

The WaterWise project's experience

Rose Roche

May 2019

Context

The WaterWise Project is one of several projects that sit under CSIRO's Digiscape Future Science Platform. The focus of the project is on developing digital solutions for reducing the water footprint of high-value irrigated crops. In the 2 years since it was set up, the project has developed a world-first, cloud-connected sensor platform and an app which provides growers with forecast canopy temperature and weather details to help give them confidence in their irrigation management decisions. This was achieved by a team that brought together people with different disciplinary and technical expertise and knowledge. This Practice Note shares the project's experience working as multi-disciplinary team and the challenges, achievements, and lessons learned encountered along the way.

Why we decided to have a multi-disciplinary team

Prior to the WaterWise project, we had a project focusing on predicting canopy temperature in cotton. While we had a somewhat multi-disciplinary team, we realised that we did not have the expertise we needed. There were things we could no longer solve ourselves as it was out of our skill sets. This led to a subsequent project in 2016 where we brought in data scientists with expertise in advanced analytics. The successes from that one-year project (the development of a predictive algorithm and ability to use sensors and data faster and smarter) opened our eyes to how bringing together experts from multiple disciplines could have a multiplication effect on what you could achieve in a project.



In the WaterWise project, we wanted to replicate what we did in cotton across other projects. We wanted a similar multi-disciplinary approach – i.e. to bring together different fields of expertise such as modelling, sensing, physiology and advanced analytics. The WaterWise team we pulled together was comprised of crop physiologists; agronomists; data scientists; software engineers; and technicians with expertise in electronics hardware, field experimentation, and linking the instrumentation with field work. Within each of these fields of expertise, team members brought a range of slightly different skillsets. The team was also diverse in terms of where they were in their career. We had a post-doc and other early career scientists as well as mid-career and senior scientists. Some were core team members; others we called as needed, such as the user-experience team and external specialist software engineers.

Our experience

Initial opportunities and challenges

Because several of us had already worked together in a multi-disciplinary fashion in earlier projects, we were quickly form part of the core team. The Digiscape platform also enabled us to start talking to others working in the same space, such as software engineers and younger staff with a digital agronomy perspective.

However, one of the key challenges we faced was figuring out how to best work in Digiscape. Because Digiscape is meant to be innovative and ambitious, there is a lot of pressure and there are high expectations. Some team members had different ways of working. Some were comfortable with a loose structure, while others were not used to working in an environment such as Digiscape where ‘some level of working it out as you go’ was needed. Another challenge was that team members also had other projects and, for some, their allocation in WaterWise and other projects in Digiscape was small or dispersed.

What we did

Given the Digiscape context and being a newly-formed team, at first, we spent a fair bit of time talking about the project, our goal and how to work together. In the first few months, we had several **face-to-face meetings** as well as **conducting grower interviews to get an understanding of user experiences**. The team also **visited an irrigation farm**.

In these meetings we focused on our key goal and the skills we needed to achieve our goal. All team members were asked to **take notes and to share them** on Confluence.

It took us longer than we thought to really get going. However, within a few months we ended having a clear target – we had to have a working app and instrumentation, and all the analytics workflow in there, completed in 3 months.

After we managed to get the first major deliverable done, we had **a reflection session**. Based on feedback from team members we made a few changes. This included shifting to **more regular meetings** (fortnightly meetings). These meetings enabled the different parts of the team (the field and application team members, those working on the analytics, and those working across both) to share, on a regular basis, updates on the process and what we were doing, to talk about our science talks, as well as work through things together. Some meetings took only 10 minutes; others took longer. We **continued documentation and sharing of notes** on Confluence.

What worked well

- **The grower interviews, user experience process and farm visit** provided the team with an understanding of what irrigators and others think and wanted. This gave the team, including the app developers, a framework that instead of being driven by scientists was guided by the interests and needs of growers. Throughout the project, this was something we kept on referring to. It brought everyone on the team together.
- Despite having to initially invest quite a bit of time talking about the project, **the team was able to get early on a clear understanding of the project goal and output for the first year**.
- **Bringing in lessons learned from previous projects** was also very helpful. For example, we were able to talk with people involved in GrainCast (another Digiscape project) about what they had done.
- Being **flexible and open** about skillsets needed. Among staff and project managers, we had conversations such as ‘this next financial we are not quite 100% sure how much we are going to need this person, but this is what we are thinking, and there’s going to be these periods where there is going to be a burst of activity and then nothing. How does that fit in with your group’s workplan?’
- **Not having a hierarchy in the team**. Everyone on the team was equally skilled and experts in their disciplines.
- Having **regular meetings** was important for supporting common awareness and understanding across the team.
- **Science talks**, such as presentations from the analytics group. By sharing details about our science from different fields of science we started to get a better understanding of the different expertise in the team.
- **“Sprint processes”**. We learned from the software engineers their experiences of coming together for short periods of time and getting things done. Setting aside solid time and very regular meetings; documenting things; and commenting on things helped us work well as a team.
- **Everyone on the team taking notes and making them available in a shared space**. Notetakers bring in their biases so we had everyone on the team take notes and upload them on Confluence. This helped team members become more aware of each other’s expertise, be able to comment on ideas and help the team work together to achieve the project’s key goal.

- Having a **reflection session** at the end of our key deliverable in year 1 and asking, in a safe environment, ourselves ‘what could we have done differently?’ was helpful to us making some changes in the way we worked. It also helped us get to know each other better. Now, internal team members and external project collaborators feel more comfortable asking more open questions around issues that had arisen before (e.g. needing to have clear decisions).
- **Being on the front foot of potential bottlenecks around key people’s expertise and availability.** Based on past experience and being alerted early on of where potential bottlenecks would be, the team managers were able to get very organised to ensure that the project got access to software engineers.

What did not work as well as we had hoped

- **We could have had more face-to-face meetings, especially early on in the project.** There can be misunderstandings in e-mails. For example, the team leader didn’t realise that the software team members were waiting on a few key decisions from team leader. In retrospect, had we had a face-to-face meeting where it is a more formal type of meeting that probably would have been resolved then.
- **We also needed more regular internal (CSIRO team) meetings.** Early in the project, we found that we had not met often enough to resolve issues sufficiently prior to meeting with external software contractors.

Challenges, bottlenecks and critical junctures

The key bottlenecks/challenges we faced were:

- Communications barriers: e.g. misunderstanding around what key decisions needed to be made/were being sought
- The team being geographically dispersed and having to rely on WEBEX and travel
- For some team members, it took time to fully understand the working relationships and priorities before being able to engage in productive activities
- Team members being allocated across many other projects and priorities

There were two moments in the project where we hit a critical juncture, i.e. where key decisions had to be made or things could have gone pear-shaped. At the onset of the project, we realised that we had to flip around our outputs. We moved the software engineering and app development to the first year rather than the third year. If we had not gotten our ducks in a row and organise ourselves to do that we would have hit a bottleneck and become stuck. However, because as a team we had been upfront about what the project needed and acknowledged that we may not know everything the project may need, we were able to get ourselves organised and move around our outputs and seek the necessary skillsets.

The second critical juncture also happened early in the project. We did not have the sensors we needed so suddenly we had to make some. We were able to go to another team and explain that we had a problem and needed help. Because of the flexibility of the project which allowed us to reach for skillsets that we did not know we needed at the beginning of the project and our ability to access funds, we were able to get sensors built in a short period of time. In previous projects, we did have not have that ability. However, it could have gone pear-shaped had it not been handled in a collaborative nature. It was about relationships and conversations and finding the skills within CSIRO.

Achievements

We created in 3 months something that we had been trying to do for the previous 4 years. That was because of the multi-disciplinary skillsets that team brought together and money. In half a day we mapped out what we needed to do and because we had all the expertise in the team, in 6 weeks we went from having a plan to working out the process to store the data automatically and having a user interface that was tested and useful.

Surprises and lightbulb moments

A surprise was how quickly we got the work done. We had created a team that was extremely focused and highly motivated.

A lightbulb moment was when we first saw a shift in the conversation and everyone in the room got it at the same time; when someone on the team finished your sentence, who couldn’t understand your sentence two years ago. These are the moments where you realise you are a team. We are now thinking about what we can do next as a multi-disciplinary team.

What would we have done differently

We could have had better defined roles at the outset, particularly for the newer and younger members of the team. They needed a bit more structure and their own defined piece of the project.

It also would have helped to have broken down the milestones and deadlines a bit more, even if they were not set in stone. It would have given team members more certainty around things that need to be done and given them a better sense of how they could help.

These issues may not have been important to all team members, but it was important to realise that they probably would have helped some team members.

The benefits of working the way we did

Multi-disciplinary teams in the digital agriculture domain are particularly important, as people from pure digital backgrounds need a platform to apply their methods and people from applied science backgrounds are not equipped enough to do it on their own. The conventional way of bringing different disciplines together has been to employ people as needed and/or upskill existing team members (e.g. sending a technician away to learn how to use instrumentation). While upskilling is good, it is slower. In the WaterWise project we brought together the needed expertise from the onset to work closely together. Each team member was seen as an expert in his/her domain and learning from other people without needing to broaden their expertise. There is a 'cost' in terms of the time it takes to have the conversations needed to work together and it is more expensive on an annual basis but not over the longer term. Bringing in an expert who was not in your team originally also broadens your team's networks as they bring in their own networks.

For early career scientists, some of the benefits of working in the multi-disciplinary WaterWise team have been: having access to a wider set of contact; being exposed to a huge breadth of experience, skills, and ways of working; ability to explore new ideas; and seeing great science published and science impact being demonstrated.

Key takeaway messages and practical tips

1. **It is important that you come together for a key purpose and think about if you would be better served gaining an expert than employing or upskilling someone in your own team.**
2. **Face-to-face meetings early on, and regular meetings and discussions, are really important.** Working together is about sharing regularly and reflecting. Otherwise team members go away may not have not quite understood the project. There is also the issue of translation – where the language that one expert speaks does not necessarily mean the same thing to others on the team.
3. **Having the 'customer' telling you what they want early on in the project gives you that clear focus.** It helps pull the team together around a shared understanding of the project's purpose, usefulness and impact.
4. **In setting up a multidisciplinary team, you need to be focused on the skills needed.** It is important to try to step back from the traditional approach (have one set of people/skills and have to find a way to 'fit' them to a project). Prepare to be flexible and bring in new skills when needed.
5. **What you need to think of and do with a multidisciplinary team differs if the project has a clear goal or if things are less clear.**
6. **Be mindful that for most, this is a new way of working** (being in a multi-disciplinary team and in a project that is flexible).
7. **High motivation among team members makes a big difference.**
8. **It is important to be aware about team members' different needs and priorities.** Even if team members are very motivated, they have other projects or personal circumstance that may pull them away or make it not possible for them to contribute at the time you need them.
9. **Be flexible.** Being able to be flexible, if possible, with timelines allows team members to contribute to the project and other work they have.
10. **Be aware that translation across disciplines may not be clear.** A good way to make sure everyone is on the same page is for the various team members

to go away after meetings and document and share discussion points.

11. **Be prepared that issues will come up and head off in different directions because you have people with different disciplines and may be dispersed geographically and time-wise (allocated small bits of time).** It is important to come back together and reflect on what is working and not working. It helps going back to what is the core purpose of what the team is trying to do.
12. **Listen and be prepared to change your mind about things; about ways of working and ways of doing things.** If you are working in a multi-disciplinary team it means that all team members are experts, so it is important to be listening and learning from each other about what is the problem that the team is trying to work on and about the different ways it can be approached. Being open-minded and listening to each other allows the team to see how the sum of the whole is greater than the sum of the parts.
13. **Ask the team what they are getting out of it.** If no one sees the benefit of participating in the project, then the way the team works will not change (i.e. work better together, be motivated).
14. **It takes time for a multi-disciplinary team to come together and work well together.** Often one needs to start off with a loose structure and spend time getting to understand what the problem is and what each team member can contribute. In our experience, we found that with time mutual trust increases and positive working relationships strengthen, and the team work becomes more structured, focused, and productive.

About the author

Dr Rose Roche's research is focussed on developing new technologies and integrated digital systems for the agricultural industry to improve farm productivity. She has 19 years of experience in working with irrigation farmers (cotton, tomatoes, sugarcane) to develop management solutions in irrigated agriculture. Her research into crop physiology and agronomy has led to changes in production practices within the Australian Cotton Industry and she has strong collaborations with researchers overseas.