

Focusing on behaviour to ensure adoption of Big Data information services in Precision Livestock Farming

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Abstract

Big Data has a lot of potential for PLF as it allows for monitoring on a constant and real-time basis and can show connections between different data sources, which results in insights on the level of the individual cow that cannot be detected by the human eye. Technical implementation hereof is however not the only hurdle to take for data-driven PLF; business and social aspects also challenge the realization of this ambition. For Big Data solutions to work in PLF, cooperation is therefore needed throughout the value chain, the farmer will need to change his role, and transparency and trust become crucial factors for the adoption of data-driven farming. The project Smart Dairy Farming encountered those challenges, forcing the project to take behavioral- and organizational change processes into account. Starting with a value chain analysis pointing out the relationships, responsibilities and value exchanges, followed by other tools from human centered design such as Personas, the adoption of the Smart Dairy Farming innovations by all stakeholders was ensured.

Keywords: Big Data, human behaviour, organizational change, value network

Introduction

The innovative project Smart Dairy Farming in the Netherlands, aims to develop PLF Big Data services that facilitate farmers to make decisions that support a longer productive stay at the farm and an increased lifetime milk production due to improvement of individual health (Knijn et al, 2013). This is realized by giving specific actionable advice to farmers, following from (near) real-time analysis models based on real-time sensor data. Data is collected on farms from existing and new sensors. These sensors can be applied to an individual cow or used in existing equipment such as milking robots and water reservoirs. The advice can consequently focus on the topics of animal health, fertility and nutrition. An information architecture is created to this end, for reasons of clarity from here on called 'SDF platform'.

Combining data from different sources on and around the farm, has a lot of potential to deliver the promise of longer life expectancy for dairy cows. Much focus is therefore now put on extracting information from sensors on and around the cows themselves, and combining these with other relevant sources such as databases with historical information on cows, medical records, computational models, and so on.

Crucial for a successful implementation of these technical solutions and to actually realize their potential, is however the adoption of the SDF platform by farmers themselves. The adoption by end-users and the related organizational changes and skills and competences are some of the non-technological challenges in successful data driven innovations (OECD, 2014). Naturally, farmers as many others can be incentivized by better earnings and more efficiency in their work, but this will in practice only come forth from the possibilities he or she sees to apply these new possibilities. In fact, it requires many to work far more data-driven than they are used to.

Furthermore, as mentioned earlier, data exchange in PLF is not exclusively related to data generated by the farmer and his stock. On the contrary; for PLF to become of value, a myriad of data is needed. This inherently causes for a challenge to open up, be transparent, and actually exchange data amongst different parties.

The challenges described above have a common thread; they address the importance of adoption by those that are actually impacted; the end-users, most importantly the farmers. More specifically, this means adoption of the concept has to be secured on the one hand, and adoption of implementing the forthcoming new possibilities in one's daily life on the other. Farmers need to change their behavior in order for PLF to be successful in their farm.

Human centered design provides with a methodology in which end-users can be involved in the design process (of new ICT) to ensure adaptation of the product to users' needs, and to make adoption more viable (Steen et al, 2011; De Boer & Kuiper, 2008; Sanders, 2002; IDEO, 2011). Such an approach was also applied to the design of the SDF platform.

The methodologies used, and the consequent results, are discussed in the following, in order to answer the research question: How can we influence adoption of the SDF platform with a Human Centered Design approach?

The sub-questions are:

1. How to increase acceptance of the SDF platform, by end-users and all stakeholders involved?
2. How to ensure the SDF platform can be implemented in the daily life of end-users (farmers)?

Methods for human-centered design

Human-centered design processes can make use of several tools that facilitate involving end-users in an easy, structured and appealing way (IDEO, 2011). For each sub question we selected two tools that we feel can answer the question, or at least part of it:

Increase acceptance:

1. Value Network Analysis: A value network analysis is a method for comprehending and visualising the relationships and exchanges within a dynamic ecosystem. A Value Network approach can thus help to get a better and shared understanding of a multi-sided issue or concept involving a lot of stakeholders, and how to progress in an effective way (Van Dort, 2013).

2. Co-creation workshops: Co-design and co-creation activities are related to the involvement of end-users and stakeholders in developing services. Organizing these activities is expected to benefit the project itself, the quality of the service that is being developed and the organizations that are involved in the activities (Steen et al., 2011, De Boer & Kuiper, 2008). Co-design is said to lead to innovations that may be better adapted to the context of use and be more likely to be adopted (IDEO, 2011).

Implementation in daily life:

1. Personas: Personas are archetypical users, representing a target group and their specific characteristics. The purpose of Personas is to create reliable and realistic representations of your key audience segments for reference (Usability.gov, 2015). A Persona is not a real person, but does make an abstract target group, based on insights and data, come to life. The Personas for the SDF platform were based on 30+ interviews with stakeholders.
2. Use cases: A use case is “a formalised story that describes how someone procedurally interacts with an existing or proposed system” (Goss, 2007). It is used in human-centered design by describing use cases with accompanying requirements for the platform that respect needs, wants or even barriers of end-users.

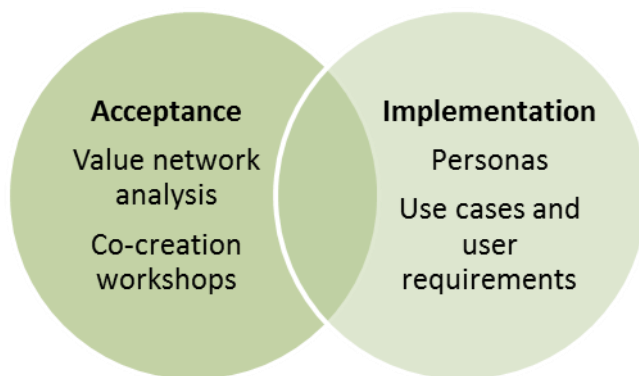


Figure 1 Human-centered design methods for adoption of the SDP platform.

Results and Discussion

As proposed in figure 1, the adoption of the SDF platform is split up in two components: the acceptance of the concept by farmers as such, and tools for the implementation of the SDF platform in the daily life of farmers. This ‘two-sided’ adoption requires the usage of human-centered design approach, with supporting methods.

Value network analysis

The value network analysis (figure 2), created with a group of different stakeholders in the SDF project, showed what roles are in more or lesser extent involved in an initiative

such as SDF and how value streams such as data and money flow from one ‘role’ to another. The value network analysis created a ‘common ground’ for further developments, helping with discussion points such as for whom a design is made and why.

The initial phase of the development of the SDF platform encountered quite some difficulties that for a significant part came forth from a lack of mutual understanding of roles and responsibilities. Once the value network was blatantly depicted on a large screen, many of these (sometimes also implicit) misunderstandings diminished, also creating an atmosphere of trust because all the roles, responsibilities and dependencies were made explicit. As for reach, the analysis was presented to and discussed with a key group of sixteen farmers in a review session, and later presented to a larger group of farmers and representatives of the sector (about 100 in total).

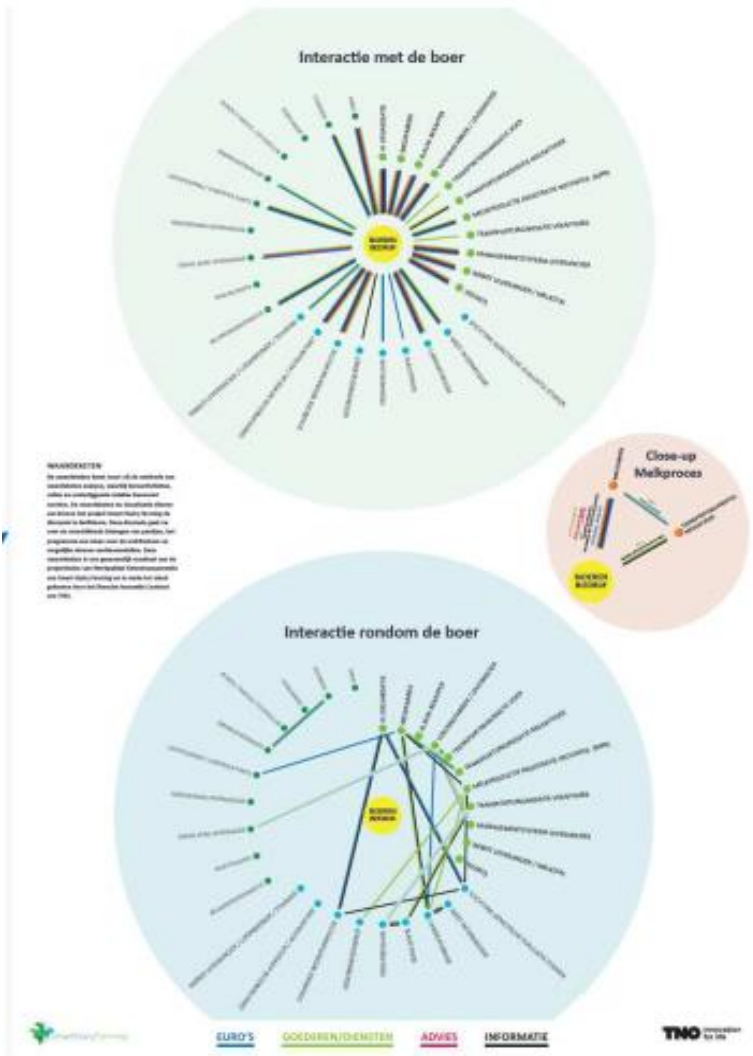


Figure 2 Value network analysis SDF.

Personas

During the project, four Personas were developed, each one representing a major user of the SDF platform (i.e. the dairy farmer; the representative of companies in the value network such as the dairy factory and suppliers of food and seeds; scientists that make new models based on the data, and developers of the platform itself). Here, we focus on the first: the dairy farmer named Douwe. He was created based on several interviews and refined by actual dairy farmers, and made the expectations, needs and barriers of a dairy farmer regarding the SDF platform explicit.

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 **Douwe (43 jaar)**



Douwe is actief en betrokken, dus hij wil graag invloed hebben op hoe hij welke data krijgt aangereikt

Douwe herkent zich in de term 'manager' (diermanagement, personeelsmanagement, graslandmanagement, etc).

De meer traditionele veehouder is meer bezig met verzorging dan met dagelijks management en besturing

Douwe gaat als gebruiker van het SDF platform data actief gebruiken en leveren. Populaire functionaliteit is daarbij het **ontvangen van SOP's**.

Succes van het SDF platform komt volgens Douwe door **praktische toepasbaarheid**,
snelheid (informatie 'near-realtime' overall beschikbaar), betrouwbaarheid,
niet alleen méér data maar juist gerichte data, en een eerlijk verdienmodel





Het rendement voor Douwe blijkt uit **tijdsbesparing** en **hogere opbrengsten**

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Figure 3 Persona with user requirements.

Although intuitively logical, it was a welcome finding that the usage of the Personas method not only secured a design of the platform that would suit the farmers, but also helped with the adoption of the concept of the SDF platform as such. It is suggested that a reason for this, is that by referring to the farmers as abstract persons, it made it easier to open up and exchange thoughts, needs, and critical points. Participants in the workshops no longer had to talk about themselves, but about “Dairy farmer Douwe”. The same happened for the other, sometimes competing roles represented by the other Personas. The introduction of Personas thus made a significant difference in the results obtained from co-creation workshops and created a valuable overlap between adoption of the concept and helping to ensure a good implementation of the SDF platform in daily life. Comparable to the reach of the value network analysis, the Persona’s were presented, discussed and refined together with the key group of sixteen farmers and presented at a domain-specific congress (AgroConnect, 6th June 2013) to more than 100 farmers and other sector representatives. Lastly, the Persona’s and related methodology was recently (8 May 2015) presented at a Smart Industry congress in Hamburg for about 15 representatives from knowledge institutions and Smart Industry.

Co-creation workshops.

The co-creation workshops were held with representatives from major parties in the value network, such as the dairy factory and a cattle management company, and scheduled for a whole day every two months. In these workshops, with a participant number of on average 8 participants, the results of findings (e.g. the interview results for creating the Personas) were discussed, elaborated upon and used as input for next steps such as defining suitable use cases.

By applying co-creation as a method, instead of merely asking for feedback, ensured applicability of the SDF platform, as parties and viewpoints are heard, thoroughly discussed and brought into perspective of the whole value network. Also, adoption of the end 'product' (e.g. Personas and use cases) was assured, simply by having people think along and recognizing their input in final results.

Use cases

Based on the specific profiles of the users represented by Personas, real user-based use cases could be developed, such as 'receiving specific advice' and 'adjust authorizations' for the dairy farmer; 'give specific advice' for the representative of the supplying companies; and 'testing new solutions on the SDF platform' for the scientist and the developer. Above, a use case for dairy farmer Douwe is depicted. This use case describes how farmers have very little time to analyze new information each morning, and require information to be available on different devices. This implies certain design specifics for the information architecture to be in place.

By working towards design requirements of the SDF platform in a way that is human centered, use cases could be made that actually address user needs, such as authorization issues (who can see my generated data). These requirements complement the definition of IT-specific requirements for topics such as uptime, speed of use and data management. These are of great importance, but when given too much attention compared to user requirements, can even cause for a bad user experience. The reach of the use cases is due to similar activities, comparable to the reach of the Persona's.

Conclusions and further steps

The four human centered design techniques applied in the SDF project have had a positive impact on the adoption and adaptation of the SDF platform. Project members could constructively cooperate within the project, and the farmers involved in the early stages of the development of the platform, could find their place amongst the industrial organizations that were representing the project. Although the tools as such are not new in developing new ICT solutions, they are new in respect to data driven innovation, where much focus is on retrieving valuable information from data, and creating viable business models and less so on behavioral and human aspects of successful data driven innovation.

The tools as described in this paper were, however, not sufficient to come to a full implementation of the SDF platform. Once it became clear that the technology could actually deliver the value that was desired by farmers and organizations involved in the project, new challenges arose; who would own the data? Who would pay, and who would gain? Also it relates to a more detailed description of how the daily life of a farmer changes once the SDF platform is introduced on a larger scale. Now that the product has become more feasible, those aspects need to be detailed. In the next stage of

the project therefore more and sometimes new human centered design tools will be required to overcome these challenges.

We recommend to continue with co-creation workshops and update use cases accordingly. Personas are still up-to-date, and can be used as reference material throughout the project. The value network analysis needs to be updated if major changes in the value delivery are being made. New Human Centred design tools that could be introduced are usability testing and pilots.

Acknowledgements

This research was supported by the Dutch Smart Dairy Farming research program, which is financed by Friesland Campina (Amersfoort, the Netherlands), CRV (Arnhem, the Netherlands), Agrifirm (Apeldoorn, the Netherlands), Dairy Campus (Leeuwarden, the Netherlands), Investment and Development Agency for the Northern Netherlands (Groningen, the Netherlands), the Dutch Dairy Board (Zoetermeer, the Netherlands), Mesdag fund and the Ministry of Economic Affairs, Agriculture and Innovation, Pieken in de Delta (Den Haag, the Netherlands).

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