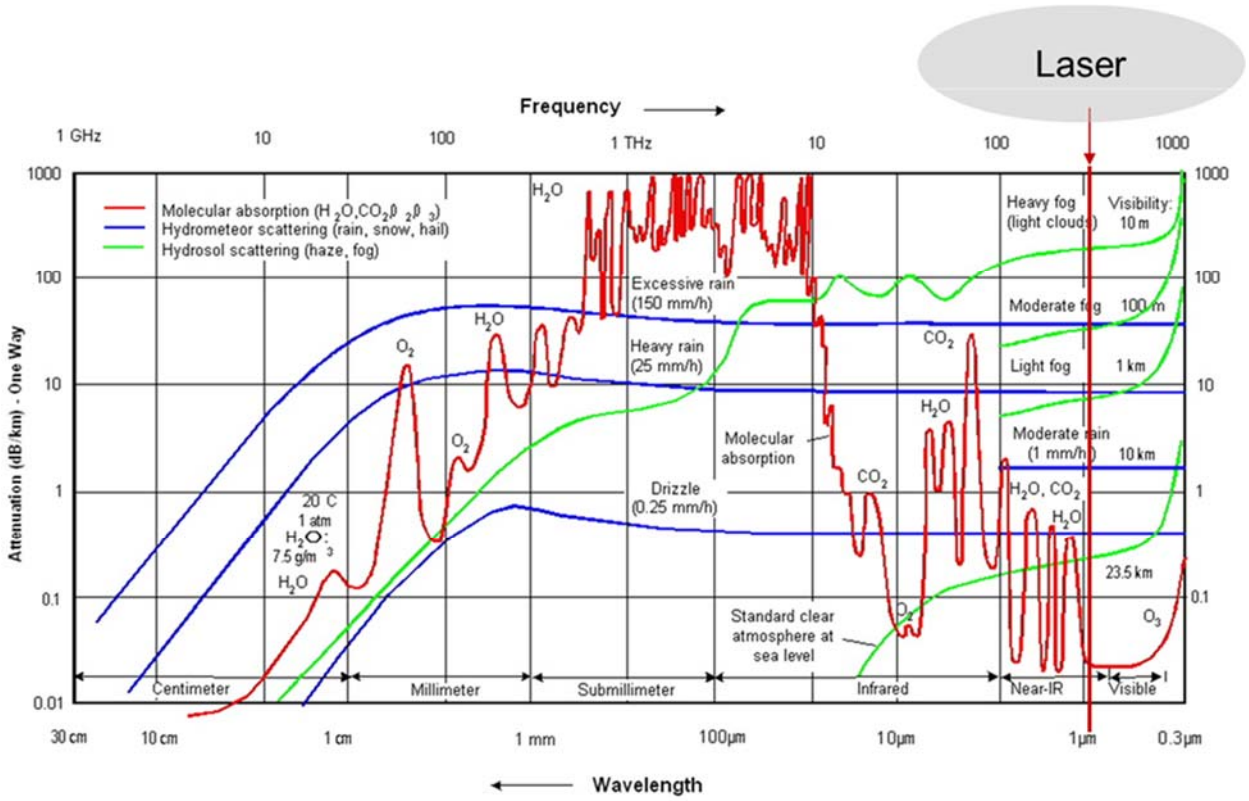

Figure 2: Absorption of electromagnetic waves in the atmosphere

Along with the technology assessment, the ideation process started very early. Ideation is usually seen as the fun part of the project, and it is. However, ideation is also hard work, and it needs to be based on the right framing to be relevant. The first headline for the ideation process was : "Can we find a competitive concept?". Further on, the key challenges framing the ideation process were:

- Which problems do we really need to solve?
- What is state-of-the art? Can we match it, or do better?
- How can we make a difference?
- What is really useful?

One of the early outcomes of the ideation process was about using detector arrays rather than a single detector to detect the light reflected from the reflectors. As the idea developed it turned out to give several advantages:

- Improved range accuracy
- More stable tracking under roll/pitch movements
- Separation between reflectors at different heights
- Increased integrity and capability of rejecting false targets

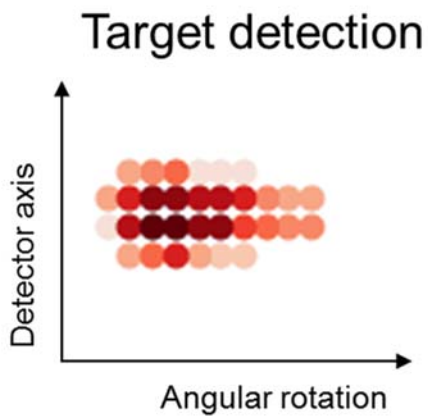

Figure 3: Target detection by using a detector array

Humans in the loop

An important part of the Design thinking process is to look at keeping the human aspect in mind by personating the users. They are not some kind of humanoid, but real persons with thoughts, concerns and even feelings. We need to know who they are and how they think. We also need to know the problems of their work life and the context where they are working. They are usually not solely concerned about our product irrespective of all its attractive features. To understand all this, we need to connect with the users and learn from them. This process requires mutual respect and trust. The ultimate goal is to make a useful proposition in the end.

It is also important to realize that there might be several users, e.g. depending on the different phases of the life cycle of the product. Our list of users is:

- DPO
- Captain
- Crew member
- Ship owner
- Yard staff member
- Workshop technician
- Purchaser
- Engineering staff member
- Customer support engineer/technician

All these people try to solve different tasks related to our product, and they have different needs. It is not likely that we can solve everything, but we should always have this multi-user perspective in mind.

Iterations

The key part of a Design thinking process is actually the thinking. It might look trivial, but it is about making the culture, framework and room for thinking. Thinking cannot usually be institutionalized by procedures, standards and checklist and requires another environment. Thinking is about observing, ideating, experimenting and learning. Making mistakes is an important part of this iterative process. However, mistakes should be made as early as possible, and on a small scale. The hardest part of making

mistakes, is usually realizing that you really made a mistake and start exploring a different path. We are usually too afraid of changing our minds. To reveal new layers of knowledge, it is important to look and listen carefully, and we need to observe the real life of an operation.

Figure 4: The real environment of a DP operation

What we actually observe is, however, dependent on who we are. Two persons observing exactly the same situation, make quite different reflections. It is important to observe with an open mind, and especially be aware of the human interactions involved. In the Design thinking process, we try to make observations from different perspectives and by more than one person. It is also useful to use the mindset and competence from professional interaction design in the observation process. This has given new insight in the user environment and accelerated learning in the product development process.

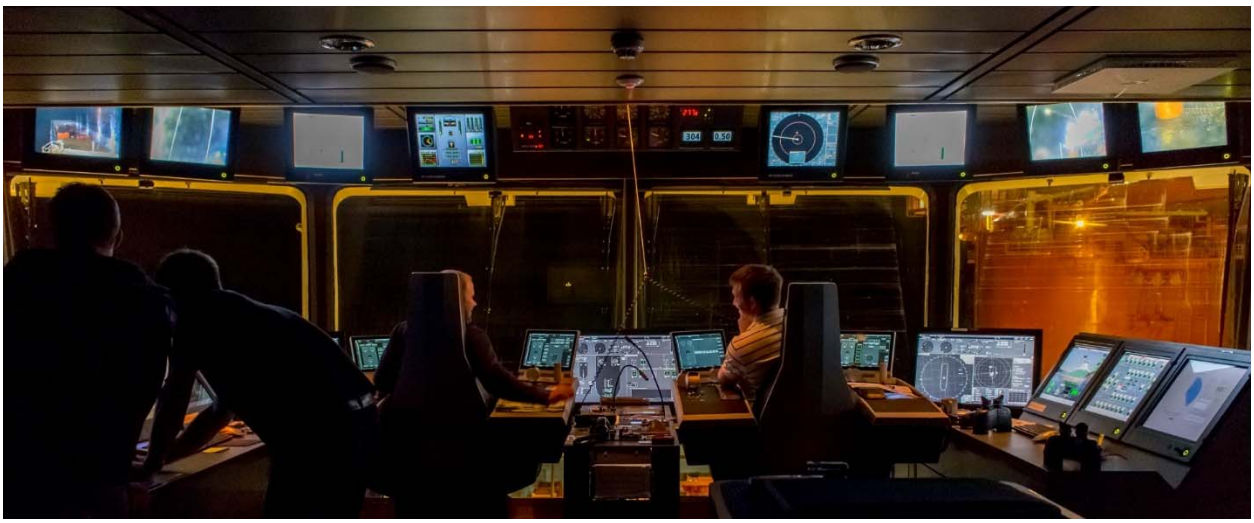

Figure 5: The user environment

An additional method of accelerated learning is to using rapid prototyping. It is for instance not always necessary to develop a lot of software to prototype a new graphical user interface. Making a mock-up with almost no functionality can provide early feedback and input before the costly process of developing software starts.

Figure 6: Mock-up display in operational environment

A well-functioning Design thinking process creates a lot of choices and alternatives, and it is necessary to find a way to make choices and decisions in order to avoid scope creep and chaos. First, it is important to realize that nothing is perfect. There will always be compromises and trade-offs and there will always be room for improvements. It is also about zooming to the right level. To make a choice you can zoom in to a level of detail, giving the impression that you know everything but risk zooming in on the wrong patch. Another pitfall is thinking that you can make the same decision every time without, realizing that the conditions might have changed. It is useful to ask the question: “What is different this time?” Timing is important in the decision making process. Sometimes it is better just to make a decision even if you are unsure, just to get on. It might be the wrong decision, but learning might be an adequate result too.

Then, there is the implementation phase. This is when costs really start accumulating and you cannot make too many mistakes. It requires discipline and focus on progress. You should still listen to new ideas, but usually put them in the basket for future improvements.

Figure 7: The product…

Figure 8: ... and some of the items the product needs

If discipline is necessary in the implementation phase, it is even more important in the testing phase. In fact, implementation and testing is a kind of Siamese twins. Testing of products built on advanced technology always reveals bugs or weaknesses that need to be fixed. It is necessary to make those fixes in a rapid cycle. It is also important to test in a realistic user environment over time in order to be exposed to the situations where exceptions occur, and you will be taken by surprise. It is not particularly difficult to make something work “most of the time”. It is much harder to make things work “all the time”.

Figure 9: Test environments

Rewards

It is said that to fulfil a task in due time you should start early. This is also true about product development. It usually takes more time than anyone thinks. In this particular case, we can trace activities over a period of 8 years. Full product development only lasted for 3 of these years.

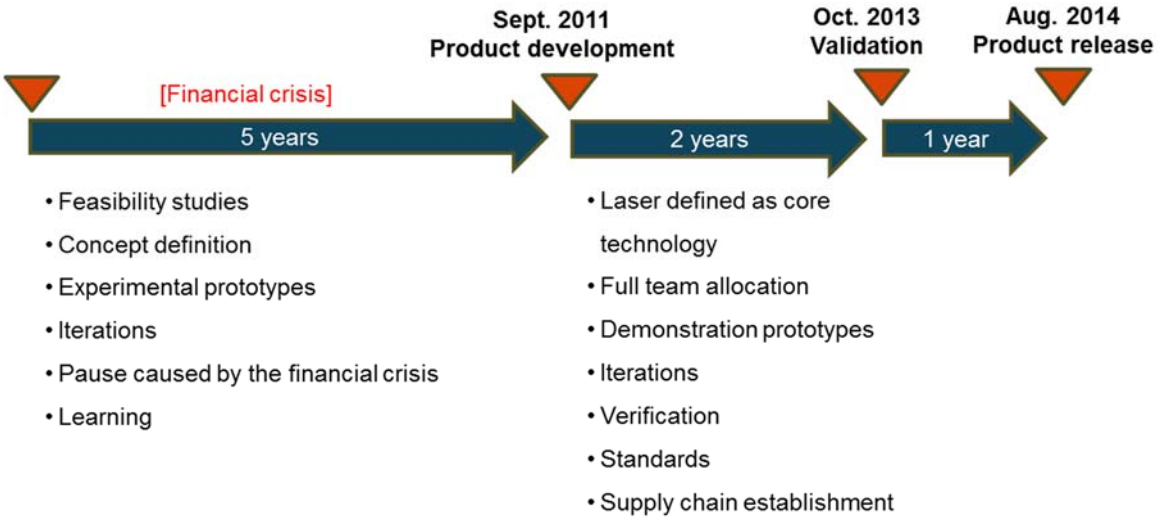

Figure 10: Retrospective timeline

When working hard over such a long period of time the ultimate reward is the product being adopted by the market. Therefore, the moment when a product is passing the first official release, is exciting. All

kinds of positive feedback is appreciated, and it is an encouragement for a DP reference sensor to win the Norwegian design award, “Merket for god design”, in two categories in 2015.

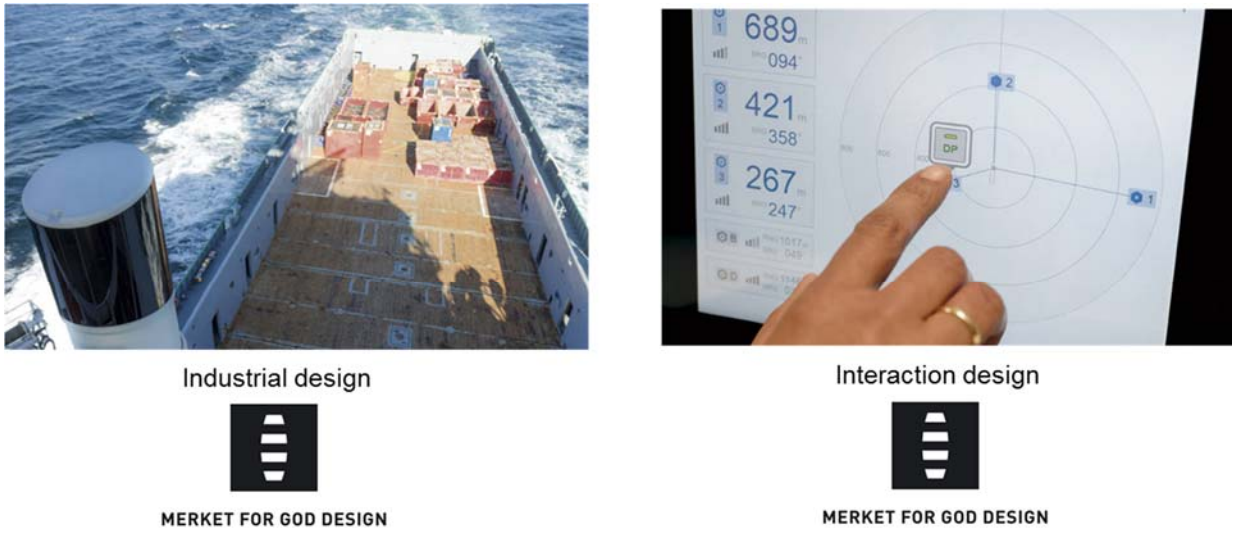

Figure 11: Design awards - "Merket for god design" in two categories

However, the final judgement is not to be made by a jury, but by the users.