Cape Peninsula University of Technology

Interactive tools supporting agriculture in the wine industry.

by

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DECLARATION

I, Hester Claassen, declare that the contents of this dissertation/thesis represent my own unaided work, and that the dissertation/thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed **Date**

THE VISUAL CALCULATOR

ABSTRACT

To design from a human perspective rather than from existing technological opportunities, and involving multiple stakeholders with their different perspectives, is an important aspect of participatory design and user-centered design. This thesis project was an explorative study done on a wine estate, in the Western Cape, South Africa, to find novel ICT solutions, for supporting co-operation and planning between multiple and individual work tasks in the work practice. This research explored potentials to manage multiple stakeholders and use their different perspectives to inform design research. The thesis project shows the ethnographic research gathered through video shadowing, workshop results involving the users to contribute to the development of the design by acting with a projection, leading up to a design opening and further focused on the concept development with the stakeholders.

The thesis proposes a simulated concept namely the Visual Calculator (VC). This system is designed to involve several participators within a work practice. It supports calculation activities for spraying and buying chemicals. It saves the user time by incorporating standard calculations to output needed information faster. It supports planning, management and record keeping aspects of the farm manager's work practice in the vineyard spraying process. Although the concept was more fully developed for the farm manager, the VC involves two other work roles including the owner and foreman. The concept focuses on a human centered perspective, instead of making the system fully automated, giving users control and not controlling the users. For this to be successful work should be divided and have equal responsibilities, each stakeholder can contribute and value their part of the work, knowing where it fits in, why it is important and how it influences other aspects of the work practice. The research outcome involves, envisioning the future potentials of the design (VC), design for participation, a way to identify design openings, problem solving and conceptualizing by utilizing user's strengths.

KEYWORDS

Interaction design, future technology, information and communication technology, participatory design, user-centered design, video centered design, human centered, multiple perspectives, cape town, south africa, visual calculating, wine estate.

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1 UNDERSTANDING

1.1 INTRODUCTION

Although most of the time the scientific aspect of wine production is dominant, an equally if not more important aspect of this production system is the human aspect. By exploring activities according to the time of year, one can find relevant design openings of the work practices between individuals work responsibilities, and in particular in this research project focusing on these openings to lead to new designs in mobile technology.

1.1.1 RESEARCH AREA / SETTING

The wine industry is a fruitful place to do research. It is a complex and intricate process from beginning to end, almost bearing unlimited opportunities to design for. Over the last decade, deployment of information technology has increased in the wine industry (Burrell & Brook, 2003; Wang et al., 2006; Morais et al., 2008; Matese et al., 2009; Cunha et al., 2010). But one can almost say that these studies dumped predetermined technology into a situation, making their research technology and engineer driven. So arguably, there is further potential for exploring the use of mobile information technology and embedded technology, in particular from a user-centered point of view. Also considering viability as a point of view, concepts should be malleable to the user so that it could be applied towards different goals and flexible in the way of use.

According to the Platter's South African Wines Guide (Van Zyl et al., 2011:32), South Africa's wine industry physically covers a big part of South Africa (101,259ha) and we are producing almost 4% of global production, making us the 7th largest wine producer in the world. Private cellars are increasing and micro-cellars vinifying less than a 100 ton of grapes, seem to strengthen the industry.

Although these statistics seem impressive what is actually happening is a different story. According to South Africa Wine Industry Statistics (WOSA SA, 2009) looking at growth in wineries, the number of primary wine producers and producer cellars declined form 1991 to 2010. The number of cellars crushing grapes declined from 2009 to 2010 and the only increase can be seen in wholesale producers. Looking at Total SA exports the amount of liters exported declined from 2008. Also, the wine prices haven't increased according to the rising food/living expenses in the last few years.

Locally the current wine economic state is heavily affected by the decrease in exports. Shockingly this negative impact is clearly seen when driving around the wine areas. I have observed a number of 'for sale' signs on wine farms gates in the Stellenbosch area. Talking to Altus Van Lil the farm manager of Goede Hoop, he told me that before the farmers resort to selling the whole farm, usually owned by generations of the same family, they will first decrease the farm size by selling sub divided portions of the land. With this background it becomes important for management to be efficient in order for the farms to survive.

There are numerous examples of technical and engineered driven systems adopted to wine farming (see ‘Current status of research area’ on page 14), but in general they start from technological opportunities rather than from user needs. Although these examples are not based on Interaction Design, they still give an idea of related work and areas of concern/interest on wine farms. Earlier projects have focused on developing technical systems, like wireless sensor networks, for precision viticulture to help with management and weather monitoring.

It is very clear that commercial wine farms are using new, automated technology in their practice, for example automated irrigation and automated tractor driving and calibrating via satellite. Also the increasing rate of technology advances within mobile devices, are becoming a powerful tool, and with additional technology like sensors becoming more affordable, the opportunity becomes greater to incorporate such technologies on privately owned wine estates.

However, changing the work practice by deploying technology without having investigated the current work practice is seldom a good strategy. The goal here is not to design monitoring systems, automated systems and data communication systems (only for the farming managers use/eyes), but to design for the mere fact and heart which keeps the farm running. This is the human factor which should be used to its full potential as this is already a strong point of the current practice studied. Smaller farms don’t have these expensive technology solutions because they rely on the human aspect/input on their farms.

There is definitely a strong human aspect involved in producing wine throughout the whole process. According to Albert Ahrens, winemaker from Goede Hoop (Claassen, 2011), to produce good quality wine, it is still vital to pick grapes by hand and crush them by foot. Automated machines which may make the process easier are not always as good for the quality of the wine or for nature and therefore cannot always replace the human aspect. So this research needs to be user-centered driven, which was not apparent in previous research done in this context on a local estate. A user-centered approach puts the people who will use the product in the middle of the development stage. By involving the users actively in the design process would help ensure that the end product would improve the quality of the work as perceived by its user (Buur & Ylirisku, 2007).

Previous research also only focused on one person’s job (for example the farm manager), and did not involve the other stakeholders in the process, as where this study would aim to consider the different perspectives of the stakeholders. This paper also tried to look at ways on how to involve illiterate people in the design process and communication aspects revolving around the design. The reason for this was because of another researched problem in this field of study, namely why the adoption of technology in wine farms are slow to non existent. To address this issue it was necessary to involve the future users to participate in the design process, giving them the power to influence the final product. This Participatory Design process helps the user to have increased knowledge about the developmental stages, which makes them take

ownership of design ideas and in turn helps fluent adaptation of the new solution (Buur & Ylirisku, 2007).

Local problems preventing ICT use by employees on wine farms that were identified were that most employees are poor and uneducated or lack the skills to use such technology because they are not used to it, as it is too expensive to buy for their own use. According to Tembo (2008) these people would need training in technical skills for ICT to be successful. Language is a huge barrier in interacting with ICT and because most of the farm workers are illiterate and have low educational skills makes it even more difficult for them to contribute to such a system. An important point Tembo pointed out though, was for ICT to be successful in such a context, all participants within the line should be able to make use of the technology (Tembo, 2008).

What I found after my study was that technology is expensive and many farms could not afford it. Or maybe it is not that they can not afford it, but new technology is one more expense and the technology needed to make a big difference by contributing to more income. The designed systems available are not that useful to some users and it may feel more difficult for them to do their work, because these systems were probably designed without the help of the users. According to the users for example, some record keeping systems constantly need to be fed updated information in order for the system to work, taking up much of the users' time. Usually they don't have knowledge of the design process and more importantly the designers don't have knowledge of the users work practice. This makes it difficult for the users to value or use the product as they perceive it. The amount of physical/mental effort required by the user to use such technology is usually more than what they value the result outcome.

Recently in the Journal of Agricultural Informatics, Csótó (2010) argued that for ICT to work in agricultural contexts, the ICT tools should be centered around the human element. For users to gain, process, use and evaluate information there are main characteristics of quality information, these are relevance, accuracy, comprehensiveness and timeliness. More reasons for slow to no adoption can be that most of these systems are complicated and lack 'user-centeredness'. Also the age and open-mindedness of the farmer or studied user plays an important role in the success of such technologies. Previous technology may have failed with ICT because of the user's age and adaptability to technology. It is therefore a relevant time to study the 'new generation' of farmers who are more accustomed to current technology and who relate to these technologies they use in other aspects of their lives. The key challenge for design in this area is to satisfy the user's needs. It is however not easy to design one system to fit all. Backgrounds of farmers are different, cultural background, local community, way of doing and managing information strategy all differs from farm to farm (Csótó, 2010). With this information one may start to look at the characteristics of a farm and the personnel characteristics and attitude of the future users.

Burrell, Brook and Beckwith (2003) dismissed farm worker's importance and level of contribution in the value chain, saying effort should match reward in a ubiquitous system and

because they only follow orders, their only input into the system can be through sensors. But what if they need to become more involved on a more complex level and not just through sensors? This points back to the human aspect which needed to be explored, incorporating responsibilities and an understanding of how the whole farm works and the value and importance for each step.

To contribute to the human factor being key in this study, Bannon (2011) argues that the HCI discipline should explore new technology forms that make the human the primary actor in the system. People's goals, activities, values and environments should be on the forefront when designing new technology for their use and can support research in a big environment and help to contextualize/understand complex tasks, as it unfolds in time (Buur & Ylirisku, 2007). Computing should not only be for calculating but rather it should be used by people for collaborating through. There is a fine line between human control and automation which needed to be considered. As Bannon says, "It requires us to go beyond approaches that aim for full-blown automation, with some residual role for humans added as an afterthought when complete automation is impossible," (p. 52.) and "It is not what can be automized but what should be automized?" (p. 57). Certain things need to stay under human control and things like record keeping may be automatic if desired. The goal was not to replace human labour as so many technological farms seem to do, but the idea was to support people through technology (Bannon, 2011).

With my third visit to Goede Hoop wine estate, I had already established contacts. With these pre-study interviews, in parallel with background research on the subject, it convinced me that there is potential for exploring interactive tools to support the work on an estate. My goal was to study the estate and search for the potential to enhance user experience of people working in this context. Through video, I was able to study the users, analyze situations and envision design. The qualities of using video in different ways and why it was appropriate to use for this study would be explained under the heading 'Research design". Possible stakeholders included, were the winemaker, farm manager/viticulturist and other permanent and non permanent field workers. This of course was determined by the time of year and where all the activity was. Working with the users throughout the design process would yield valuable and meaningful information, important to them.

With this background, my problem framing was as follows: The use of Information technology is prevalent in wine farm regions, but as a whole, not all estate farms have yet fully exploited this possibility. With the increase in power and decrease of price within available technologies, there is an opportunity for design to enhance user working experience, making them aware of the importance of work accuracy, on a privately owned wine estate, exploring mobile technology. Estate not only means an area of land with people living and producing on it, but according to the Wine of origins label laws, 'wine estate' is a farm growing grapes, producing wine and bottling wine on site.

When looking at the amount of land covered by vineyards, there must be many employees involved either directly or indirectly. At this scale there is a big opportunity to design concepts for supporting these people's work activities. Also looking at the current economic situation, it becomes important to manage money, resources and time more efficiently. It is critical for all the people in the production chain to become aware of the importance of precision in which activities should take place in order to save money. Accuracy becomes vital to help minimize costly mistakes.

The users are the permanent workers on the estate that have to multi task (users that have a work 'overload') and to share work responsibilities, for example taking turns every second weekend to help with wine tastings. There is simply not a single employee for each single task. Albert (the wine maker) has to do all the cellars admin, help with tastings, help with harvesting, make wine and sell/promote the wine. What is meant by enhancing the 'user experience', is to design concepts of future technology that could help with the amount of work needed to be done on a estate, making work manageable for permanent workers(users), enhancing their work experience. This is important because, saving time with one activity meant time could be spent on more 'important' activities that generated more income. For example, for Albert, the less time spent on doing admin, the more time spent on blending their next masterpiece.

For the farm manager there is a lot to deal with (see Fig.1.1), keeping in mind and visualizing managing a farm. What I also later discovered through my research was that there are numerous information steps to consider through the farm managers processes alone. Looking at this summarized representation in Fig.1.1 one can easily imagine how overwhelming it can be. This Fig.1.1 is based on factors that influence and shape their decision making. The clouds in Fig.1.1 also shows the opportunities of where interactive and information sources may support work tasks. The final design addressed the issues highlighted by the red circled clouds in Fig.1.1. The main point the design process addressed in circle C, is the 'lack of user friendly software tools'. The design helped to calculate the true prices for chemicals to help overcome circle A, 'the lack of information on the market' given by the chemical companies. The design aimed to improve reporting involving more workers, addressing circle B, the 'lack of accessible information on employee performance'. The design allowed dividing of work tasks to make the work load easier for all participants addressing circle D, the farm manager being 'engulfed in routine tasks'. In the end if the design could be considered successful by the users, it should help to save money and time, create awareness to use resources sparingly, help work accuracy, and put the human actor's values and goals in the center, the design would be a success.

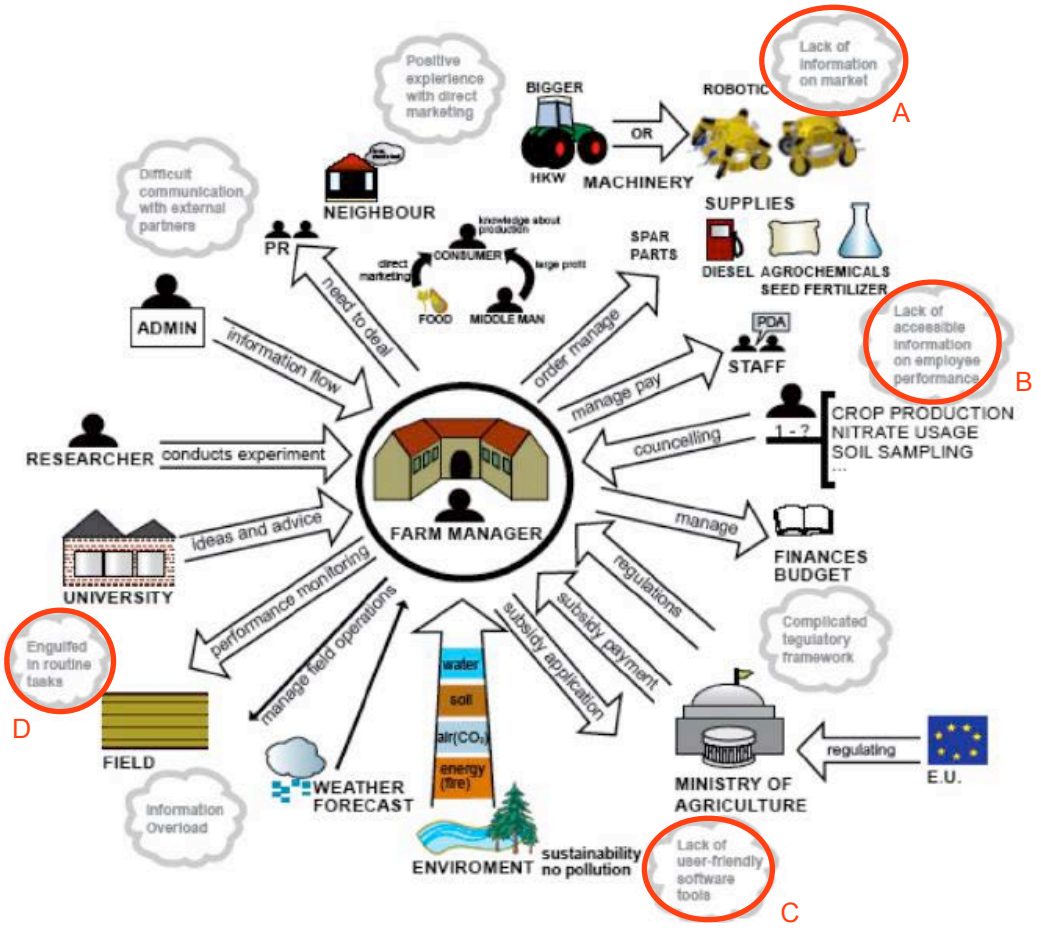


Figure 1.1: Farm management, the “rich picture” (Sörensen et al., 2010).

1.1.2 CURRENT STATUS OF THE RESEARCH AREA

As mentioned in the ‘Research Area’, the previous studies done in agriculture seem to lack a main factor in such work practice which is human-centeredness. What follows is a detailed discussion on technical and engineered driven systems and to incorporate the human element. This study would focus on methods in Video-centered design, User-centered design and Participatory design. Finally, by using Research-through-design will generate knowledge from the design project to be applied beyond the design project.

A study done in 2006 showed that technology, such as wireless sensors, are increasingly being applied and developed in agriculture. Wang et al. (2006) discusses the increasing market growth of these wireless sensors and their future potential/trends in the agriculture sector. These technologies offer a wide range of usage within environmental monitoring, precision agriculture, machine and process control and traceability systems (mostly using RFID tags).

Wireless sensor networks are popular in viticulture. Three papers explore the use of such networks. Matese et al (2009) suggest a wireless monitoring system (The NAV system) that can be used to understand the wide range in factors on a wine farm and through suggestions based on this data, assist in management decisions and improve the quality of wines. Temperature,

solar radiation, leaf wetness and soil water sensors are all placed in a vineyard block sending the data out to a computer. The ZigBee system being developed and tested in the paper of Morais et al (2008), would ultimately consist of a network of wireless sensors distributed between the canopy of the vines. The network would help predict pesticide risk. The third project was motivated by the number of applications available, the number of daily tasks people on a wine farm have, and the possibility to address these tasks through applications. Cunha et al's (2010) project utilized tags placed in the vineyard and when scanned with a mobile phone, an application simplifies the viticulturist task by automatically contextualizing information and reduces response time of capturing information, without the need to go back to the office. The information is associated with the specific tag and allows the worker to exchange site information and to access services on site.

Ways of accessing data became more mobile. Looking at the mentioned projects, the NAV system only sent data to a central server located outside of the vineyard, where the user can access the information (Matese et al, 2009). The users of the ZigBee system would have access through the local network on devices such as laptops and PDA's (Morais et al, 2008). However one should consider the effect and design viability of implementing these central servers. The managers are being distanced from their work through some of these wireless technologies, moving away from reality and tangibility of what happens in the vineyards. But Cunha et al (2010) identified the lack of tools that support in-field use, therefore they suggested the use of a mobile phone in their solution. They designed an application for the vineyard manager and winemaker, for inputting all their data.

Although Cunha et al (2010) have not considered why their solution is more effective than a central server; a valid reason was discovered by Nilsson et al (2000), while doing research in a waste water plant. The system already in place was a central control room, but the operators did not rely on the visual representations on the screen alone. Nilsson et al. soon discovered the importance of physical inspection done by the process operators, where they used all their senses and experience to evaluate equipment. Similarities can be seen between the waste water plant and a smaller wine farm. Both are physically big spaces, run by a few people in the space and the importance of knowing firsthand (Human senses and judgment) what is going on is important for growing the vines and making the wine.

An example based more toward interaction design, is Brook and Burrell (2003) who did an ethnographic study of a vineyard. As a starting point to design interfaces for the users, they have looked at people's roles in the wine making chain and created several concepts for each person. There was a gap between the ethnographic study and design phase regarding users, although they interviewed people and observed participants, they did not include the users throughout the design process and only at their assessment phase did they receive informal feedback from participants at presentations, demonstrations and prototypes.

Burrell et al. (2003) identified themes, helping to understand the context of use in ubiquitous computing. These themes are Actionable Data, Allowing Technology to Change Practices While Continuing to Support Existing Practices and Human Touch points into Ubiquitous Systems. Regarding the first theme, they designed a system that went beyond only gathering data and presenting it raw, the system also analyzed the data calculating other variables such as pesticide risk and displaying it on a map interface. The second theme allowed users to shape the interface and visible data of the vineyard map, according to their preference and way of practice. This is an important theme regarding farms with a traditional way of doing things. Information systems should consider applications that are based on a farmer's current working pattern. One should also consider their age and their technology awareness (Cunha et al, 2010). The third theme, suggests that systems are linked to environments rather than individuals and that several users may interact with it depending on the different roles they play. This theme might be considered/ or is worth keeping in mind when mapping the different users on the farm. This may show where the user's work overlap and could create a possible design context.

Earlier studies have mainly been driven by adopting technical systems to implement large scale networks into regions of viticulture. Projects were only for vineyards and vineyard managers, with the intention to develop these systems for a specific wine region. An example of a region in South Africa, would be the Coastal region, with districts such as Cape Point, Stellenbosch, Swartland and wards within districts such as Constantia, Bottelary and Malmesbury, all forming part of the region. This study is based in the Bottelary ward, Stellenbosch, Coastal region, where the other studies were done overseas. The focus of the networks was for grape growing farms (with only vineyards). Only two studies touched on 'places' outside the vineyard itself, for example the cellars. Cunha et al. (2010) with their tag and mobile project, used the tags on barrels (in the cellar), because of the pliability/malleability of their designed application. In the Ethnography project by Burrell and Brook (2003), they mention speaking to vineyard owners, vineyard managers, winemakers, wine storeowners and vintners, but they don't mention that these people were all from the same farm. So these interviewed people could be from different locations, as wineries can be located away from the vineyards (grape growers) where they purchase the grapes from. Burrell and Brook (2003) mention that they have developed concepts for all the interviewed people, but they only explain /discuss concepts for the vineyard managers.

In contrast my research is based on methods used in 'Designing with Video' (Buur & Ylirisku, 2007), and will start from a user-centered perspective which forms part of this methodology, with focus on a farm that have both cellar and vineyards on the same property. By exploring and focusing on the users/workers on the farm and involving them in the design process by participating in the making of the videos, I will discover valuable and meaningful issues to design for. Goede Hoop as an estate has the cellar and crops located on the same site. This means that the winemaker would come into contact/work with the vineyard manager. By keeping his eye on the crops the winemaker helps in decision taking on how to grow the grapes

to help drive it towards styles of wines they want to make (Claassen & Messeter, 2011). Also an interesting opening is the mediator roles people play on the farm.

A possible question to consider for further research in this project was what the current limitations on mobile computing technology were. This is relevant, but this project is not looking at the current possibilities but rather future potential. The goal is not to limit the design or project to current state of affairs within technology. Can the question then become, what is the future of mobile technology and how closely can it relate or combine with wearables? Mobile and wearable technologies should definitely be kept in mind when designing concepts, as there is little to no research combining proper wearable technology into the agriculture context. The only wearable technology one finds is a box supposed to hang around the neck, which is still an obtrusive object and uncomfortable to use. Working in the vineyard is hard enough as is, so why make it more physically straining. Considering things such as wireless wearables, using your phone for a connection and then storing everything to a cloud? Activity Aware Computing for Healthcare is such a project example of combining a wearable bracelet for informing of activities and logging activities combining it with a smartphone (Tentori & Favela, 2008). Something like this can possibly be used on the farm in the form of a reporting device.

Widely available technology to keep in mind is what a mobile phone can do. The different mobile applications are vast and may contribute to the design, for example Location based reminders and geo tags in photographs.

Other possibilities to consider, learned from studies involving wireless technology and viticulture are, more development needed to be done on usability and user interfaces with tag technologies and a wide range of possibilities exists to use the same tags for supporting wine tourism. The use of LCD or digital screens is used as a norm, although it is difficult to read in bright light/outdoors. None of the mentioned works consider using different interfaces to LDC screens in the field, for example ‘e-paper’. These technologies also only helped to support one person’s task or his/her decision making process.

1.1.3 RESEARCH DESIGN

The big overview of methodologies used in this project can be called research through design. This is a closed loop consisting of, observation with video, editing (design), feedback from users, arriving at a new point and the loop starts over with the new information feeding in. Methodologies looked at is designing with video which encapsulates ethnographic studies, user centred design and participatory design.

1.1.3a Designing with Video

I used ‘video centered design’ as the basis for my design approach and relied a lot on the book , ‘Designing with Video’ (Buur & Ylirisku, 2007), for processes and methods. Buur and Ylirisku promoted the use of video as a designer clay and a social glue for design projects. Video can be used to model abstract concerns, helping the designer to ‘capture activities as they unfold in

time', without loosing any detail, which would have been impossible to do in your own capacity with only field notes. Video can capture and portray feelings and personalities of people the designer is designing for in a concrete way for showing other participants and video can be used to show fictitious futures. Video would therefore be useful for this project as it would not only help me to refer back to it for details on activities, but to effectively involve and focus on the users, which is the main focal point of this study. It is difficult if not impossible to design in isolation. Video as a social glue described by Buur and Ylirisku, also helped me to design collaboratively, using the video as a discussion point to bring together the users, making them part of the 'design team'. This allowed for considering different interpretations on the video material/design openings which positively influenced the design. In the design phase video was also used for documenting purposes for capturing ways of working with the stakeholders. By analyzing the 'video data' through an approach based on the Video card game (Buur & Ylirisku, 2007), video artefacts were produced (for example Video stories) as a by-product of the designers understanding of the studied place. This can be done alone, collaboratively or with a combination of the two. Instead of working with video in the design phase I used video cards in several workshops (not as a game but as a highlight tool) to explore differences in perspectives and scenarios with the stakeholders.

Buur et al. (2000) discusses the use of video as a design material when doing ethnographic fieldwork. Video can be used to create design "moves" in the project. Steps/moves in this process consist of following individuals while doing their daily work, edit small portrait videos of the individuals to take back to them, create theme related videos enabling co-authoring with the participants and creating video scenarios with cardboard mock ups to "test" the design. The edited video material is called video artefacts. In this project I tried to create video artefacts.

The qualities of using these video artefacts are :

1. 'Video stories' describe how things happen and show if the designer's understanding reflect what happened in field studies by showing it back to the participant.
2. 'Video portraits' show a person's character and their point of view, helping the designer to understand and empathise who he/she is designing for.
3. 'Video collages' combine video clips with the same theme in one video and help develop new questions on the subject, informing the design process.
4. 'Video scenarios' create a 'stage' for users to act out and discuss design ideas (Buur & Ylirisku, 2007).

1.1.3b Ethnography

Ethnographic methods are ways of looking at a "problem" in practice and can be combined with video as mentioned above. This can be seen as a way of gathering information of the work practice and therefore ethnography forms a base for User centered design (UCD) A researcher can observe a place, person, event or an object as a participant-observer (being part of events) or as an observer-participant (not intruding on events). Sometimes the role of both can yield valuable insights. A more specific 'artefact analysis' can also be done to learn more about how a

person executes his work (looking at Altus's notebook, blackboards and maps). Not only by observing, but through interviews (moving from informal to structured conversation) patterns and themes can be discovered (Blomberg, 2003).

1.1.3c User Centered Design

After gathering information on the work practice, it can be used to generate new information by involving the users in workshops. From a user centred design point of view, Brandt and Grunnet (2000) suggests ways of setting meetings with users and using props when collaborating in the exploration and generation phases of ideas. Bringing props or tools to the workshops helps both the designer and user to think and talk through concrete ideas, more easily bringing understanding to both parties. Props in simple abstract generic forms can be used to generate ideas from the user's side and to let them comment on shapes and sizes they preferred. Props with more details can also be used later in the design process, although "inside" components are not necessarily known at this stage, illustrating concepts of interfaces to the user is valuable, because this is what the user will interact with most when the product is finished.

1.1.3d Research-Through-Design

This is an explorative, qualitative study of the work practices on a wine farm with both cellar and vineyards, producing small quantities and higher quality of their own wines on site, as well as selling bulk wine. For Interaction Designers to follow a research through design approach, it is possible to produce novel knowledge for the research community through design research, by trying to design 'the right thing', demonstrating significant invention and not a commercial product. The work should be criticised through a set of 'lenses' (Process, Invention, Relevance and Extensibility) as Zimmerman et al. (2008) describes it. This would show if the research contribution can benefit other research and practice communities, by highlighting technology opportunities, to be of use to potentially move products into the world and it motivates to reflect the potential impact a design may have. The 'Process' employed by the designer, should be accurately documented so that other researchers can reproduce it. The process or methods should have meaning and be applicable to other research. In this study I aim to engage multiple stakeholders with different organisational levels in the design process and through this would present a possible tool to allow the designer to engage the stakeholders for extracting valuable information from their perspectives for the design. The 'Invention' produced from relevant findings, should highlight details on how the contribution would effect/advance its context when applied. This is applicable because the design result of this project would enable to be used in other research to be developed as a potential product. The 'Relevance' of the research project is based on current situations in the studied field, and has to have a motivation for the work being done as already described in this projects introduction. The design in my project would articulate the preferred state of its impact on the users, by allowing them to 'act as experts in their field of practice' (Lowgren, 2007) to show the impact such a design would have on their daily work. The Design thinking of such a project involves a model of grounding, ideation, iteration and reflection (Zimmerman et al., 2008).

1.1.4 RESEARCH QUESTION AND SUB-QUESTIONS

Based on the information in the Introduction, this project aimed to enhance the user working experience on a wine estate, by designing ICT support involving the users throughout the design process. For the design to support work tasks of multiple and individual employees, it should be used for co-operation and planning between the different users. Valuable questions could be formed that were used as a guideline for conducting the research. Firstly I needed to observe what characterizes operation at a wine estate to understand an overview of the place. By knowing the activities they were busy with at the time, I could explore further details regarding the work practices by shadowing and identifying stakeholders through interviews. Through exploring ethnographic video material and related themes with the users in workshops, design openings that were important to the users could be discovered. Concept evolution took place after selecting the design opening by constantly involving the users in the iterative design process. Finally the users were asked for feedback on how the design would influence their daily activities and how the design could be applied to support other work tasks on the farm. This information is presented as future possibilities and opportunities around the design and knowledge for other similar research.

Research problem	Enhancing user working experience on a wine estate, through exploring/designing mobile technologies by involving the users in the design/video process.	
Research question	How can a visual calculator be designed with the involvement of the end-user to provide for multiple working roles?	
Research sub-questions	**Research method(s)**	**Objectives**
1. What characterizes operation at a wine estate?	Interview, Observe, Video. (Activities happening on site)	Explore context. Understand overview of place. Establish activities, regarding time of year. Video clips of first impressions.
2. What are the work practices on a wine estate?	Shadowing/observation, Interviews, video and analyze video.	Identify stakeholders. Capturing the essence of the practice and personalities of each person. Video clips of themes and Video profile.
3. What design openings can be found from studying the work practice?	Workshops with users analyzing the video footage with the video cards.	Inform design process. Find themes to raise new questions and to see in a new way. Video Collage and Video story.
4. How can one explore mobile solutions regarding valuable and meaningful issues, involving the stakeholders?	Using props and created scenario in the users environment and acting out ideas.	Creating and describing ideas. Derive concepts form involving users in design process. Video scenario.
5. How could the concept change or let people adapt their daily activities in the context?	Presentation and discussion with the three stakeholders.	Test concept/provoke people to realise the opportunities of the design/s. Get feedback and establish if concept is valid/ meaningful and valued.

Table 1.1: Research Question and Sub-questions.

2 STORY OF A WINE ESTATE: LEARNING BY OBSERVING

2.1 THE DESIGN PROCESS

Throughout the project I documented everything on video. The video footage was used as part of the design process by supplying information, allowing reflection, and capturing/documenting methods of doing in the project and most important of all it can be used to support design decisions. The context was always in the participant's environment on the farm.

By observing and interviewing people on the farm I could determine where the activities were regarding the time of year. I then moved to where the action was, to observe, interview and shadow people doing their daily work. Naturally questions started to arise after visits and by reviewing parts of the video, I could then ask the participants the questions the next time I went. To make editing easier, I tried to work from memory after each visit, writing down short notes on things that caught my interest. From there I could easily edit the video clips, themes formed and when I showed it back to the participant, it naturally sparked more questions and discussions.

For participation in the workshops I needed to give the participants 'tools' to enable them to 'think with their hands'. This helped me to gain a deeper understanding of aspects in the work practice, which I may not otherwise have discovered. It also helped coming back after a workshop with 'concrete' progress, instead of only video, which in contrast to using it for field observing, can loose detail in a workshop of what happens on the workshop table.

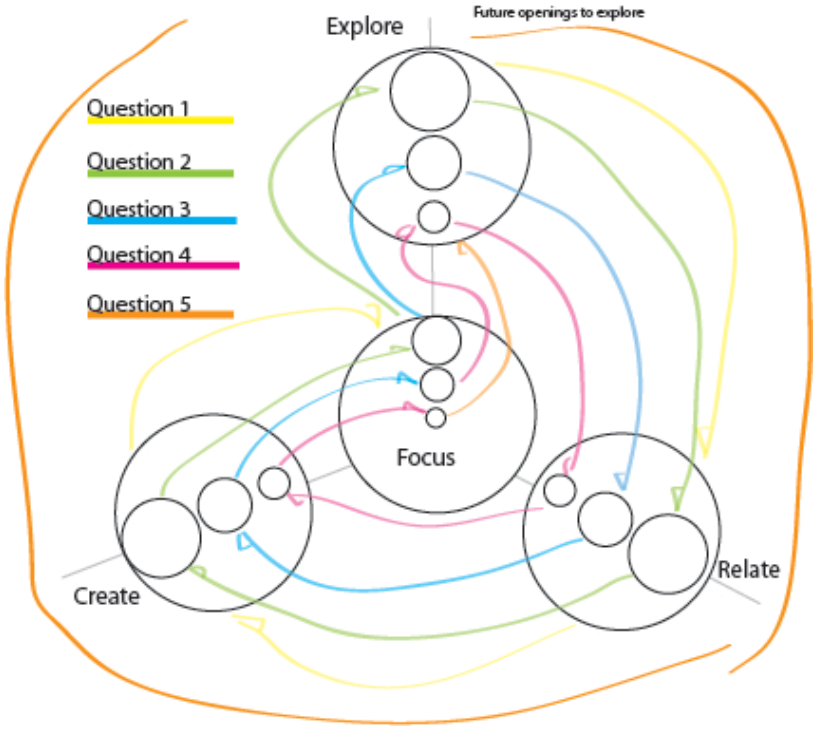


Figure 2.1 : Iterative Journey Focusing and Expanding Research.

It was an iterative journey, each cycle becoming smaller/condensed circles. Looking at Fig.2.1, each cycle or research question carried over selected information from the previous step, slowly focussing on the end goal. Until the desired design is reached (smallest circle) the cycle grows bigger again (orange representation in Fig.2.1), regarding future possibilities and knowledge contribution of the design. Each step in the cycle consisted of exploring, digesting/reflecting, back to user for feedback arriving at a new point/creation and starting the process over again by exploring the newly reached point. However this is only a model in words and steps are more integrated into each other, keeping in mind that the framework used is flexible. Figure 3 does not have all the detail of the whole project, but can be used for a visual idea of the design process. This framework is based on the suggested one in Designing with Video (Buur & Ylirisku, p 17: 2007). Looking at Fig.2.2 and research question 2 as an example, Altus and the work he was involved in became the focus. By exploring his work practice through video shadowing and then relating video material to form themes of the work practice, help with editing video material as video clips to be used in a workshop with the users. The process 'starts over' with question 3, the workshop become the next focus based around the 'new information' and the outcome of the workshop would lead to further exploration of one activity.

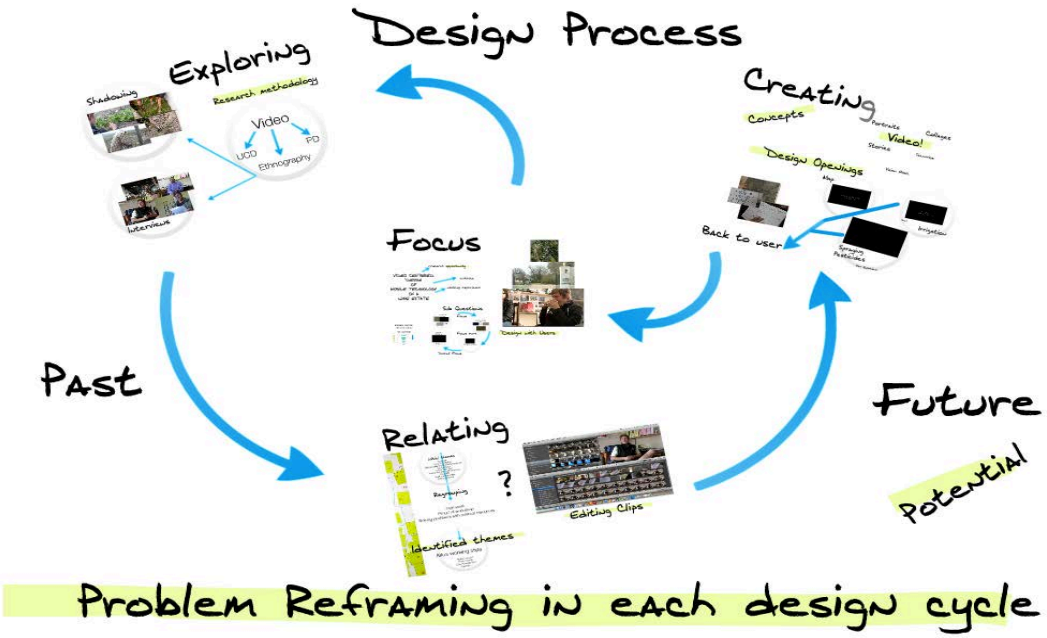


Figure 2.2 : Design Process.

This project spanned over 4 months from July 25th to December 2nd, with 14 visits to Goede Hoop wine estate. The total time spent on observing/shadowing and interviewing was 8 hours, 55 minutes and 57 seconds and the total time spent on workshops was 9:59:43. The total video footage time came to 18:55:40 and the total duration of video shown in the thesis is 01:40:07.

2.2 CHARACTERISTICS OF GOEDE HOOP

The first research question asked was what characterizes operation at a wine estate. In this chapter I provide an overview of the farm, based on unstructured interviews and observing the general environment. These research methods combined with video helped me to understand an overview of the place. Out of this 'pre-study' it was possible to establish the current activities they were busy with on the farm regarding the time of year. This information would then help me to make a decision on what to focus/do research on further on in the study, to get an detailed account of the work practice. This chapter covers the steps from getting into the farm, interviewing the manager and the winemaker and the first video clips. *Note: The quality of the photos/pictures and video in the thesis differs. This is because of the use of screen shots from videos and the use of a mobile phone (for taking video and photos), HD video camera and digital cameras.

2.2.1 OVERVIEW OF PLACE

2.2.1a Map of Goede Hoop Wine Estate

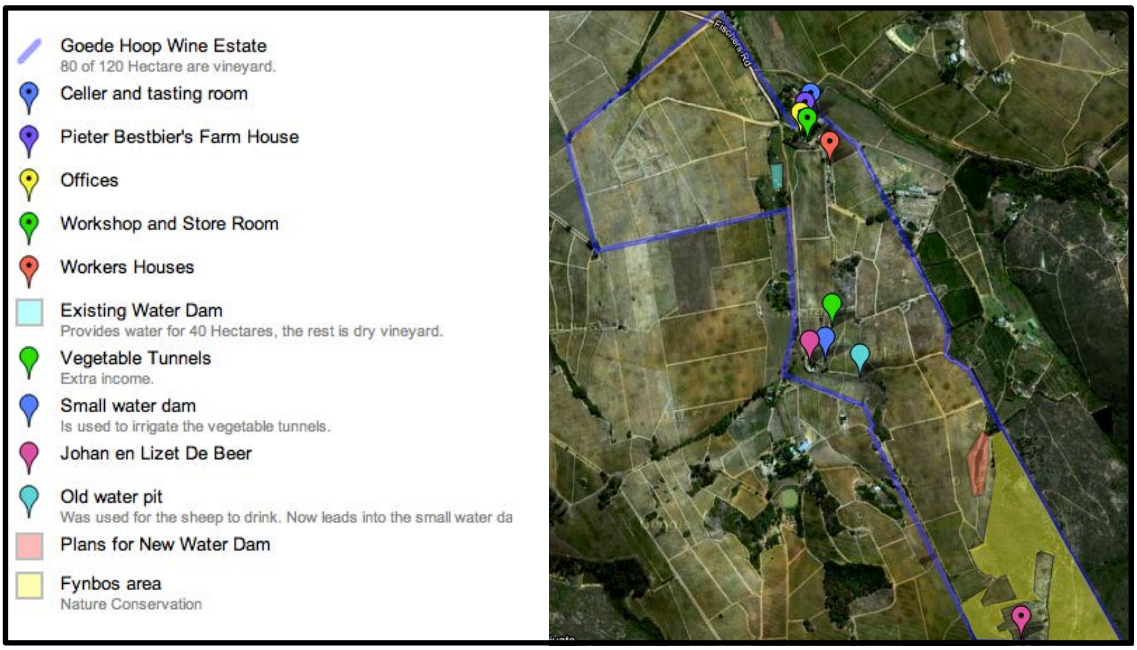


Figure 2.3 : Map of Goede Hoop, showing position of places.

After I have been to the farm for the 'pre-study', I could draw up a map of the farm indicating locations of buildings and places. I have included photos of the places throughout the text.

Map Available online: <http://maps.google.com/maps/ms?msa=0&msid=207227379369723319483.0004a8e54f69b1a1b94b6&hl=en&ie=UTF8&t=h&ll=-33.914589,18.761215&spn=0.022722,0.045447&z=15&vpsrc=6>

Photo 2.1 :Through the gates of Goede Hoop Wine Estate.

2.2.1b Summary of Farm

Goede Hoop is a small independent wine estate which forms part of the Bottelary Ward. The Goede Hoop Farm was bought by the Bestbier family in 1928 and the farm has a rich history, Pieter Bestbier is the third generation private owner. Most employees are permanent and live on the estate.

To be labelled ‘estate wine’, the grapes must be grown on the estate and the wine must be made and bottled on site. Currently only 40 hectares of the vineyards are irrigated, but with the build of a new water dam, the plan is to irrigate all the vineyards. A small area of the farm is covered by Fynbos and is protected by Nature conservation. Goede Hoop is open for wine tastings and can facilitate a maximum of 20 people for a conference. Once a month Pieter’s private cellar is open to the public, when vintage wines can be tasted and gourmet food enjoyed. Their cellar can be seen as a micro cellar, because they only bottle 10% (28 tons) of the wine in the cellar, labelling 7 wines for Goede Hoop. Currently they are selling grapes to other wineries, but they also export wine after Malolactic fermentation.

Photo 2.2 : Pieter Bestbier’s farm house.

2.2.2 EXPLORE CONTEXT

2.2.2a Getting In

Goede Hoop is a wine estate situated on the Bottelary Road between Kuils River and Stellenboch. Driving from Zonnebloem, Cape Town to the farm takes about 40min. The first step before the study could start was to get acquainted to the first person that could show me around

on the farm and for me to introduce myself and what research I aimed to do on the farm. This formed part of the pre study.

I arranged with Johan De Beer (the previous production manager at Goede Hoop wine estate, a contact and an acquaintance) to come and see him about a research project I was planning. On Monday, July 25, 2011 I met him at Goede Hoop. He still stays on the estate with his family and occasionally does work at Goede Hoop. He introduced me to Altus Van Lill the current farming manager on the farm. While we drank coffee, I explained my study background in Industrial Design and how it is different from Interaction Design which I'm currently studying. I did not mention fully what my plans were, because this was only the first meeting and I didn't have a plan myself. I only arranged to come and see both of them again for informal
interviews about their work experience in general and asked for permission if I could spend time on the farm to observe/shadow Altus while he was working. Altus seemed keen to participate in the project and liked the idea that I may design something that would make his work easier. Both of them are outgoing/opinionated, easy to talk to and don't mind being recorded on video. At this stage it was difficult to follow Altus around as the Land Cruiser (a four-wheel drive vehicle, Photo 3) was broken and he was driving a motorbike on the farm.

Photo 2.3 : The Land Cruiser parked between the vineyards.

As 'typical' farmers they have a lot to say about what is currently broken or things in general that is not working properly. They are always busy planning, improvising and solving problems. Johan and Altus used the time we sat down to quickly talk about things on the farm. Only part of the farm is irrigated and they still rely on the rain for all their vineyards. There is a future plan to build a water dam, but at that moment Altus thought they should implement a type of system to regulate the water usage of all the people living on the farm, because currently water is misused and runs out.

They also struggle to quickly get hold of other workers on the farm, because they usually don't answer their mobile phones. This creates tension as some of these calls are of an urgent nature for example, informing someone to get oil for the motorbike, which Altus needs to drive with on the farm.

It was clear that between Johan and Altus I would be able to get a good understanding of what happens on the farm. Johan have been working there for 11 years and has developed his own "management methods" to make his tasks easier, on the other hand Altus was quite new in the position as manager and still struggled to find ways of dealing with problems in his own manner. One thing he found difficult was when they were spraying chemicals and he could not keep track of where they have sprayed before. Basically all farms spray chemicals too keep the vineyards healthy (Photo 2.4). Herbicides are chemical combinations that kill unwanted weeds between the vineyard rows. Fungicide prevents funguses like powdery mildew and downy mildew. Fungicide can either be a contact spray (not taken up by the plant) or a systemic spray (taken up by the plant and protects new growth). He tried to make it easier for himself by printing a map to use, but he never worked on it again. Johan advised him to just spray in a "pattern" or simple order to keep track. Johan created and used this method, but there was no permanent "installations" to make the next employee's job easier.

Photo 2.4 : Example of the tractor with the trailed sprayer and tank.

What I could gather in this short period between the phone calls and first meeting, was that it was intense to manage everything they do, they were constantly busy with ongoing tasks and it was physically a big place to manage. A farm manager is constantly performing a “juggling” act.

Photo 2.5 : Altus van Lil, the farm manager, standing in the workshop.

2.2.2b Situated Interview and Getting Familiar With the Environment

On July 27, I went to see Altus (Photo 2.5), just for a casual conversation (with a few questions from my side) and he showed me around the building that houses the cellar (Photo 2.6), tasting room and Pieter's Private cellar (Photo 2.11). He introduced me to Pieter the owner of the farm and Albert the winemaker (still part of the pre study).

Photo 2.6 : The building that houses the cellar and tasting room.

Altus at that stage was new on the farm, he only started in April 2011 and he is originally from Rawsonville. Altus has a lot of different tasks on the farm. He manages the irrigation tunnels for vegetables, works with and trains the staff, makes and receives calls about quotations, helps with tastings and recently learned how to work out loans.

Altus's week starts on a Monday with a meeting with all the workers at 07:30 in the workshop (Photo 2.7). He then discusses what needs to get done for the day, what he plans for the week were and then gives everybody their tasks. There are three tractor drivers, two pruning teams, a women's team (11 permanent) and a men's team (10 permanent). Not all the workers stay on the farm and on Goede Hoop the women work from June to December, where on other farms they only work from June to August. Samuel has been working on the farm the longest and he is the foreman. He is also one of the tractor drivers and the group leader of the women.

Photo 2.7: On the left behind the tree is the workshop/storeroom and on the right are the offices.

The workload on the farm varies from season to season. The busiest season is from July to December when they train new and young vines, spray for weeds and diseases as soon as the

budding of the vines starts, buying new supplies such as chemicals for spraying the vines, wire and hooks for tieing young vines to the wire between the poles, lifting them off the ground. From January to around April the grapes must be harvested and the wine making processes would begin for the new crop. Then winter comes and they go into a rest period till July again. In October 2011 they were trying to get plans approved for a new water dam.

When asked how this farm differs from the rest, Altus explained that all the estates are similar, but some may spend more money on new technology or implements while others still do things the “great grandfather’s” way. A lot depends on their budgets.

The farm was purchased in 1928 by the Bestbier family. The farm wasn’t a wine estate from the beginning. Pieter’s father farmed with several things including, tobacco, horses, sheep, vegetables and a little vineyard. It was only when the tobacco prices dropped that they slowly started changing over to wine farming. There are old photographs in the tasting area (Photo 2.8) of the horses ploughing the land and transporting grapes. This was the reason for saying the older people stick to their traditional ways of doing and that they don’t adjust well to new technology. But if a new spray machine comes on the market, Altus would not hesitate to test it and look at its price. He does not shy away from technology. He has a Nokia E73, he uses Facebook and BBM and if the budget allows it next year, he may get a computer for his chemical and spraying programs.

Photo 2.8 : Old photo of people and horses working in the vineyards.

After the visit some interesting things stood out for me:
The farm and way of doing things had a strong sense of tradition. Some things are still being done as it was when the farm became a wine estate years ago. Albert the winemaker told me some of their red wines were still stomp by foot. Secondly, gravity plays an important part in the winery in several ways, one example is to transfer the wine from one container to another without using pumps. Some wine is also stored in cement 'tanks' that date back to the beginnings of the farm. Albert’s desk in his office is stacked with papers and he said he needed a personal assistant for doing his filling.

When Altus and I walked through the cellar another interesting thing caught my eye. In the old horse stable, now used for storing barrels of wine, the floor was not completely cemented.

There were 'strips' in parallel going through the cement floor filled with gravel. Placed over some of these were wooden structures holding wooden wine barrels. When asked about this Altus explained that the reason why these barrels were placed differently was because Johan (Peter's father) believed it was better for the wine to be stored over a 'natural' surface, and that this would influence the wine. I would like to ask Albert if he knows the science behind this (maybe it has scientific meaning like stomping the grapes by foot).

Overall because it is an estate (only one owner, and not owned by several people like a more 'commercial' farm I suppose) there is not much money to spend on unnecessary or new 'technology' or equipment. The way of thinking on this farm is if the old way of doing something worked, why replace it with a new way of doing, and do you then say my way of doing is wrong? On the other hand as things break down beyond repair, they have to buy, most probably, new things to replace it. As Altus pointed out, some new farming equipment is simply not equipped to function properly on the farm because of the geographical layout. The steep hills are the reason for using a lot of diesel and making it difficult to calibrate the pesticide machines.

Mondays were the busiest time for Altus, the manager, and would therefore be the best day for me to shadow him. Unfortunately the motor vehicle was broken down and I had to wait three weeks for our next appointment. That however gave me time to observe Albert, the wine maker, to establish his activities.

2.2.2c Being Flexible with the Users

The first meeting I could arrange with Albert, the wine maker was on 17 August 2011. It had to be cancelled as he was too busy that day to see me. His work load at that stage was very heavy with a lot of administration (filing of export forms, keeping track of orders and wine,) organizing and helping with the tasting on weekends. The secretary, Marie, helps with a lot of the paperwork and more complicated IPW forms and procedures concerning the exporting and selling of the wine as well as doing the salaries. Every alternate Saturday she helps with the wine tasting sessions. Altus, the farm manager’s, tasks are “outside” in the vineyards, working with the workers in the field, repairing equipment, doing the orders concerning his field and dealing with mishaps. On weekends he helps with the wine tastings as well. Our meeting was moved to 19 August 2011.

Photo 2.9 : Albert Ahrens, the winemaker, in his office.

2.2.2d Inside the Cellar

On August the 19th, I asked if Albert (Photo 2.9) could explain the process of winemaking on Goede Hoop estate. We walked through the cellar and he explained the processes. What follows is a summary of this discussion. The tractor comes with the full trailer of grapes and dumps it into the hopper. This hopper does not have a scale like other cellars, because it is so old. From the hopper the grapes are de stemmed and then crushed. The crushed grapes are pumped through a 'mash cooler' where the red grape goes into the fermentation cubes. Preferably it would be better to cool the grapes before they are crushed to prevent oxidation from taking place in the crusher. The white grapes are pumped to the separators to separate the skins from the juice and then the skins are crushed for the remaining juice. It is then pumped into the cellar.

Photo 2.10 : Steel fermentation tanks in the cellar.

Inside the cellar are the fermentation cubes. After fermentation it is pumped back outside to the press, but as it ferments they constantly push down rising skins to mix with the juice. In modern cellars hydraulics is used, here they do it by hand using plungers.

The most important things in wine making are the hygiene, temperature management and good grapes to make quality wine. The juice first goes through an alcohol fermentation, then the second fermentation is when malic acid turns into lactic acid. This step should happen at 20 degrees Celsius. Also very interesting, Albert doesn't have to add bacteria for this process, because it happens naturally in the cement tanks and keeps the temperature stable, where as the stainless steel tanks (Photo 2.10) loose temperature. Sometimes they will use barrels for both fermentation processes but most of the time only for Malolactic fermentation. The barrels help to let in minuscule amounts of oxygen for maturation to take place. Only the wines they bottle themselves goes into the barrels and the rest of the red wine is sold in bulk, for blending and bottling elsewhere. After the second fermentation is finished the barrels with their wines go into the cold room (old horse stable). When it gets time to bottle the wine he blends the wines from the barrels into tanks, refine it if required (not often) and then it is ready to be bottled. They have mobile bottlers that do the bottling on site as they do not have their own bottling line. By law as an estate, the grapes should be grown on site and bottled on site.

One ton of red grapes, after working losses, yield 650 liters of wine. One ton of white grapes yield 600 liters and for their straw wine they get 65 liters out of a ton. The total of grapes harvested per season on the farm is usually 600 tons, Albert would take 280 ton, which were all the red grapes and part of the white grapes to make wine. The rest of the white grapes are sold. 90 % of the wine they produce is sold in bulk to Europe (of which they can't increase their prices). They bottle 7 wines under their own label but if they want to increase profits, the challenge would be to bottle more wine under their own label. In SA he estimates that there are about 9000 different labeled wines. He reckoned if the wineries stop exporting and South Africans drink more wine, the wine economy would be better.

After the harvesting in January and the making of the wine, Albert's work consists mostly of administration for the rest of the year. On the smaller estates the wine makers do most of the admin work themselves. The size of the operation do not allow for administration staff.

The biggest problem in SA in the wine industry is the cost of production. The last ten years the business hasn't been good. The exchange price stayed the same while the Rand strengthened and living expenses kept rising in SA (for example petrol and electricity).

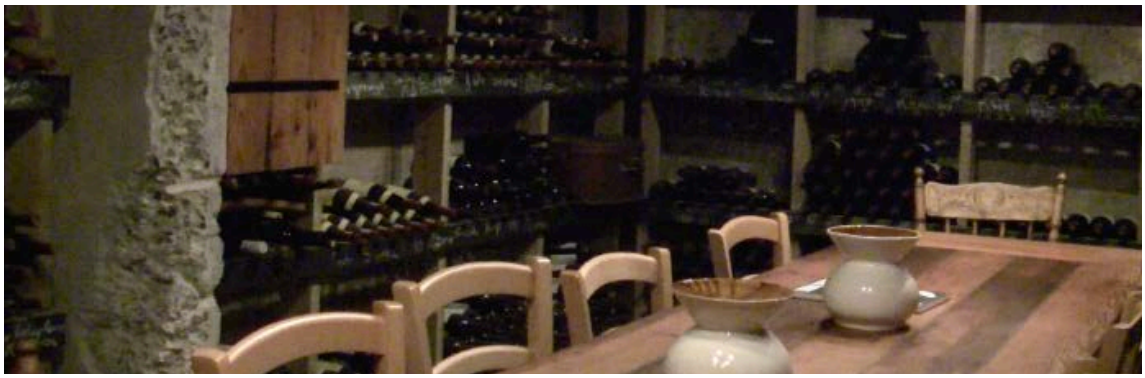


Photo 2.11 : The room where the guests attend an evening in the private cellar.

2.2.3 FIRST VIDEO IMPRESSIONS OF ALTUS AND ALBERT

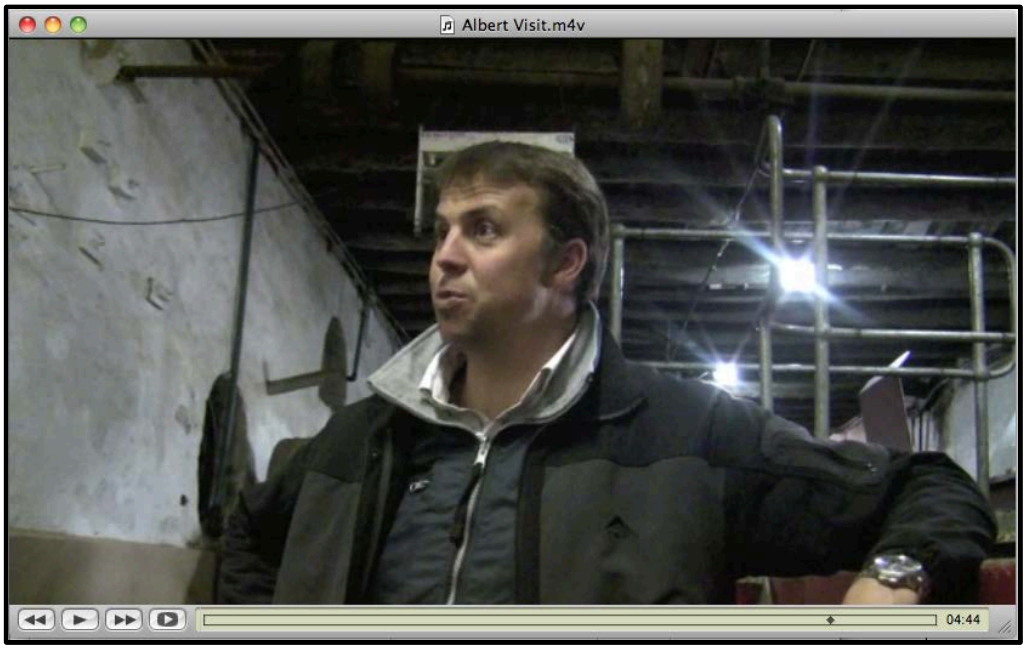
To get a better feel of the environment, I have made a few video clips of the first two visits, mainly also to practice the skill of working with video. (Click on the video in the PDF to play).

2.2.3a Altus Van Lill

Video 2.1 : Altus Visit [Duration: 00:05:52].

Clips of the first day with Altus, after the Unstructured Interview (July 27, 2011). Name and Brief Description.	**Location Time in video.**
Communication, Pesticide Problem'. Clearly there was a problem, but I did not understand the situation very clearly. It was needed to see the calibrating in action.	[00:00:05]
'Wine cellar, old school'. Altus is very new on the farm and he does not have a background in winemaking. So to be clear on what is happening in the cellar, one should talk to the winemaker.	[00:01:37]
'Albert the Winemaker'. Altus introduced me to Albert and he had a few tips on designing for a cellar.	[00:02:20]
'Storing Wine Barrels, Traditional Method'. Once again Altus is not completely sure about the older methods.	[00:03:11]
'Management, Tool system'. As I found out later, the tool system was a new way of doing, installed by Altus.	[00:04:00]
'Pesticide cans by Law'. There is a lot of paper work to do around most of the things that happen on the farm.	[00:04:48]

2.2.3b Albert Ahrens



Video 2.2 : Albert Visit [Duration: 00:05:30].

Hour visit with Albert (August 19, 2011). Name and Brief Description.	**Location Time in Video.**
'Cement Fermentation Cubes'. The cubes may be old, but they are still working better than stainless steel tanks.	[00:00:06]
'Clarifying Storing Method of Barrels in Old Horse Stable'. Albert has an explanation about the gravel openings in the cement floor.	[00:00:54]
'Human vs. Automation, and Economic Situation'. A good clip where Albert explains how he feels about the topic.	[00:02:17]

2.2.4 DECISION WHERE TO GO NEXT: BETWEEN ALBERT AND ALTUS

It was a pity that there were no activities happening in the cellar at this time of year and that the only action taking place was admin. The human aspect seemed very prominent and the use of older techniques was very interesting. One aspect that stood out for me was that Albert did not even had a thermometer to test the temperature of the wine, but that he stuck his whole arm into the wine to feel the temperature. There are definitely a lot of interesting opportunities for all kinds of design in such a small cellar. When looking at other researches, I felt that this was an unexplored area as most of the research done have focused on the vineyard side. Harvesting and all the activities around the cellars happened in a very small time period during the year, and I guess it would be difficult to do research in a cellar when they are busy. Still it would have been ideal to experience their activities in the cellars and not just listening to a verbal explanation.

What characterizes an operation at a wine estate? It is a big place with few people working there. Albert the winemaker have worked there for a longer period of time, while Altus the farm manager is relatively new and still needs to find his feet. On the estate they grow their own

grapes which they then sell locally to wineries or they export wine in bulk. They also use some of their own grapes to make seven varieties of their own wines in the cellar located on the farm.

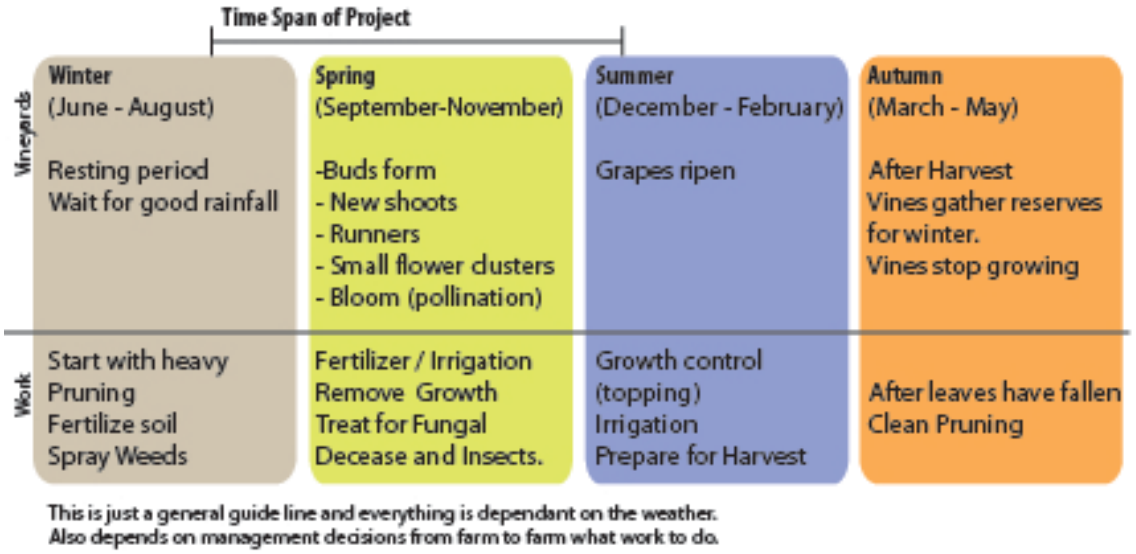


Figure 2.4 : Vineyard developing stages and work related to the time of year.

There seems to be a lot of tradition regarding methods of activities on the farm. Goede Hoop is not a commercially owned farm and the amount of money available for the newest technologies is limited. This time of year they are busy in the vineyard and it is quiet in the cellar. Because of the nature of this study, the designer needs to observe activities first hand and not only through descriptions from the participants and this were the reason why it was a better choice to focus on the farm manager for further research. Through exploring using video shadowing, video observing and video interviewing people, I would uncover current activities and details of the people involved doing these activities.

2.3 DETAILED STUDY OF WORK PRACTICES

To develop an understanding of the work tasks they where busy with at the time of year when I started the study, I shadowed workers with a video camera. After each shadowing, I edited the video material and selected clips, which raised new questions I could take back for the next shadowing session. The focus here was to start observing Altus the farm manager and through this strategy slowly start to identify other stakeholders. Interviews would become more structured and shadowing would give insight to activities. By analyzing and creating videos, one can capture the essence of the practice and the personalities of the people. I shadowed Altus on three occasions, interviewed him once and showed him video clips for confirmation and clarification from his side. I interviewed Samuel the foreman once and on other occasions briefly observed him. From the video material I developed video cards of the work practices, and this could feed into the workshops for developing a deeper understanding of the work practices.

2.3.1 ALTUS'S WORKING STYLE

On the farm they have different modes of transport namely the Land Cruiser, a motorbike and three tractors. Depending on the situation, Altus would alter between the modes of transport. He would usually take the women and men to where they needed to work on the farm using the Land Cruiser. When Altus needed to pick up something small in town, he would use the motorbike to save diesel. He used the motorbike when the Cruiser was broken down to more easily and quickly move between the teams in the vineyards. With him on the motorbike he took his scissors and communication radio. He kept his notebook under his jacket, his pen in his pant pocket and his mobile phone in his front jacket pocket. Sometimes his mobile phone would drop out and he looses it in the vineyard, he then needed to borrow another phone to call his for tracking it by listening where it was.

Altus kept everything that he needed to remember written down in his notebook. These things included important numbers, names of contacts, what he needed to buy and what needed to be done. Something interesting he kept in his notebook was a vine leave. It turned out that Samuel would sometimes bring him a leave and Altus then uses the leave to check for decease by placing it in a plastic bag. If something grew on the leave they could prepare and act accordingly.

When Altus was not in his office, he would use his mobile phone for communication. He preferred to send messages through 'Whats App' because it was cheaper than making phone calls. By doing this he tried not to go over his monthly limit, but when it was about something important or urgent he would call. Sometimes he would use the internet on his mobile phone to check the weather predictions when he was in the vineyards, otherwise he would check on the secretary's computer.

In Altus's office he had binders full of records. He briefly showed the different things he needed to keep record of for example quotations, receipts, employee loans and attendance registers. On the wall was a map (Photo 2.12) with a satellite view of the farm. He used the map to try and keep track of activities in the vineyards. He wrote on the map where the blocks have started to bud and bloom first and work tasks finished on the blocks.

Photo 2.12 : Altus explaining the use of his map in his office.

When it started to rain the women was taken to the vineyard block in front of their houses. I was curious whether there was another reason apart from shelter. It turned out that Altus doesn't want to transport the teams back and forth unnecessarily to save time and diesel. However Altus also keeps in mind that not everyone's health is the same. Other farms would give their employees raincoats to work with in the rain, but at Goede Hoop estate they never work in the rain. When it rains they try to do work indoors for the rest of the day, to earn a full days pay.

2.3.1a Blackboard Systems and Maps

In the workshop Altus showed and explained the use of the blackboards he has put up. On the side wall of the smaller storeroom where they store the chemicals in the workshop, he has a board with all the spraying information on it (Photo 2.13). This notice board keeps everyone involved in the spraying process informed. It shows the tractor operators what chemicals to mix into the tanks with the amount of water and the calibration settings of the individual tractors. Inside the smaller storeroom Altus has put up small blackboards identifying the chemicals packed in rows on the floor. These indicated or repeated the quantity of the chemicals to be mixed, not to have to remember the information from the outside board when collecting and measuring the chemicals in the buckets inside the storeroom. Inside the room were older black boards with similar chemical information written on it, but it was a different system used by the previous farm manager. The other black boards in the workshop are used for irrigation and for borrowing tools.

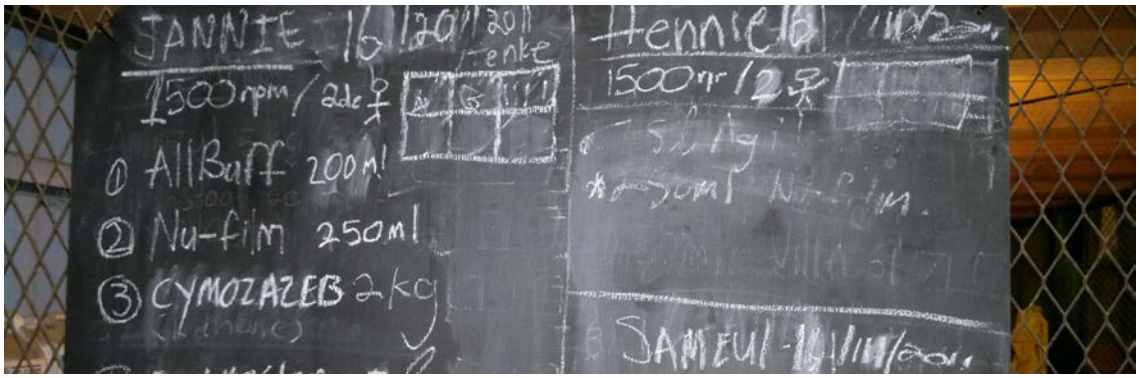


Photo 2.13 : The spraying information notice board.

The farm map was a reoccurring object in several forms. It was interesting to me and it seemed to have different information roles of keeping track. Only after a few visits and persistence in asking about it each time, a fuller understanding about the map was reached.

The first time I heard about a map, was with the first interview with Altus in his office. At that time he did not use a map but kept track by spraying from one side of the farm to the other, following a pattern. There was an outdated map in the office that the previous farm manager used. But I then realized that it would be difficult to maintain that way of keeping track, because the different vineyard blocks develop differently and get deceases at different times. So when

keeping the spraying pattern, some blocks would most probably not need to be sprayed at that moment disrupting the spray pattern.

Only on the second visit to shadow Altus, I got introduced to his temporary farm map and he explained how he sometimes kept a record on the map of the work being done. He received his large laminated map back from the printers the next day. On this map he wrote the block numbers and in some instances he redrew block boundaries. He showed me another paper with a list of information for the individual blocks. Some information included the cultivar, the size of the blocks, the number of rows and the dates the vineyards were planted. Most times he would refer to this information paper using it in accordance to the farm map, for working out chemical amounts and valve combinations depending on combined pressure for the main irrigation pump to function effectively.

After a few days a new map with the blocks and block numbers was presented in the workshop. Altus drew it on a black board and he wanted to put it where everyone could see it. Because he was new on the farm he referred to the blocks by their numbers. Most employees have worked on the farm longer and they used to talk about the block names. Altus used this map to bridge the ‘communication’ gap because everybody knew where the blocks were in spite of their different names.

2.3.1b Video Collage of Map

Video 2.3 : Video Collage of Map [Duration: 00:02:58].

Video 2.3 was used for provoking design ideas. A farm map was also a point of interest mentioned and focused on in previous research studies (Burrell & Brook, 2003). The map of the farm played a central role in planning and decision making.

2.3.1c Irrigation

On the farm they have an existing water dam that is used for irrigating only 60% of selected vineyard blocks and the rest of the time they depend on the rain. At a certain growth time they give extra water the vineyards to ensure that the clusters grow big. This was why they were planning to build an extra water dam. With more water they could double their production.

The water coming from the existing dam was also used on the farm for general purposes and for the employee's homes and Pieter's home. However there was another smaller water resource they used. Located toward the irrigation tunnels of the vegetables was an old water well/pit. This water was used for the vegetable tunnels and general use for the other house on the farm. Altus needed to manage the water level from the pit/well collecting it in a smaller dam by opening and closing the valve. The reason for not keeping it open, was that when the well runs dry it needed to fill up again and by closing the valve the pipe leading the water to the dam is under pressure. Then he had to suck on the pipe every time to get the water running again if the valve is permanently open.

Photo 2.14 : Altus opening one of the many valves located between the vineyard blocks.

The first time Altus talked about irrigation he mentioned that he constantly needed to remember to open and close many valves for watering the vineyards (Photo 2.14). It was difficult to understand his explanation at the time, but it became clear after several visits when he showed how he did it. What people say and do is different and this was a very good example of Altus, because he was new he mixed up his previous experience of managing the irrigation to what he should adapt to on this farm. They experienced several problems with irrigation regarding other people interfering with the settings and stealing the copper fittings or pipes.

The process of irrigation consist of the following steps: Altus opens sub pipe line valves on selected blocks and he closes valves on blocks which were irrigated the previous day. When the pump at the dam was running, Altus could irrigate 4 to 5 hectares at once. This was when he needed to check the map to see which blocks he could irrigate together, if the block was 4 to 5 hectare on its own, he could only open valves for that block. For a safety measurement he opens a backup valve on the same line, usually located above/higher to the actual blocks he wants to irrigate, to prevent the pipes from bursting if someone accidently closes open valves or

in case something else goes wrong. Altus then drives to the main pump house located next to the water dam to open one of two main pipe line valves (one goes to the upper part of the farm and the other one to the lower part of the farm). He then goes into the pump house where he follows several steps to start the main pump. He checks that everything is working correctly and then drives on the one side of the block to see that all the small irrigation pipes are working and that they are closed on their ends. He irrigates the blocks for 3 to 4 hours before he changes to other blocks. He kept track of irrigated blocks firstly in his notebook and then on one of the blackboards in the workshop. This included the dates, the time irrigated and the block numbers. Interestingly when they wanted to fertilize the vineyards they could use the irrigation lines. They add the fertilizer through the lines, individually attaching a tank to the block's tap/ valve system and the blocks with no irrigation lines got pellets that were thrown by hand.

2.3.1d Tools

As Altus and I drove in the vineyards he stopped at the location where their weather station used to be. The unit was stolen for the little copper wiring it contained. This was quite a big set back for them, because they relied a lot on the weather station for making decisions and it was too expensive to replace again soon. We went back to the offices, where Altus introduced me to Pieter, the owner of the farm. I briefly spoke to Pieter about how they used the weather station before it was stolen. The station used to send out emails to Pieter with different sensor readings. The weather station formed part of a network of more or less 15 stations in the area (Stellenbosch, Paarl and Bottlary), where all the farms have access to these weather emails. This information is more accurate than looking at general weather forecasts and help with decision making on a daily basis.

Important communication tools they were using on the farm were two-way radios. Altus, Samuel the women team's leader and Hennie, the men's team leader, used the radios to talk to each other. Altus could check up on teams and it was useful when Hennie or Samuel wanted to ask Altus about work tasks when they were not together. Hennie, also one of the tractor operators, contacted Altus to confirm if he should fill his spray tank to spray the next vineyard block. Altus then made a decision based on the strength of the wind and if there is enough time left in the day to empty the spray tank.

2.3.1e Outside Income

On the farm are other means of income besides the vineyards. The themes for these can be divided into 'outside income' and 'more income'. Examples of outside income are the monthly payment they receive from communication companies for having mobile phone towers on the farm. This is convenient as the towers are not taking up any usable land and the farm is geographically suited, as the towers are located on the highest part of the farm (See Fig.2.3, towers indicated by the pink, black dotted indicator at the bottom of the map). In this same area between the Fynbos and the steep hills, they are renting out a small block of bush vines. The lessee makes his/her own quality wine in his/her own small winery. On this 2 to 4 hectare the yield was 800kg in 2010. They pay a lot of money to be able to grow the grapes. The bush vines

were planted in the 80‘s making them highly valuable, because of the excellent quality and flavour of the grapes. The vines don’t produce many grapes because of their age, but you could produce expensive wine from them. The people renting the land do their own pruning and spraying of chemicals. They bring their own resources (workers and tools/implements), but Goede Hoop estate may interfere to spray pesticides if an outbreak occurs.

Photo 2.15 : Altus walking through one of the vegetable tunnels with the beans.

Johan, the previous farm manager, started the irrigation tunnels for the vegetables as a side business, to generate more income (Photo 2.15). Altus now manages the vegetables tunnels on the farm, where they grow tomatoes, cucumbers and beans. They sell the vegetables they grow to the local super markets and fresh produce markets. Before they sell their produce to any market, Altus would try to find out current market prices by making phone calls.

2.3.1f Terminology

I found the Afrikaans terminology they used for describing parts of the vines and tasks they do very interesting, because it personifies the vines. They would talk about the arms, feet, legs and belly of the vines and they would do suckering to clean the vines of unwanted growth. This is general/standard terminology used on all farms. Instead of using scientific terminology found in study books, the 'fancy' names all have 'nick names' or easier names. This makes it easier for all farm workers to understand what was talked about when working between the farms.

2.3.2 SUB MANAGEMENT

Altus mentioned that the employees ‘owe him hours’. The hours they owe him comes from previous working days, where they took time off work. According to how many hours they owe him, they would work half an hour longer each day for an agreed number of days to catch up. Normal working hours changes depending on the time of the year. At the time the study started, they started 7:30 and ended 17:00, the following month the they would have started at 6:30, take breakfast between 8:00- 9:30, lunch between 12:30 to !3:30 and finish work at 17:00 or 17:30, depending on how far behind in work tasks they were. During harvesting they would work from 6:00 to 18:00. There are two teams working in the vineyards. The women’s team does different work than the men’s team. The men would do the more intensive labour, like planting poles, putting up wiring etc. While the women would do most of the pruning.

Photo 2.16 : The farm church in the foreground and employee houses in the back.

2.3.2a Samuels's Responsibility

Samuel Williams (Photo 2.17) has been a tractor operator and foreman on Goede Hoop estate for 11 years. He has much interest in his work and he took his responsibilities seriously, but he also enjoyed his work. He told me that the most important work on the farm was the growing of the vines, because this was where the income of the farm lies and their salaries generate from. He also finds it important to foresee that all the work gets done correctly and to take into consideration that everything was used sparingly.

Photo 2.17 : Samuel Williams, the foreman.

He plays an important part as team leader and in the management of the women's team. He keeps the team together and he handles conflict within the group. When Altus was busy or if the vehicle was broken down and the women team had to work on a block located far away, Samuel would transport them with the tractor and trailer. The men's team would usually walk to where they needed to be, but when both teams work in the same block, both are transported by the tractor. Samuel works with the women and sometimes he would show them how something needs to get done and why it is important to do it the right way. Another responsibility Samuel had this time of year was walking through the vineyards on the weekends, to spot pests or deceases. If Pieter or Altus then asks him about the situation in the vineyards, it was important for him to be able to give feedback. Sometimes the spraying team (Himself, Hennie and Jannie) had to work on Saturdays, because the weather dictates most of the work.

Hennie is the team leader of the men's group and he also has a drivers license to go into town to buy things when needed. He plays a different role in the men's group than Samuel in the women's group. Most of the men are still young and inexperienced in the work that needs to happen and Hennie has to give good guidance. The men are allowed to make a fire to keep warm and to get dry when it rains. Other farms do not allow this because of managing differences considering the risk of fire. There the employees needed to put on more layers of clothing. They also make a fire in the early morning when it is very cold in harvesting time. Usually they would use off cuts of the vineyards and branches from the trees to make the fire.

2.3.2b Pruning

On one of the days that I shadowed Altus, we dropped off the women team in the vineyards. It was a cloudy rainy day so he stayed with the Land Cruiser for if the women needed shelter from the rain he had to take them back. They were doing heavy pruning on the vineyards, (Photo 2.18), removing all unwanted growth. Firstly they would cut the shoots growing upwards from established arms to an equal height; they then removed unwanted shoots/arms, followed by cutting the remaining arms shorter, leaving two buds/eyes on each. When it started to rain Altus decided to take the women back to the houses for shelter, so that they could work in the block in front of their houses when the rain stopped.

Photo 2.18 : The women team pruning the vines.

Suckering is when they clean the 'belly' and 'legs' of the vines. The women would do suckering, which meant they would go over blocks they already pruned to take away any new growth, like water shoots. Altus pointed out that all farms have different ways of doing these work tasks.

At the time of the study they were busy with planting new vines and Altus showed me the younger untrained vines they have planted the previous year. This meant that the vines were not yet growing on the wire. These vines were still being pruned to develop strong 'legs', before they could grow 'arms' on the wire. These new blocks still needed infrastructure like poles, wire and irrigation lines.

Photo 2.19 : Altus showing a bush vine.

The bush vines yielded fewer grapes and it is more labor intensive to prune and shape. Bush vines don't grow between the wired poles (Photo 2.19). Instead two of their arms are tied together to form a circle on which the grapes could grow. This is hard work because one is bending down all the time and it takes longer to prepare these vines.

2.3.2c Spraying

2.3.2d Video Story of Calibration

Video 2.4 : Video Story of calibration [Duration: 00:04:52].

Video 2.4 is a short video story that forms part of the story line in the spray process, later developed in a workshop. This video forms part of the 'Calibration' chunk in the story line (see Fig.3.6). It shows the complexity behind calculations for calibrating the tractor and spray tank.

Before they could spray the vineyards, the tractor with the spray tank needed to be calibrated. They started by choosing nozzles they thought were appropriate according to the hight of the vineyards. They adjusted the valves by opening and closing them with a spanner. When this

was finished they asked Hennie to switch on his tractor so that the water could spray out of the nozzles. The spray tank was filled with clean water and had no chemicals mixed into it. Before they started the tractor they attached pipes to the nozzles to be able to catch the water in a bucket. According to the revolutions per minute (RPM) of the tractor they catch the water according to a certain time. They could then measure and calculate the water sprayed per meter. They multiply the water caught on the one side of the tank with two, because they use both sides of the spray tank. Then they divide the liters by the row width and multiply the answer by 100 to get the liters per hectare for spraying. However if you spray every second row, you should divide the answer by 2, to get the liters per hectare.

Johan (the pesticide rep) increased the dosage of the sulphur after they calibrated Hennie's tractor. The sulphur went up from 1.5kg to 3kg per hectare. The new quantity to mix in the tank was now 11 kg. Altus needed sulphur bags, so they multiplied 3kg with 70 Ha to work out what they needed for one round of spraying. The reason Johan increased the sulfur from 5kg to 11kg was due to the pesticide risk that increased. This decision was made collaboratively. It depended on the weather and on what the surrounding farms were doing, if Samuel and the other workers noticed problems, if Altus noticed changes and Peter and Johan with their experience to ensure that the vines did not get sick.

A few times during the season, Johan would drive around on the farm with Altus to inspect the vines before he makes suggestions. By using his experience and visual clues from the vineyard, and taking into consideration the weather and other variables, he made decisions on what was best to spray the next time and where to spray. Neither of them made notes, Johan is used to remembering (what was surprising, is the amount of information he needs to remember, because he also does the same job on other farms) and Altus relied on Johan to remember. As soon as Johan saw something, Altus would stop and they would climb out to see and walk into the vineyard block. Johan would say things such as: 'the colour doesn't seem right, they need fertilizer,' or 'the grass is not dead yet, next time we should make the mix stronger,' or 'you need to spray the banks, then we have to re-calibrate, but this can wait,' or " it is too late already for spraying this.'

At the time I did not know all the details yet, but it was necessary to be aware that they do spray for a lot of different reasons and that calibrating should be done each time the reason for the spraying changed or a different tractor was used.

Keeping track of calibration for spraying chemicals was necessary, because changes occurred all the time depending on what they were spraying for, for example spraying for grass or other weeds was different to spraying the grapevines. When they sprayed for weeds, every row would be sprayed, where the spraying of the vines would start with every second row and later every row. There were two different spray devices, one could be trailed by the tractor and the other was a boom mounted on the front of the tractor. The front boom was used to spray weeds between the rows and could be calibrated both for the whole surface and only for the banks.

The back sprayer has more valves and depending on the height of the vines and the leave density, it was re-calibrated. Also when spraying pesticide, the tractors could be used to lay down a constant stream instead of spraying a mist. Backpack sprayers were used in areas where the tractor could not drive.

Throughout the vines growth cycle the amount of water per hectare sprayed changes. The dosage of the various chemicals also changes to increase the mixtures strength depending on various factors. Equally important, one could not just assume the tractor and equipment you wanted to use, was correctly calibrated. Communication problems and misunderstandings could happen between all the stakeholders in this process. This was what happened (as seen in the first video clip of Altus), where there was an incident when double the amount of pesticides was sprayed, but Altus did not want to discuss it in detail. I thought this might have been his reason for suddenly putting up his own notice board about spraying information, calibrating and mixing in the pesticide room to avoid misunderstandings.

At that time I thought it would have been ideal to get an interview with both Altus and Samuel present, to discuss ‘information flow’ between them. I thought it was relevant to know what information Samuel would like to have for better decision making, without the need to constantly ask what needed to be done. What information would Altus like Samuel to have. When I wanted to discuss this with Altus, he seemed not to want to share all the information with the workers, but rather making them aware of certain things. So to a certain extent he tried to manage a flow of information through his black board systems.

Photo 2.20 : Samuel spraying the vineyards.

2.3.2e Analyse Video

To be able to analyze the video of the field studies, without working/looking at hours of video footage alone, collaborative memory and/or brief discussions were noted directly after field visits to use as references to edit video clips. The basis of these ‘notes’ were created after the first day spent following Altus around and these helped to edit collage videos and a video portrait of Altus. These notes formed themes that were used to represent an overview of activities of the current work practice. For a deeper understanding I started connecting the notes through colours to form new meanings between the themes. For example I connected all the notes on

communication or a reoccurring object like the farm map so that it was easy to edit and compile a video collage of the map. As Altus featured in most of the videos, I used this ‘note map’ to connect notes and his way of doing (from the themes) as examples/representations of his personality to help with editing his video portrait. The ‘note map’ allowed a visual way of exploring certain activities more, by highlighting some notes allowed to see where to ask more questions. In Photo 2.21, A was the basis of the ‘note map’, B had extra notes added and in C one can see symbols and colour connections between the notes.

A *B* *C*

Photo 2.21 : Development of the ‘note map’.

Analyzing the video for the video cards.

Not all the video themed clips were suitable for video cards, which I planned to use in the first workshop to interrogate design openings. With reference to ‘Designing with video’, I tried to edit new clips. According to Buur and Ylirisku (2007) video clips should be activities with a beginning, middle and end. There was a time limit to stick to (30s to 2 min) and the clips should have titles describing the activity and the name of the person doing it. The clip and the card have the same name (and number), use person’s name and a brief description of the activity, 5 people (4 participants, one facilitator) 10 clips per person, makes +- 30 cards. The average time of the clips was 48 s. In the end I managed to make 28 video clips.

Some clips I may have done too short and I also left the titles of the clips out on the cards (only numbered them with the corresponding video clip) to allow for a more open interpretation from the stakeholders, although the video clip had a name showing in the beginning to contextualize it. I thought about the possibility to mute the videos while showing them to the participants to try and draw their attention to what was happening rather than focusing on explanations (would help to draw attention to what is visible, handling of objects, body movements and facial

expressions, maybe also help with language barriers). I asked them to take notes about the video clips on corresponding cards and use the cards to find which problems needed attention, asking them to arrange their cards into groups and name their groups. Collecting card families from all of the participants was not done, because they all watched the same video clips and therefore had the same cards. Discussing the card families would have only have worked if everybody had different video cards.

2.3.3 VIDEOS: OVERVIEW OF ACTIVITIES AND PERSONALITIES

A conscious effort was made not to repeat a video clip between themes, video cards and Altus's portrait. Themes only consisted of clips with a 'show and tell' nature or situated interviews (learning the personality and goals of the participant and how things are structured) and no activities, as these only happened later in the project. The activity clips were used for the video cards, to depict the practice. As for the portrait a combination of all the type of clips were used.

2.3.3a Video Clips of Themes

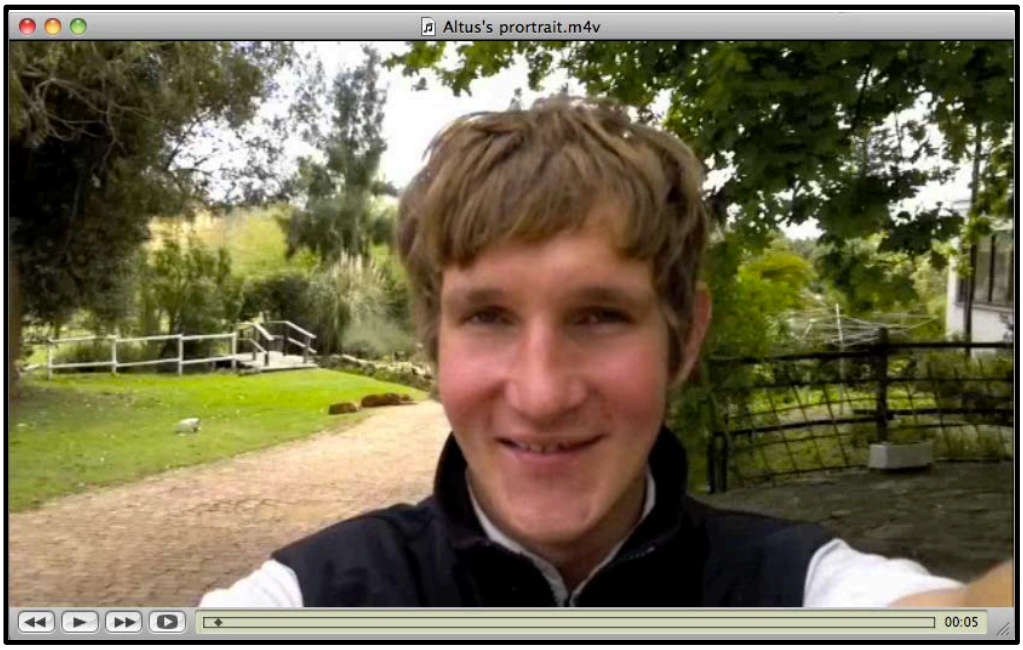
Video 2.5 : Video Clips of Themes [Duration: 00:39:36].

As mentioned these clips came from the 'note map', so they represent a overview of activities on the farm.

Name of the theme.	Location Time in Video.
1. Altus Working Style.	[00:00:01]
2. Reducing Cost.	[00:12:40]
3. More Income.	[00:13:01]
4. Outside Income.	[00:13:54]
5. Sub Management.	[00:16:38]

6. Animals and Nature.	[00:20:43]
7. Tools.	[00:23:59]
8. Buying and Sharing Resources.	[00:27:59]
9. Loose Videos.	[00:28:49]
10. Weather.	[00:38:55]

2.3.3b Video Portrait of Altus



Video 2.6 : Altus Portrait [Duration: 00:07:34].

By gathering details on the sticky notes after each visit, it was as if Altus's personality for the video was starting to form. His personality traits could be drawn while looking at clip examples and combining it with the feel that was carried over at the visits: the trust placed in himself and in others to do all round work, fixing problems and completing tasks, his compassion and consideration of his workers health and safety, taking the women home for shelter from the rain and allowing the men to make a fire. He had a strong ability to teach himself to do the necessary tasks and not to wait on someone else to do it for him. Taking initiative, he was installing blackboard systems to help with management communication and he solved problems with minimal resources. Giving workers space and teaching workers to be independent, he wanted the workers to be able to come to him and suggest solutions to solve work tasks. He taught them skills and he showed them tasks they did not know how to perform. He has respect for other people (like the neighbour) and he has loyalty towards his working partners and saw teamwork as important.

2.3.4 TAKING THE NEXT STEP

A brief summary follows, of the various work practices Altus and the people he managed were involved in. By video observing, video shadowing and more interviews I could identified several stakeholders, captured the essence of the practice and personalities of the people.

Although the focus was more on Altus the farm manager, other people and their roles came to light by exploring what Altus did. Samuel the foreman played an important part as the group leader for the women. Samuel is also one of the tractor operators and he takes this responsibility very seriously to effectively spray the vineyards with chemicals to prevent decease or pest outbreaks. He said if the vineyards are not healthy it would influence the

harvest and fewer grapes would influence the farm's income. Pieter the owner played a more subtle role and was not that involved in the daily activities in the field. He did more office related work that I was not able to observe. Although later in the workshops I could form a clear idea of what information Pieter wanted, I noticed that sometimes Altus and Pieter would discuss and plan activities together, mainly influenced by the amount of money available. Samuel and Altus would discuss and plan time management strategies regarding activities relating to the vineyards.

One reason that Altus became the main focus of this study could be because he was in the centre of all the activities the time of year the research began. He was the person that needed to deal with the other workers, the owner/boss and external people for example the chemical reps (Fig.1). This made him the 'primary' stakeholder, whose work practice could be supported through ICT involving co-operation with other work roles.

It was discovered that the main groupings of activities were Irrigation, Pruning and Spraying of the vineyards. After analyzing the video footage of the ethnography study, I developed video clips that were grouped into themes, such as 'Altus's Working Style'. These clips showed a clear outline of the practice.

Video artefacts like a video portrait of Altus the farm manager was made to show his personality and work style. This was used to convey user empathy and to better understand the stakeholder to design for. Extra video artefacts like the short video story and video collage was later used to contribute to the design opening and give a design direction (Buur & Ylirisku, 2007).

Other video clips were specifically edited according to the video card game setup (Buur & Ylirisku, 2007) and used for the first workshop with video cards, showing activities around Irrigation and Spraying. This is presented in the next section. Professor Jörn Messeter was an observer in the field study and he helped to facilitate the workshops. Together we reported findings from the first workshop regarding highlighting stakeholder perspectives in PD workshops (Claassen & Messeter, 2012).

3 STORY OF A DESIGN: LEARNING BY DOING

3.1 FINDING DESIGN OPENINGS

The following chapter covers the first two workshops in finding design openings. The workshops were used to study the current work practices discovered in the previous chapter. By involving the stakeholders to analyze gathered video footage on Irrigation and Spraying will help to inform the design process of issues that can be addressed. The main workshop tools were video cards used in a new way to find design openings and highlight the different stakeholder perspectives.

3.1.1 EXPLORE WITH USERS

3.1.1a Video Clips for Workshop

Video 3.1 : 28 Video Clips for Workshop [Duration: 00:20:54].

These are the clips shown to the stakeholders in the first workshop. All three stakeholders were shown the same clips and they all had the same set of cards. After viewing each clip we asked them to write down anything of significance they see in the shown activity. Although the video clips were almost 21 minutes long, the exercise took around 50 minutes to complete.

3.1.1b Workshop 1

Photo 3.1: From left to right, Samuel, Pieter, and Altus looking through the video clips.

In the first workshop all three stakeholders, including the owner, farm manager and foreman, were shown the same video clips and they all had the same set of cards. After viewing each clip they wrote down anything of significance in the shown activity. Then they grouped their cards individually and named the groups. We allowed them to fill in blank cards if they felt at any point that something was missing to the bigger picture.

Altus took the initiative to start the discussion. He packed out his groupings and named them, they were: Irrigation, Irrigation Problems, Calibration, Mixing Pesticide, Spraying Blocks, Communication and Record Keeping. He pointed out that we didn't have cards on pruning. He filled out a few blank cards together with explanatory drawings.

We started to discuss a group of irrigation clips and laid out what should happen first. We used the map, some coins and the stickers to pinpoint valves on the farm (Photo 3.2). [Idea - use scenario layout of cards to number the coins for placement on the map, to see distance/area where a scenario happens, helps to visualize the environment the story line takes place in]. This helped to place the activity into context and triggered explanations from the participant's side to why things were done in a certain way. They only watered blocks that needed water and they could not irrigate the upper and lower part of the farm simultaneously.

Photo 3.2 : Using the farm map to trigger discussions (Messeter, 2011).

Next we started to discuss a group of clips around the theme of record keeping. Altus pointed out that the records of the farming played an important role together with the farm map, in showing block sizes to determine the amount of pesticides/chemicals used and for calculating other necessary info. Pieter stated that you needed the relevant record keeping for the Integrated Production of Wine (IPW). The IPW is a voluntary environmental sustainability scheme established by the South African wine industry in 1998. They needed information on how much chemicals were sprayed annually on the farm, the dates when it was sprayed, what type of chemical was sprayed and if the dosages used was correct. This information was needed for regulation purposes. Therefore it was important to keep record of all these things as well as for the buying of the chemicals. If it happens that Goede Hoop estate used an unknown/ unpopular chemical, the IPW wants to know why it was used and they check if it was approved by the wine industry. In the end Altus kept records for himself, for Samuel and other workers as well as the IPW. The amount of record keeping Altus needed to do keep him after working hours, to keep all the record keeping up to date. Altus kept records of irrigation, where Samuel has sprayed chemicals, which chemicals were sprayed, the amount sprayed and the chemicals they bought. Altus knew of computer programs that help to keep records for these kinds of things, but he did not have a computer at the farm and he felt doing it by hand still worked best for him.

Video cards that were most important to Samuel were the cards regarding the spray activity. At this time of year Samuel was mostly involved with spraying. It was important for him to monitor the vineyard to see if there were any symptoms that indicated decease or pests. If so they have to report it immediately. Certain pests needed to be treated right away, if it went from the leaves into the cluster, some of the harvest could be lost. It was therefore important for Samuel to keep the vineyard healthy. Out of experience they knew when to keep a closer eye on the vineyard regarding the weather.

Altus and Samuel prioritized the activities they were busy with this time of year. This was the layout if everything could happen in a linear time span: Pruning, Suckering, Wiring + Poles, Spraying herbicides (kill weeds), spraying fungicide contact (chemical not taken up by the plant, only prevents funguses to stick to the leave where contact is sprayed), spraying systemic (taken up through whole plant and protects new growth) to prevent powdery mildew and downy mildew and then they will spray ants if present. All the spraying needed calibration, the front mounted spray booms as well as the trailered spray tanks.

Fruitful information and details of the spraying were gathered from both Samuel (foreman) and Altus (farm manager). We discussed what could go wrong with the calibration process. Altus explained: first you look at how many hectares needed spraying, then you look at how many chemicals you needed, calibrated the tank (currently 500 liter per hectare), and then you counted the tanks to see if the calibration is out. Calculated errors anywhere in the process could increase cost drastically, therefore it is very important to do it correctly. When chemicals changed Altus had to write it down immediately on the notice boards and let everyone know that

it changed. Every time before the spraying started Altus had to check if the calibration was still correct, according to a calibration paper. They wrote things down constantly in order not to forget as well as for record purposes. As the vineyard gets denser, they opened up more valves on the spray tank.

This was the time when the whole farm needed to be treated. Altus ordered the chemicals needed for 70 Ha from the chemical rep. He would then tell Samuel and the rest of the team where to start and where to continue every day. It was Samuel's responsibility to keep an eye on the amount of chemicals in the store room to ensure enough stock. Communication regarding spraying was very important between Altus and Samuel. Altus always needed to know the amount of tanks the team sprayed as it was a way to find errors in the process quickly. It helped Altus with controlling the calibration if Samuel wrote down the amount of tanks he sprayed at the end of each day.

They always started spraying with a full tank, 1000L, driving on the level part of the farm, until the tank was half full. Because the top part of the mountain has many loose rocks, it was safer to brake with a half tank that was not too heavy. Samuel knew how full the tank was by feeling it as he drove and not looking at a gauge. He discussed more details of spraying from his side, why he mixed the chemicals a certain way. Altus pointed out the reason for not storing a tank with chemicals still in it, was that it forms a layer at the bottom of the tank and could then not be used again. This was a very important fact that underlines the importance of planning the spraying well.

It seemed that spraying was a 'wide spread' activity and something to explore more, so we started to put all the video cards of this activity together for discussion. Things Altus wrote down or needed to keep track of for this activity included the calibration paper, chemical paper how much to spray, chemical paper on how much was bought, which blocks were sprayed and how many tanks were sprayed. Another difficulty in the spray scenario was when cans and names changed of the chemicals they were using, that was why Altus put small notice boards into the storeroom, as a way of communication.

Summary of the workshop: it steered towards spraying, as it was a complex activity and involved more users and an overlapping of responsibilities, they would be grateful if the design could help saving time and money in the activity, as mistakes were expensive and record keeping tedious. The outcome of the workshop was the completed annotated video card groups of the participants, a first attempt of a story line and a direction toward spraying.

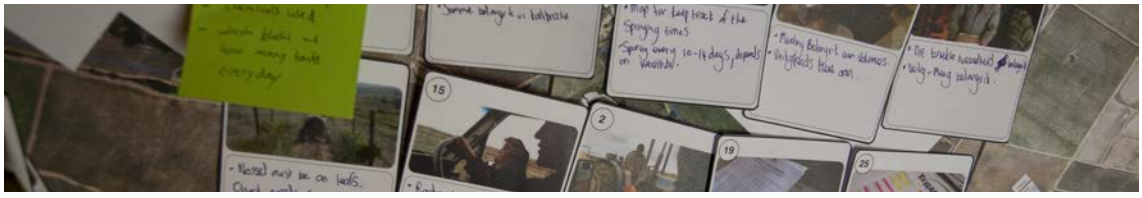


Photo 3.3 : First story line of spraying, with added detail on green notes (Messeter, 2011).

3.1.2 REFLECTION ON WORKSHOP: ANALYSIS OF VIDEO CARD ANNOTATIONS

3.1.2a Comparing Perspectives

By analyzing the video cards of the participants, I found two ways that highlighted differences in their perspectives, namely group names with groupings and the layout of the cards in three lines comparing how the cards were different to what the participants wrote.

By looking at the group names within each participant's pack of cards, helped to show the differences in perspectives between them. The owner's groups represented an overview of the activities, while the manager had more groups showing that he was involved in managing all activities and the foreman's groups not only showed that he understood the manager's work, but his one group called 'Spray Program' clearly showed were he was involved the most.

Owner/Pieter's group names: Working of pump system, Planning Calibration and Planning Irrigation.

Manager/Altus's group names: Irrigation, Irrigation Problems, Calibration, Mixing Pesticide, Spraying Blocks, Communication and Record Keeping.

Foreman/Samuel's group names: Record Keeping, Tap/Valve Control, Spray Program and Valves/Taps are working.

A reoccurring adjective in Altus and Samuel's cards were 'important'. Cards that Altus described as important activities were the work he was most involved in, as well as the administration that was not his preference, (record keeping) working with a budget, irrigation, communication, good relationships/understanding and specification. Samuel's Cards with the word 'important' was work that involved him directly, having to do with the calibration of his tractor, doing his work correctly and communication/contacting. It was interesting that Pieter did not use the word 'important' anywhere on his cards, showing either his non - involvement as long as things were going well or maybe everything was important to him, because the farm is his business.

Figure 3.1: Layout of the different stakeholders cards. Yellow representing the owner, gray the manager and blue the foreman.

I focused more on Fig.3.1's layout analysis of the cards which involved laying/grouping corresponding card numbers from all the participants packs and comparing what they wrote. By comparing the annotations to see how they relate or where the 'overlap', resulted in three annotation patterns A, B and C in Fig.3.1 and detail examples in Fig.3.2, 3.3 & 3.4 . The illustrations/figures were changed from the original cards to make it readable if for the paper. The title came from the video clip and was not printed on the cards.

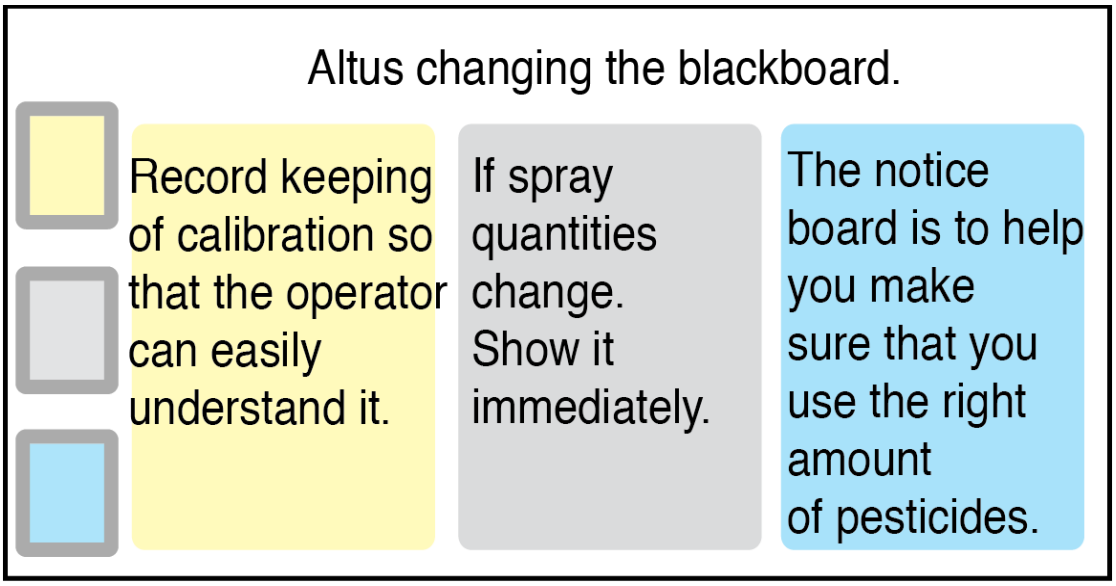


Figure 3.2. No overlap between annotations.

In Figure 3.2, the cards were all different from each other. This clearly defined the roles between the stakeholders. The owner used the word ‘record keeping’ and was concerned with it as a way to implement understanding down the line. The manager had a responsibility to keep the information up to date, because if this was incorrect the spray team would make mistakes. One could see that the notice board helped the foreman with mixing the right amount of pesticide.

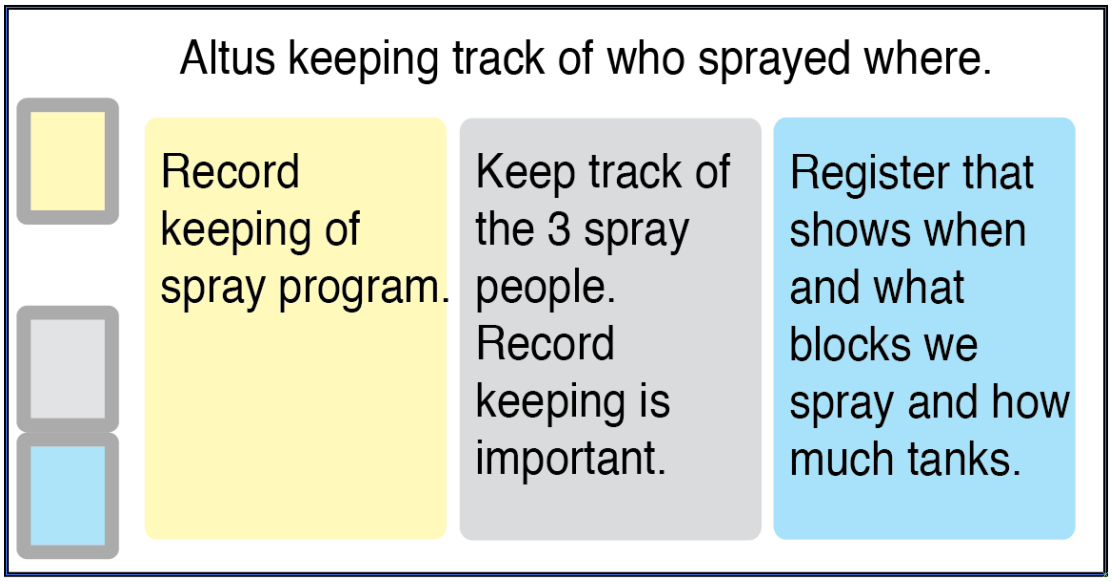


Figure 3.3. Overlap between the two bottom annotations.

The layout in Figure 3.3 shows that the two bottom cards were more similar in writing/closer together, as where the top card was more apart. The two together is where co-operation of activities between two stakeholders happened and it came naturally in the practice. The manager referred to his workers as the spray people and the foreman explained that the manager wrote down what the team has sprayed. The owner was not directly involved with record keeping or managing the spray team, therefore he stated it rather clinically: talking about a ‘program’ and not about the people.

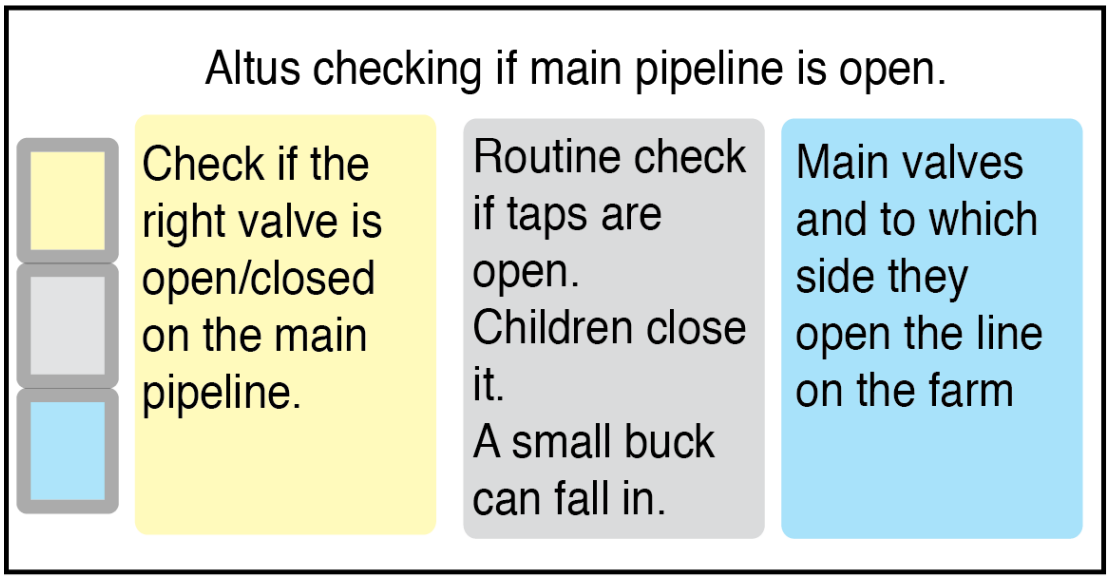


Figure 3.4. Overlap between all annotations.

However there were cases where the cards were closer to each other and the differences not that big (Fig.3.4). Some where quite mundane activities for example the farm manager using his phone in the office. However in other examples, it involved activities based on irrigating the vineyards. Could this indicate that there were no clear stakeholder roles or responsibilities in the activity? Was it everyone's concern or could it indicate a design opening? This had to be confirmed in the next workshop.

3.1.2b Workshop 2

Photo 3.4 : Presenting Perspective Findings.

The workshop started with presenting the annotation layouts founded through analyzing the video cards. Several examples like Fig.3.2, 3.3 and 3.4 were presented on the table for discussion with the stakeholders. We (Professor Jörn Messeter and I) noted that the cards represented three clearly different perspectives. We explained our interpretations on layouts A and B, but did not explain our interpretations of layout C. We asked the stakeholders if they could see meaning in this, why it might be that some of the cards were closer to each other and others not. We also noted that it was almost always with the activity of Irrigation that the cards were very similar, with a few exceptions like communication, (telephone calls).

Only Pieter commented on what we presented. He said it seemed that if it was practical tasks, the cards indicated similar reflections. If the pipe burst, it is an immediate practical problem, and it must get fixed. There were no managing differences between the roles in high priority situations regarding saving water (a scarce resource on the farm). On cards where planning was involved though, there would be no overlap. Some people's plans were more practical while others planned more from an overview. Cards where 'Controlling' was involved, were the same, because there was no planning needed or practical task to do, just controlling or checking if something is correct before continuing with an activity/task.

He as the owner did not want to know about the method used to execute tasks, the manager was in charge of the method, as long as everything were working and working correctly, he was satisfied. He was concerned about the keyword 'Effectiveness'. This needed to be pulled through all of the layouts we presented, even when all the cards were apart. Pieter used the example in Fig.3.5 to show if key issues for farm operation could be pulled through the all cards, like efficiency or safety, it indicated a good understanding of the work task across the different organizational levels.

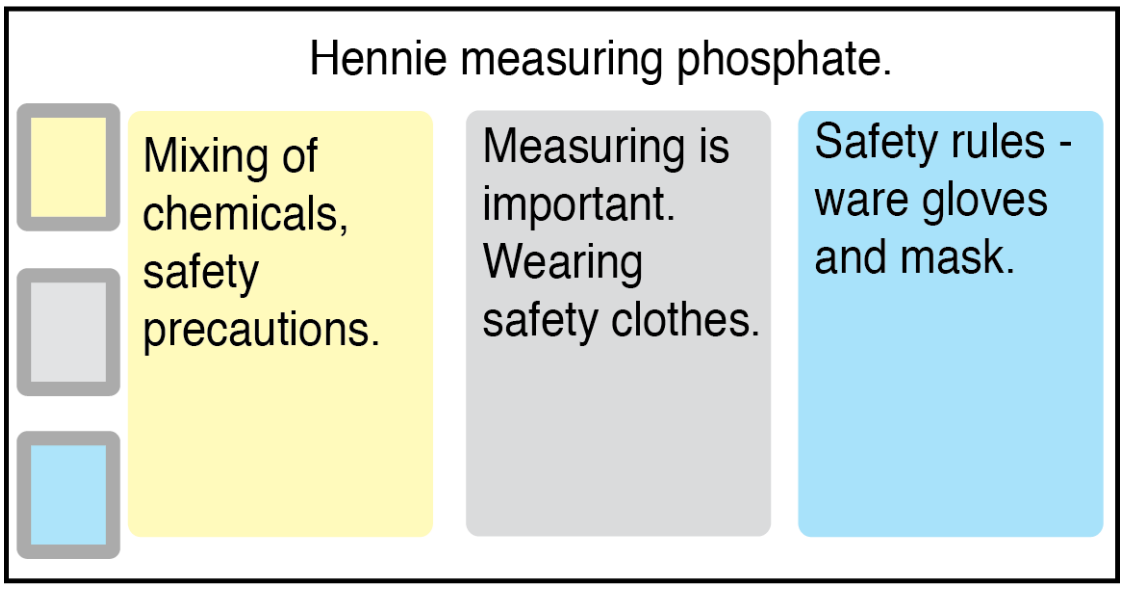


Figure 3.5 : Shared understanding.

We pointed out that layout C/Fig.3.4, might show a less clear role between the stakeholders in an activity. The owner replied by looking at the cards 'Hennie adding chemicals to spray tank'. Although these were very close together: 'mixing of spray chemicals', 'the correct amount, 'first measure then mix', again it was the manager's responsibility to see that the quantity was correct and that went back to the top with effectiveness. If the quantity was not correct and the calibration on the pump was not correct, your effectiveness was gone and you were loosing money. That was the whole point, everybody should understand why they must do something, while there should still be people checking continuously, because anything could go wrong during the day.

He explained the three different cards as follows, the top card(owner) organizing/looking at effectiveness from the outside, second card (manager) managing it/correctly fixed, and the bottom card (foreman) fixing it. The bottom two cards also had to do with the method or practicallity, the practical day to day tasks, where the top card was more about managing. Pieter suggested the more detail the participants gave on an activity, the more the differences between the cards would be. For example: the foreman told you he was driving his tractor at a certain speed and gear, while the manager would tell you the different chemicals you could buy and the owner could tell you the cost.

3.1.2c Combining Perspectives

Next was to evolve the story line of the spraying activity with Altus and Samuel. We presented the story line of the spraying to them, according to the cards they have put out in the previous workshop. Only now with two separate lines, one with Samuel's cards and one with Altus's cards, to represent the two perspectives (Photo 3.5). We asked them to look through the story line and to add missing steps or to move the cards in the line to where they were satisfied that it best represented the spraying process.

Photo 3.5 : Samuel and Altus developing the story line (Messeter, 2011).

After the completed story line we started to combine the two lines into one line (Photo 3.6), using either Samuel's card or Altus's card, depending on which one were more involved in the step/ regarding which perspective was directly involved, or which were their responsibility. Although where both stakeholders were involved (for example communication) both cards were placed in the new line. They were still allowed to add cards to the final line.

Photo 3.6 : The combined story line of the two stakeholders (Messeter, 2011).

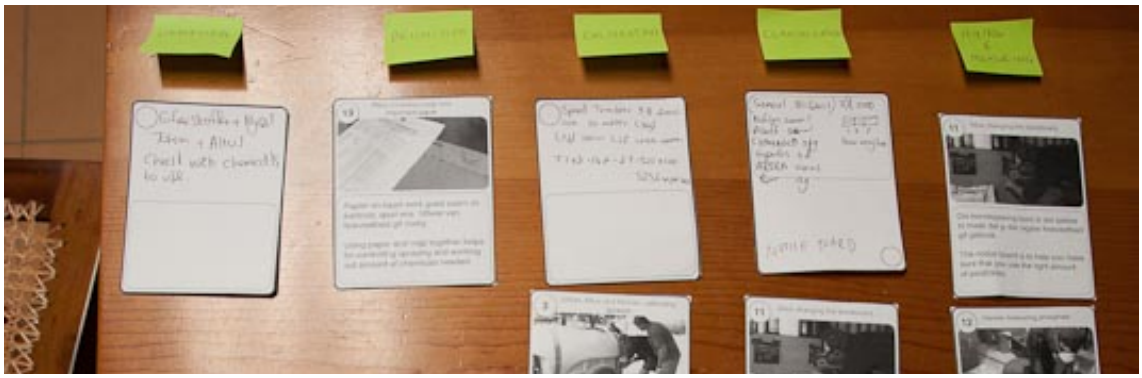


Photo 3.7 : Part of the completed story line divided into named chunks and added cards visible (Messeter, 2011).

Having our finished story line of the spraying process, we asked Altus and Samuel to divide the line into chunks and name the chunks by using verbs (Photo 3.7). We made sure that the Altus and Samuel were satisfied that the line was an accurate representation of the spraying activity, a good summary and that it was nicely condensed for us to work with. We then asked them what the most important step/chunk was for each of them. It was difficult for Altus to choose, because the line was so condensed, everything needed to be accurate. If one step was done wrong, it would carry over into the other steps.

The plan for the next workshop was to come with concepts for the whole spray scenario line. Altus would like the spraying process to be easier, but he thought it would be difficult to change and thought that it was already being done the easiest way. Of course there were no problems for them, but this was where the designer comes in to look for opportunities to design supportive technology. After bringing concepts that supports the spraying process, the idea was to apply a chosen concept/device/technology to different activities throughout the year, so that we (the stakeholders and the designer) could ask how this device could support that.

The outcome of the second workshop was a complete story line to design for (Fig.3.6), with chunks and the most important steps indicated by Altus and Samuel. We also had their opinions on the perspectives layout/representation of the video cards.

3.1.3 ANALYSIS OF WORKSHOPS

3.1.3a Discussion on Perspective Differences on the Video Cards

By comparing the different annotated video cards of the stakeholders, one could see if there was an underlying understanding that could be pulled through the operation on different levels. If the same message could be pulled through it was an indication that all the stakeholders understood the operation. One could see the different responsibilities in activities and the amount of detail could be seen within different responsibilities. Confirming and discussing the meaning of the cards with the stakeholders was a part of the method. By analyzing the meaning of the layout helped with reaching a new understanding both within the practice itself and the designer's grasping of the practice. For future work and a next step in the method, one could ask each stakeholder for more detail on the cards. A concern at the time was that if the cards were close to each other, it might indicate that the designer did not have enough video material on the subject and reflected a surface understanding of an activity indicating that the activity possibly needed more exploration. Although it is safe to say that by highlighting the differences in perspectives with the video cards and by using the video cards in scenarios of design openings, helped the designer to design where more than one user was involved.

Something Altus wanted to do was to give his workers more responsibilities within their activities. Altus was trying to teach his workers more responsibility/skills and he used 'systems' that he installed himself (systems meaning, not technical, but record keeping on blackboards), for all to see the work progresses on the farm, making them part of the process and keeping them informed of what was happening.

3.1.3b Design for Three Perspectives focusing on the Spray Process

The goal in this chapter was to find design openings by exploring the work practice with the stakeholders. A potential new method to involve the stakeholders was discovered to highlight the differences in their perspectives and organizational roles within the practice. The use of annotated video cards from the stakeholders was used to find and construct a design opening in the spraying process. Not only was the spray process a design opening but also designing for the three different perspectives within the spray process. The design opening/direction, where more than one stakeholder was involved in an activity, is showed in a scenario using the video cards from the manager and foreman. With the help of the stakeholders we combined their two perspectives on the activity into one line. If there was joint decision making in a step we used both of their cards. Furthermore we asked them to chunk the line and name the chunks using verbs. This line was used as a basis to design from. Although the line shown here has only two perspectives, Pieter, the third perspective was not closely involved in these steps, but as he wanted an overview on what has been done in practice, his perspective could be designed for in the record keeping step. He was not involved in the record keeping, but he needed the information.

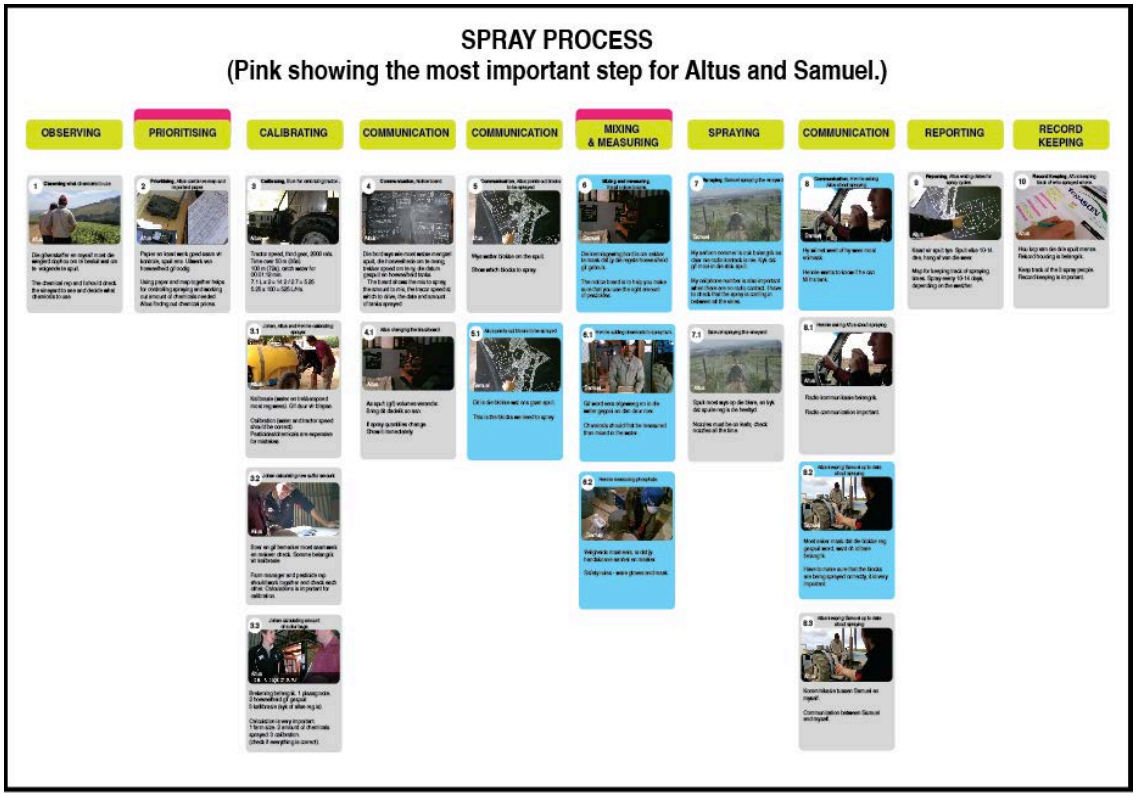


Figure 3.6 : Use of the manager and the foreman's perspectives in a design opening scenario.

An easy way to show the layout of the spray process and be able to read it was to present it in Prezi. The spray process can be viewed in its original sequence by following the Prezi slideshow, clicking on the right arrow. If the movement is too drastic, you can view it by exploring the cards, they read from top to bottom, left to right. I have changed the numbers on the cards to show their position, and on the lower left hand corner of each photo the name of the stakeholder is visible. 'Prioritizing' was the most important step to Altus and 'Mixing and Measuring' to Samuel.

Click the blue button to launch Prezi 3.1 : Spray Process:

Alternatively please visit : http://prezi.com/c8mh3rynw4ow/spray-scenario/

3.2 CONCEPT EVOLUTION

The next part of the chapter will cover the exploration of mobile solutions regarding valuable and meaningful issues around the spray process, by involving the stakeholders. By introducing props in workshops, for acting and discussing, the users were able to reflect on ideas for further concept development. After a main concept was selected it was a constant iterative process to develop it to fully support the user's needs.

3.2.1 CONCEPTS

3.2.1a Ideas for Spray Process

The Spray Process helped to highlight where work tasks and decision making for two stakeholders intersected. The aim was therefore to design concepts for support and cooperation across stakeholder roles. After workshop 2, the design opening was established and depicted in a scenario by using video cards. I used this to conceptualize for the whole line, as each step/ card in the line was important to the stakeholders. The idea was to show them a range of concepts before focusing on one or two ideas. For each step several concepts were drawn or explained on a sticky note and placed beneath the step. It was once again easier to show the illustrations in a Prezi form, although this one does not follow a slideshow format, it is free to explore. The general direction of ideas were wearable's, utilizing existing mobile technology as reporting devices and exploring designs using the farm map as a 'center' object. Click the blue button to launch Prezi 3.2 : Ideas for Spray Process:
Alternatively please visit : http://prezi.com/tl_jvrlu_mfa/first-concepts-for-the-spray-scenario/

Photo 3.8 : Ideas for the Spray Process.

3.2.1b Two Stronger Concepts

Although I had several concepts to present to the stakeholders, I chose the two stronger ideas that seemed to form the basis of any kind of system that would be of use within the spray scenario. These ideas were the reporting device (Fig.3.7,A,B,C) and the visual calculator (Fig. 3.8,D,E,F). I tried to develop more detailed versions of these concepts to get better feedback from the stakeholders. With both concepts I tried to show three drastically different versions for the same idea, to try and get a general direction on what the users would prefer or what combinations they may want to have.

With the reporting device (Fig.3.7) it was difficult to think of something new other than existing communication technology. However I tried to show a range of concepts from available resources, for example their existing use of mobile phones (A), to something existing that they would have to buy like a type of GPS or tablet device (B), to a concept showing a wearable reporting device (C).

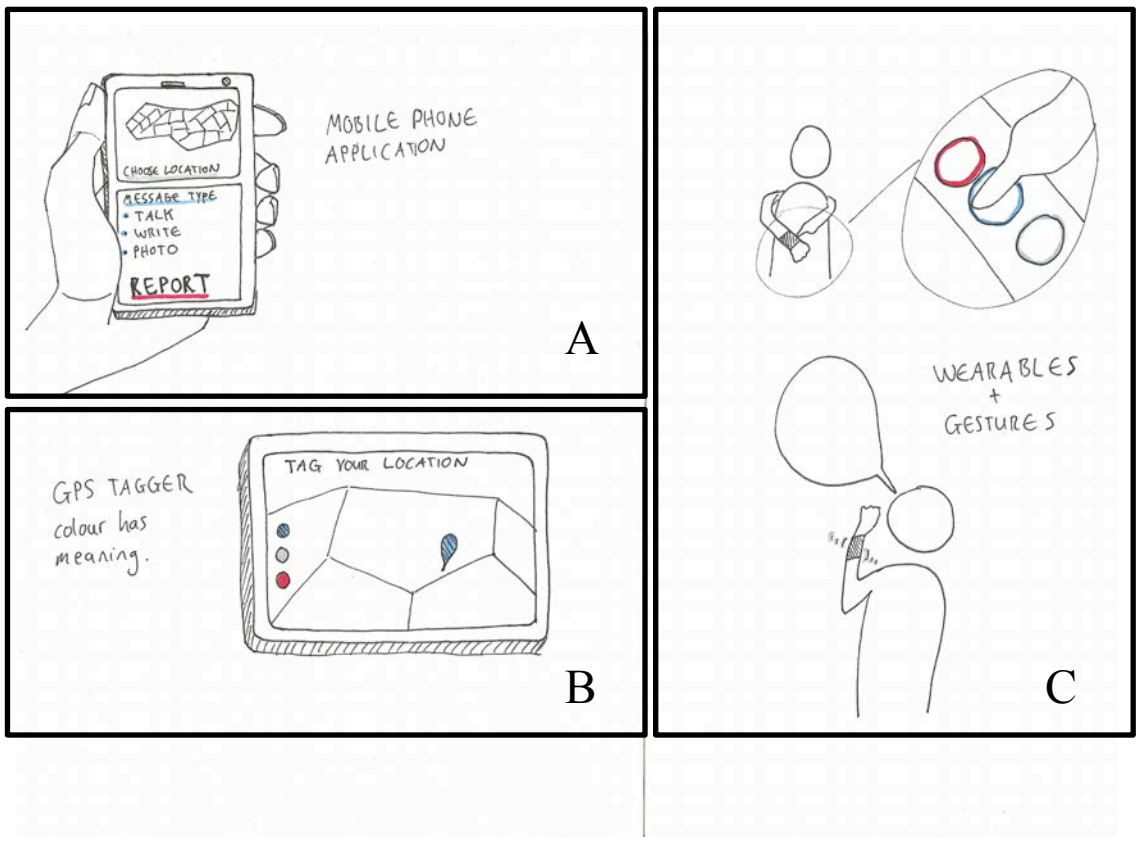


Figure 3.7 : Reporting device Illustrations.

On the mobile phone application (A), they had to choose the location they wanted to report and the type of message to report with. The type of message was a different need of urgency for prioritizing attention. When problems needed immediate attention talking to somebody immediately was necessary, when not so urgent problems arise a written report with detailed descriptions was sufficient, writing could be used not to write long explanations, but to add words to a place. A photo could be ‘in between’ or just a visual reminder instead of a ‘word’, for instance to see the wire needed fixing. The GPS tagger (B) could show where you are and you can then assign/tag a colour to the location. The meaning of the colour could be discussed between the reporters and the map readers. Wearable technology (C) can be used in many forms and not only in a bracelet form, to give meaning to its function. Instead of a screen, the wearable could be designed by using symbols or colour in button forms or with additional sensors, gestures could be part of the reporting process.

With the ‘visual calculator’ (Fig.3.8), it was easier to depict the idea in several different forms ranging from literal, to not looking high-tech, to a big touch screen. The ‘real calculator’ (D) was the concept in an everyday calculator form, with the buttons in the farm layout, depicting the different blocks. Each of these could have a numeric value equivalent to the size of the block in hectares. The buttons on the side of the ‘map’ could be the different chemicals you used or could be pre programmed for a set of different chemicals you might need to spray. The second idea was a workshop board, using magnets, RFID tags and readers, plus a LED screen to see calculated information (E). The board could have the farm map, depicting the different blocks. You would be able to place different colour tractor magnets on the blocks and it could work with their corresponding chemical colour magnets for what must be sprayed and then it could work out the relevant information. The board could also serve as a visual to show the work needed to be done and as you take the magnets down, the board would remember and place the information into record keeping. The third visual calculator was a big touch screen (F), which would enable you to calculate chemicals, estimations and spray cycles.

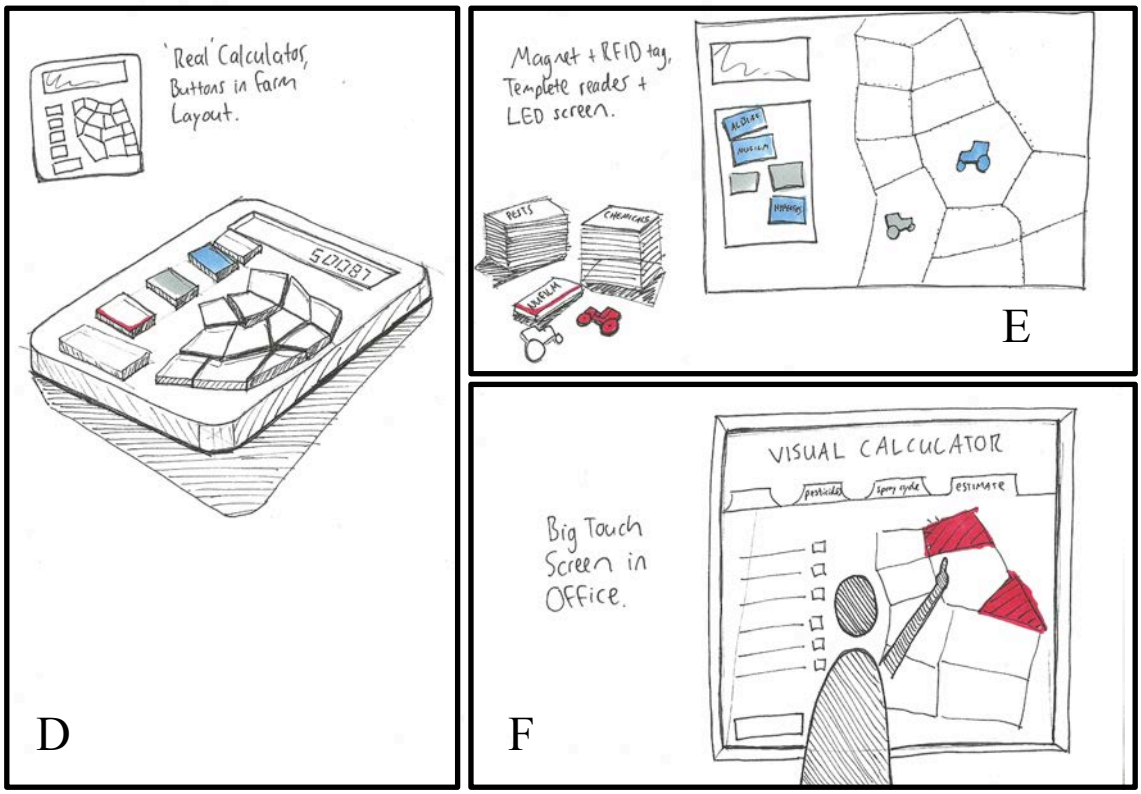


Figure 3.8 : Visual Calculator Illustrations.

3.2.1c Workshop Toolkit

Using the ideas for the reporting devices and the visual calculator I put together a workshop toolkit to work with if necessary, for when we ran out of ideas or got stuck. In this Prezi I showed the printouts of workshop number 3, to use as a starting point. These printouts consisted of questions about the reporting device and details needed to be considered for refining the concept. It was necessary to establish where the reported information should go to between the three different stakeholders, or what information should be shared between them. The different kinds of reporting should be considered and established. Are there different types of problems and which stakeholder should be informed, according to the different roles they took part in on the map. If it was work identified, Samuel or Altus could report it on the maps, Altus could prioritize the tasks; depending on how urgent it was, while Pieter had an overview of what was happening and could point out problems that needed attention.

The identified design opening was for the spray scenario and an important question to look at was what should be automated. Products that were used or finished tasks could go directly to the system's record keeping and saved time instead of keeping written records. Specific user needs such as calculating and planning should mainly rely on human input rather than sensor input.

To be able to explain the reporting device and the visual calculator, I used a future scenario of how these ideas could work. The Prezi illustrates that the visual calculator could calculate the amount of chemicals needed to spray blocks on the farm. This was only a starting point from where to develop ideas further in the workshop with the stakeholders, to describe how and where the ideas could support their daily tasks in the spray scenario.
The Prezi is in the form of a presentation, so please use the right arrow and feel free to explore afterwards. Click the blue button to launch Prezi 3.3 : Workshop Toolkit:
Alternatively please visit : http://prezi.com/jb1en_5njrcz/more-detailed-concepts/

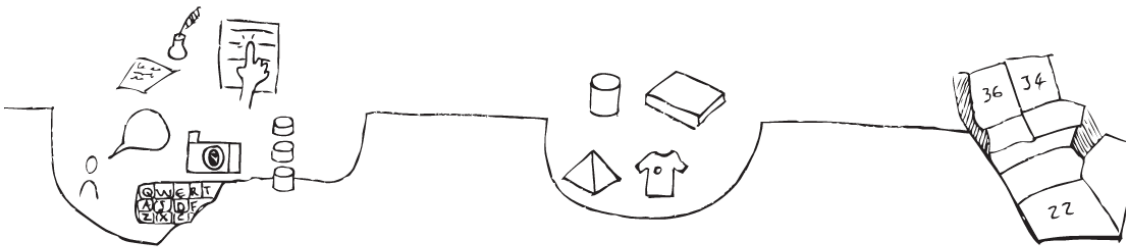


Figure 3.9 : Illustrations regarding questions about the reporting and visual calculator concept.

3.2.2 DEVELOPING THE VISUAL CALCULATOR (VC)

3.2.2a Workshop 3

Photo 3.9 : Presenting Concepts.

I started the workshop by presenting an overview of the concepts for the spraying line process and the concepts in Fig. 3.7 and 3.8. The following is a summary of the discussions and comments made by Altus and followed by Pieter's.

Both Pieter and Altus mentioned existing technology which related to the concepts I presented. Wearable technology, represented in Fig.3.7, C, was nothing new to Pieter. He was aware that there were security guards with 'chips' in their clothing, for you to see/keep track of where they were. They mentioned high tech tractors which work by satellite, to give fertilizer where most needed and it calibrated as it was driving, putting down different quantities, not to waste chemicals where it was not needed. Some programs already track the spray path of the different tractors, depicting it in different colours and the program told you when to start the next spray. There are systems on other farms where they let the workers 'sign in', it registers their name and ID and the time they go onto the land. This then helps with working out salaries and general record keeping.

Overall Altus seemed keen on something that could help him with record keeping. We discussed a general map for Altus to tick off the finished tasks like the spraying, wiring or pruning. In a scenario someone could report something and it would show on the map and when it was finished it went to record keeping. Altus suggested that the blocks on his map must change colour, turn blue if the women were working there, or turn green when they were spraying. This would help him to remember where what was happening and not get confused. Altus said if the map was in his office, he wanted a colour scheme for work progresses and dates for unfinished and finished activities. As an alternative with regards to the magnet board idea in Fig.3.8 E, he wanted to put a magnet behind his current map and as he planned the work, he could put magnets with different colors onto the blocks. Although Altus puts a magnet onto the board symbolizing for example the women's team, he still needed to write it down at the end of the day in his notebook. I suggested if he moved the magnets on the board, it could remember the information and store it digitally, without the need for him to keep record.

Photo 3.10 : Pieter explaining his concept of reporting on an iPad.

Of all the ideas presented Pieter thought that the reporting device or the magnet board could work effectively. Pieter used his own example for a reporting device; if all of them have iPads Samuel could report a leaking pipe on his iPad, which then registered on Pieter and Altus's iPads, Pieter could then confirm to Altus if they could fix it regarding to cost and Altus could then confirm with Samuel and reminded him to use a number 10 spanner. Pieter, Altus and Samuel agreed that all team leaders should have a reporting device on the farm. A general comment was that information had to be available immediately for all to see and be able to plan around it.

Pieter wanted to be able to compare profit and expenses in individual blocks. Then he could decide if a block of vineyards should be taken out and a new block planted. Pieter thought if it was a touch screen, he could give the system all the block information, rows, vines, yield, but he did not want to write down information for each block, however he thought he would have to do this to see if the block was still making a profit or not. He was worried about the time factor, to insert information into the system, but he would like it if you could 'press one button and it all went in'. The new design/system should be faster than the old way of doing; it would not be practical to put info in continuously. Some information was not always needed or used at all and he thought an overload of information might drive you crazy. There was static information that stayed the same, but the design needed to be flexible. If Pieter could see an overview of the block it would be fine. Then he could look at it the end of the year and see, it took 10 people, 10 hours to prune and then he could add a cost to it.

Unfortunately Pieter had to leave at this point, but Samuel, Altus and I started to focus on the reporting device. I brought cardboard props of various sizes and generic shapes, for Samuel and Altus to comment on what size and shape they prefer and to help conceptualize around the forms (Photo 3.11). We used the farm map again to indicate were an activity was happening when we discussed the situations. A short summary of what was discussed is presented, followed by a longer discussion on the stronger concept.

Reporting could be about general infrastructure: wire, pipes, pump house, stolen articles and poles. It could be about specifics of the work being done and the number of people doing the work as well. We started coming up with scenarios to help conceptualize a reporting device:

Samuel could press a button when seeing something wrong at his location and Altus would then see a flashing light of the location, drove up there and have a look at the problem. Although for Samuel it would be easier and quicker to talk to Altus directly to determine the urgency of the matter. If it was not that important it could show on the map in the form of a photo or a colour to represent the reported information. For instance, all the broken poles could be marked on the map and at the end of the year workers could use the map to fix all the broken poles at once.

Photo 3.11 : Samuel talking about using a reporting device.

Involving the stakeholders in the design it self was difficult and almost impossible as they didn't wanted to build or modify the cardboard and materials I supplied them with. This activity would have been more revealing, if I had prepared better tools or methods to make the design activity more accessible to them. However I had made a projection of the Visual Calculator concept to be used as a prop. Acting with a prop (Brandt & Grunnet, 2000), in this case the projection, enabled Altus to contribute by expressing his needs and gave feedback for improvements. This is core of PD workshops to enable users with no design training to contribute to the process (Buur & Ylirisku, 2007).

When I first introduced the VC to the stakeholders they did not seem to understand and were not convinced about the concept. This might have been due to my approach, when I explained/ presented the idea from drawings and in a story line. My 'storyline' that I used to place the Visual Calculator in was not accurate, resulting to direct the stakeholder's attention to the story's detail and not the design. It was a small mistake where I said Samuel reported powdery mildew and that they will only select a few blocks to spray for treatment. In reality if this happened they would not spray selected blocks but the whole farm. Later when I showed the projection of the very rough concept, illustrating a few slides after each other and by imitating what would happen as they insert information, Altus and Samuel seemed to grasp the idea of the Visual Calculator. Their feedback was still not at a desired level, but at least the presented idea came to life a bit more as a projection to imitate a touch screen. The real difference came when I asked Altus to interact with the projection (Photo 3.12), this changed his reaction drastically.

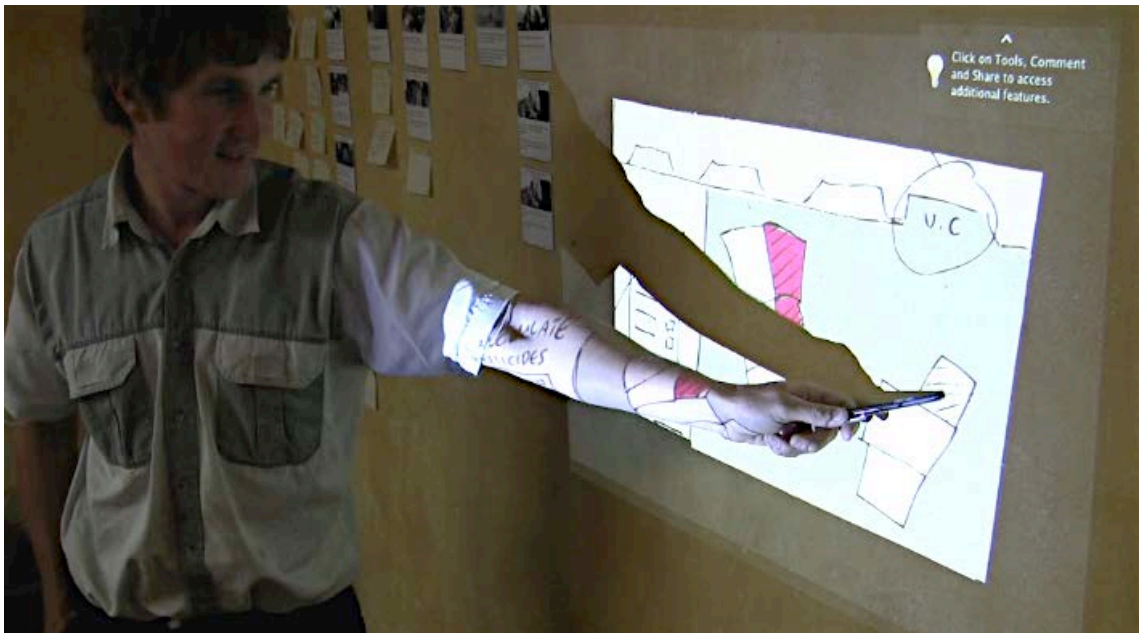


Photo 3.12 : Altus acting with a projection of the first Visual Calculator concept.

By doing it this way he gave me valuable feedback in a rather short time. As he acted he explained what he wanted to see, what he wanted to do and how it would help him. According the Buur and Ylirisku (2007), the advantages of letting users act with roughly represented props, allows greater freedom and interpretation from different perspectives to develop the concept. A second advantage of rough prototypes is that it helps the user to focus on product functions and not be concerned with details and placement of buttons. In retrospect I should have brought back the concepts on paper representing different forms of the visual calculator, to allow the user to choose something other than a touch screen.

This is a brief description of the first Visual Calculator (VC) concept (also see Fig.3.10), followed by the video of Altus 'acting' with the projection of it. Altus would open his program of the VC and on the screen he would see a map of the farm, a list of chemicals to choose from and the total amount of the cost when the calculation was finished. He could choose the blocks he wanted to spray and by selecting them they would change colour. After selecting the desired blocks the VC would then calculate the correct amount of chemicals needed to spray the selected blocks. Altus could choose from a list of chemicals on the side of the screen. As he selected items it would be indicated by colour change. When finished selecting his chemicals he then pressed 'enter' to confirm that those blocks were connected to the chosen chemicals. He could also select different groupings of desired blocks that might need to be sprayed with different combinations of chemicals. He could then select the 'total' tab to view the total quantity of products needed. The list would show the names of the different chemicals, the amount and the cost for each one, together with a total.

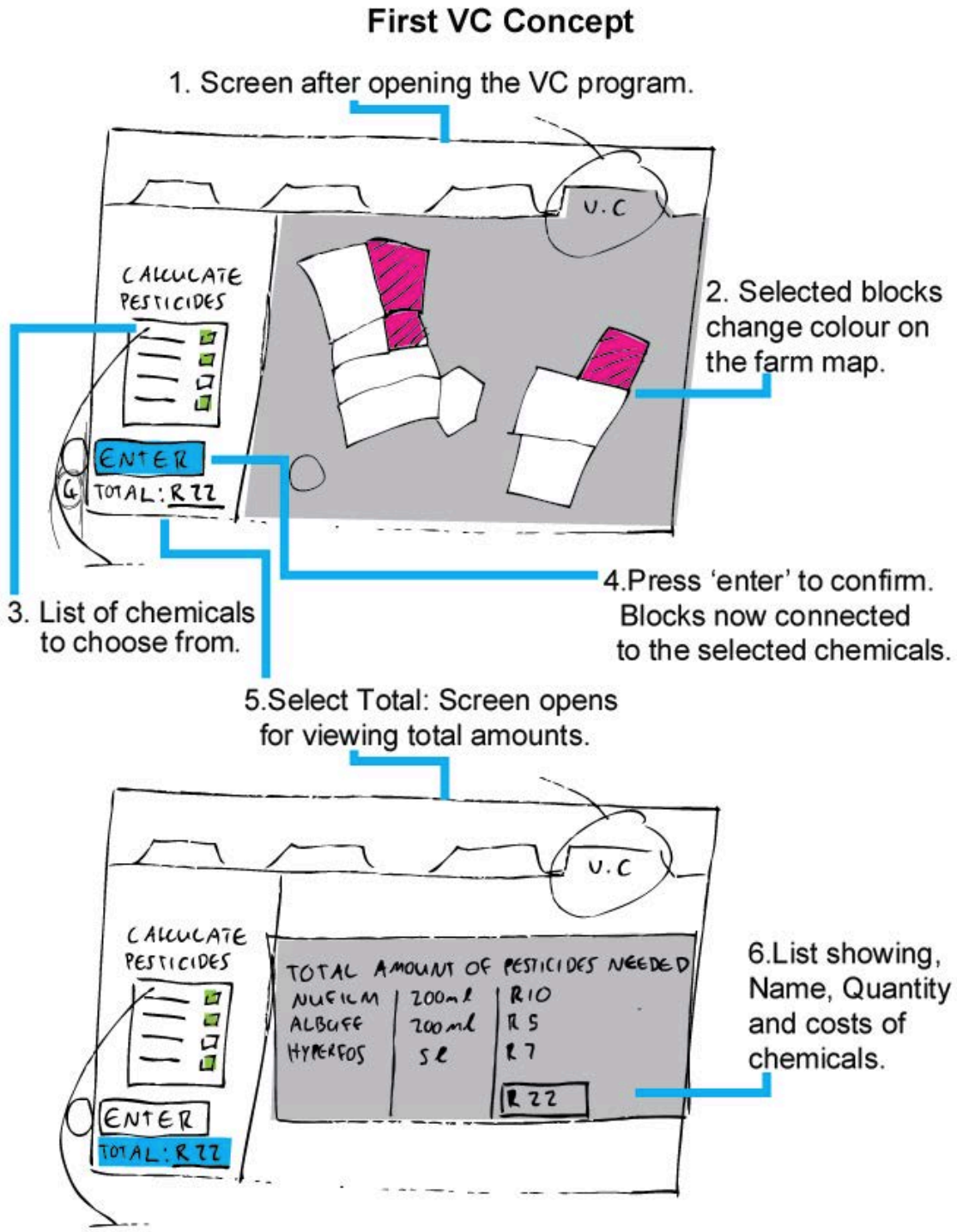
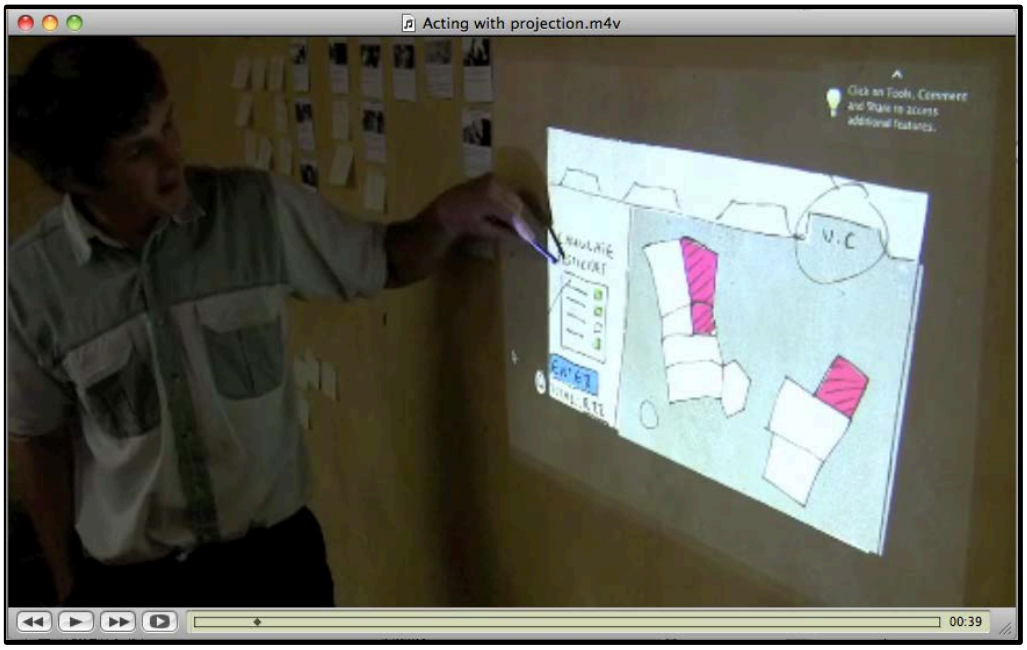


Figure 3.10 : First VC. Callouts of screen functions.

3.2.2b Video of first VC



Video 3.2 : Video of Altus acting with the First VC [Duration: 00:08:33].

Feedback from Altus led the development of the VC concept and the following paragraph highlights the remarks made by him. The VC should connect to the calibration/application rate. They would begin with 350 liters water per hectare (L/Ha) and then increase it throughout the vineyards yearly growth cycle. Altus would want a folder in which data of all spraying tractors could supply him with information that could indicate if the calibration of the tractors were still correct. The list of chemicals should show the name, quantity and cost. The blocks should show how many tanks were needed for spraying. The VC could be used as an estimation and then it would show the true amount used after reporting. A costly problem was when the calibration went out and Altus was not aware of the problem. If he didn't accurately estimate/calculated how much they would need for the 70 Ha before spraying, they could end up wasting chemicals and capital.

Outcome of workshop: The reporting device could be looked into, but after the reaction of Altus and the progress made with the VC idea, it was decided to stay with the idea. Altus gave me his chemical records and the information papers on the farm.

I identified the problem in the beginning, but it took time to gain trust and understanding of how things worked before the designer/outsider could start to 'interrogate' the problem. It took time for the users to become more open about their mistakes. I had to remember that there were three different tractors for spraying. The main work task list for each season should appear in the workshop where the teams gather in the morning. Altus did not want to move away from his notebook size for new technology and Pieter was only concerned with productivity and finances.

Regarding Pieter's screen, I worked on rough concept drawings (Fig.3.11) that would show an overview of and profit on the farm, by means of info graphics, letting all the information of activities feed into the 'system'.

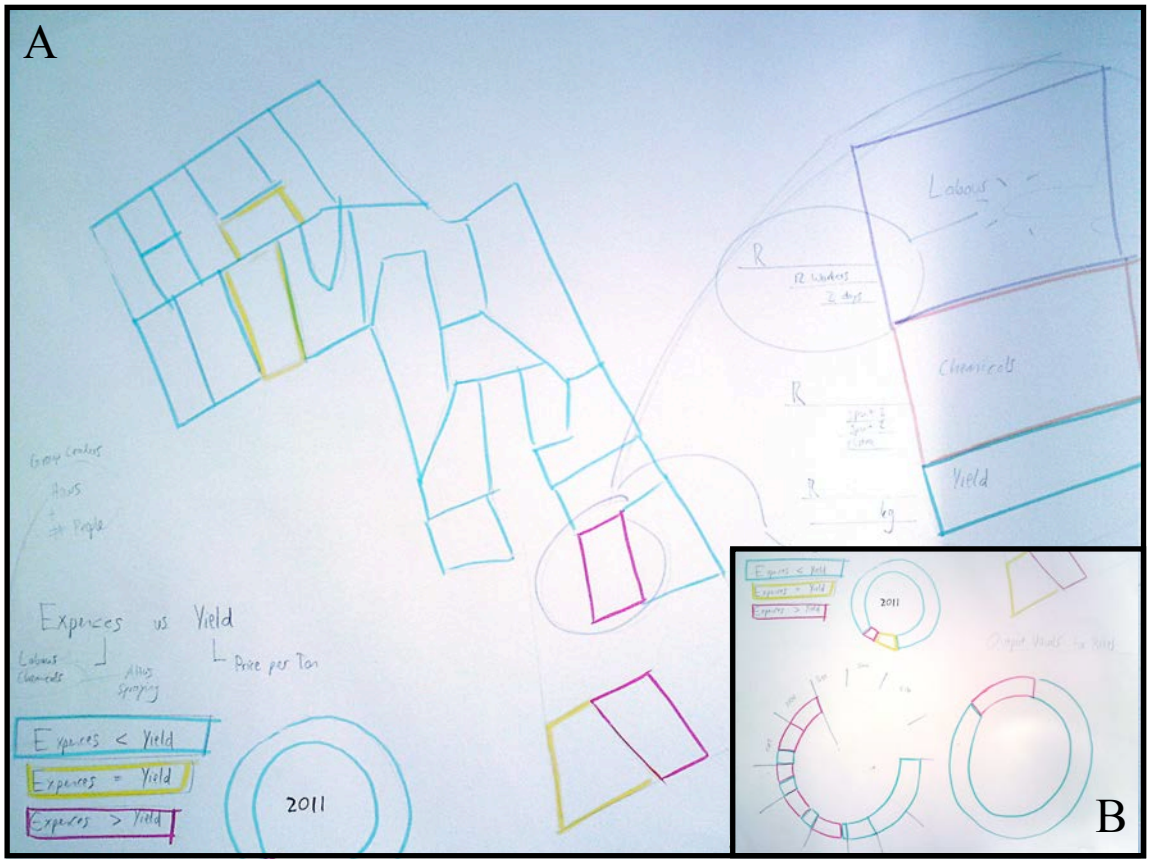


Figure 3.11 : Concept drawings showing financial situation of the farm through 'Info graphics'.

The owner would see a map of the farm with different coloured blocks (Fig.3.11A). Blue indicated that the blocks were making a profit. Yellow blocks' expenses and yield were even and the red blocks were not making a profit. If the owner would select a block, more information on the block would open. There he would be able to see a breakdown of costs regarding products and work tasks, together with the yield the block produced. The previous year's expenses and income could show in circle diagrams for more of an overview on the information. The first circle in Fig.3.11 B is divided into months showing each month's expenses in red and available capital (or budget) in green. Next to this circle another circle could combine all the months 'red' and 'green' together for a clear overview of the financial situation of the current year.

3.2.3 EXPLORING VC POSSIBILITIES

3.2.3a Workshop 4

Armed with the spraying information Altus gave me, I could add more detail to the second VC. Together with the comments on the first concept I changed the layout, added accurate information (not distracting from the concept like before) and made several layouts depending on different new suggested functions the VC could do. Now that Altus understood what the VC could help with or do it was easier to show him the new ideas, without the need to enact each one. But for simulation purposes I showed him different scenarios on my laptop screen simulating a touch screen.

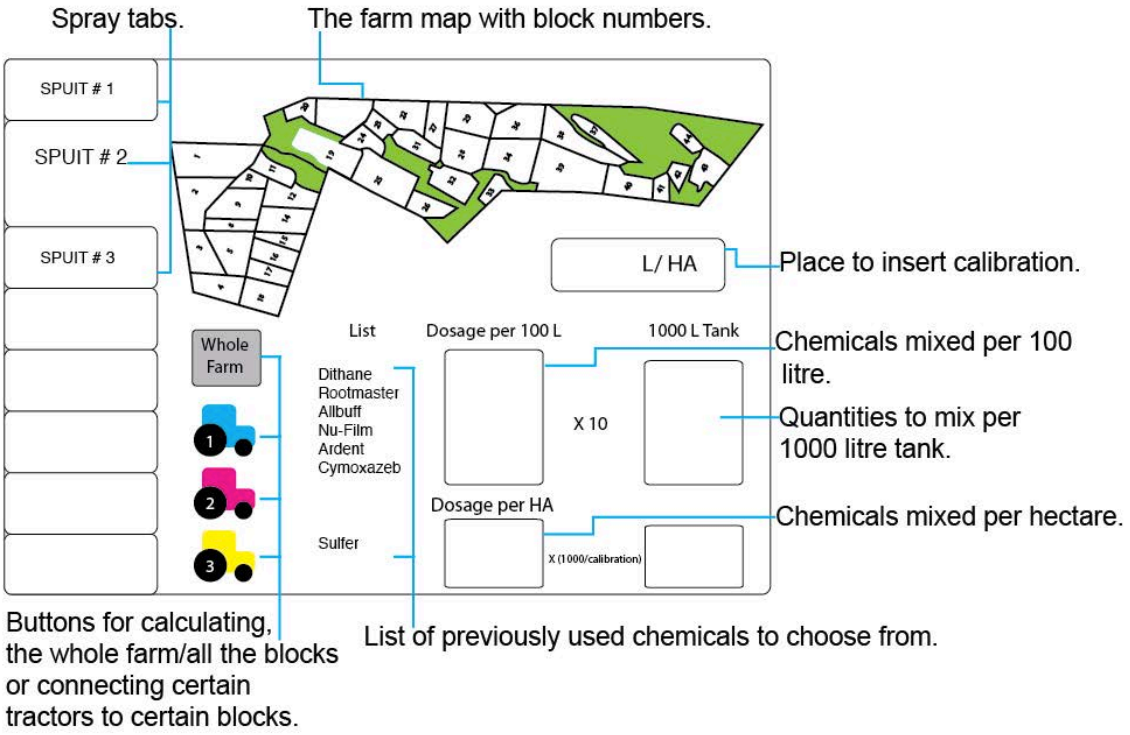


Figure 3.12 : Blank page for opening a new spray tab.

The concepts of the VC I showed Altus, involved several functions (Fig.3.12, 3.13, 3.14 & 3.15). Figure 3.12 was for calculating for the whole farm. In the example they were preparing for the second spray of the year. The ‘spray numbers’ were determined by the ‘spray programs’. Each chemical company has a suggested spray program, with up to seven different sprays. Each spray was formulated differently to the needs of the vineyard and according to the time of the year. In Figure 3.12 the second tab opened the layout without any information. On this page the farm map was visible with the block numbers and under the map a space for filling in the calibration/ the amount of water sprayed per hectare. Then there were different options to choose from, depending on what you wanted to calculate. You could select the whole farm with the one button, or select the different tractors and then the blocks each tractor would spray. To the right of these options a list of previously used chemicals was visible. Some chemicals were mixed by dosage per 100L and some chemicals were mixed per hectare. The last column was for the amounts needed to mix into one tank (a full tank of 1000L was the norm).

Refer to Figure 3.13 on page 75. The calibration would then be inserted. When touched a number keyboard would appear and the water per hectare could then be inserted. When that was done the entire farm or separate blocks could be selected and would then turn the colour corresponding to the button, in this case gray. Because the sizes of the blocks were already part of the program, the VC could now estimate the amount of tanks needed. This would help with keeping track between the estimated amount and the actual amount sprayed to monitor the calibration on the tractors. Chemicals would now be selected from the list, and because some were added to 100L of water, their dosage would stay the same (this is what I understood at the time, but actually the dosages can increase per 100L) and it would show up in the columns next to the list. The reason for inserting dosage per 100L was that this information was given by the chemical companies. Chemicals like sulphur's dosage could change, therefore when selected, a number keyboard would appear and the amount you were using at the time could be inserted. The VC has now calculated the amounts you needed to mix into one tank. Now you could go to another page and see the total cost to spray the whole farm with the selected list of chemicals. A breakdown of each chemical plus its total cost will be visible. The VC would also show you the number of units you had to buy, with the colour representing the percentage you would use (for example, three full cans plus half a can of Rootmaster), the litres and the kilograms visible would be the sizes of the units (Fig. 3.13, screen 9). Still visible on this page would be the farm map with the selected blocks and their numbers, the estimated tanks and the calibration needed.

In Figure 3.14 (on page 76) was an example about inserting a new chemical on the list. Under the list of existing chemicals there could be symbols for adding or deleting a chemical. When a chemical needed to be added to the list the following would appear across the screen: the name of the chemical, the dosage per Ha or L (depending where you were adding a chemical), the unit price and the unit size. Afterwards only the chemical name would be seen and when selected the dosage will show. The other information like the unit price and size will be kept in memory and would be visible on the 'total cost page', used for working out the total cost and amount of units needed at a later stage.

Figure 3.15 (on page 77) is an variation on inserting the spray program information and could be as follows: Under the 'spray number' tab, an 'Info' button could be available. The new tab will be the layout page with no chemical list. To add a chemical list the 'Info' button must be selected. Another screen will open with an information list, where the chemical name, dosage per L or Ha, unit price and the unit size could be inserted, edited or deleted. Instead of this information being invisible all at once, this option will allow access and viewing at a glance which chemicals were used for each spray and the information for each chemical. The same layout of information about the previous spray will be visible in the background, only smaller and translucent. By selecting these lists the different spray information will be easily available.

Figure 3.13 : Storyboard for Calculating the whole farm.

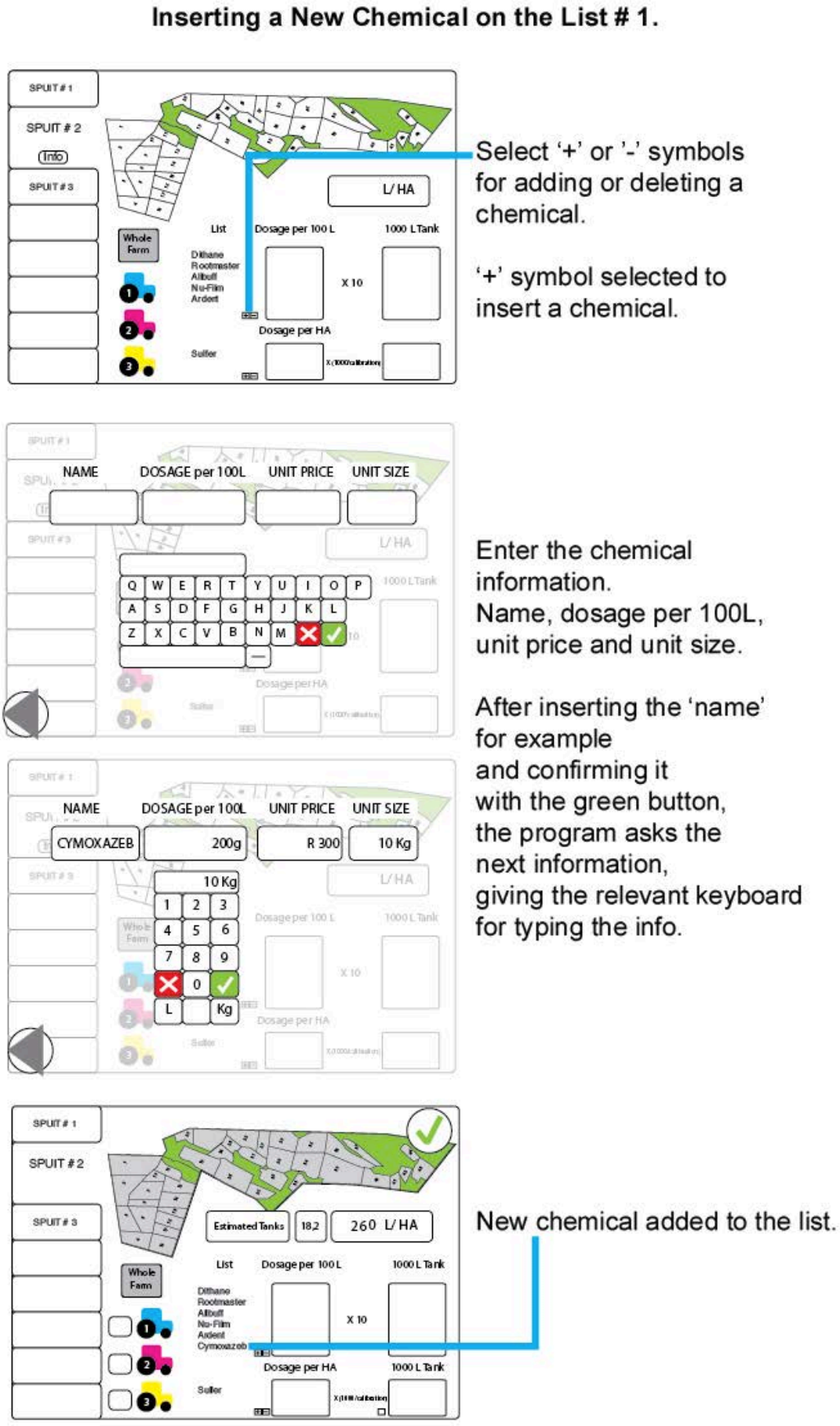


Figure 3.14 : Inserting a new chemical on the list #1.

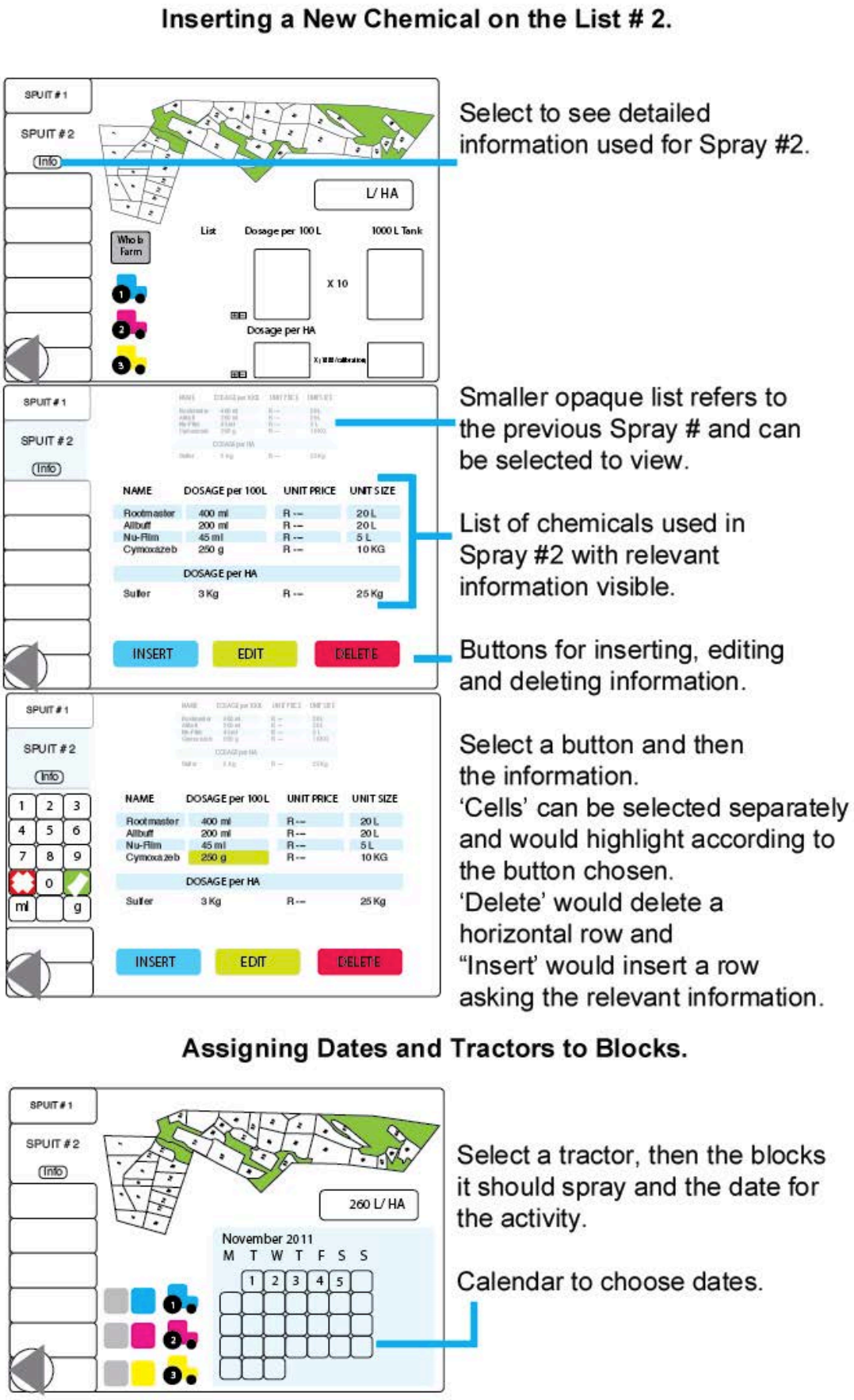


Figure 3.15 : Inserting a new chemical on the list 2 and Assigning Dates and Tractors to Blocks.

In Figure 3.15 at the bottom of page 77 is an example of assigning dates and tractors to the different blocks. A tractor representing Samuel, Hennie or Jannie could be selected, as well as a number of blocks per tractor and a date on the calendar. It could be planned ahead of time and the blocks needed to be sprayed would show up on the general workshop board on the day it was assigned.

These new ideas presented in Fig.3.12, 3.13, 3.14 & 3.15, were used to start a discussion and laid the boundaries for the rest of the day's workshop. With this basic understanding of the idea between the designer (me) and Altus (the main user), we spent the rest of the day working with paper mainly to pinpoint the calculations the VC needed to do in order for it to work correctly. We worked out the minimum amount of information one should enter to get several useful calculated results. Other focuses were to determine the highest ranking of information Altus needed. When I finished showing him the concepts, we started to work on finer details.

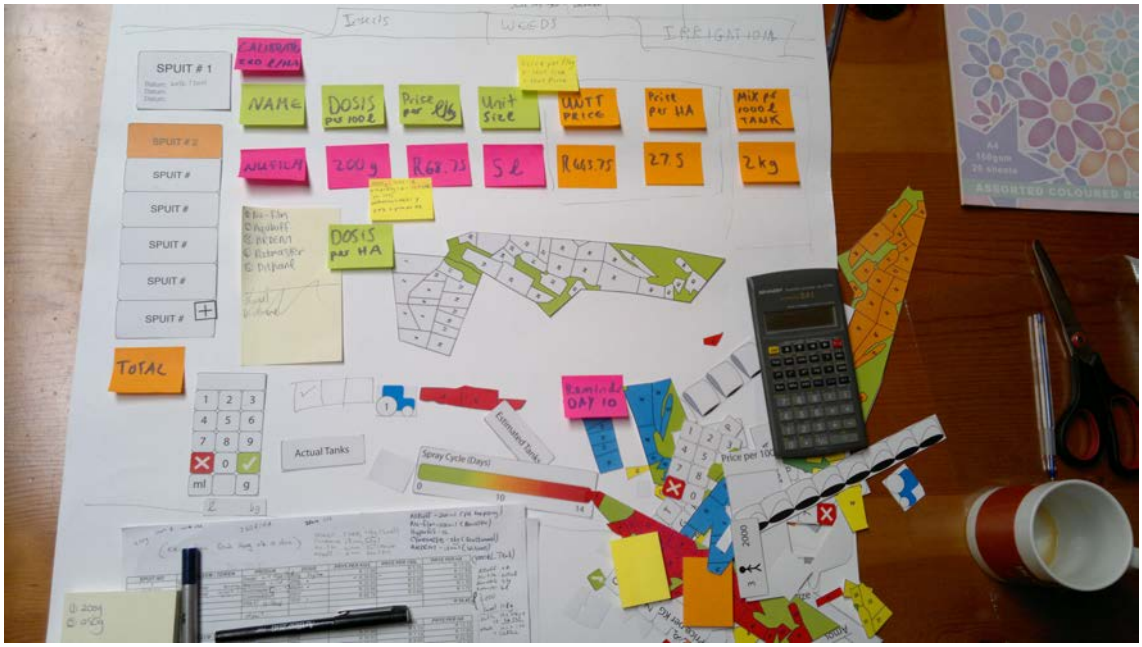


Photo 3.13 : Outcome of the Calculations with Paper for the VC.

By using paper printouts and small sticky notes as tools, details about the list of chemicals, total cost per spray number and price per hectare versus price per tank were discussed (see outcome in Photo 3.13). Usually Altus wanted to know how much a tank will cost and then they could work out the amount of hectares they wanted to spray. Altus would prefer it if each 'spray tab' showed its own chemicals. He did not want to choose from of a list. He wanted to create a list from the start for each spray process, because the amounts (dosage or quantity per 100L water and per hectare) change according to the different spray programs or how far the vineyards have grown. They buy a combination of chemicals from three different companies, so Altus uses all these companies' different papers to keep track of the chemicals and amounts he uses and used. It would be easier if Altus could create his own spray program where everything is kept in one place. For inserting quantities, the digit keyboard that pops up, should show

choices of metric unit capacities (ml, Kg, L, g). Altus explained that the more water they spray, the amount of chemicals they use increase and they would spray more tanks. In other words the higher the calibration gets, the fewer hectares they can spray per tank. The program should capture and store data of the dates sprayed together with the blocks sprayed on that date. Then you can look at your record keeping and see the date on which blocks were sprayed, with which chemicals and the amount of tanks sprayed. Altus suggested that this information be shown in a graph format. There was a waiting period of ten to fourteen days between the spray cycles. We then looked at how the VC could help to show or remind Altus when to start planning for the next spray cycle. The spray cycle visual could a colour indicator, showing the amount of days past after a block was sprayed. For example when a block was reported finished, the block would turned green on the map. This indicated that it was freshly sprayed. As the days pass the block will start to change from green to red, indicating that 14 days have passed. Another idea for the spray cycle was that a reminder pops up to say ‘Day 10, spray 9,10,11’. Ten days have passed and the numbers are the blocks that need spraying. If the weather station was connected to the spray cycle it could help to suggest spray dates. Although Altus felt you still needed the human factor or experience which indicated that human control was necessary instead of relying on sensors and programs to make decisions. The VC should therefore not be completely automated (Bannon, 2010). The record keeping aspect of the VC can be what it costs per block or per hectare. The different ‘sprays’ would also stay there without needing to save (for example, like iMovie on Mac). The user should also be able to add his own tabs and there has to be a total of all the spray information as well as outgoing cost. The VC should count the tanks sprayed, and show the estimation of tanks before spraying, together with price per tank. The Integrated Production of Wine (IPW) wants to know what quantities of chemicals Altus used in accordance to what quantity of chemicals were bought. They want to know because of disposing, safety and environmental reasons. This concept could support Altus with record keeping, to easily compare the different sprays, help him remember when to start the next spray cycle and to accurately work out the prices of the chemicals they buy. We discussed how we could apply this concept to the rest of the year’s work. We thought there could be tabs for the different purposes of spraying, for example he could still use the VC when they spray for insects, ants and snails. A final option we discussed was to possibly add a printing option for a paper trail and/or an email option for emailing the calculated information to Pieter/the owner for approval regarding finances.

3.2.4 PAPER SCREENS FOR FEEDBACK

3.2.4a Workshop 5

The third concept could now be moulded with the new information from the previous workshop. I brought the layouts of the concept in paper form (Photo 3.14) to discuss the final changes. Paper screens allowed us to make small changes on the designs by drawing or writing as we discussed detailed changes.

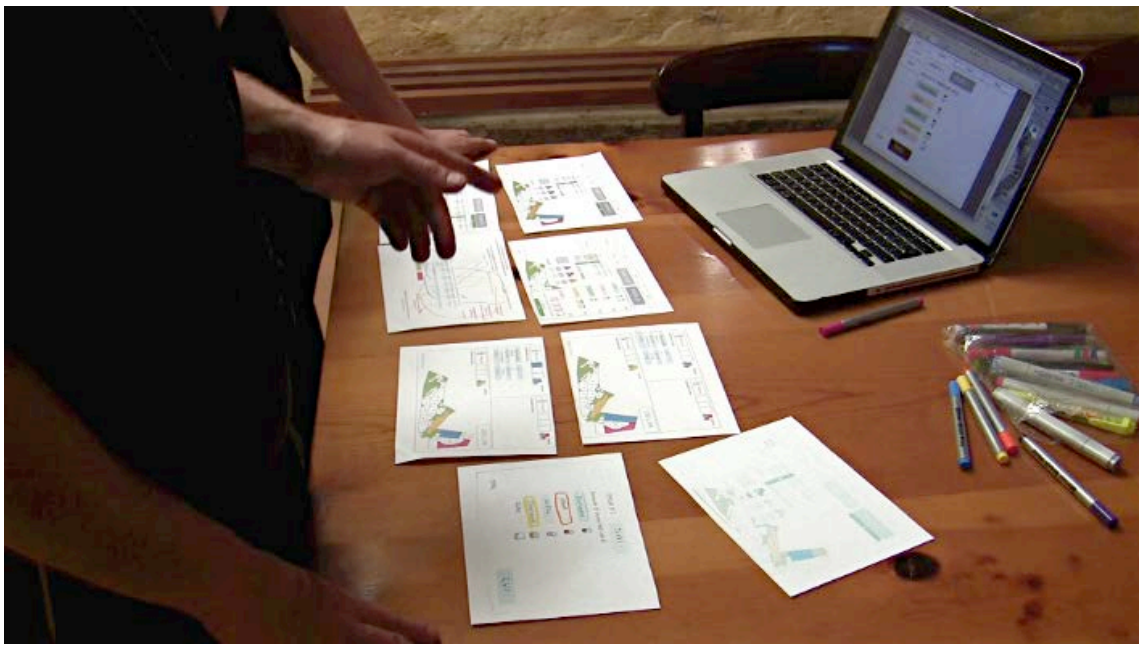


Photo 3.14 : Paper screens.

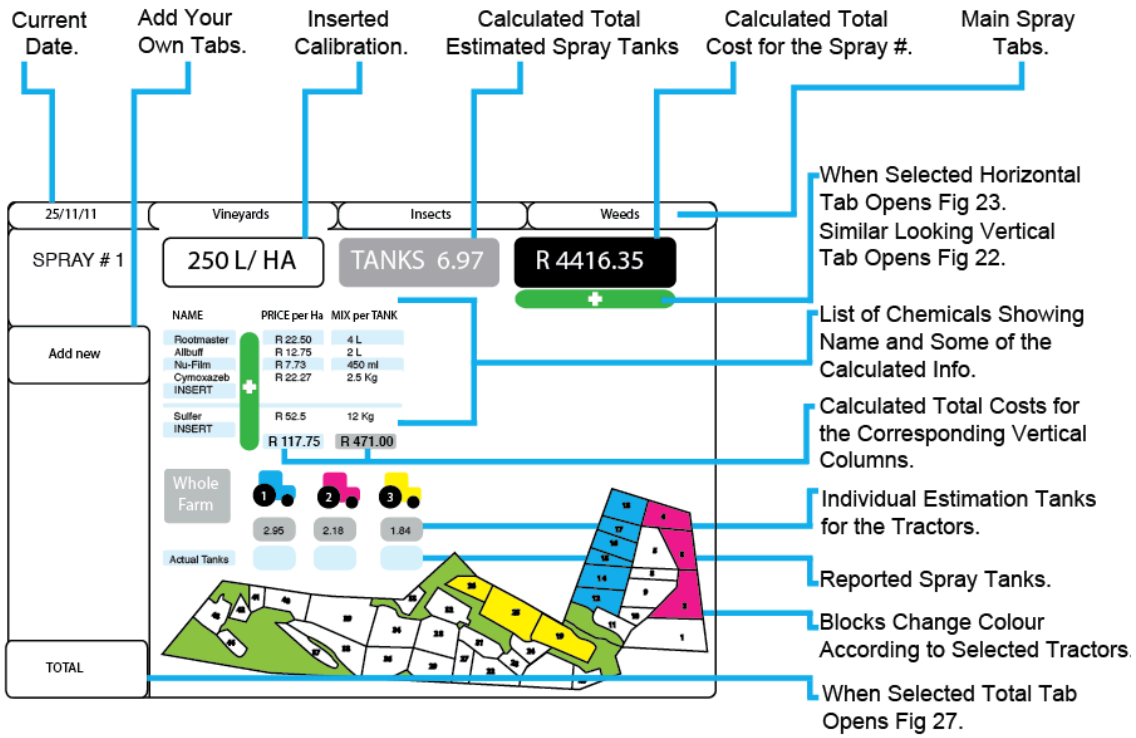


Figure 3.16 : Main Screen for Altus.

The new layouts of the VC were not only for Altus, but included ‘screens’ for Samuel and a Total tab for Pieter. For Altus (Fig.3.16) the new layout showed the current date, it had main tabs for spraying the vineyard, insects and weeds. It had the option for adding additional tabs under each main tab. On the top of each ‘page’ you could see the calibration, the total estimated tanks for selected blocks in grey and a total amount for the spraying cost. Under these one could see the list of chemicals with their names, price per hectare and the mix per tank. The total price per hectare and tank was shown under the price per hectare and mix per tank. Both the total cost for the spraying and the list of chemicals had the option to open more detailed information connected to it. Under the list you had the same options for calculating either the whole farm, or dividing the blocks between the different tractors. Under each tractor in grey, were the estimated tanks for each. The blue boxes under the grey ones were for the actual tanks sprayed. The map of the farm was still visible with the block numbers. The total tab was located at the bottom of the sub tabs on the left. This example already had information added in for better explanation.

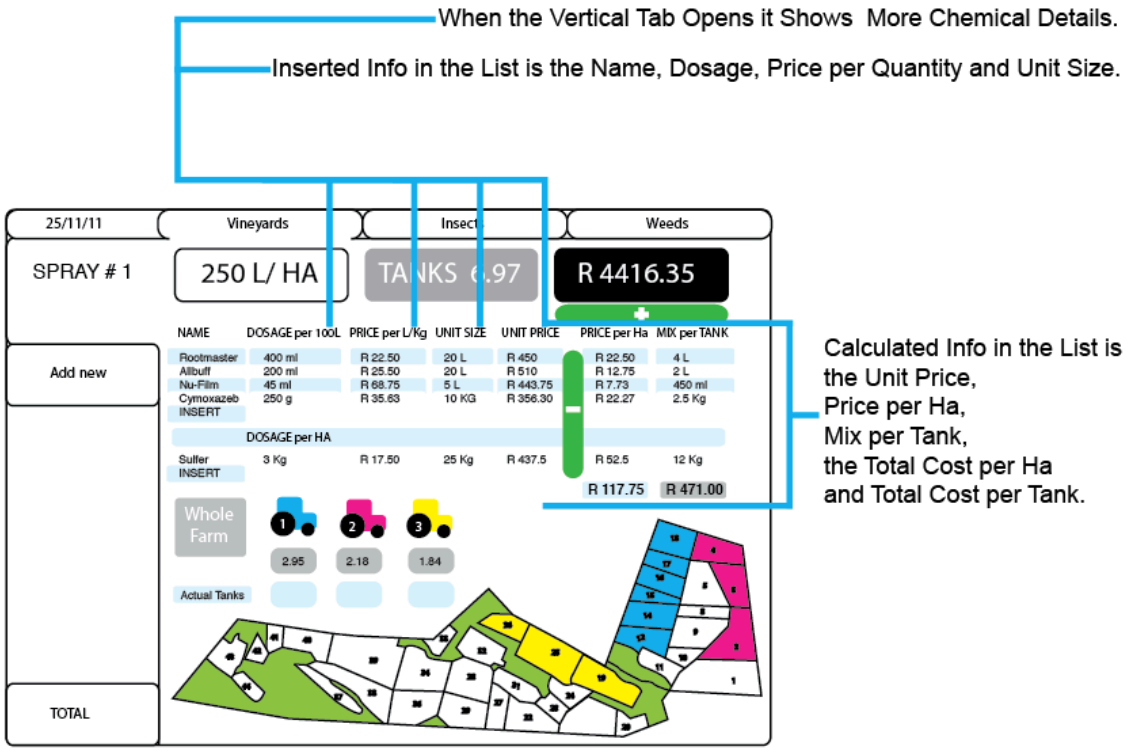


Figure 3.17 : Vertical Detail Tab Opened.

Altus could open the detail tab (Fig.3.17) of the chemical list and it would show the dosage per litre or hectare, the price per kilogram or litre, the unit size and the unit price. The information one needed to add to the list was the name of the chemical, the dosage, the price per kilogram or litre and unit size. It then calculated the unit price (the chemical companies gave price per kg or L), price per hectare for individual chemicals, the total hectare price, the mix per chemical for the tank and the tank price. After deciding which blocks to spray first and dividing it between the tractors, the visual calculator would show the estimated tanks and the total cost per spray.

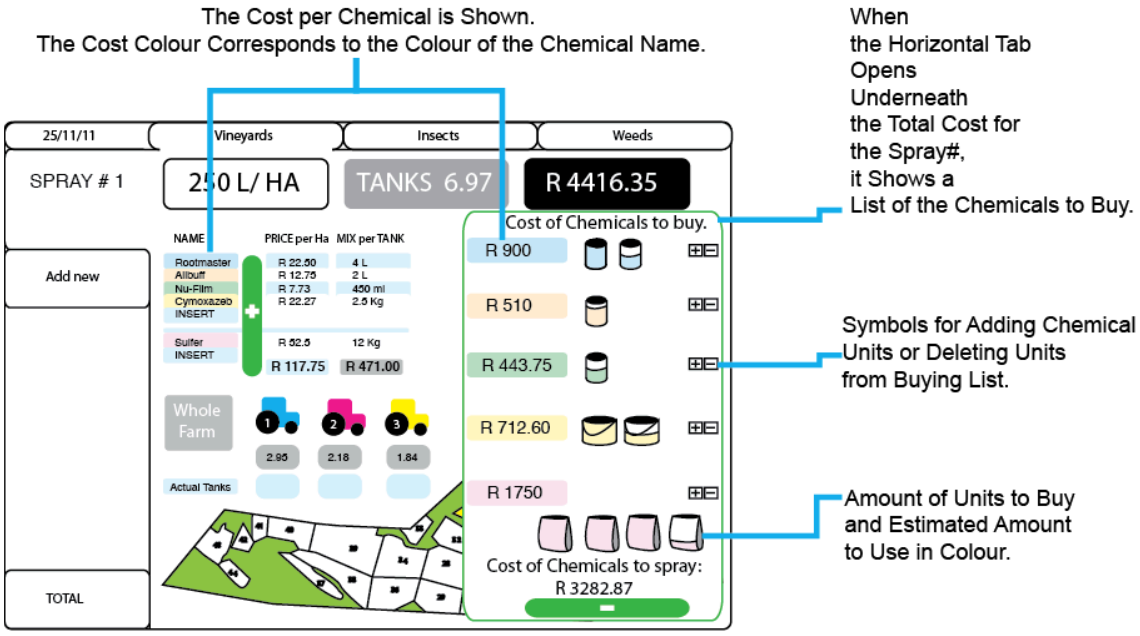


Figure 3.18 : Horizontal Detail Tab Opened

For a breakdown of the cost of chemicals, the tab under the total price must be opened (Fig. 3.18). This would show the total cost of each chemical type, the amount of units needed to be purchased and the percentage of the chemical you were going to use in colour. The names of the chemicals were not repeated, but colour highlights were used to relate the price to the name of the chemical. Extra features here were plus and minus symbols next to each chemical. Altus could use these to add or remove units to increase or decrease the total price and to determine stock purchases. For example if there were still two full bags of sulphur, he could remove two bags from the calculations. On the other hand if there was an almost full can of Allbuff in stock, the tolerance could be too small and he would have to compromise, he could then rather add an extra unit of Allbuff to the buying list.

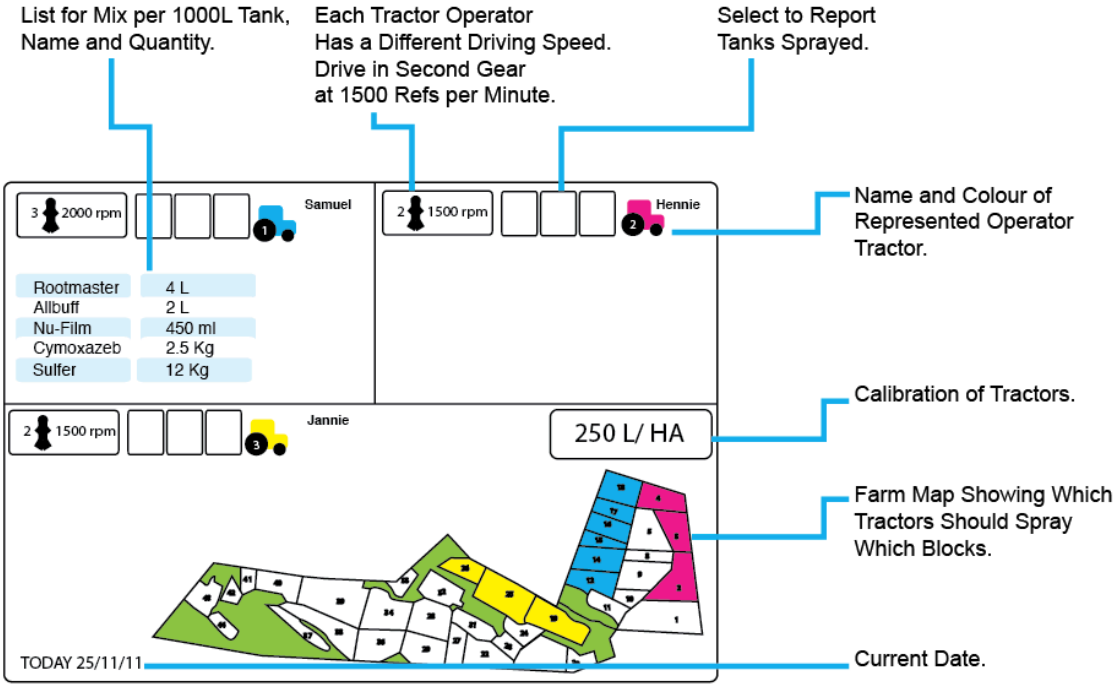


Figure 3.19 : Workshop Screen.

The necessary information, on which tractors should spray which blocks and what they should spray, went to the workshop board/screen (Fig.3.19). This layout was similar to the current workshop blackboard, because Samuel and his team was already used to working with it. The screen was divided into three, for the three tractors with each worker's name. This was for when they would spray different chemicals for different purposes. Each person would then be able to see what he needed to mix into his tank and the gear and revolutions he needed to drive at. In this example they were all currently spraying the same, therefore the list of chemicals to mix was not repeated in the other blocks. The list had the names of the chemicals and the amount for mixing for one tank. When mixing a full tank they could easily see on the board what blocks they needed to spray.

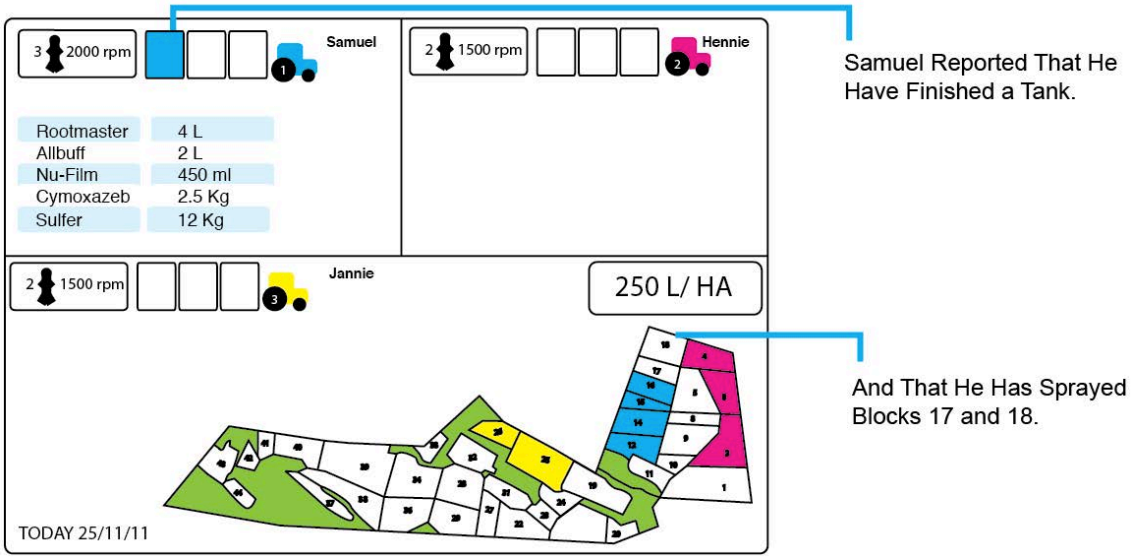


Figure 3.20 : Reported Info on Workshop Screen.

When they came back to the workshop to mix a second tank, they could help with record keeping by reporting on the board (Fig.3.20). They then selected a tank used next to their colour tractor and then they could select the blocks they were finished with. These then turned back to white or got deselected and this information feed back to Altus's side.

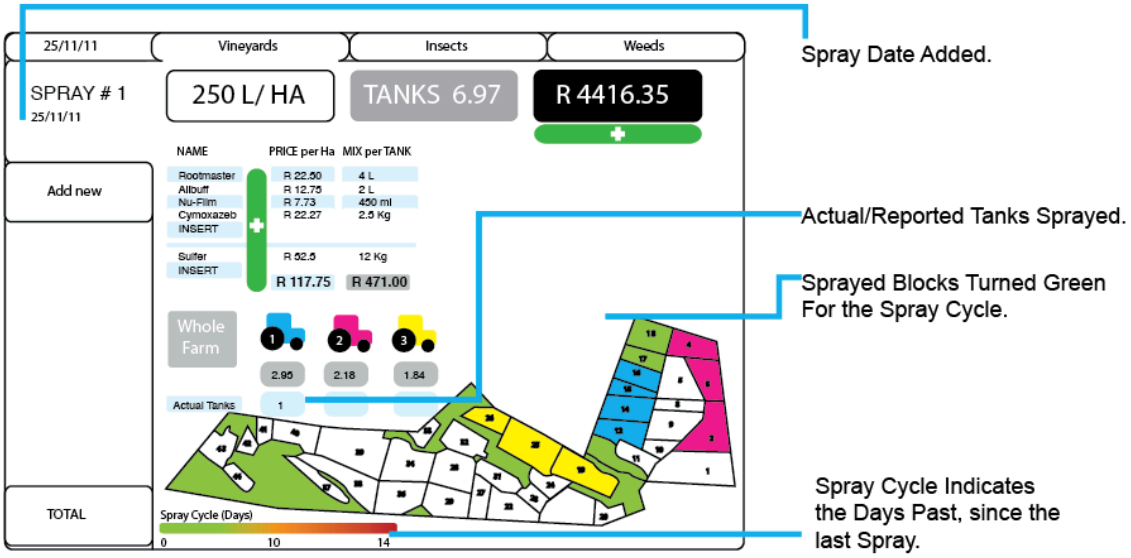


Figure 3.21 : Reported Info on Altus's Screen.

The changes on Altus's (Fig.3.21) screen would be the date that was added under the sub-tab name/spray number, the counter for actual tank under the blue tractor shows one tank and the reported blocks turned green. This meant the spray cycle already started to count the days and it would slowly start to change colour up to the fourteenth day, acting as a constant reminder to Altus. The dates were showed under the spray number tab and when selected, the map would indicate which blocks were sprayed on that date.

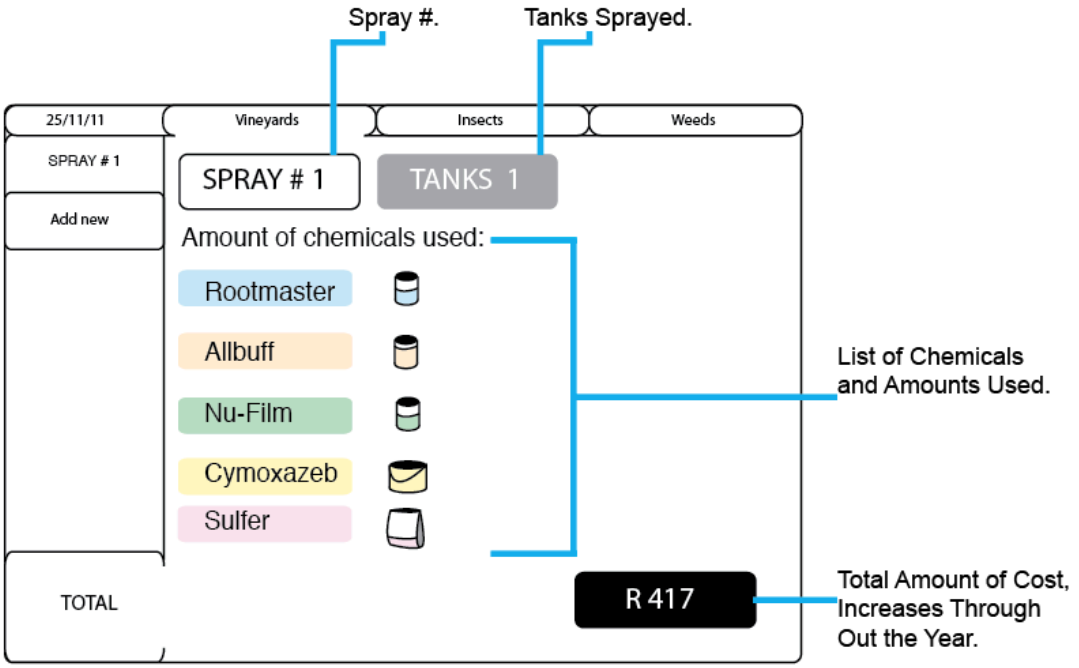


Figure 3.22 : Reported Info on Total Tab.

The same reported information from the workshop would show in the total tab (Fig.3.22). There everything will be calculated together and would show amount of tanks for each spray as well as the total chemicals used as the year progresses. This might help with the IPW, cans bought versus cans used. In this example for spray one, it showed that one tank was used and the type of chemicals that was used. The total amount of money was showed in the black box.

Changes to the presented paper VC:
Altus wanted to see all the information on the chemicals, so the hidden detail tab was not necessary (Fig.3.23). On the workshop screen (Fig.3.24) the date of calibration for each specific tractor should be visible as this would also help to see if it was calibrated too long ago, meaning it could be out. The list on the workshop screen should be numbered, and sulphur should always be last on the list, meaning it should be the last chemical to add to the tank. Instead of selecting the dates under each spray to see the blocks sprayed, a graph could be used to show the information and replace the previous total tab (Fig.3.25). Altus liked the concept of the VC, because it could save him time doing calculations and help preventing mistakes. He could actually use this tool to quickly compare the prices from the different companies, to see which one was the cheapest option, by only putting in the dosage per litre or kilogram, the unit size and the price.

Although the users did not fully engage in conceiving concepts, the workshops allowed the stage to be set for discussion and feedback on concepts. In the third workshop I presented several ideas for the spray scenario and in the same workshop we worked on the two stronger concepts, of which one was chosen to develop further in the rest of the workshops. The Visual Calculator's interface was developed in detail with the focus on the farm manager's side, while the interfaces for the other two stakeholders had less detail and remained open for future development.

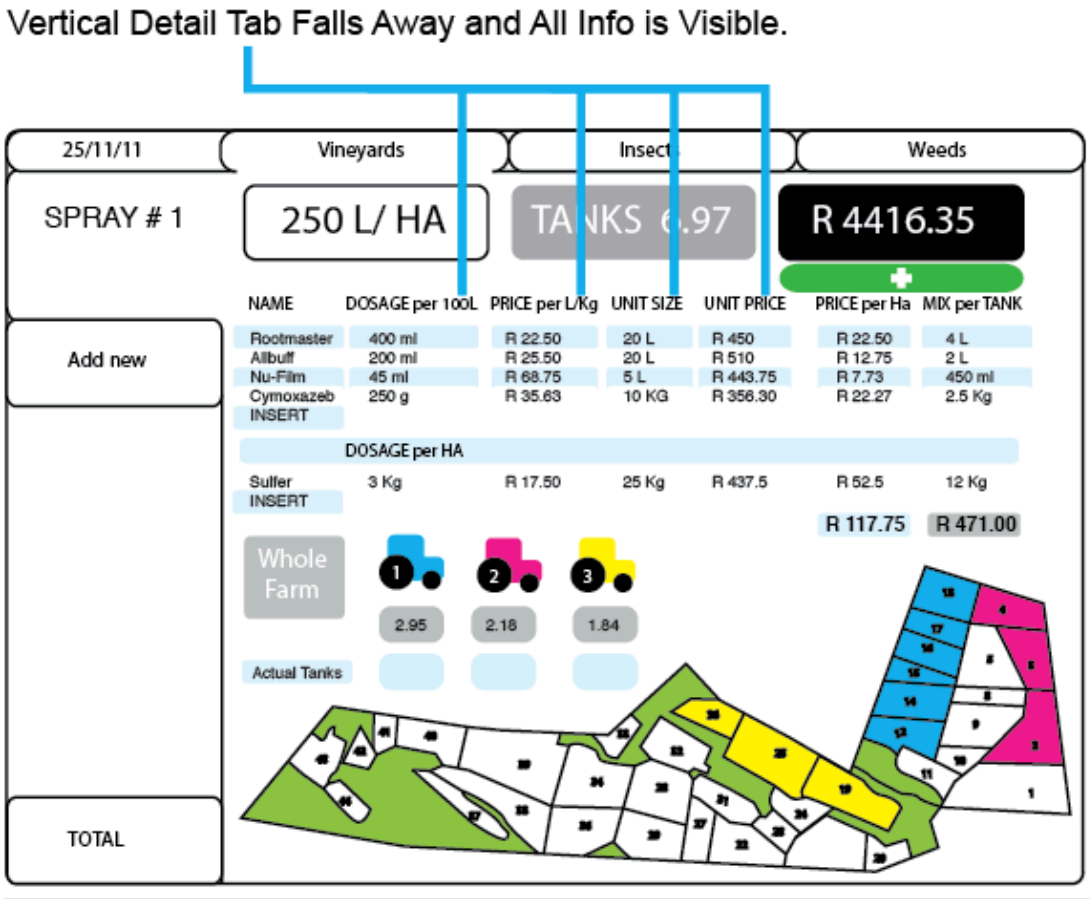


Figure 3.23: Final Main Screen for Altus.

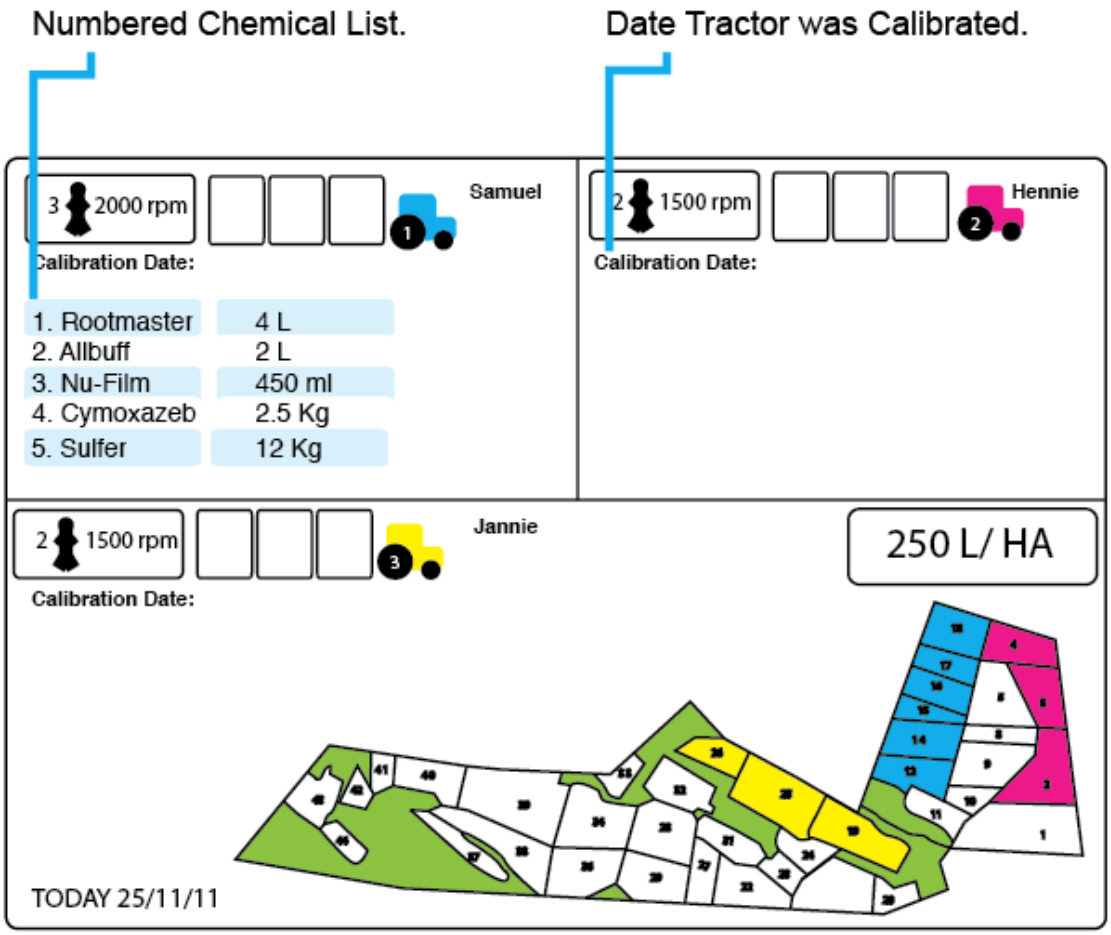


Figure 3.24 : Final Workshop Screen.

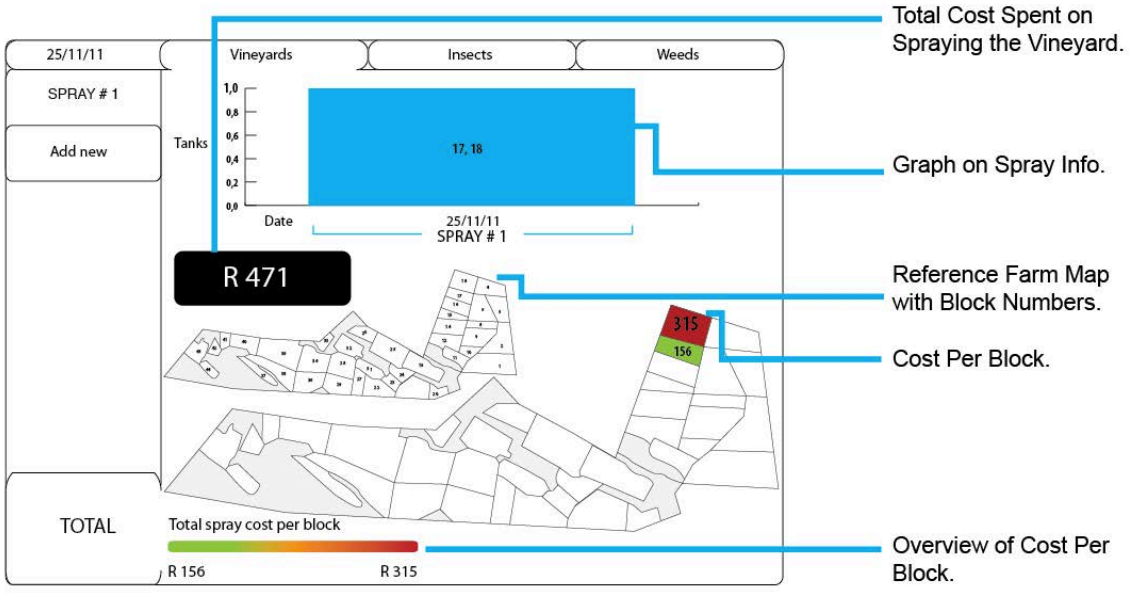


Figure 3.25 : Final Total Tab.

3.2.5 DESIGN LIMITATIONS

The focus of the VC was to design supportive technology for the three different perspectives/ stakeholders. The goal was to enable them to each do their part of the task and this would support each others goals. Within this limitation the focus of the design was on Altus the farm manager.

3.2.5a What the VC Could and Could Not Do

Prezi, showing steps the VC addressed and not addressed, together with future openings within the concept. Click the blue button to launch Prezi 3.4:What the VC Could Do and Could Not Do:
Alternatively please visit : http://prezi.com/i_mdr7zfvqrb/visual-calculator/

3.2.6 THE VISUAL CALCULATOR

3.2.6a What Was it, What Could it Do and What Was the Value for the User?

What is The Visual Calculator?

The Visual Calculator is an application designed to improve the current spraying process on the farm Goede Hoop, by supporting calculating, managing, planning, decision making and record keeping in a visual manner by incorporating the map of the farm. It was designed for several user perspectives such as the farm owner, farm manager and tractor operator/foreman, each playing an equally important role within the spraying processes, where they all collaborate to get the work done.

What could the Visual Calculator do?

The Visual Calculator supported 8 out of the 10 steps in the spray process (As shown in Prezi 3.4) and it could shorten the process. When in the field observing which chemicals to use, a list could be generated on the spot using the application. It could help with quick and easy prioritizing of which chemicals to use and it was easy to quickly see the difference in prices. If you selected which blocks to spray, it estimated the amount of chemicals you should buy plus the cost. The Visual Calculator would enhance communication, by visually assigning spray tasks to workers on the board in the workshop. This board would also allow for reporting the amount of tanks sprayed and which blocks sprayed. When reporting happened, the V.C instantly updated with this information, which was then automatically stored for record keeping. It also used the spray date in combination to blocks sprayed to visually remind one about the spray cycle, allowing one to appropriately plan the next spray.

What was the value for the user?

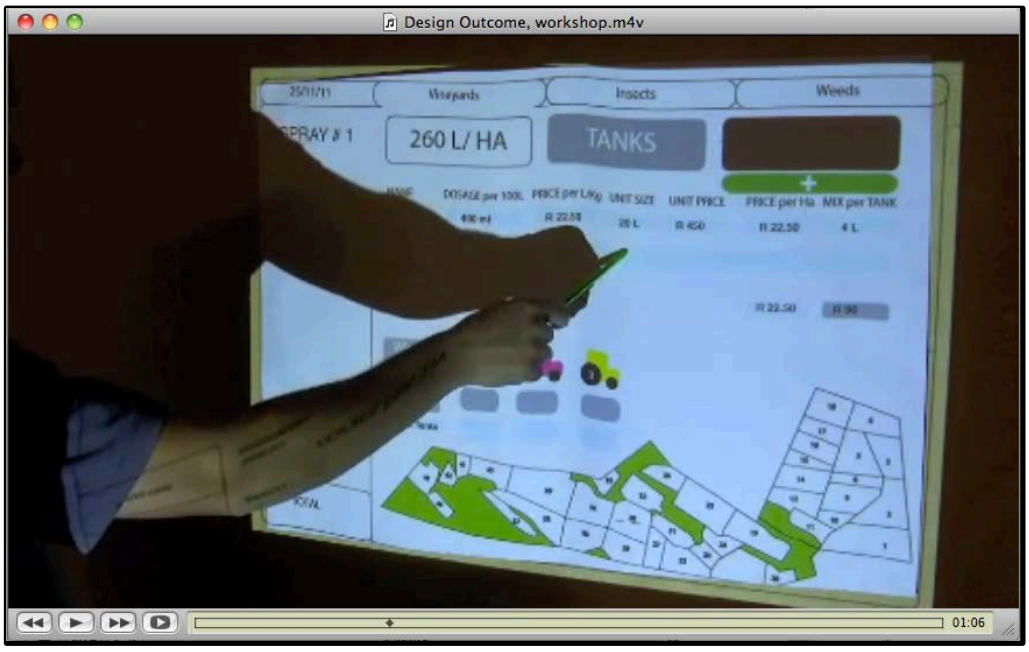
It helped with keeping all the spraying information together in one place and by only entering information once the calculations and the record keeping were done. With five inputs it could calculate nine outputs, saving time and possible calculation errors of 44 calculations. This leaves less room for error, by doing less calculating saved time, and it made it easier to check if everything was correct. For the farm manager the VC could help with planning what and how many chemicals to buy preventing waste of money, and by reminding the user of the next spray cycle, was one less thing to remember. Most important of all it was visually understandable which meant less writing. When finding out the best prices for these chemicals, one could easily compare unit price, price per hectare and price for a 1000L tank, without having to do the math.

The only input the user needed to do was the liters per hectare, the name of the chemical, its dosage per 100 L, the price per L or Kg and unit size, and the application could do the rest. The value of the VC for the Foreman provided new learning opportunities, through enhancing understanding and communication around visuals of the work tasks. He as a team leader, could then share his new understanding of the practice with the other employees, making them aware of reasoning behind planned activities. The owner would have an overview regarding financials and could make informed decisions based on it. Communication effectiveness between these stakeholders could increase. The VC allowed them to talk around the same understandable visuals enabling them to share their perspectives with each other, reaching a new understanding within their own practice.

3.3 DESIGN OUTCOME

Finally through presenting the Visual Calculator to the three stakeholders, allowing them to give feedback on the influence such a concept could have on their daily activities, would establish if the concept was valid, meaningful and valued. I will then conclude with future work and possibilities regarding the stakeholders feedback on the concept of the Visual Calculator.

3.3.1 PRESENTING DESIGN



Video 3.3 : Video of Altus explaining the VC [Duration: 00:04:18].

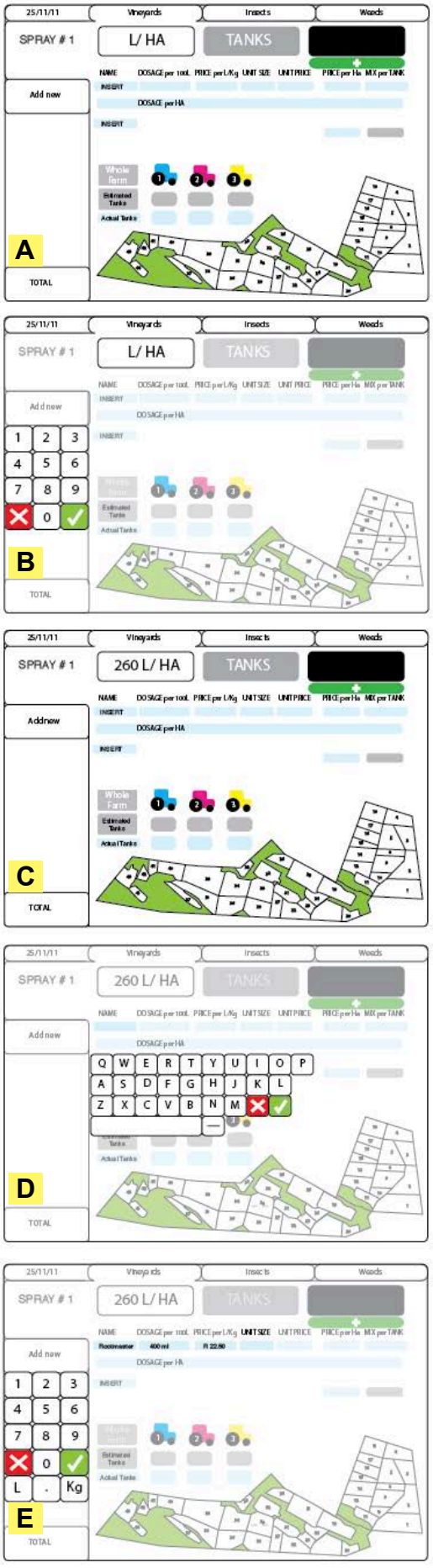
I based the Visual Calculator (VC) on the Spray Process represented by video cards. The current concept would support some of the steps in the process, but not all. There is however still design openings not fully covered and this leaves space for future work/research. The VC could do the calculations of most of the needed information within the spray scenario. The value for the user could be with saving time, minimize calculation faults, precision and could help with saving money. The following is a description of the VC with reference to the figures depicted as a storyboard following alphabetical order. The main screens are shown, but some detail between actions/steps are left out, not to repeat actions already shown/understood.

There would be a layout page without information when opening the VC, for inserting new and relevant information on each new spray cycle (A). For the VC's calculations to work it was important to start with the calibration information (250L/Ha) (B), there would be no specific order in which to insert all the information, but the outputs would not show if the calibration was absent. After the liters per hectare were inserted (C), you could start adding the list of chemicals and the details (D and E). Name, dosage per 100L, price per quantity and unit size. After inserting unit size the screen 'jumps' to F, showing price per Ha, mix per tank and totals of both.

Nearer to completing the list, the total cost per hectare and total cost per tank would update/change, until the list was complete (G). The VC could also be used to quickly compare the price differences by looking at price per hectare between different brands of the same chemical, saving time not having to do the complicated calculations manually. The list the VC asked for was the same information the chemical companies gave on their products, so by inserting the info it would instantly show which chemical was cheaper to use.

In the beginning of the spraying season, when only certain blocks were sprayed, the VC could give an estimation of the amount of tanks needed for spraying the selected blocks. The hectare for each block was already on the VC. Although they were mixing full tanks to spray, it would be helpful if the program could work in fractions, (6,97) for them to use their experience in adjusting the amounts, to allow lea way. Each tractor would have to have the estimation for each of the tanks shown under each one. Underneath this would be the actual tanks.

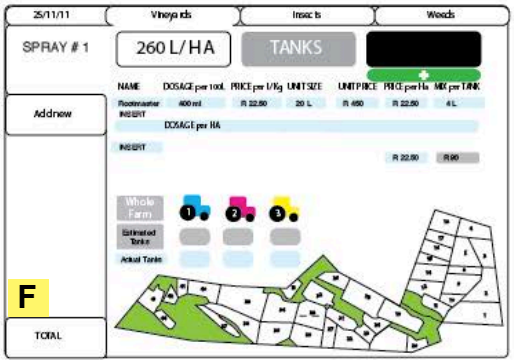
When the blocks were selected, the VC showed the estimated tanks and the black box showed the total cost of the chemicals needed (H). When opening the detail tab underneath the total cost, it would show the

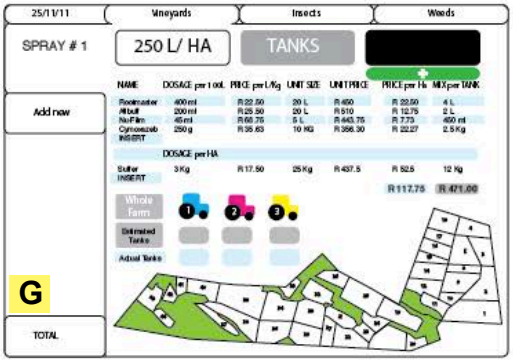


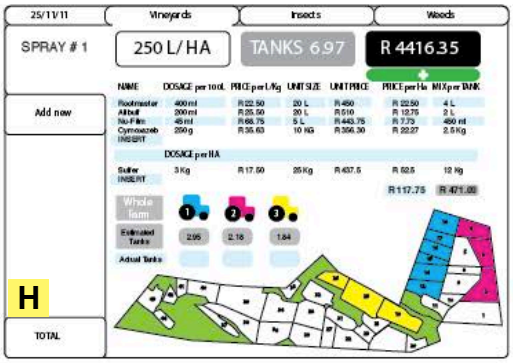
amount of units of the different chemicals that needed buying, as well as the percentage of the estimated usage (I). For example only half a can was needed instead of a full can. The reason I added plus and minus symbols next to each represented chemical, was for Altus to use when taking stock: if there were two full bags of sulphur in stock it could be taken off the 'shopping list'.

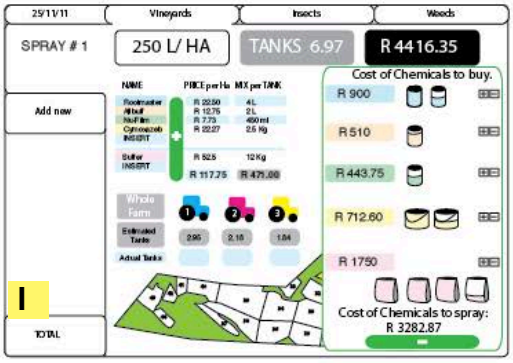
The same information including, mix per tank and blocks to spray, would then register on the screen in the workshop (J). This layout would be similar to the workshop blackboard as the spray team was used to it. It would be divided into different sections for each spray person, so when they spray different chemicals, each would see his own mix in their section of the board. Dividing the board would also help with having the tractors calibrated differently to each other, showing each the required driving speed. In the current example, it meant the whole spray team would mix the same list of chemicals. What could also be of use was to show each of the tractors calibration date on the board. This would be one more variable to consider when checking if the calibration of the tractor was still correct (If the tractor was calibrated too long ago, the chances were that it was out of tune because of rattling on the gravel road), or it could be a reminder that it was probably time to recalibrate. By looking at the map on the board, Samuel could see the blocks he needed to spray and when finished spraying the tank, it could be reported on the board by selecting a used tank, together with the blocks that were done (J). The map would then de-highlight the selected blocks and the information would be send to Altus's main screen (K) and the total tab (L).

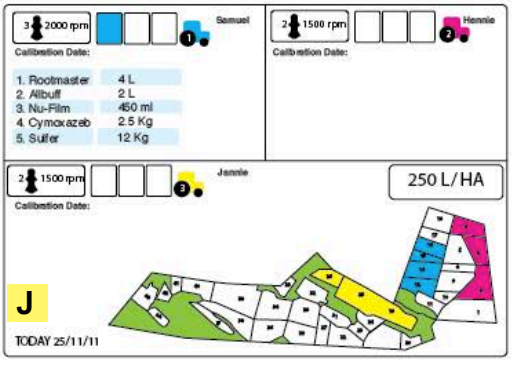
(K) Altus would then be able to see that the blue tractor confirmed spraying one tank on blocks 17 and18. The date the blocks were done would show under the spray tab name. The VC will then show the spray cycle. The spray cycle would indicate the days passed, so that you could visually see when it got to



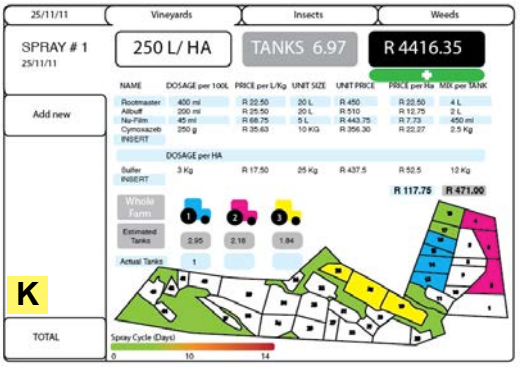




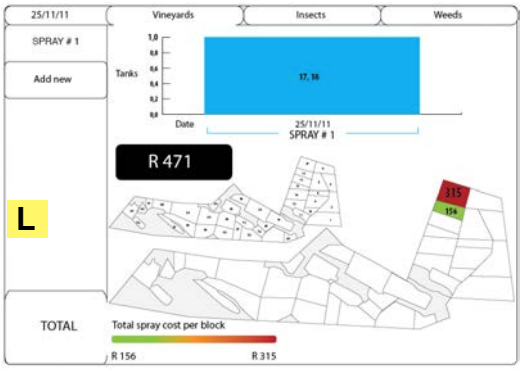




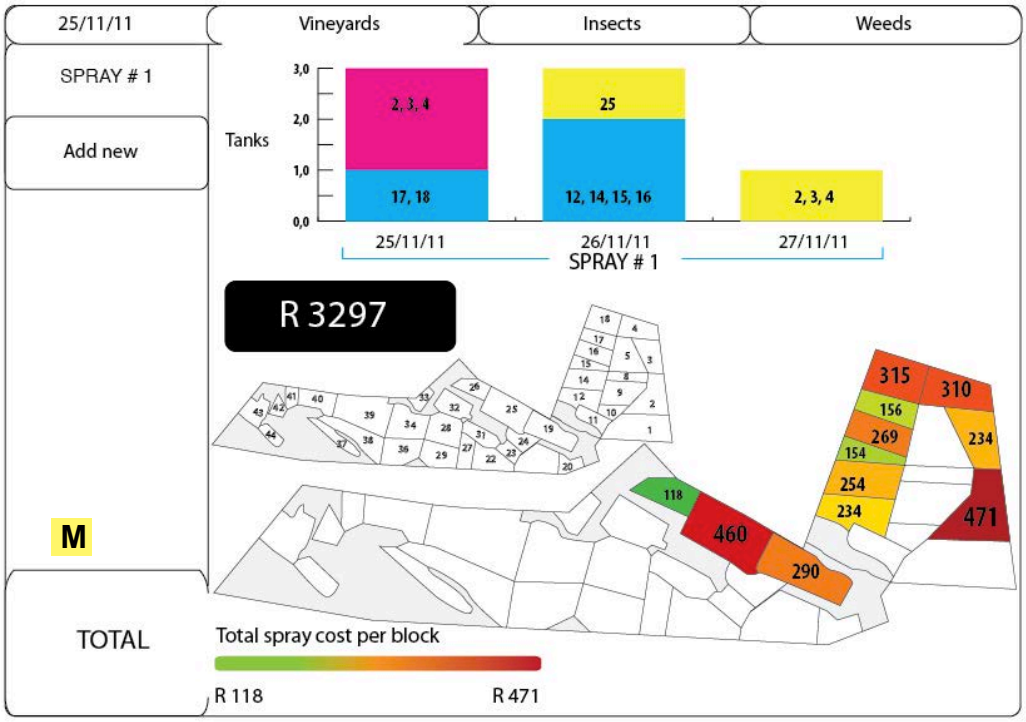
day 10 to 14. On the date it was sprayed it would show the block as green and as the days progress to day 14 the colour would gradually change to red. This information would be shown in a visual way to make it easy to understand instead of showing the next date it had to be sprayed. This would also help planning in a visual way of where to spray next.



On Pieter's side or the total tab (L), this visual information would adjust as the reported information came in and the total cost would continue to grow. This total was connected to the graph and the map seen at the bottom. In the current example the graph showed the following: it was spray number one, the date and one tank was sprayed on block 17 and 18. The cost spent on each block could be shown on the map and it would increase as money was spent on the block. (M) is an example of the total tab showing all the reported information of Spray 1.



Regarding information gathered in previous workshops from Pieter's ideas, I tried to design the total tab according to this: If the amount of money being spent on a block was known, the owner would be able to compare it to yield/profit on the blocks to see if it was still valuable to keep the vineyard block, or if it was time to take it out.



Figures 3.26 A to M: Storyboard of VC.

3.3.1a Discussion and Final Feedback

Pieter quickly discussed his answers to the questions I gave them on paper. I also printed out each stakeholders 'screen' with which they were involved in, to allow them to draw or indicate changes to the layout or any information they wanted to add or took away. None of them changed their 'screens', but they filled in their answers.

3.3.1b Albert's Feedback

ALthough I didn't plan for Albert to give his feedback, he walked in while we were discussing record keeping with regards to the IPW. He spend most of his time filling in IPW forms and therefore he felt that you needed an employee to do the IPW forms on a full time basis. He suggested the record keeping on the VC must be used for the IPW once the information was inserted into the program, for that would save a lot of time. Everybody at the workshop agreed to this. When he needed to work out the sulphur or acid contents of the wine on his spread sheet, he will then save the spread sheet with the batch number to have all the information to be able to fill in IPW forms later, but it was a nuisance to him. If all the information was already on the VC, he could quickly work out what he needed to, save it right there and have the records and forms for the IPW finished and correct. [What was done could go automatically into record keeping; this was touched on in my earlier concepts].

3.3.1c Pieter's final feedback

When the information on the list was entered (G), the VC would directly/instantly show the 'price per hectare' where one would be able to compare chemical prices. In the case of the calibration going up, the price per hectare would also change automatically. This was valuable to Pieter, because you could not compare the price per liter to see the cheaper option. They were used to comparing price per 100L, because of the different mix ratios of the products per 100L. That was why some prices may appear cheaper at first glance if you compare only price per litre or kilogram.

It was necessary to calculate the calibration of the tractors individually (on the workshop screen (J) and on Altus's screen (H)) to be able to change them individually. When spraying a younger block with untrained bush vines, like block 12, only one nozzle would be open and you would put down 100 liters of water. Later you have to put down 250 liter water, so the blue tractor would be used again for spraying the same block. Although from a practical point of view, the same tractor was not always available to use and they would recalibrate a available one. Therefore the info on each tractor would have to be adjustable, for entering different amounts of water and different driving speeds for each. These seemed like small differences, but at the end of the season it could make a big difference. Picking up on mistakes would then be easy, for example if they drove at 1600 revolutions instead of 1500 revolutions, one could see the estimated seven tanks would now turn to 6,5 tanks, thus constantly checking if calibration was correct was necessary.

To work on full tanks or to report a full tank used would not be effective (J). At the beginning of the season, you would spray a third of a tank on a block. With the next spray and a higher calibration you would only spray half a block with one full tank. Rather one should work with the liters sprayed; if the tank was 1000 liter and 800 liter was sprayed on the block, the program should know/connect to a meter/sensor in the tank and show 800 liter was sprayed on block 17. Later in the year 1000 liters was sprayed on block 17, because it was calibrated differently. The calculations would therefore not match up in example J because one tank sprayed would be reported and in the meantime the tank would not be empty. However in that specific example with the calibration set at 250 liter per hectare, spraying block 17 and 18 together, one full tank would be used. This combination in the example was used for simplicity. Although it was still necessary to consider being able to report different amounts. Maybe if Samuel reported on the workshop board, he would have the choice of saying only part of the block was finished.

When I asked Pieter if he wanted to see more detail on the total tab (L and M), his concern was that unfortunately the more detail you go into, the more information you will have to give the program. He thought that it would then be necessary to employ a manager just to control and check the program. Although the concept was very useful to him, because most of the information spoken about were IPW based and they would regularly ask for these ‘numbers’ for regulation purposes. The only problem was that a lot of time would have to be invested into such a program to make it work. The graph was meaningful to him, because it showed each spray plus the dates of spraying. For an overview he could see daily that only one block was sprayed and therefore ask why. The reasons could then be investigated: if it started raining, or if the wind started blowing or if the nozzles were blocked. It would be possible to see if the tractors were working correctly and how many hectares the tractors could spray per day.

According to Pieter, I was only touching on the cost. It was necessary to consider the initial establishment cost of each block and the investment/rent you could have made instead. For example if a profit of R100 per hectare was made on a block, you would think that it was profitable, although in reality that R100 was not enough to weigh out the capital you had to put into the block. If you spend R150 000 on a block, the breaking even point was currently around 12 years, after that you would start making a profit. The average life time of a block was 20 years, so there was an 8 year time period to make a profit on the block. That was why the first cost to establish the block plus the interest on that money should be brought into consideration.
He would also want to see the cost per tractor on the VC. This way he could see what the tractor cost initially, the running cost of the tractor and how much were spend on a tractor per year. From time to time the spray thanks needed replacement and if the profit margins were easily available it could help with planning and budget on maintenance.

Considering to apply the VC to other activities, Pieter mentioned the idea of having a device in the chemical store room. When someone took chemicals out it must register on the VC. When a chemical was weighed on a scale, (which they were already doing when mixing) the scale should be connected to the VC to register the tractor number and to deduct the amount from the

stock. Then the VC could show you everything, the information would already be there, the amount and which chemical was used. The whole process on the VC should start there. When the chemicals were bought and stacked in the store room, it would have to be added into the system right there in the store room, so that this would show immediately on the records and you would know what was in stock. The tab for the amount of cans to buy were ideal (I). It could then be seen immediately that it was necessary to buy Rootmaster, as it was almost finished. If chemicals got taken out it would go on record directly and the last person emptying a can, could punch it in and an alarm could show somewhere.

The only major changes to the VC were considerations to add to Pieter's screen, but overall he was very pleased with the current representation.

The VC was very much the same as the old method, only more organized. Most of the financial calculations he would do in his office, but it would be good if it was on a screen somewhere where everyone in the chain could see what it costs to spray one hectare with 250 liter water plus all the other expenses. Because most of the time no one actually knows what the cost is, no one sees prices, but now everyone would know. Although it could work against you, for when someone spills a bucket by accident half a kilo of chemicals were wasted, then he knows that it cost R50 and maybe he would keep quiet about the spill because he would be held accountable for that. Now he would spray half a kilo less per hectare and then it would be possible for the vineyard to get sick. Then nobody would understand why there is a problem because they would believe that the right amount was sprayed. But it would be good if everyone in the chain knew what was happening and have a better understanding. This would create awareness and efficiency.

It would be meaningful if the time spent on inserting information into the system be limited to a minimum. Also if the work load could be distributed; if Samuel could put in the kilograms, Altus puts in the blocks that needed spraying and Pieter puts in the amount it costs, it would work effectively. This way at the end of the day, inserting information would not be one persons responsibility. Maybe you would need an administrator, giving a paper to the worker and saying that this was his part to fill in, otherwise the manager and owner could not do their part. For example if the tractor operator fills in that his tractor was calibrated in the morning, the amount he mixed, what he mixed, how many tanks he sprayed the day and then he pressed 'enter'. Altus would now get the information to check where the worker sprayed, what blocks were not yet finished and he would send it to Pieter. Pieter could then see that it cost him X amount.

The next day this information must be available to everyone, they have sprayed 30Ha, this tractor sprayed this much, that tractor that much, the tractors running cost was this and this was the overall costs. Now everyone down the line would know the cost and how much chemicals where sprayed, and, and. This would enable them to start asking questions; the vineyard was getting very dense, should we rather not start to spray 400L/Ha? Currently Samuel only got assignments and most times do not know why they should do the assignments, because they

don’t have all the information. Evenly distributed responsibilities could make the working load lighter for all. If Pieter needed to do this on his own, and it would take too much time and he would be hesitant to do it. He would then rather spend a quick half hour to do a calculation, it would not be with so much detail, but then he would know if it was profitable or not. But by doing it this way the rest of the workers do not know about it and this was a problem, they also needed to know.

3.3.1d Samuel’s final feedback

Samuel’s tractor has got a bigger spray tank than the other tractors and takes longer to empty. The other tractors can spray 2 Ha and he can easily spray 2,5 Ha. Samuel pointed out that was why you should be able to adjust the different tractors on the VC. The others would spray for two hours to finish their tanks and then Samuel would spray three hours to finish his tank. At the end of the day, they would have sprayed more tanks than Samuel, but all of them would have sprayed similar amounts of hectares. To Samuel this method seemed a lot easier and more reliable than the old method. It was valid and meaningful because it would work effectively and the workshop board is clearly outlined and understandable to him.

3.3.1e Altus final feedback

Altus commented that there was a similar program he knows of, but it took too long to work with and that you needed to sit down for the whole day to insert information. Then when you then come to the end of the day, you have made mistakes because you were too tired. If Samuel could say how much chemicals he used and the amount of tanks, Altus would get the information to see how many chemicals they should buy and Pieter can see what work was done and ask questions accordingly to keep them on their toes. That was why it all comes back to dividing responsibility. For Altus it was valid because it would help him to do the work a lot faster and calculations would be correct. It was meaningful to him because it would keep all the information in one place and it would help with the IPW. The VC was valuable because of good record keeping and making it simple and easy. It would save a lot of time and everybody would know what was going on.

All three stakeholders thinks the VC could be applied and used for supporting activities happening throughout the year such as pruning, suckering, irrigation, planting poles, weed control, seasonal workers and tractor expenses. All the activities would contribute to see if a vineyard block was making a profit or not. If every worker could put in a little information along the way and understood the complete picture, the VC would work effectively.

3.3.2 FUTURE POSSIBILITIES

The amount of effort with input was always going to be an issue, there was a fine line for automating things in the system. As discovered in the beginning with giving each person his/her own responsibility within the chain and not just let them take straight orders, the amount of work to input into the system would be divided and work would be lighter for all parties. Then such a system could help. When everyone was aware of their responsibilities and that it was connected to finances. Everybody should do their bit in the 'system'. It should not be one person's job to work alone with all the different information. This easy visual understanding should be explored with all the other workers on the farm.

A few suggestions were made and if technology could directly and seamlessly be incorporated into an activity, without obstructing the activity, it might be beneficial. However this would be a research project on its own.

More things could be 'automated' for record keeping, although sensor outputs should not replace human experience. Looking back to my first concepts the 'future' scenario I created to explain the reporting devise and visual calculator. The idea was that a sensor counts the tanks sprayed and knows which blocks were/are being sprayed. Later in concept evolution I dropped this idea to enable more human input into the system, although record keeping stayed automated. The human input allows one to also confirm that information going in was correct and checked already, while GPS tracking of which blocks were being sprayed was too invasive of a person's space in doing their job. Although in the last workshop Pieter mentioned a few small automated things that could save time by doing an activity rather than to do the activity and then 'reporting' it by writing/punching/typing in what has been done. Further exploration is needed to identify such activities and it is important to keep in mind that there is a fine line between automation that could support work activities and the need/input from a user. Bannon (2010) says the question should not be what could be automized, but what should be automized. Human confirmation combined with reporting information could help, otherwise on a farm setting, when things were automated, you would need someone to go through the data and re-digest it, so that it could be useful/applied to what they needed. Controlling information about activities already done would then become a 'double job' and I think that was what Pieter meant by wasting time to manage the already completed tasks information, which may not be of use or needed specifically, to be able to plan for the immediate future. The VC could maybe be used to fill in an IPW form automatically.

The map is central to all activities and it could be use/apply to most activities on the farm. The VC could be made more simplistic, in ways the information was entered and the way the information was displayed. Instead of numbers it might help to show 'changing info graphics' applicable to farm activities, making it visually understandable for all the stakeholders using it. The Visual Calculator could easily be applied to other farms, just by using their farm map together with the vineyards relevant information.

More exploration is needed into the cooperation between stakeholder roles for supportive ICT technology. Pieter's interface needed to be developed further, also with the possibility to look into something that could support them with the IPW forms, from the vineyards through to the cellar. Instead of showing cost going into individual blocks, the VC should show the profit, or how far a block was from making a profit, almost like the drawn concept for Pieter in Figure 16.

More work needed to be done on the owner and foreman's perspectives, although it was clear that they would accept such technology if everyone in the 'value chain' contributed. It was difficult to convince them through a projection that the concept would be effective, as their biggest concern was the time it would take to insert information for such a system to work effectively enough to benefit them.

In the last workshop I clarified Pieter's concern about the example I used when Samuel reported that he used a full tank. In this specific example the calibration was set to 250 liter per hectare, and that block 17 and 18 together, would use one full tank. I only used this combination in the example for simplicity. However it was a valuable point to consider reporting the amount of the tank used. I thought if Samuel reported on the workshop board, he would maybe have the choice of saying that only part of the block was finished instead of reporting part of the tank was used. But in hindsight, the program would be able to know actually according to the calibration and the block sizes, how much tanks were needed for each block/or how much liters. Then the map in the workshop could show/represent tanks with percentages/pictures of filled tanks or show liters if the tractor had a water gauge in the tank. This estimation could then be used as a guideline to show Samuel how much he needed to spray on the block. Then he could also use this guideline as a way to check his calibration or if something else was wrong. This way the sensor/meter in the tank did not have to 'talk'/connect to the VC, because the VC already knew the estimation, but this way you brought back the human element, by using experience and not automating it. So if Samuel sprayed block 5, the picture would show him how much of a tank he was using and if he was spraying drastically more or less, then he would know immediately if the calibration was out. It was not about controlling Samuel, it was about giving Samuel control. It was about knowledge that can empower the workers and make them more engaged rather than just being a 'cog in the wheel'.

4 RESEARCH OUTCOME

4.1 REFLECTION

I wanted to do a project which was a challenge to me and what a challenge it was. Not only was the farm a physically big environment for one person to study, but also working with more than one user, with a different design outcome for each user, was something new to me.

4.1.1 ANSWERS TO THE RESEARCH SUB-QUESTIONS

1. What characterizes operation at a wine estate?

There seems to be a lot of tradition regarding methods of activities on the farm. Goede Hoop estate is not a commercially owned farm and the amount of money available for the newest technologies is limited. Therefore they mostly rely on the human factor within work tasks. It is a big environment with few people working there. Albert the winemaker have worked there for a longer period of time, while Altus the farm manager is relatively new and still needs to find his feet. On the estate they grow their own grapes which they then sell locally to wineries or they export wine in bulk. They also use some of their own grapes to make and bottle seven varieties of their own wines in the cellar located on the farm. At the time of the study (Late August to early December) they were busiest preparing the vineyard for harvest and it was quiet in the cellar.

2. What were the work practices on a wine estate?

A brief summary follows, of the various work practices Altus and the people he managed were involved in. It was discovered that the main groupings of activities were Irrigation, Pruning and Spraying of the vineyards. Of what was observed at the time, Altus fully managed and did all activities himself regarding Irrigation. He managed/guided and worked together with two Pruning teams. He planned and calculated information needed for Spraying activities and managed three tractor operators. For all the activities he kept record, got quotations and bought resources.

Samuel the foreman played an important part as the group leader for the women. Samuel is also one of the tractor operators and he takes this responsibility very seriously to effectively spray the vineyards with chemicals to prevent decease or pest outbreaks. Pieter the owner played a more subtle role and was not that involved in the daily activities in the field. He did more office related work. Sometimes Altus and Pieter would discuss and plan activities together, mainly influenced by the amount of money available. Samuel and Altus would discuss and plan time management strategies regarding activities relating to the vineyards.

One reason that Altus became the main focus of this study could be because he was in the centre of all the activities the time of year the research began. He was the person that needed to deal with the other workers, the owner/boss and external people for example the chemical reps. This made him the ‘primary’ stakeholder, who’s work practice could be supported through ICT involving co-operation with other work roles.

3. What design openings could be found from studying the work practice?

The first design opening was to design for 'one' perspective or for similar perspectives. I could have designed one device to support a single task done by all the stakeholders for example, a general reporting device or smart safety clothes worn by all. They would all use the product for the same reasons with no organizational level differences.

The second design opening was for design to involve multiple perspectives. There was a need to design a ICT system to support cooperation and planning across multiple and individual tasking. The Spray Process was the perfect 'vehicle' for such a project.

4. How can one explore solutions regarding valuable and meaningful issues, involving the stakeholders?

By letting the user act with a projection of the first idea encouraged involvement. It helped to bring the concept more to 'life' and the user could deliver valuable feedback from his/her perspective.

By 'Playing' with paper, one can level the understanding between the designer and stakeholder. It helps to work with something familiar to both parties. Paper is a versatile medium for either showing and working with ideas still open for interpretation, or paper can represent a fully developed idea. Firstly sticky notes and other paper cutouts were used for pinpointing calculations and layouts of the VC. This was a critical stage in the design to establish acceptable Input and Output results with the user. More 'concrete' ideas were presented on Paper Screens and used for changing finer details and was used for layout confirmation.

5. How could the concept change or let people adapt their daily activities in the context?

Not only did the VC design simulation help to save time, money, improved efficiency/accuracy by calculating complicated information, or allowed the reporting activity to 'become' the record keeping in one step, but it did it without using sensors and complete automation to control human input, rather the design gave the control to the people using the design. It actively involved more employees, creating learning opportunities across the different organizational levels. The expandability/adaptability of the VC concept could be applied to and used regarding all the activities on the farm, for successful engagement, planning and cooperation across all stakeholder perspective roles.

4.1.2 SUMMARY OF THESIS/ METHODS AND OUTCOMES

I started this project with the goal to explore ICT solutions which could support work practices on a small wine estate. On the quest to find design openings for supportive technology a few sub questions divided the work tasks and objectives. Firstly I set out to explore the characteristics of the operation on a wine estate. I became familiar with the context of the farm through conducting unstructured interviews and observing the general environment. By combining the methods with video it allowed me to understand and gave me an overview of the place. The goal of the 'pre-study' was to establish the current activities they were busy with on

the farm regarding the time of year. Through situated interviews, Altus, the farm manager and Albert, the winemaker showed me their environment and explained what they did. These interviews were unstructured and open to whatever caught my attention. This gave a good idea of which activities they were busy with at that time of year and it established that they were not using supportive information technology, only spreadsheets. Regarding the time of year and activities the focus shifted to Altus the farm manager, who didn't even had a computer in his office. Short video clips were produced of both the winemaker and the farm manager to get a feel for the environment they worked in. A map of the farm was produced to see and understand the environment and be able to place were activities happen.

After I established which activities were taken place at that time, with the focus on the farm manager, the next step was to gather video material regarding main activity groups of Irrigation, Pruning and Spraying of the vineyards. Analyzing this video footage of the ethnography study resulted in developing Video clips that were grouped into themes showing an overview of the practice. Other video clips were also specifically used for a workshop with video cards, showing activities around Irrigation and Spraying. A video portrait was made of Altus the farm manager to show his personality and work style, to be used for better understanding the stakeholder to design for and extras like a video collage and short video story was later used to contribute to the design opening. The collage included different clips of the recurring use of the farm map and the short video story showed the complexity behind calculations for calibrating. To find design openings in all this video material based on the work practices, it was used as a tool in the workshops.

The first two workshops were done to establish design openings by involving the stakeholders. In the first workshop issues regarding the work practice were discovered by involving the three stakeholders in annotated video cards. In the second workshop we used the cards to complete a story line of the spray scenario. It was discovered that the design needed to accommodate the three different perspectives within the design direction, with the focus on the spray scenario. By combining the perspectives each with valuable and meaningful issues regarding their role in the spray scenario with the video cards, it was used as a basis to explore design solutions in the following three workshops.

Using the combined perspective line representing the spray scenario, first concepts for each step were presented for the third workshop. Concepts aimed to support work and cooperation between and across stakeholder roles. The stronger two concepts were discussed more in detail regarding usefulness, if it was really needed, would it make the work easier and its value. These two concepts were a reporting device and a visual calculator. By involving the farm manager to act with a projection of the concept, the outcome of the workshop was to develop the visual calculator in the forth and fifth workshops. Instead of using projections to communicate and develop further VC ideas, paper was used as a tool to pinpoint calculations needed for the concept to work.

By presenting the final idea of the developed VC in a feedback workshop, the stakeholders acted as experts in their field, highlighting the value of the concept, its meaning and how it could support their working practice with the spray scenario and applying it to other work regarding the rest of the seasons. This last workshop helped to realize small changes to the Visual Calculator, potential bigger changes and the need to explore more detail involving the other two perspectives to develop the VC according to their input/responsibility. However the farm manager's side could be considered complete.

4.1.3 CONTRIBUTION OF RESEARCH

4.1.3a Design For Participation

The Visual Calculator design, bridges across stakeholder perspectives. It was designed to be used and understood by all the workers on the farm. It is an artifact that encourages communication and cooperation in ‘overlapping’ work tasks between the stakeholders. The VC caters for different perspectives throughout the value chain of the work practice. The design makes it easy for each stakeholder’s perspective to easily make sense of information in their activity, for example the owner can easily see if he is making a profit.

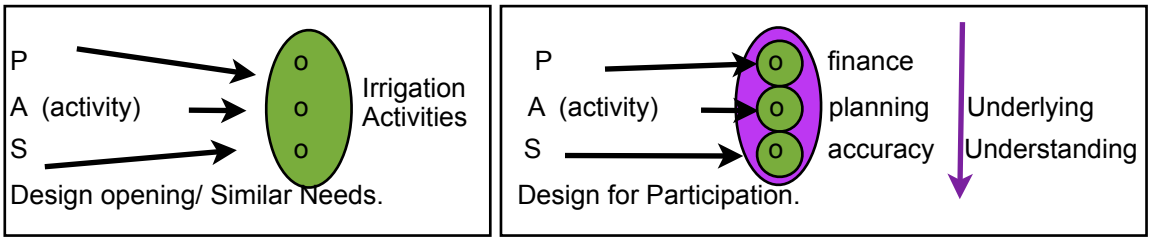
The VC makes all workers aware of reasoning and planning of activities. It especially empowers the workers doing the practical work. Visuals engages them, creating a learning opportunity to be able to understand context and more levels of the practice, including their own, without the need to have knowledge/skills for reading and understanding complicated information such as spreadsheets and tables. Imagine Samuel and his team gathers in front of the VC workshop screen in the morning. He can point to the map and explain what the current situation is regarding work done and work that needs to happen. Through these changing colour visuals he can explain the priority of tasks, or why it is important to work longer hours that day. This would help them understand the context, the importance of their work and be proud of the part they play on the farm.

4.1.3b Identifying Design Openings

By using annotated video cards of the three different stakeholders, one could compare and combine perspective differences and shared understandings. By comparing the content ‘overlap’ of the cards and visually indicating it in several layouts (Fig. 6), it might indicate a strong common concern where all the cards ‘overlap’ and other layouts might also indicate work activities where there was an underlying understanding (Claassen & Messeter, 2012). However, when the perspective cards were together (Fig.9), it seems that you could design one device to be used by all three stakeholders, sharing the same work responsibilities in an activity (in this case activities in irrigation). When they are doing the same activity, they are not separated by organizational levels, it is safe to say that it could indicate a shared need and use, which can be designed for resulting in one product.

If the cards were apart, (Fig.7) the design should be different to each set of skills the stakeholders had and the different roles they need to play in the system. The design should

consider each user separately for the different ‘screens/interfaces’ involved. Each users’ knowledge is different, for example Pieter/owner - finance, Altus/manager - planning, and Samuel/foreman - accuracy. However if the design needed to have the separate screens for each stakeholder (for example the VC), there needed to be, or the design should create an underlying understanding (or in other words everybody involved should have an understanding across the multiple work roles) for the work practice/design to work. The underlying understanding should be ‘simple’ for everyone to grasp and pull through to what they were doing, so ‘overlapping’ of information should be shown on each user ‘screen’. Info graphics were an easy way to view complex information, this could then be explored as a way to carry over the underlying understanding within cooperation activities in a work practice.



Underlying understanding = info graphic = farm map and symbols.

4.3.1c Problem Solving and Conceptualizing by Utilizing User’s Strengths

The use of the combined ‘storyline’ by using the annotated video cards, have proven fruitful to develop design work in the project. Not only was it a chronological representation of the spraying process, but it helped one to see where the work tasks of the stakeholders intersected (Claassen & Messeter, 2012). Because the participants were not designers, I suggested ways of using the combined ‘storyline’ as a method to help with solving problems and conceptualizing with the stakeholders. This however relied on the user’s strength, which in this case were that they were good at solving problems with minimal resources in their daily activities as farm workers. An example of this in the thesis was the ‘paper run‘ workshop held with Altus, where we knew what the VC’s output should be, and from there solved the calculation problems to reach the goal. By using the ‘storyline’ as a tool to derive concepts from, by involving the stakeholders, one could ask them to either write down possible problems for each step in the process or used it as a provoking tool. We could have just asked them to write down problems that could occur in each step of the process, but again doing it separately from every stakeholder perspective.

By getting stakeholders involved in creating concepts, an idea that emerged was the possibly to provoke users by deliberately leaving out parts of the ‘storyline’. Users could then be asked how they would solve the problem. For example in the case of the spray scenario, leave out the video card where they communicate over the radio. Now they can imagine/conceptualize how they could communicate without being able to talk over the radio. Leaving out a ‘step’ is part of a ‘Escape Provocation’. By choosing something that is taken for granted in a situation and ‘escaping’ from the given by removing it, encourages one to solve the problem creatively (De Bono, 2002). Escape Provocations to Stepping Stone Provocations could be looked at and the

'storyline' used to visually represent it to the participants not used to De Bono's methods. This way of provoking could made them part of conceptualizing by utilizing what they were naturally good at. Their nature of problem solving also reflected in the way they described problems or scenarios to me, by asking questions and then explaining the actions. Overall one had to be flexible in workshops, plan beforehand but be able to adapt the plan to the stakeholder's nature/ characteristics.

4.1.4 CONCLUSION

Although not fully explored with a working prototype, the users confirmed that the Visual Calculator concept would be supportive to them in their work practice and cooperation. By referring back to the introduction, I concluded with similar points as in previous research. For such a system to support the work on a farm, and for the farm to adopt it successfully, everyone in the value chain/line should use it. The work load would be lightened by dividing insertion of information (making it easier to insert information), dividing responsibilities (pride and understanding of work, instead of just following orders) and what was 'past tense' would be automatically recorded after human reporting - reporting acting as a clearance/confirmation/ checked (to avoid duplicate work, doing and inserting done information). Only needed information for planning the future was important and all the information should be available immediately to everyone involved.

The Visual calculator concept can be applied to different goals considering different work activities throughout the year on the farm. It supported management in accurate calculations improving efficiency. The concept was designed to be used across three different organizational levels, although more prototype testing needs to be done to make sure all participants within the line would be able to use it. The amount of effort that is put into, vs the result outcome, determines the VC's value to its users. It was difficult to judge with a concept only, and it would need to be a working model for the users to accept fully/or develop to the desired need. The VC concept focused on its usability regarding the user interfaces. Information of such a system should be relevant to the user on the current day, it should be accurate enough for the user to trust and rely on, it should be comprehensive calculation of all reported information and it should be timeless regarding record keeping.

By researching and incorporating responsibilities and an understanding of how the whole farm worked in the design, the value and importance of each step could be realized. The humans were the primary actors in the system, above sensor input. The design should support collaboration, which linked back to shared responsibilities. It is critical for all the people in the production chain to be aware of the importance of precision in which activities should take in order to save money. Accuracy becomes vital to help minimize costly mistakes. The VC supports calculation steps followed by steps fully dependent on the accuracy of the calculations. The design could help with saving time and money, to use resources sparingly, to help with work accuracy and put the human actor's values and goals in the center of such a system.

Using the themes Burrell, Brook and Beckwith (2003) mentioned and applying my research outcome to it, correlates with their findings. Their themes are ‘Actionable Data’, ‘Allowing Technology to Change Practices While Continuing to Support Existing Practices’ and ‘Human Touch points into Ubiquitous Systems’. Looking at ‘Actionable Data’ the users would know where to spray, what to spray, what to buy and how much to buy or spray. Looking at ‘Allowing Technology to Change Practices While Continuing to Support Existing Practices’, by using the VC you calculated differently, divide responsibilities and workload, but the underlying understanding of the activity principles stayed the same. Looking at ‘Human Touch points into Ubiquitous Systems’, the VC supported three different perspectives in several different areas on the farm. It seemed that it would be difficult not to use wireless technology for any concept in a farming context, although if it was used, it should be to keep relevant communication and information between stakeholders up to date.

Although no device has been decided on for the concept, it might have to be mobile device (field observing, tractor use, benefit of use at home, Altus’s different transport on the farm, office, workshop, store room). Wearables are openings for future concepts, also wearable safety clothes for mixing and spraying could be valuable. Maybe mobile technology could have another meaning (not only mobile device changing location), but mobility in the way the system could be adapted to different farms or the way it could be used should be more open (user can create new ways of use/output). Mobile technology should become malleable technology, where if the VC is an application, it should be relevant to the user within different situations.

Perspectives in participatory design are nothing new, but the way I used it to manage and work with stakeholders is something new. Brandt and Grunnet (2000) suggested for a designer to become aware on a physical level, of user perspective, they can mimic ‘frozen shots’ out of a work situation. Although I did not do this specifically, I used video cards instead to highlight the differences in user perspectives between organisational levels. Not only did I became aware of the different perspectives, but by using the annotated video cards in several workshops I gained a deeper understanding of the work practice and participants which I designed for accordingly. Brandt and Grunnet also suggested by bringing props or tools to workshops helped both the designer and user to think and talk around concrete things, more easily bringing understanding to both parties. Props in simple abstract generic forms can be used to generate ideas from the user’s side and to let them comment on shapes and sizes they preferred. The first concept projection of the VC can be seen as a simple generic representation of the VC. This helped to engage the user by actively commenting on it. Later on in the design process it was valuable to the user to illustrate concepts of interfaces with more details, (the VC ‘props’ had more details) because this was what the user would interact with most when the product was finished, although “inside” components are not necessarily known at this stage.

Mentioned in Designing with Video (Buur & Ylirisku, 2007), the video card game often times results in surprising perspectives on the video material, bringing to light issues to explore further of the design. Although I used video cards, I did not use it in the game form and also not just as

a way to analyse the video, but as a way to work with the users and their different perspectives in the workshops.

There is definitely scope for improving this project, but time was very short and it would have been great to explore the rest of my findings and the rest of the year's activities on the farm. It is necessary to also explore more 'concrete' methods of involving illiterate stakeholders, instead of just having conversations. It helps to give them things they were familiar with and good with, for example the black board they used could represent or 'translate' to a touch screen, paper calculations and notes 'translate' to an electronic application and a paper notebook to an electronic notebook.

This research project was different from the other research projects done on wine farms considering ICT solutions. I explored where they needed support and what technology could support them, instead of applying a technology from the beginning of the project. My project involved the users throughout the design process, instead of only researching what they did and my project included all stakeholders in the end design, instead of having only one design for one user.

The knowledge contribution of this project would have to be the 'Perspective method' (mentioned in Contribution of research) and the way the thesis was done by combining the video and the Prezi's. The video used, brought to life the research done instead of only presenting text. Video may carry over a 'feel' and understanding to the viewer, which the writer could not always put into words. The Prezi's helped to make the work I have done more tangible for the reader. In the case of the video cards, it would have been unreadable and difficult to understand by only looking at a small static figure. The Prezi's overcome the boundaries of space, size and legibility in a thesis. Anyone who attempts to involve several people in their project with more than one language should plan carefully and smartly, because this could easily influence your project results. It is time consuming to translate workshop materials between languages and for a South African context there is definitely an opening to research ways to facilitate such a difficulty. For the research contribution the thesis have a lot of farm knowledge on the farm manger's side, together with the concept to visual calculating, plan and manage activities.

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*All photos/figures, videos, Prezis and illustrations not referenced was done/created by me. In possession of Hester Claassen. Cape Town.

4.3 FIGURE LIST

4.4 PHOTO LIST

4.5 VIDE0 LIST

4.6 PREZI LIST

4.7 APPENDIX:CLARIFICATION OF TERMS

ET: Embedded technology, embedded technology on a wine farm would be technology that form part of a complete device in the surroundings. It is used in embedded applications including digital consumer products, automotive and wireless/ubiquitous computing.

E-paper: Electronic paper or electronic ink are a range of display technology which are designed to mimic the appearance of ordinary paper. It reflects ambient light and this is why it can be read in bright sunlight.

Estate: An extensive area of land in the country, usually with a large house, owned by one person or organisation. A property where crops are cultivated.

IPW: 'IPW is a voluntary environmental sustainability scheme established by the South African wine industry in 1998.'

IT: Information technology is the acquisition, processing, storage and dissemination of vocal, pictorial, textual and numerical information by microelectronics based on the combination of computing and telecommunications. In short IT is the use of computers and software to manage information.

Mobile technology: This is a collective term used to describe the various types of cellular communication technology.

PDA: Personal digital assistant: A palmtop computer used to store information such as addresses and telephone numbers, and for simple word processing and spread sheeting.

Precision Agriculture: Also precision farming, is management concept based on observing and responding to intra-field variations. It relies on new technologies such satellite imagery and information technology. It is also aided by farmers' ability to locate their precise position in the field using satellite positioning systems.

Precision Viticulture: Precision farming applied to optimise vineyard performance, in particular maximising grape yield and quality while minimising environmental impacts and risk.

RFID: Radio frequency identification, denoting technologies that use radio waves to identify people or objects carrying encoded microchips.

Viticulture: The cultivation of grapevines.

ZigBee: Is a specific short-range wireless data transfer technology used for personal area networks. ZigBee is targeted at radio frequency application that require a low data rate, long battery life and secure networking.

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