Australian Government

Wine Australia

Platfarm

Development of a digital support tool for improved vineyard management



FINAL REPORT to

Wine Australia

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Abstract

The Platfarm project was designed to create a Minimum Viable Product app that enables the wine sector to carry out work on vineyards with greater precision, using low cost smart phones and tablets.

Developed in collaboration with growers, contractors, input suppliers and viticulturists, the project has identified a number of vineyard tasks which would benefit from targeted management. The project has identified the current practical challenges of using standard smart phones and tablets to carry out precision viticulture and has delivered solutions to help overcome them.

Executive Summary

The Platfarm project was initiated due to the lack of cost effective viticulturally focused tools to enable grapegrowers to carry out work on their vineyards with greater precision. Their previous choices were either to manually mark a work area with tape to communicate where to start/stop, or to make significant investment in the precision agriculture technology that is primarily used in the broadacre sector.

The aims of the project were to create a Minimum Viable Product 'MVP' version of Platfarm which can be published on the app stores (Google Play / iTunes) for users to download for free, to use on standard consumer smart devices.

The Platfarm project includes the core functionality to:

- Import geo-referenced imagery (aerial vine vigour or EM38 soil maps) to show the variability of the vineyard.

- Import an external prescription map to indicate where work needs to be carried out or use Platfarm tools to create it.

- Geo-locate the user accurately along the correct grapevine row using the GPS in the smart device, track the position of a user as work is being carried out, provide a visual display and audibly communicate with the user to tell them when to start/stop work or change the application rate.

The MVP has been developed and iterated with the input and feedback from the core user groups of grapegrowers, contractors, input suppliers and viticulturists. Platfarm was initially trialled and tested by over a dozen vineyards in McLaren Vale, and the Clare and Barossa Valleys, with the following key results:

- Due to the current accuracy limitations of GPS signals, Platfarm has developed a tool to enable users to calibrate their current position against a known location in the vineyard before they start a task (e.g. the start of row 1 and 2), this then places them on the correct vine row, with actions such as starting/stopping spreading typically being executed within an accuracy of 0-2 vines of the original target point along the row.

- Platfarm also created a technical solution to overcome the other main challenge of the external layers of imaging not lining up with the base layer satellite imagery.

- Platfarm was successfully demonstrated to work without the need for internet connectivity when carrying out work in the vineyard.

- Users who trialled Platfarm also suggested a number of tasks (other than application rates) that it could direct. These included mid row ripping, planting alternative mid row cover crops in higher/lower vigour rows, split picking, shoot thinning and leaf plucking. Tracking spray application to ensure that no rows are missed and facilitating more efficient tractor operation to optimise travel time.

The project also raised a number of recommendations for how the wine sector can maximise the opportunity of AgTech start-ups:

- By having a number of common building blocks that would be beneficial for AgTech companies in the wine sector to have in place: Vineyard block boundary files and high resolution aerial imagery of Australia's wine regions. It is suggested that Wine Australia would be best placed to store and update this information and make it conditionally available to accredited third parties.

- For Wine Australia to continue to support promising start-ups with small pre-seed level grants, to demonstrate 'proof of concept' for new technologies.

- For Wine Australia to further collaborate with the various Australian start-up accelerators (SproutX, Cultiv8, GrowLab) to co-invest in early stage ideas that have the potential to deliver the greatest benefit to the sector.

Background and Project Aims

Currently there is a limited number of free digital tools to help stakeholders (grower / contractor / viticulturist / input supplier) in viticulture to effectively collaborate to complete various vineyard management tasks. This project aimed to develop software which can be used on smart devices to carry out vineyard tasks more efficiently.

Through the use of the software, vineyard owners will be able to collaborate with their viticulturist to draw informed prescription maps as a part of a plan to optimise the yield and quality of their block. It will also enable them to manage costs by accurately ordering the required amounts of inputs such as compost.

This would allow tasks such as variable rate application to be carried out without the need for major expenditure in technology, or alternatively the time-consuming task of marking vineyard rows with tape in order to identify start / stop points.

The objective of the project was to develop a Minimum Viable Product 'MVP' version of the 'Platfarm' app which can be published on the app stores (Google Play / iTunes) for users to download for free, to use on standard consumer smart devices.

The MVP will enable users to:

- communicate with other stakeholders through the app in order to coordinate and complete tasks
- import geo-referenced imagery such as aerial Plant Cell Density maps and EM38 soil maps in order to identify areas requiring different management.
- create a set of simple to use tools, that will enable the user to draw a prescription map to identify where tasks need to be carried out
- track the position of a user as work is being carried out, and visually and audibly communicate with the user to tell them when to start/stop work or change application rate
- record where the user has been in the vineyard to help ensure that no rows are missed during a task
- be geo-located accurately along the correct vine row using the GPS in the smart device.

Platfarm would be able to function in the field without requiring internet connectivity as long as the user has previously logged in and imported a prescription map.

Methods

Platfarm has worked with key user groups to inform the development of the minimum viable product (MVP), with a focus on:

- Requirements and the current challenges and frustrations faced by growers, contractors, suppliers and viticulturists

- Technical specification of external imagery (vine vigour maps / soil maps / prescription maps) to ensure that Platfarm can easily integrate the maps.

The Platfarm MVP has been developed with Android as the initial platform, with smart tablets as the initial target device. Subsequent development will see deployment on the Apple operating system, and for mobile and desktop devices.

Platfarm has currently been developed as a hybrid mobile application, with a technology stack using Ionic3, Angular5, Google Firebase and Mapbox.

Initial proof of concept testing was conducted on The Madgett's Block vineyard in McLaren Vale, with the Beta version of Platfarm being demonstrated to growers during viti tech demo days in the Barossa Valley, Clare Valley and McLaren Vale. Platfarm.com was used for growers to register their interest in being a part of the trial phase, and Platfarm has subsequently been tested by over a dozen growers and contractors that vary from large corporates to smaller independent vineyards.

For evaluation purposes, Platfarm was supplied on pre-configured Android tablets, as well as using the tablets that the growers already had, and this has been an integral part of the on-going discovery process of working within technical limitations. These limitations include the challenge of a wide range of end user devices, the physical environment when using Platfarm in the field, internet connectivity and the technology proficiency of the user.
To provide insights for grapegrowers on the variability of their vineyards, Platfarm has integrated with a variety of third party data:

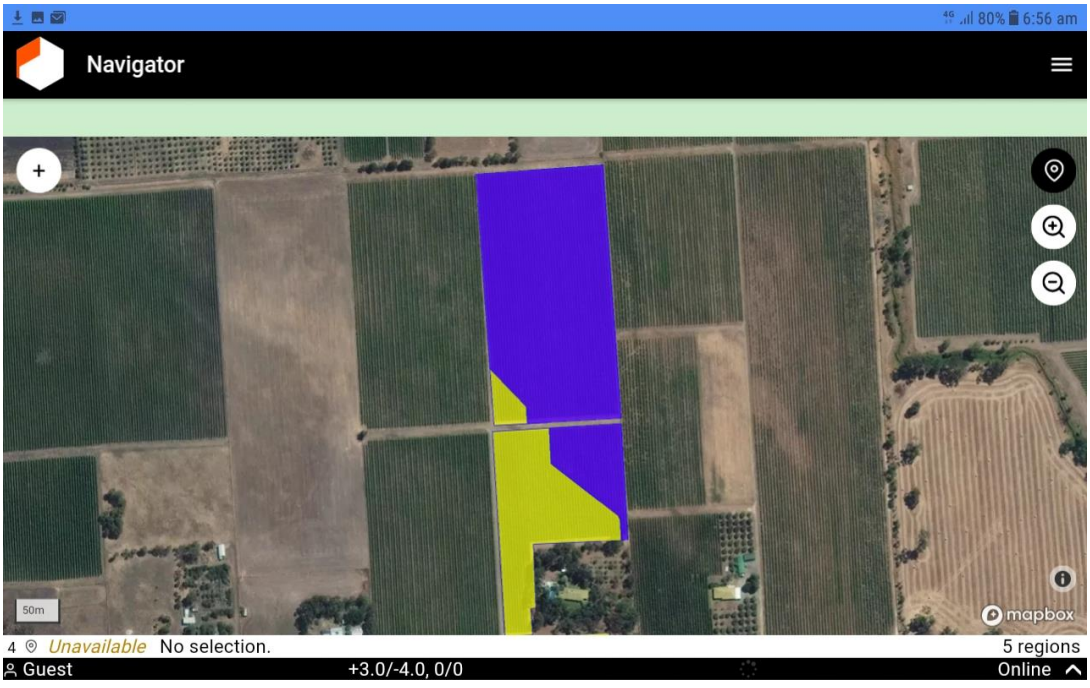
- Aerial vigour mapping from both fixed wing aircraft (40 cm resolution) and satellites (50 cm resolution)
- EM38 soil mapping
- Near real time data layers sourced from Sentinel



Satellite aerial vigour image overlayed in Platfarm to help illustrate variability

Prescription maps of where work needs to be carried out and at what rate, have been produced by either:

- Third party GIS software (such as Trimble)
- Google Earth
- Platfarm's own tool set



Prescription map created by third party software overlayed in Platfarm

During testing with Leasingham Wines in Clare, a trial was carried out with the vineyard manager to demonstrate that Platfarm can be used to very accurately predict the amount of inputs (compost) required, and then precisely execute the application of the material in the vineyard. Vineyard blocks of known areas were selected that would require up to a maximum of one spreader load of compost.

The Platfarm tools were used to draw a variable rate prescription map for that block and calculate the volume of compost required. The vineyard team calibrated the spreader so that it would output at either of the two rates required using a pre-set gear shift to slow down for the higher rate. The required compost was then measured into the spreader and the tractor operator followed the instructions given by the Platfarm interface.

End user feedback as well as data and learnings from field trials have informed the on-going iterative development process, and Platfarm is currently field testing Build #29. These insights from end users have guided the scope of the initial version of Platfarm to be released on the Google Play store at the start of the 2018/19 season, with an initial focus on tracking spraying being carried out so that tractor operators are able to see their current progress in the vineyard.

Results and Discussion

The main learnings and discussion points from the ongoing development of Platfarm to date:

<u>All things GPS related…</u>

The GPS accuracy of out-of-the-box smart devices is typically within 3-5m when positioned in the window of a tractor, and this can mean that the user is placed on the incorrect vine row. This can be remedied by connecting the app with an external GLONASS GPS receiver (Platfarm tested with a $140 Garmin GLO Bluetooth GPS) to improve the level of accuracy to approximately 1m, but this relies on purchasing additional hardware to use Platfarm. It is recognised that such a requirement may reduce the attractiveness of adoption by growers. There is a more accurate QZSS GPS system currently being rolled out that will ultimately benefit Australian grapegrowers, but there will be a lead time before consumer smart devices are shipped with the appropriate receiver.

Platfarm's solution to this challenge is to deploy a tool that enables the user to calibrate their current position. This is made possible because the error remains constant in the general geographic area of the user. A user goes to a known position in the vineyard (e.g. the start of row 1 & 2) and they move their location point to the same spot. Once a user has calibrated their initial position, it accurately places them on the correct vine row from then on.

The objective of Platfarm is to enable actions to be carried out on the vineyard with an accuracy of 1 or 2 vines along the correct vine row; the feedback from growers was positive about this level of practical accuracy. During field trials a number of variables were observed:

- There is a 1-2 second lag between the current position displayed in the Platfarm interface and the actual position in the vineyard.

- The work being carried out by an implement can physically be up to 4-5m behind where the GPS is positioned on the windscreen of the tractor.

During testing, these two factors typically counteracted each other, so that the 1-2 seconds delay with the user being notified that they had entered a prescription zone meant that the implement trailing behind them was at the correct position at the time.

Trials were done to calibrate the current position displayed in the Platfarm app against where the work was being carried out by the implement (e.g. the position of the output door of the spreader), but it was found that if this was calibrated going on north/south rows, then if the user subsequently carried out work on east/west rows they would be positioned incorrectly on an adjacent row.

For this initial phase of the Platfarm project, using the app's calibration tool, it is possible to correctly position the user in the correct vine row, and execute tasks on the vineyard with an accuracy of 1-2 vines. In the future, if Platfarm is going to be

used to automate the work of implements (e.g. turning a spreader on/off, or changing rates) then there is additional development work to be done in this area to take account of variables such as the tractors speed, the refresh rate of the user's interface displaying their current position, and the distance between the smart device and the implement carrying out the work.



Testing the accuracy of Platfarm GPS travel line at a vineyard in McLaren Vale

The results from testing Platfarm at Leasingham Wines showed that inputs could be applied with ± 5% accuracy using the prescription map and the Platfarm tools to direct the spreading.



Testing the accuracy of Platfarm at Leasingham Vineyard in the Clare Valley

In the early trials of Platfarm, the GPS travel line tended to wobble due to the current constraints of GPS accuracy, and an algorithm (a combination of the Douglas-Peucker and Radial Distance algorithms) was applied to smooth out the travel line. In the future, Platfarm would benefit from using a vineyard model where the vine rows are drawn in as a layer of data. Platfarm could then identify the GPS travel line, align it with a vine row, and draw a straight line down the mid row. This enhancement would assist growers in using Platfarm for tasks such as accurately tracking and 'painting in' a vineyard as it is sprayed.

Managing the positional variability of the external image layers

Platfarm utilises multiple layers of external imagery:

- Base layer map (using Mapbox)
- Geo-referenced image to show the variability of the vineyard (delivered as a KMZ file)
- Prescription maps drawn using third party tools (delivered as KML files)

Discrepancies in the positioning of different map layers, leads to difficulties with overlaying and can lead to inaccuracy of a row width. In order to manage this variability, Platfarm developed a tool to enable users to move the layers so they could be lined up accurately. When enough data are available to see any consistent patterns, the long-term objective would be to automatically correct positional errors.

Precision viticulture using consumer smart devices requires high resolution base layer imagery

One of the key learnings from testing and trials is the significant variability in the quality of satellite imagery of Australian grapegrowing regions.

Platfarm requires high resolution imagery for users to be able to accurately calibrate their position against a known reference point (e.g. at the start of row 1 & 2), but this is not possible if the imagery is of very low quality.



Example image from the Barossa (PIRSA vineyard) with very poor resolution background image

During the testing phase, Platfarm worked with aerial imaging provider SpecTerra to pull in imagery at a higher resolution (40 cm/pixel) which vastly improved the usability and ensured that Platfarm could deliver to the required accuracy. Having high resolution and recent aerial imagery of Australian wine regions will be a vital building block for Platfarm, and any other AgTech tools that require spatial information.



Example image from the Barossa (PIRSA vineyard) with high resolution image from SpecTerra.

Platfarm also prototyped importing near real time imagery layers publicly available from the ESA Sentinel missions, including moisture and NDVI satellite imagery, however the resolution at 10 m/pixel was too coarse to be of practical use. Investigations are ongoing into the commercial viability of integrating with similar providers.

Working within the constraints of consumer smart devices

The objective of Platfarm was to enable growers to carry out work on their vineyards using low cost smart devices that they already own and know how to use. Trials and testing uncovered several constraints and challenges that need to be considered.

For example, Android tablets have variable performance due to their differing processing power, and this could create sub-optimal user experiences, especially when using Platfarm to draw multiple prescription regions. Platfarm found that the latest Samsung tablets (SM-T385) performed optimally after some fine-tuning, and cost less than $400, and will be the initial recommendation for growers.

Trials showed that the same Samsung tablets are shipped from differing suppliers with varying default settings. This is specifically an issue when GPS accuracy is set too low, as this impacts the out-of-the-box usability. Platfarm is working to ensure a smooth user experience and will be working to identify any settings that need adjustment.

Platfarm may need to consider alternative device software components in the technology stack (namely, 'native' apps for Android and iOS) to mitigate some of the variability issues and maximise performance, however this investment may be deferred to a later time, once the user requirements have been fully tested.

Challenges in streamlining the import of imagery from stakeholders

Platfarm leverages an industry standard format for import of imagery and prescription maps. However, there are competing formats and therefore a conversion process was developed to address this. An online tool was developed and trialled to assist in converting the images exported from Trimble agriculture software for use with Platfarm.

A challenge is that although the formats are standard, how data is specified within the format is not. Although input providers can simply generate files that appear suitable for use with Platfarm, there is no standardisation on naming of metadata properties and structure used to describe their prescription maps. Such a tool as trialled does not easily scale when every user has a unique way of defining how properties such as application rates are described. Therefore, Platfarm will need to engage in a combination of user experience design, training programs, and development or extension of an interoperability standard.

Similarly, data made available by SpecTerra, which was provided using a sector standard file format used by Platfarm, internally was structured quite differently from that useful to Platfarm, so we had to work with SpecTerra to adjust both the app and the data to allow import of high-resolution imagery into the app.

Enabling users to find the utility in the technology

The initial beta version of Platfarm was focussed on enabling growers to accurately spread mulch and compost at a variable rate on their vineyards, but user feedback has suggested other tasks where Platfarm can deliver value:

- Tracking work being carried out such as spraying, with the Platfarm interface 'painting in' the vineyard after the user has initially entered their spray width. This will enable users to ensure that they don't miss a row, especially when they have to refill the tank, and being able to share that map on work carried out with the vineyard manager.
- Optimising the route driven by the operator. This was particularly apparent in vineyards orientated in complex contoured patterns, and tractor operators can spend significant time turning around between rows to maintain their

patterns. Enabling operators to identify where they have been via Platfarm will create more efficient driving patterns (e.g. spraying rows on adjacent blocks before they come back to the original block), thereby saving time.

Other potential tasks using Platfarm:

- Mid row ripping in either specific areas, or at differing depths
- Variable rate application of granular or liquid soil ameliorants applied as a part of the ripping process
- Planting different mid row crops in higher/lower vigour areas to fix nitrogen / create a mid row mulch layer, or to help de-vigorate the vines
- Applying inputs at a variable rate before a vineyard is planted
- Directing where shoot thinning / leaf plucking should be carried out
- Marking areas of weeds for spot spraying
- Identifying and directing the split picking of blocks

Overcoming the vagaries of mobile connectivity in rural Australia

Platfarm is designed to operate in the field without the requirement for a mobile signal, with internet connectivity only needed to import any external data (maps and prescriptions). Data generated in the field is stored locally on the device until there is internet connectivity, at which point it can be uploaded to the cloud.

During the trials, there were varying levels of mobile connectivity but Platfarm was able to successfully perform in the vineyard without internet connectivity as long as the data required was preloaded.

The recommendation to growers purchasing tablets to use Platfarm would be to ensure they have 4G capabilities. This will optimise the flexibility of Platfarm whenever there is internet connectivity, so that the progress of work being carried out in the vineyard can be viewed by other users, in near real time.

Other digital building blocks that would be beneficial for the wine sector

Platfarm is working to facilitate the use of digital tools by growers, to allow them to carry out work on their vineyards with more precision. Our focus is to make the tools intuitive to use and to automate tasks wherever possible.

Over the coming years there will hopefully be many spatially orientated digital tools available to assist the wine sector in areas such as precision viticulture, biosecurity and the automation of vineyard tasks. Many of these will require a common base layer of vineyard boundary maps as well as a vineyard row model.

The Wine Australia 'VinSites' project which aims to identify and map out each vineyard and vine row in Australia, has the potential to be used as one of the building blocks to enable a more collaborative approach to digital viticulture. This approach will greatly benefit the wine sector and would increase the likelihood that technology is developed for the sector that delivers a genuine step change to profitability of all stakeholders.

How the wine sector can maximise the opportunity of the AgTech ecosystem

Platfarm is one of the first AgTech start-ups to have received support from Wine Australia, and in terms of our learnings and feedback on how to maximise the opportunity and value that the AgTech ecosystem can deliver for the wine sector:

- There is a greater risk that start-ups are going to fail compared to traditional research organisations, which may often mean that they've decided to pivot to a different area as a natural part of the process of proving product market fit. Suitable contracting and commercialisation models will increase the likelihood of success of 'start-up' projects and improve their eventual impact.

- AgTech companies are likely to play a significant role in growing the Australian agriculture sector.

- Wine Australia provided support for Platfarm as it addressed a need highlighted by grapegrowers to improve vineyard management. Platfarm secured further funding from the SproutX accelerator program, and there is a great opportunity for Wine Australia to further collaborate with the various Australian start-up accelerators (SproutX, Cultiv8, GrowLab) to co-invest in early stage ideas that have the potential to deliver the benefit back to the wine sector.

Conclusions and recommendations

The conclusions and recommendations based on the initial learnings from Platfarm are:

Platfarm is helping growers to work more efficiently, to significantly increase the profitability of their vineyards by optimising the combination of processes and reducing input costs. Over the coming seasons there will be advances in technology that will benefit Platfarm's approach, with more accurate GPS positioning, higher powered smart devices, and aerial vigour imagery that covers all Australian grapegrowing regions with increasing frequency and at higher resolution.

The start-up mantra of 'moving fast and breaking things' doesn't fit well in agriculture, with growers and contractors having a very low tolerance for any errors in technology. It is therefore important not to rush ill-considered AgTech solutions into the market.

We believe that Wine Australia has a pivotal role to play in enabling innovative early stage technology for the wine sector to get off the ground. This needs sector support in the knowledge that start-ups are inherently risky and there are likely to be some failures, but solutions that provide genuine value and returns to the wine sector are likely to achieve product market fit and go on to raise the additional external funding needed to deliver those benefits. With equity crowd funding now possible in Australia, there will be opportunities for stakeholders to directly invest in technology that delivers genuine value, and that they want to champion. There is also considerable knowledge and expertise in the current viticultural tech industry that has not yet taken full advantage of the current AgTech opportunity, and it is important that they are also included in the innovation process.

It is therefore recommended that Wine Australia continues to support promising start-ups with small pre-seed level grants and should also consider further and deeper collaboration with the specialised AgTech start-up ecosystem of Accelerators, Incubators, Innovation Challenges, AgTech Meetups and Conferences.

There are a number of digital building blocks that would be common to potential innovative solutions for the wine sector (e.g. vineyard boundary files with additional metadata attached such as the variety / rootstock, high resolution aerial imagery, and a digital overlay of vine rows). It is understood that information of this kind is proposed to be collected as part of Wine Australia's 'VinSites' initiative. In future, it would be beneficial for Wine Australia to consider making these resources available to accredited third parties, as these assets are the common building blocks for digital services such as those offered by applications such as Platfarm. In return, third parties could commit to adding any additional metadata that they have collected (e.g. row width / year planted / row number) to enable this central store of geospatial data to remain as current as possible.