Wilderness Weather Station – Requirements – Stakeholder Interviews

The following are extracts from Wilderness Weather Station stakeholder interviews.

Interview 1 – Service Manager

What is your role in the organization?

I am the service manager. I have responsibility for the base station, the individual weather stations, staff, resources, budget, logistics, etc.

Can you describe to me the purpose of the current system?

The basic purpose of the system is to provide reliable weather data from the inhospitable northern zone of this vast country. The current system uses manned stations in several locations. It's quite a risky enterprise. The places where the guys have to go are some of the most inhospitable places on the planet. So, obviously, manpower is a factor. Not everyone is willing to spend half the year in the tundra or in the high mountains. I'm hoping that the new system will allow us to dispense with human agents altogether. Also, that it will allow us to expand our network of weather stations to about 500 so that we can produce a more accurate picture of the weather across the country.

How does the current system work?

The way the current system works is as follows. The guys on the ground have an impressive array of measurement instruments. They measure the whole range of weather-related parameters, including barometric pressure, rainfall, snowfall, wind speed and wind direction, and air temperature and ground temperature. They keep records of their readings in an Excel spreadsheet. At the end of every day, weather permitting, we establish a radio contact between the base station and each weather station. The guys at the weather station then read the weather parameter readings to us and we enter them into a custom Excel spreadsheet here. Obviously, there are

pitfalls with this approach. It can take an age to communicate It is also quite easy to make mistakes. We've had this on a number of occasions, where errors of been introduced during transmission. It drives the data analysts crazy, which is understandable. They just want to get on with their work.

What are the main problems with the current system?

Some days the weather out at the stations may be so bad that the guys can't get out to look at the instruments. In some cases, the weather has been so bad that some of the instruments have been damaged and put beyond use. It really is a hostile environment, especially in the northernmost stations. And obviously, we don't ask our guys to take any risks. They're taking a big enough risk as it is just being in those places.

The longest we ask anybody to stay up there is six months. There must be at least two people in any one station at any time. This means that we need a minimum of four people per station per year. This has proved really difficult. Not just getting the people. But, training them with the skills that they need just to exist and survive up there. Thank God, we've never had any fatalities. However, we have had some quite serious injuries and illnesses, and guys have had to be evacuated by helicopter. When this happens, we have to completely shut down the station. This can be for months on end, during which time we lose access to valuable data, and our picture of what is happening across the country is left incomplete.

Can you describe to me how you envisage the new system will operate and how it will fix the problems of the current system?

The good thing about the new system is that we will be able to have many more stations without the need to have people manning them, and without the associated risks to human health and life. We will also have more regular and accurate data transmission between the weather stations in the base station, as we will be using satellite transmission rather than the old system of manual radio transmissions.

We will also be able to build a more accurate picture of the weather, as the new system will take more frequent readings. Previously, weather station staff were only required to take readings four times in a 24-hour period. The new system will take readings every minute. The data will then be stored locally in a database and transmitted as a batch at midnight each day. The data will be transmitted as JSON data. This will make it as lightweight as possible, and help overcome bandwidth issues. If for some reason transmission is not possible, perhaps because of extreme weather conditions or loss of connectivity, data will be maintained locally, and transmitted at the next possible opportunity. There is a limit on how much data can be stored locally at the stations, but this wouldn't become an issue unless it was impossible to transmit for about three weeks. At that point, we'd start to run out of storage space, and we might be in a position where we lose some data. Fingers crossed, this shouldn't happen though. We've never had an extreme weather event last for more than about two weeks before .

What about the power aspect of the new system? I believe the current system uses diesel-powered generators?

Yes, the current system uses diesel. And that diesel needs to be shipped up to the stations by air. In the new system, each station will come with its own solar driven power source. A full charge should be enough to prime the batteries to last for around seven to ten days. The system must be fully optimized to preserve power. Nothing should be wasted. When a component is not actively performing its task, it should be shut down. In extreme conditions, the whole system should shut down. There is no point having sensors and other components active if conditions are too harsh for them to record anything.

You say the system will be solar powered, but what about during the long winters when we have permanent darkness?

Oh yeah, I forgot about that. I believe the suggestion is to have wind power as a backup, although some people are wary that even having solar and wind might not be

enough. Still days during the winter months could prove problematic. There has been a suggestion that we can get around this problem using geothermal energy. Clearly, this would work, and it would give us the sustained power source that we need. The problem is budget. Geothermal systems don't come cheap. It comes down to whether the minister holding the purse strings is willing to commit the extra outlay required. I for one will be arguing that geothermal is the best option in terms of system dependability.

Can you tell me about how you intend to deal with maintenance and upgrade issues?

The system should be self-monitoring and managing in all respects. Any problems with the sensors and the power system need to be detected and reported to the base station immediately. What we don't want is faulty components producing faulty data. This would put the whole future of the project at risk. The project sponsors might pull funding if the system does not perform optimally. This again raises the question of dependability and reliability. Our budget is limited. But, what I would like to see is duplication of sensors and of other system components, like the communication system and the database, and the operating system. This way we could deal with failure, without the team having to make helicopter journeys of hundreds of miles in adverse conditions to fix things.

Interview 2 – Operations Manager
What do you see as the main challenges for fully automated weather station system?

The real challenge is to have a system with so many different components in so many different places, and to be able to manage that system from a single location. We have never attempted anything like this before, although precedents do exist for similar systems, like the oceanic tsunami monitoring system in the Pacific. The success of the whole enterprise hinges on communicating the data from the weather stations to the base station. We are using quite a narrow bandwidth, and although the data being

transmitted is not particularly bulky, we need the coms to work perfectly. Data transmission will take place overnight. That way data should be ready for processing and analysis in the mornings when our data analysis team get to their desks.

Can you tell me a little more about how you see the data aspects of the system working?

At the weather station end, the data from sensors will be stored in a MySQL database. For sending purposes, database data will be converted to JSON format. This is about a lightweight a format as you can get. XML would be richer in terms of metadata. However, JSON offers better transmission rates. At the base station end, the JSON data will be unpacked and stored in our main system, which runs on top of an Oracle database. The whole process should be simple and seamless. Fingers crossed!

What about system maintenance?

Of course, we are going to need to perform remote maintenance periodically. These kinds of undertakings never go without hitches and sometimes catastrophes. At times, we may need to update software, for example, when new and better versions are developed, or when bugs rear their ugly heads. Worst-case scenario is we have a complete system collapse. In this case, remote maintenance may prove difficult, and we may need to send the chopper out with a maintenance team. But, this is where backup comes into play. If the Department is willing to spend the money, we should have at least one backup system that we can switch to, should we experience a major outage.

To help us avoid problems, we are also going to need periodic feedback on the performance of the system. This can include stuff on power usage, sensor status, processing time, etc. The more data we have about how the system is functioning, the better we can maintain the system. It would be good if the system flagged any exceptions to normal operation. That would save us trawling through status reports ourselves looking for anomalies.

Interview 3 – Weather Data Analyst

Can you tell me a little bit about your current role?

My role is strictly to do with the data. I have to make sense of the data. Make it talk, if you like. However, there is currently too much work getting the data into a processable format to spend enough time working with it.

As you are no doubt aware, we currently rely on radio transmission in order to transmit the data from the weather stations to the base station. This means sitting with the headphones on listening to crackly radio signals from afar, and hoping you don't make mistakes when you enter data into the database. Although, I'm sure that sometimes mistakes are made.

There are currently 10 stations in 10 regions. That's a lot of data to have to enter manually on a daily basis. To be honest it drives me crazy. What I would like is simply to have the data automatically transmitted from the base stations into the mainframe. Then I could get on with my job, which, as I said, is to make sense of the data. Truthfully, I didn't sign on as data entry clerk.

In terms of data analysis, what exactly are the outputs of your work?

We do all kinds of interesting things with the data. We are looking at the data on a day-to-day basis and producing regional reports. These give us a clear view of what's happening region-by-region. They also serve the more important purpose of providing weather updates to people working in those regions, like the mining companies and the trawlers, as well as various scientific teams that are working in the northern zone. Our daily weather reports and seven and fourteen day forecasts are vital for those people. In some cases, it can be the difference between life and death.

Our data is also used in several longitudinal studies. Of course, we are very interested in climate change and the effects of climate change. Data from the stations helps us to see how the climate is shifting. We feed the data into a specialist system called aClimatize. The system is able to build models of weather patterns over extended historical periods. It is also enables us to produce longitudinal predictions, so that we are able to see how the weather is changing in the short term, and will change in the long-term.

We also very interested in weather anomalies. Part of my role is to map the progress and effects of storms. We look at weather leading up to storms. We look at the storm itself. And, we look at the aftermath of storms. It's a very exciting field. It gives is a very different picture of the effect of storms on local weather patterns, and individual features in the environment such as animals, forests and rivers.

What will the new system will allow you to do that you can't currently do with the system that you have?

Well, as I said, it will cut out all those hours we spend manually entering data of into our system. Apart from that, it will be business as usual. I will still be creating the same reports. I'll just have more time to do it. In turn, this will free up time to spend more time analysing the data.

I've also talked with the management team and put forward the idea of making commercial use of our data. We are state-funded here, and state funding is not guaranteed forever. One way I suggested that we might do this is to build an API, so that external agencies, like news providers, universities, oil companies, etc. can access our data on a pay basis. I really believe this is the way to go. There's a hell of a lot of interest in what we do and the data we produce. Why shouldn't we make money from it?