Deliverable D4.6: Main Barriers and Solutions found on the DSS application

WP	4	Demonstration	
Task	4.6	Main Barriers and solutions found on DSS application	
Dissemination level[1]	PU	**Due delivery date**	11/31/2019
Nature[2]	R	**Actual delivery date**	

Lead beneficiary	IRTA
Contributing beneficiaries	LINKS

Version	1
Total number of pages	27

[1] Dissemination level: **PU** = Public, **PP** = Restricted to other programme participants (including the JU), **RE** = Restricted to a group specified by the consortium, **CO** = Confidential, only for members of the consortium

[2] Nature of the deliverable: **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

Version history

Document Version	Date	Author	Comments[3]
0.1	11-24-19	Omar García Tejera (IRTA)	Main structure
0.2	11-25-19	Quynh Nhu Nguyen (LINKS)	Section 3 Result of survey evaluation
0.3	11-29-19	Omar Garcia Tejera (IRTA)	Section 5 and review of the document
0.4	11-30-19	Omar Garcia Tejera (IRTA)	Final version
1.0	23-12-19	Josep Maria Solé (MET)	Revision of Final version

Deliverable abstract

The objective of the present deliverable is providing a first report on the main constrains encountered after the first year of DSS application. The analysis presented here corresponds to the results based on surveys delivered to the end-users. Such analysis is qualitative, given the small number of end-users involved in the project. On the other hand, a one-to-one interview was maintained between DSS developers and end-users to discuss survey's results. The result of this interview is complementary to the survey and gives context to the analysis performed. Finally, it is worth remembering, that the results presented here should be taken as preliminary, and will be extended in the by the end of the project.

[3] Creation, modification, final version for evaluation, revised version following evaluation, final.

Contents

List of Figures

List of Tables

1. Document objectives

The present deliverable focuses on the basic requirements of the DSS and the feedback collected from the end-users during the 2019 growing season. The feedback resulted from a detailed survey focused mainly on the usability of the tool passed to the end-users involved in the project.

On the other hand, a description of the basic requirements of the DSS is provided. The requirements presented in the corresponding session, are the minimum needs for the DSS to run properly and provide all the services. Along with the requirement description, there is a comment on some of the critical aspects related to the DSS necessities.

2. Survey structure

To evaluate the VISCA DSS we provided a beta version of the system to the end-users to be used in their real daily activities, starting from June 2019. After the harvest season, in November 2019, we distributed an online survey to collect their overall feedbacks. The survey was made by an introductory part that aims at collecting a high-level understanding of the way end-users used the system (e.g. frequency, most favourite, and frustrating aspects), followed by a section dedicated to the specific functionalities. The first part has been built integrating the System Usability Scale (SUS) to evaluate the usability together with ad hoc questions about the dimensions of attractiveness and willingness to recommend the proposed solution. Below the SUS scale and sets of questions are described more in detail.

System Usability Scale. The SUS (Brooke, 1996) is a standardized form that collects the evaluation of the participants soon after having experienced the system. The SUS works well for easiness and it is applicable at different stages of maturity of the solutions, regardless of whether the user is looking at a design wireframe or implementation (Muddimer, 2012). It consists of 10 items to be evaluated on five degrees of agreement, from 'Strong agree to 'Strong disagree'. Results provide an overall evaluation expressed in a score ranging from 0-100. The SUS score is not as percentages but should be considered only in terms of their percentile ranking on the population. Based on the literature, a SUS score above 68 would be considered above average and anything below 68 is below average. The SUS items are:

1. Intent: "I think that I would like to use this system frequently."
2. Complexity: "I found the system unnecessarily complex."
3. Easy to use: "I thought the system was easy to use."
4. Support: "I think that I would need the support of a technical person to be able to use this system."

5. Integration: “I found the various functions in this system were well integrated.”
6. Inconsistency: “I thought there was too much inconsistency in this system.”
7. Desirability: “I would imagine that most people would learn to use this system very quickly.”
8. Cumbersome: “I found the system very cumbersome to use.”
9. Confidence: “I felt very confident using the system.”
10. Learning: “I needed to learn a lot of things before I could get going with this system.”

The sus score can provide information on how users perceived the application’s usability, but it doesn’t tell about what is unusable or what to fix in order to improve the experience. The SUS in fact help in tracking the overall experience of the user while using the system.

Ad hoc questions.

Recommendability: to assess the recommendable level of the VISCA DSS we asked end-users to answer the following question on a 1-10 points rating: "How likely would you recommend this system to a friend or colleague?” and calculated the average score. This value is useful to get a synthetic opinion on the perceived maturity, even if at a very early stage, to be considered as a baseline for future assessments.

Attractiveness: to gather feedback on the interface appreciation, the following questions about the attractiveness, worthiness and novelty dimensions have been added, asking the end-users to rate them on a 1-5 points scale:

- Interface attractiveness: “The VISCA DSS front-end user interface is attractive.”
- System worthiness: “The VISCA system is worthwhile.”
- System novelty: “The VISCA system represents a novelty in this domain.”

Questions per functionality sections. Finally, the survey has been organized in sections covering diverse aspects of each functionality (Table 1-1), regarding interface (layout, the organization in the space), understandability (quantity and quality of information) and easiness to accomplish a task. These questions are formulated on a 5 options scale and for any answer below 3, we asked for a comment to explain the score and better pinpoint the reason behind the user feedback.

Table 1-1: Survey sections per functionalities

#	SURVEY SECTIONS PER FUNCTIONALITIES
1	VISCA DSS overall evaluation
2	VISCA DSS
3	VISCA DSS for daily work
4	Dashboard
5	Dashboard > parcel

6	Dashboard > phenology monitoring
7	Dashboard > irrigation monitoring
8	Dashboard > weather station
9	Dashboard > weather forecasts data > general
9	Dashboard > weather forecasts > seasonal
10	Map view
11	Navigation
12	Parcel Detail
13	Irrigation Block Detail
14	VISCA Models
15	Upload data
16	Help
17	About you

3. Results of survey evaluation

In total, the surveys involved 3 end-users from the three demo sites (Italy, Spain, Portugal), including vineyard managers and R&D viticulture profiles.

The sample composition is heterogeneous per gender (33% female, 67% male) and age (33% of people aged 25-35, 67% for the group 36-55).

Due to the small number of respondents, the results of this survey will provide qualitative insights, but cannot generate statistical outputs as it would require a larger sample size (typically at least 20-30 users).

3.1. Overall SUS and ad hoc scales evaluation

System Usability Scale. The average SUS for VISCA DSS is **47.5** (Table 1-2) which is below the average 68. Considering this is the first season of usage of VISCA DSS we expect this value to increase. The SUS is in fact determined by several factors, including the level of experience-a-priori of the tested system, which generally results in an increase of SUS between 6% -15% (Muddimmer et al., 2012). This average value can be a base to compare future iterations.

Table 1-2: SUS VISCA DSS overall

SUS	APP MEAN
Min	42.5
Max	50

Average	47.5

Looking at the single scales (Table 1-3) we can have some more indication. The Intent is the item that scored the highest (2.7) indicating the will to use the system but there is no confidence in using it since the Confidence item scored the lowest (1.3). The main reason can be researched in the perceived Complexity of the system which scored the second-highest value (2.4). In general, the end-users need more integration between parts and an onboarding period of time to learn the VISCA DSS.

Table 1-3: SUS average per item

SUS ITEM	APP MEAN
1 intention to use	**2.7**
2 complexity	2.4
3 easy to use	1.7
4 need for support	2
5 integration	1.5
6 inconsistency	2
7 desirability	1.7
8 cumbersome use	2
9 confidence	1.3
10 learning	1.7

Recommendability. The average value is 6 (Table 1-4: recommendability score values, on a 1-10 scale, indicating the system is sufficient but there is room to increase the adoption, confirming the findings of the SUS.

Table 1-4: recommendability score values

RESPONDENT	SCORE
Responder 1	7
Responder 2	5
Responder 3	6
Average	**6**

Ad hoc scales. The aspects of attractiveness, worthiness, as well novelty have been highly appreciated (evaluated on a 1-5 points scale, Table 1-5) showing that the VISCA DSS is desired and seen positively, despite the overall experience is still not optimal.

Table 1-5: Attractiveness scales-app

AD HOC ITEM	APP MEAN
Attractiveness	3,3

Worthiness	3,7
Novelty	3,3

3.2. Functional evaluation of VISCA DSS

The respondents' profiles involved 2 vineyard managers and 1 R&D on viticulture, where the formers already had some experience with another DSS system. VISCA DSS looks to them familiar (Figure 1) and they would use it on a daily basis, spending between 10 and 30 minutes or less than 10 minutes (Figure 2). In this scenario, the system should be able to provide a quick understanding of data, in order to support their decision-making process when planning field activities. The Weather Forecast data, in particular, raised a lot of interest as the management indicated them to be the most important but also missing data, at present, when it comes to planning future activities. The possibility to make them available and integrated into the daily operational decisions would be very helpful.

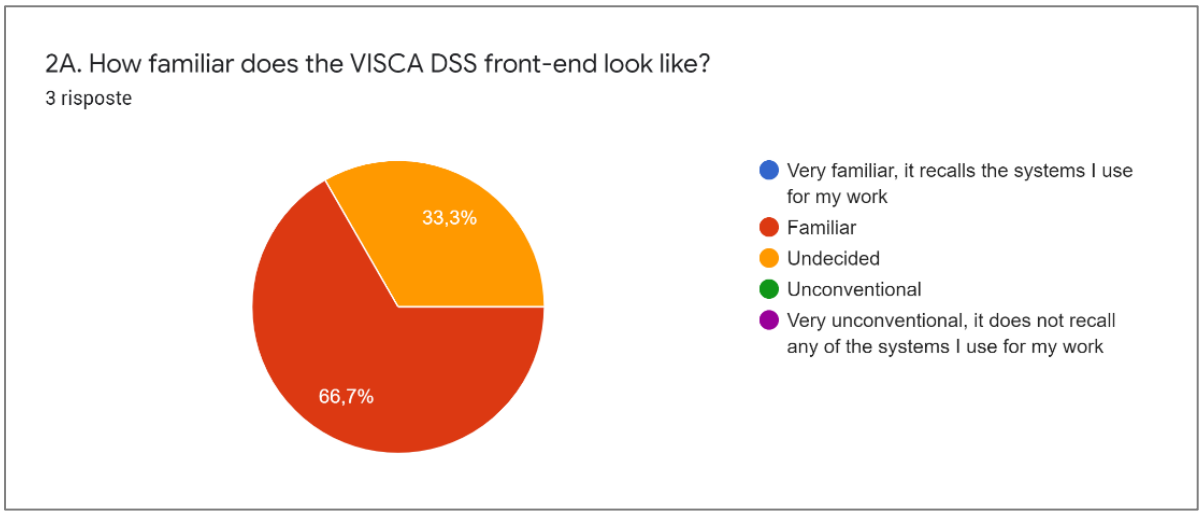

Figure 1: VISCA DSS familiarity with other front-ends

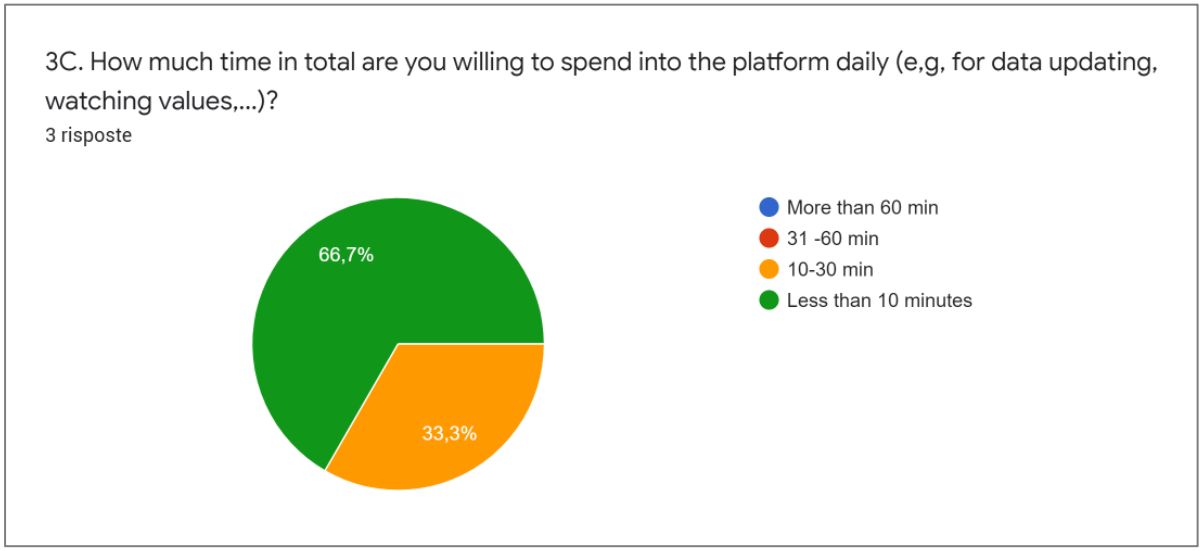

Figure 2: daily amount of time the end-users are willing to spend on VISCA DSS

The overall system registered high intent to use and it is attractive, especially the Dashboard. Still, there is a general perception of complexity about the presented data and the usage, due to lack of knowledge about how the data themselves have been generated, but above all end-users would like more indications about how to interpret them. End-users also asked for more possibilities to interact with data, especially when presented as graphs or on the map in order to make more direct selection and exploration. About the 'learnability' of the system, at this moment they do not feel confident in using it but at the same time, they judged the User Guide section quite exhaustive, meaning they would prefer a self-explaining system when using the functionalities, rather than read the User Guide.

In the following paragraphs are described the results on the functionalities, divided in '1st Level' for the contents displayed in the dashboard screen and '2nd Level' for the remaining contents.

1st Level contents

Dashboard overall. The *Dashboard* is the first view that appears after the login. End-users found the quantity of data provided to be very exhaustive and displayed in a logical layout.

Vineyard selection. To select vineyard results it is not easy and they suggested implementing more interactions with the map.

Phenology monitoring. The Phenology data are placed in the upper section of the dashboard and comprehends three groups of data: *Achieved Phases, Upcoming Phases, Predicted Weeks*. The 'Achieved Phases' are the easiest to understand by the whole group of responders while some uncertainty was expressed about the 'Upcoming Phases' and the 'Predicted Weeks'. Since one

responder declared them 'very clear' this suggests that it depends on the level of familiarity with the type of data more than visual representation.

Irrigation monitoring. The Irrigation monitoring functionalities resulted overall weak and they should be improved; concerns were raised both on the selection procedures and the data understandability. Specific aspects are detailed below.

To *select an irrigation block* it is nor easy nor difficult, the sample is undecided on this task. Since it has the same structure as the vineyard selection, it can be improved similarly by implementing more interactions with the map.

The *Calendar Widget* is 'very useful' for one responder while for the other two it is 'not very useful'. One comment from a responder can explain that: "It would be useful if it was linked to data visualization: give access to past data selecting weeks from the past." This functionality is already provided by the time-window selector but the end-user would like the Calendar Widget to work as selector too for dynamic queries.

The information provided by the *Irrigation Box* is sufficient in quantity but judged poor in quality, especially when there are no data visualized (e.g. achieved irrigation bar, predicted irrigation bar or both). For the end-user is confusing not to see any bar on a week and this means we need to provide more understanding of how the system works, in this case, that the irrigation charts depend on the irrigation data uploaded and it is possible to have empty bars (e.g. with a tooltip).

Weather Station. The Weather Station module, compared to the Irrigation Box, is much richer in data and selectors, it has diverse filter options and it allows the user to consult past data about different measures, from the available weather stations. We asked the end-users to match the User Interface (UI) elements to the proper description to verify if the functionalities were clear. This exercise was accomplished very successfully, nevertheless, two end-users over three judged the *Weather Station Box* difficult to use for two reasons: **lacks knowledge about some data parameters and complexity to have easy and quick information**. The third responder instead, found the Weather Station Box overall easy to use. This means that VISCA DSS should take into account that end-users can have different levels of knowledge of the data provided and the system should enable anyone to understand and use the data. To improve this aspect, the VISCA DSS could integrate into the User Guide a future section about Data types with descriptions and information on how to interpret them for daily operations. Then specific tooltips and recalls across the VISCA DSS can be linked to this section. The other need that emerged was to make the data consultation more straightforward, suggesting that future implementations could automatically help the end-user to spot relevant situations (alter triggering) instead of manually check the values.

Weather Forecasts. Weather forecast data includes three types: *short-term, medium-term, seasonal.* During this year they have been checked with different frequency by the responders, from

occasionally (once a month) to weekly (Figure 3). The Medium-term forecasts have been checked the most, for forecast comparisons and develop week's activities, followed by the Seasonal forecasts (Figure 4).

Overall*, the Medium Forecasts resulted in the most understandable* and since they were the most checked during this year, this is a positive result. The Seasonal Forecasts have potential from the vineyard management perspective but still, need of support as end-user does not know how to practically integrate them in their decision making process.

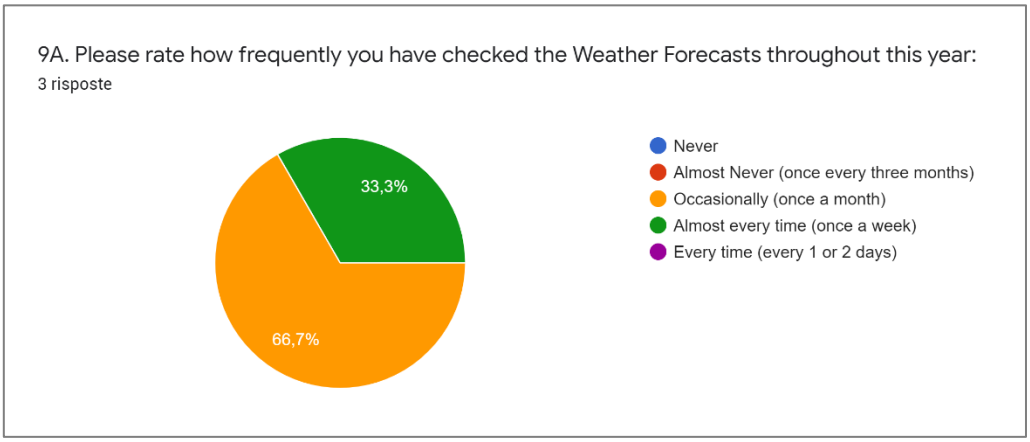

Figure 3: Weather Forecasts' check frequency

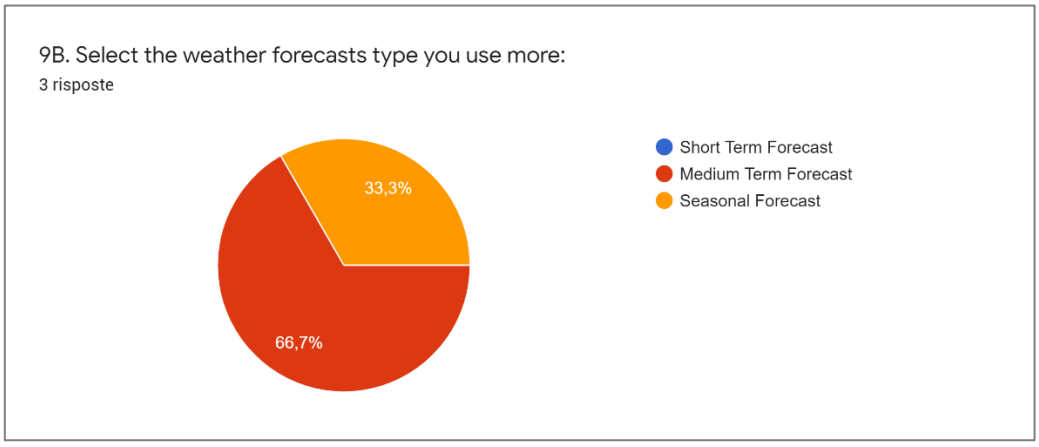

Figure 4: most used type of Weather Forecasts

The evaluation per type is detailed below.

- ***Short-term:*** the Summary is quite good while the graph readability (of a single measure) should be improved. The responses are in fact not homogeneous and go from 'easy' to 'complex'.

- ***Medium-term:*** both the Summary and the graph received very positive judgment, especially regarding the quantity of information provided which was evaluated very exhaustive.
- ***Seasonal:*** the Seasonal forecasts are not very familiar to the end-users (Figure 5), they 'never' or 'almost never' used similar information (Figure 6) because they do not know how to deal with probabilities ("Problems to deal with probabilities to make decisions") or on the contrary because they do not have a system to evaluate bad decisions based on Seasonal Forecasts (Figure 7). Even if not very used, they all agreed that Seasonal forecasts could be very helpful to plan viticulture operations in the field such as for leaf removal ("For long term planning.", "Very helpful for the management of the viticulture operations in the field", "Planning many vineyard actions"). Regarding the Summary and the Graph, the Summary resulted well for the majority of responders as well as the Graph, which was judged in general exhaustive in terms of the quantity of data provided. Just for one end-user, they miss information about trends that could improve the fruition of these data.

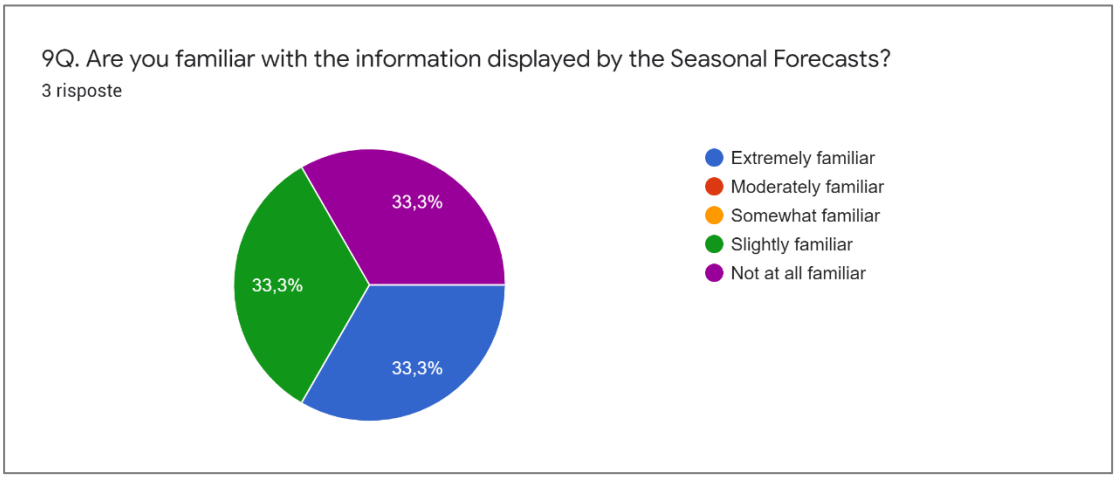

Figure 5: familiarity with Seasonal Forecasts data

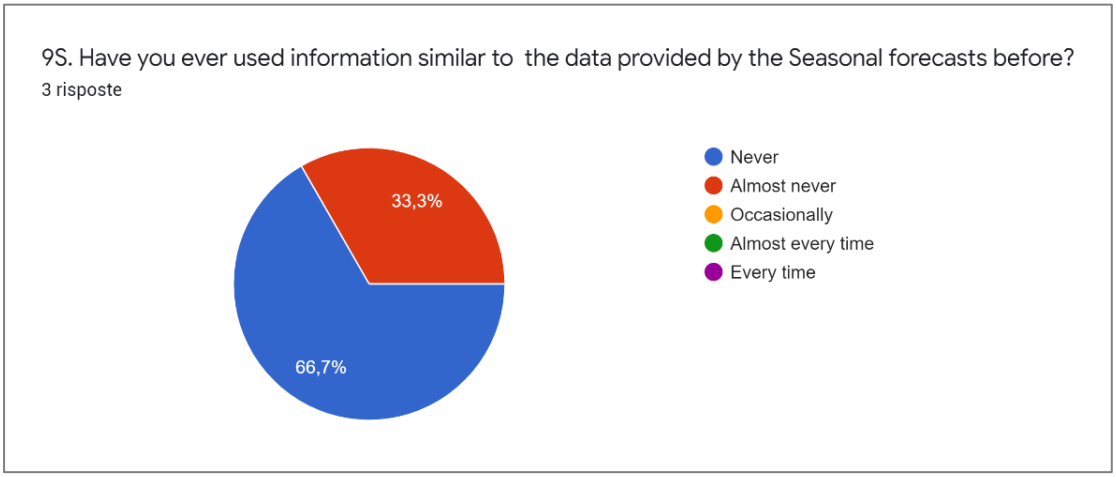

Figure 6: previous frequency of use of Seasonal Forecasts data

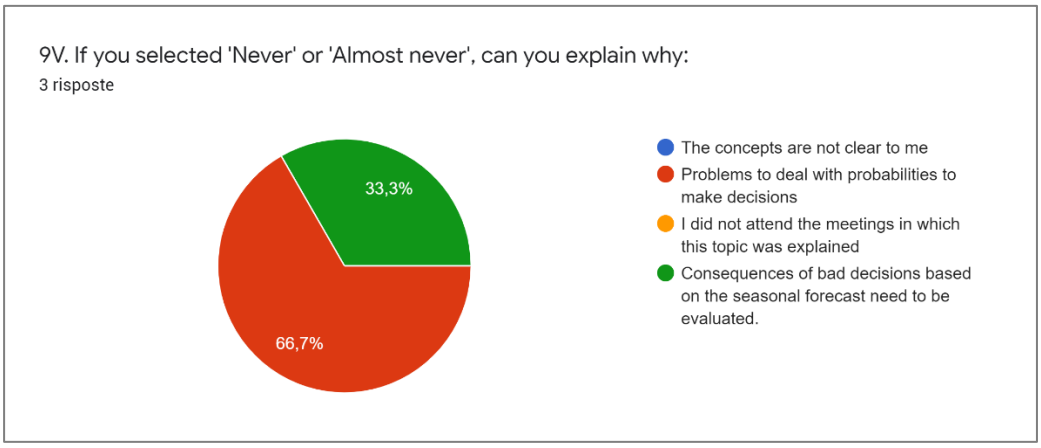

Figure 7: an explanation for 'never' or 'almost never' use of Seasonal Forecasts

2nd Level contents

Navigation. In general, the side menu has clear labels in relation to the linked functions, such as: 'Map', 'Irrigation Details', 'Parcel Details'. Only 'Editing' should be changed because it leads to the 'Profile Company' description and it is mismatched.

Map View. The Map view allows consulting data layers and their progression over time. End-users found this functionality difficult to use and the majority expressed indecisiveness about their final opinion (Figure 8). Both the visual and informative aspects have to be improved. *On the visual side, the elements on the screens are perceived as unconnected* (layer, legend, player widget), so more visual cohesion is needed and some corrections should be made to enhance the appearance (e.g. the

legend is easily readable but: “it looks poor”). *On the informative side, it is not quick to achieve useful information,* as stated for other sections (e.g. Weather Station data). In general, the data exploration on the map requests many selections and they suggested to make appearing automatically some elements, such as the legend. Other comments were made about the Player Widget, which was slow so having the possibility to set the play speed could help in a *more fluent experience.*

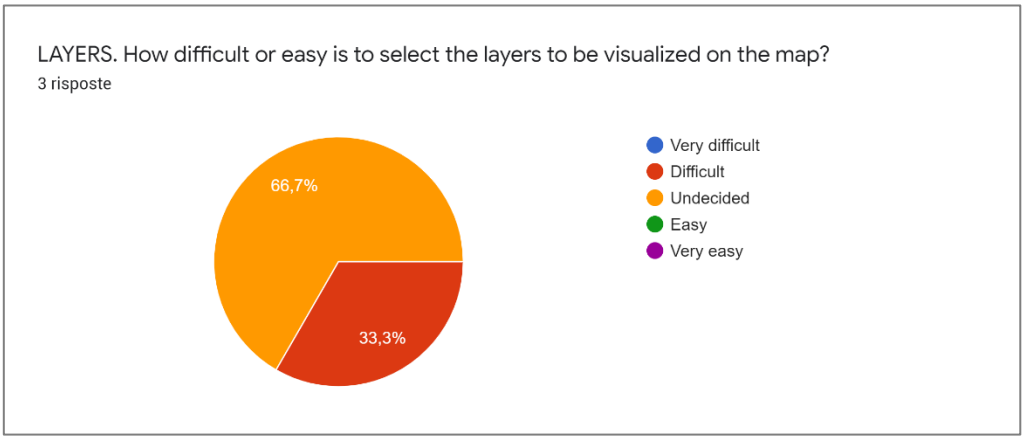

Figure 8: perceived difficulty to select layers to be visualized on the map

Parcel Detail and Phenology data. The Parcel Detail section was homogeneously judged clear and easy to use, Sugar Chart included, as shown in Figure 9. Nevertheless, additional pointers should be added to highlight where to insert and validate predicted data since some end-users needed some time to find where to do these operations.

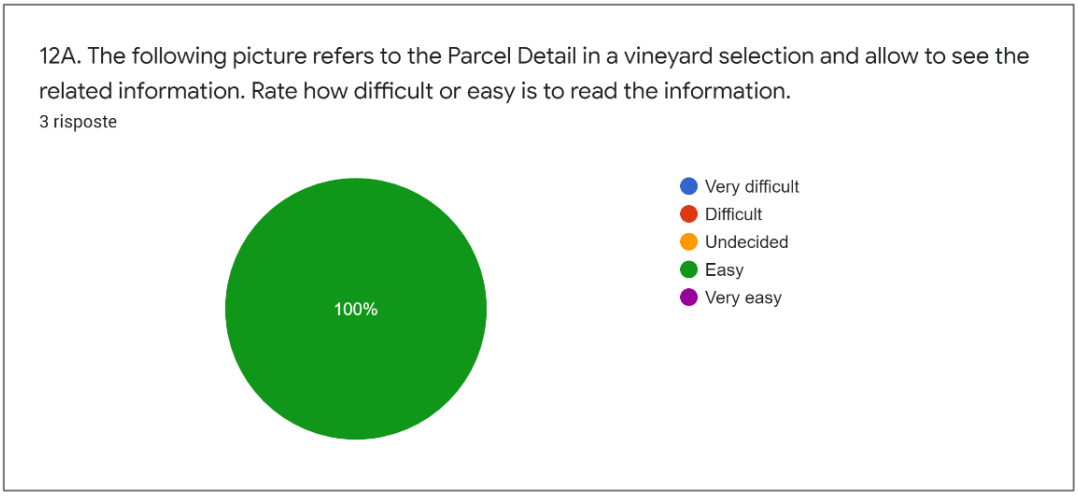

Figure 9: Parcel Detail readability

Regarding the use of Phenology data, end-users stated they only sometimes use phenology records to plan fieldwork. Phenology Forecasts are judged surely useful for planning treatments, moderately useful for irrigations and mostly useless for pruning, as shown in Figure 10.

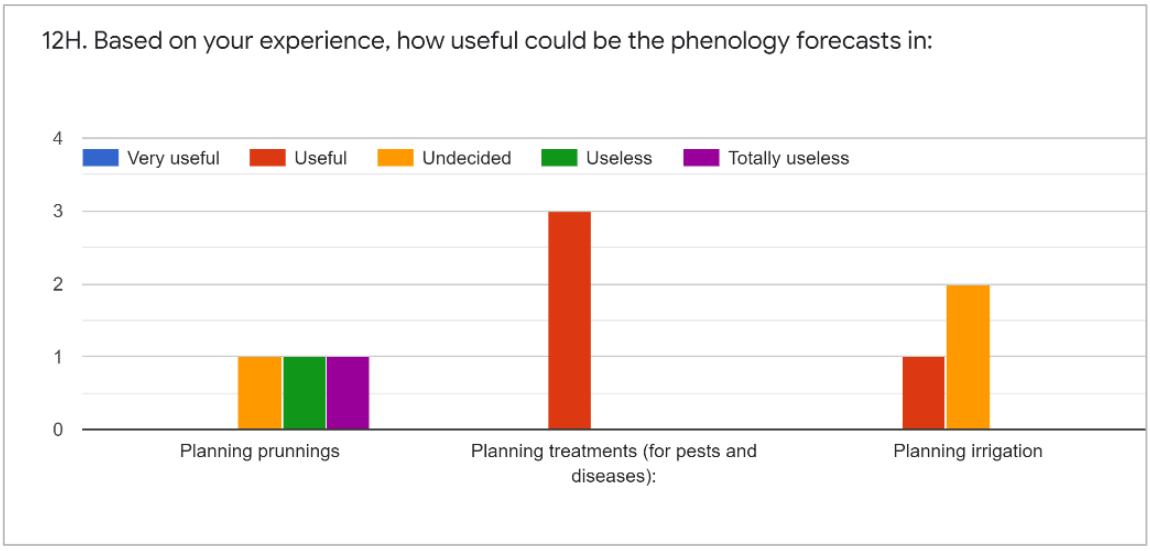

Figure 10 – Graph showing how useful could be the Phenology Forecasts

Irrigation Detail. The irrigation Detail data are exhaustive to the majority of end-users, only one end-user commented that the understandability of the Irrigation graph is lacking (for the same reasons described in the *Irrigation monitoring* paragraph: missing histogram bar when there are no data).

Regarding the usefulness of the data to program irrigation activities, the responders are more undecided meaning that they do not know how to translate operatively these data (Figure 11).

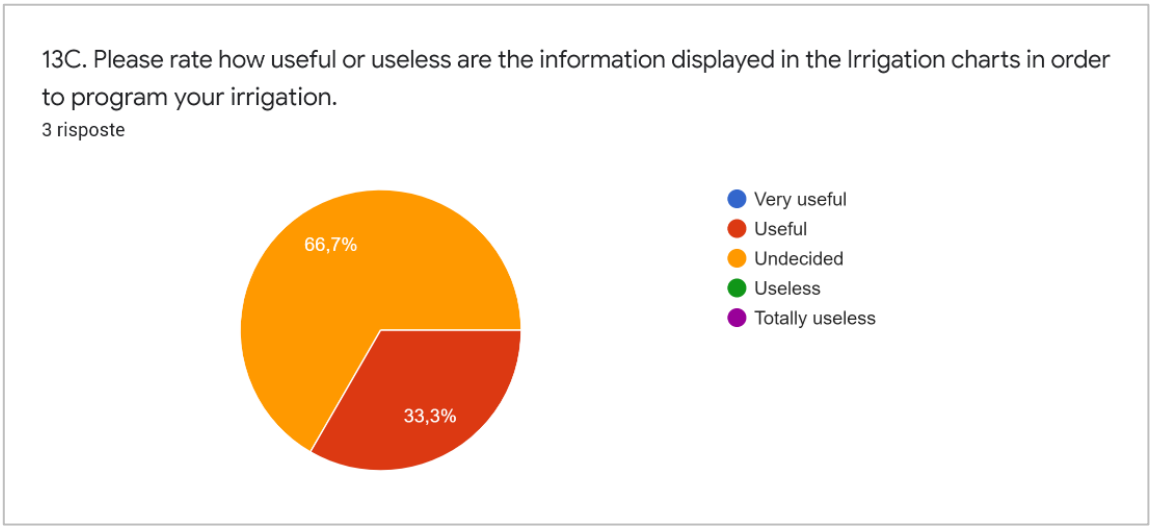

Figure 11: usefulness of Irrigation chart data to program irrigation activities

Processes and supporting contents

VISCA Models. End-users have a different awareness of how the model procedures work to generate data. In Figure 12 there is the awareness level distribution per model type. The Phenology model is the most understood, followed by Ripening and Leaf Fall models, while the Irrigation model collected a diverse range of responses, from 'moderately aware' to 'not at all'. According to the majority of end-users, there is a direct relationship between the awareness level of the models and the perceived attractiveness of the VISCA DSS (Figure 13). This finding is confirmed by what already emerged in the Weather Station survey subsection (see above), namely the need for resources to better understand the data provided in order to make more informed decisions.

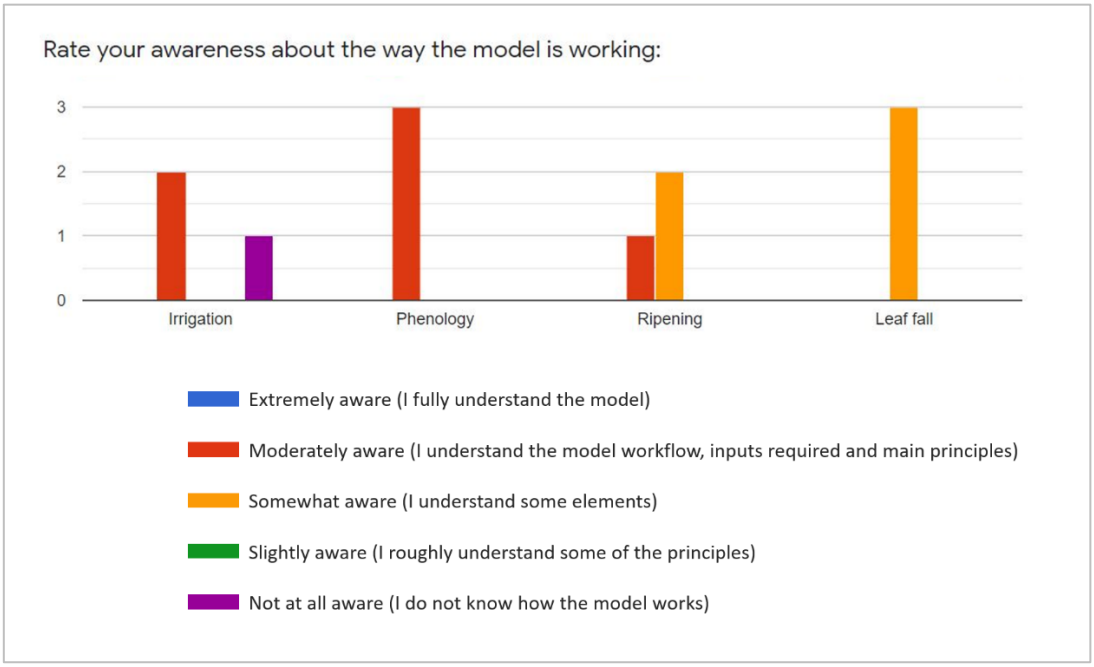

Figure 12: awareness of model procedures

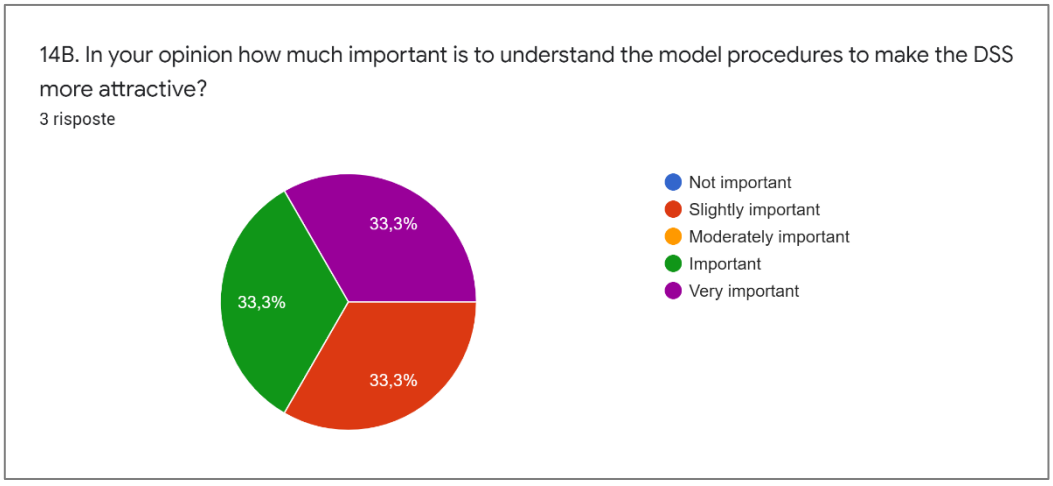

Figure 13: the importance of model procedures' awareness related to VISCA DSS attractiveness

Data uploads. The procedure to upload data was judged in general not very fluent since there are many fields to be filled and it is not easy for all responders to find the template in the VISCA DSS, so the accessibility/visibility could be improved.

User Guide. The User Guide collected a very positive vote from two end-users (who rated it 'exhaustive') while one end-user was undecided. This means that overall the User Guide provides all sufficient information but some integrations are needed.

4. Conclusions of the surveys

4.1. VISCA DSS main interest: Weather Forecasts for field planning works.

VISCA DSS is very interesting to the end-users who would like quick information at hand that could help their decision when planning field works. In this perspective the type of data more useful is (ordered from most to less useful): Weather Forecast data – Weather Station data– Irrigation data – Phenology data. Different levels of awareness influence the confidence in the use itself, for example, the Weather Forecast data are less familiar than the Phenology data that are very well known. While end-users need to consult the Phenological data only sometimes to plan their field activities, they would consult the Forecast daily or weekly, but they need more resources to use them (e.g. trends indications) and also to evaluate their decision process over time.

4.2. Data exploration: more interactions needed.

When there are visual elements displayed, such as graphs or map layers, the user tends to research a direct interaction to further explore the data. When this expected behaviour is not supported, there is some frustration. Moreover, they perceived that a lot of selections are required before reaching the interesting data. The only visualization of the information is perceived therefore static and they would like to do more dynamic queries for an improved exploration flow.

4.3. Data understandability and usage.

The VISCA DSS is very rich in data, finding it complex for end-users to consult them. At present, every end-users rely on his/her own knowledge and field experience to read the data, but this can vary a lot as shown by the responders' group. A dedicated section in the User Guide to describe the data would be beneficial to end-users.

4.4. User interface: more visual coherence and guidance needed.

The UI is overall sufficient, there are no criticalities that hinder the user to accomplish a task, but the VISCA DSS sections present different levels of visual coherence. For instance, the Map view is the weakest while the Dashboard view was judged attractive. The overall perception should be improved as well as the guidance by better highlighting existing functionalities that sometimes were missed by end-users.

5. One-to-one interview

After the survey analysis, a one-to-one interview was scheduled between the end-users and DSS developers. Such an interview included not only the people involved in the development of the DSS structure and functionalities but also the modelling groups. The aim of the interview was to discuss the survey results to contextualize the conclusions and to provide new guidelines for the next season. The following paragraphs summarize the general agreements between the end-users on the distinct sections analyzed in the survey.

5.1. VISCA DSS main interests

There was a common consensus on the weather forecast importance. For all the end-users, having forecasts at different temporal resolutions is very useful to plant their main field activities. However, all of them agreed in the difficulty to interpret the seasonal weather forecasts and to include them in their decision management process. For the rest of the modules implemented into the tool, the level of importance varied depending on the end-user. The discrepancy was mainly due to their field necessities. For Symington, "irrigation and phenology forecasts are nearly at the same level, but if I have to organize them I will put irrigation first". On the contrary, Mastroberardino stated, "To me, irrigation module is not important because we do not apply irrigation in our vineyards". Their main interest (after the weather forecasts) was in the phenology module because it will help them to decide on strategic orchard management techniques.

5.2. Reachability and understandability

The comment of the end-users regarding the reachability and understandability during the interview coincided with the results generated by the survey analysis. However, they also highlighted the need for a longer period to work with the tool. They all agree that the delivered date of the final version of the DSS established in the project was not suitable to spend time with the tool. After the tool was released in June, there was a training session in July. However, as people from Codorniu stated: "the training session in July is too late". At that time of the year, the grapevine growing season is usually

close to its fieldwork peak. As a consequence, the end-users had almost no time to interact with the DSS. In this regard, it was agreed to have another training session during the next general meeting in Barcelona (from December 9th to 11th) to acquire the necessary skills to work with the DSS during the next season.

It is worth noting that, two of the three end-users agreed on their willingness to use the tool after the project ends. The third one stated that the final decision in using the tool beyond the end of project could be made after the coming season. Such comments reinforce the necessity of the project extension to provide meaningful results on the DSS usefulness.

6. References

Muddimer, A., Peres, S. C., & McLellan, S. (2012). The effect of experience on System Usability Scale ratings. *Journal of Usability Studies*, 7(2), 56–67. Retrieved from http://uxpajournal.org/the-effect-of-experience-on-system-usability-scale-ratings/