Wind Profilers: Transitioning to Operations in Europe

Tim Oakley
Met Office, Exeter, UK
+44 (0) 1392 885511, +44 (0) 1392 885681, tim.oakley@metoffice.gov.uk

Abstract
Transition to operations, also known as operational acceptance, is a phrase that is commonly used in today’s World of Meteorological instrumentation and increasingly having a significant impact on the funding and timing requirements for implementation projects. However, it is an area when working with instrumentation, that is often misunderstood, frequently not correctly budgeted for and can be a significant point of contention between the R&D (research and development) and operational teams in an organisation. Using the development of the European wind profiler network as a working example, this presentation will cover the main components of operational acceptance, the challenges encountered and the outcome/plans for the future.

Introduction
Transition to operations is not something new, in fact it is a process that most people in observing systems/instrument research, development and operations would have come across at some time. It is a vital component in the process chain when transitioning instrumentation and systems/networks from the R&D environment to operations; however, it is often an area that is overlooked, poorly resourced and a point of contention between teams responsible for the transition. Yet although complex in detail, much of the content is common sense, with a primary aim of documenting the end-to-end components of the data flow and the systems involved in that process. Figure 1 shows the schematic of the European wind-profiler integrated network/processing hub (E-WINPROF) which has recently been granted a full operational licence within the UK Met Office. It is this system that will be used as an example throughout this report, introducing the main components of the transition to operations process.

Figure 1 – Schematic of the European wind profiler network/processing system (E-WINPROF)
A common mistake when planning and implementing the transition to operations is to focus on the instrument and/or IT system itself rather than consider all components of the service. The primary areas that need to be considered are as follows:

- Management and Governance
- Design, planning and evolution
- System operations and maintenance
- Quality Management
- Standardisation and data compatibility
- Data and metadata management, delivery and archival
- Communication, capacity development and outreach

**Design, planning and evolution**

In an ideal situation when designing an operational network (or system) it would be easier to start from nothing and build something that matches as close as possible to the user requirements. However, in reality it is often the case we are working with something that is already in operations and likely to be working to different user requirements. Whilst the latter has the benefit of having documented history (both technical knowledge and performance statistics) and often is more cost effective, it has the downside of being less flexible, requires careful communication and collaboration and might mean we have to compromise on meeting the user requirements. This is especially true at the regional and global level where we are linking networks/systems from different institutions and across national borders.

The European wind profiler network (CWINDE) was initiated as a demonstration project in 1999 by a COST (Cooperation On Science and Technology) action entitled ‘Development of VHF/UHF wind profilers and vertical sounders for use in European observing systems’. At this time there were already a number of individual wind profiler systems installed and operating across Europe but most of these were still in the research environment being used for scientific studies or specific nowcasting requirements. The aim of the demonstration project was not only to show that these systems were capable of being operated (and delivering data) at a level suitable for both NWP and forecasting but to develop and document the necessary components (i.e. network hub, BUFR message format) to ensure that transition to operations would be possible should the project be successful. Initially there were 9 systems connected to the network hub hosted by the UK Met Office, this increased to 29 systems by 2005 by which stage the management of the work and hub been taken on a 2nd European project called WINPROF under the management of EUMETNET.

Today, the number of systems reporting in real-time remains at a fairly constant 27-29 with the network, still referred to as CWINDE, having been in operation for 13 years and gained a full operational accreditation within the UK Met Office. We also process data from systems outside of Europe, for example 10 sites in Canada. Figure 2 shows how the network has evolved since its inception in 1999, also interesting to note how the network plot (taken from the website) has changed from a fixed map with names, to an interactive map and finally an interactive map using Google.

Since it’s in inception in 1999, the ownership and day to day management of the contributing wind profiler systems has remained with the national meteorological services and institutes, with the WINPROF project providing the network management tools and guidance. This has resulted in a less than ideal network coverage at the regional scale which is clearly evident in the final plot in Figure 2. However it should be noted, and it is a very important point to remember when designing networks, that the wind profiler network is part of a composite European observations network of wind measurements and as can be seen in Figure 3 the combination of 4 observing systems (wind profiler, radiosonde, aircraft and weather radar) can provide a significant increase in data coverage and improved network/system redundancy.
1999 – 9 systems (real time)
Demonstration Phase

2005 – 29 systems (real time)
Semi-Operational Phase

2012 – 28 systems (real time)
Full Operational Phase

Figure 2 – Evolution of the European wind profiler network 1999 to 2012
System operations and maintenance

A fundamental component of the operational service is the method and support provided to the observing system/equipment operations and maintenance. Whilst for the more traditional observing systems (i.e. radiosonde) there are long records of both operational experience and knowledge, for the newer, more bespoke, systems (i.e. ground based remote sensing) there is less experience and significant work is needed in producing the manuals and guides. A good example of this can be seen when referring to the CIMO guide, where there is very limited advice or instructions on how to site and operate a wind profiler system. When developing the European wind profiler network this lack of experience/knowledge in networking these types of systems was compounded with the point that we were working with a range of instrument types and owners. Once it was evident that networking these systems was feasible and that there was a user need for the data, the project concentrated on key areas to improve the operational basis for the network. These were as follows:

- Instrument configuration
- Data coding
- Technical support (both software and hardware) and spares
- Maintenance policy
- Data availability, timeliness and quality

Based on the individual sites conformance in these categories, an operational categorisation was given to each system which not only identified those systems working at an operational standard but also provided a level of confidence to those using the data. Figure 4 shows the current classification for the network, where green is ok, yellow is not ok (but is close) and red is not ok (and needs significant improvement).
Quality Management

For all operational services the quality management process is a key component and is often used to demonstrate the success in meeting the user requirements. Whilst quality management has a part to play in all areas of the observing system it is normally the data availability and quality that is the focus of the monitoring and operational reports. The uses of these types of statistics are widespread across most observing systems as they provide not only a measure for the reliability of an instrument or network but also a means for the data user to question the performance and request improvements. It is also these statistics that drive the research and development requirements, looking for improvements in system performance or ultimately replacement by new technology.

In terms of the European wind profiler network these statistics were incorporated into the network design at an early stage, with monthly reports being generated of availability (messages received by the hub), timeliness (time at ingestion in archive) and quality (comparison with NWP models). At a later stage an independent measure of these statistics were generated through the EUCOS portal which is hosted and maintained by the German weather service (DWD). Figure 5(a) provides an example of the monthly, on a day by day basis, availability and timeliness from a sample of the E-WINPROF network. Where the top line shows the number of messages received each day and the bottom line the mean daily timeliness of these messages, as received in the DWD database. The end column shows the monthly performance of that site against the agreed targets. Figure 5(b) provides an example of the quality monitoring in the EUCOS portal, for a single sites (mean vector) as compared with the COSMOS EU model.
Figure 5(a) – EUCOS portal availability and timeliness statistics for E-WINPROF (July 2012)

timeseries of wind profiler daily mean OBS-MOD differences as obtained in COSMO-EU model domain:
wind profiler: 10135

Figure 5(b) – EUCOS portal quality statistics for E-WINPROF (July 2012)
Standardisation and data compatibility

It is important to carefully consider standardisation and data compatibility when introducing instrumentation and observing networks into the operational environment, not only is this often more efficient (building on something which is already tried, tested and accepted) but it will lead to something that is more reliable and more readily accepted by the end user. Areas that need to be considered, but not limited too, are as follows:

1. Data coding and measurements reported
2. Data routing and method of communication
3. IT operating system
4. System security
5. Data archives, method of access and data policy
6. Documentation
7. Technical support and training

In terms of the European wind-profiler network the above items were considered as followed:

1. Very early in the project it was identified that a new data code would be required to communicate the information to the end user. It was agreed that we would use the BUFR code (internationally recognised by WMO), with a format designed by the wind profiler experts and end users. The BUFR code was granted WMO operational accreditation in 2000 and is still in use today.

2. As with most operational observing systems the GTS was the preferred method of communication, however for some operators this was not possible so an FTP solution was offered by the CWINDE hub.

3. The IT operating systems both for the instrumentation and network services was governed at the National level but guidance was provided to ensure that it was fully supported and had a suitable level of compatibility to work with the networking/hub system.

4. Similar to the statement above that this is governed at the National level but guidance was provided for mandatory and recommended security processes that needed to be implemented.

5. (6 & 7) Requirements for these areas were developed by the project both from the National perspective (using existing documentation and processes) but also working to the Regional (EUMETNET) and Global (WMO) requirements.

Operational Acceptance

Since the start of the European wind profiler network (CWINDE) in 1999, one of the primary aims of the project was the development of an operational service. Initially the network was entitled ‘a demonstration’ but once it was transferred to the control of EUMETNET it quickly became a semi-operational service. However it remained evident, that whilst the network was quite capable of delivering an operational service, many of the data users and managers considered the systems and outputs in the research and development environment. Thus in 2011 the Met Office, under the direction of the E-WINPROF programme, undertook the operational acceptance of the CWINDE (renamed to E-WINPROF Hub) service. Whilst primarily this focused on the IT systems, process and documentation within the Met Office, it also considered the end-to-end data chain. By the end of 2011 the E-WINPROF Hub was granted a pre-operational licence by the Met Office and full operational status is expected before the end of 2012. Figure 1, shown earlier, provides a schematic of how this system is configured within the Met Office.
The Future

And with operational acceptance (transition to operations) it does not end there. The process and system should remain under continuous review, checking for problems, improvements and redundancy. The Met Office has adopted a set of practices called ITIL (Information Technology Infrastructure Library) which is used to manage, develop and approve all its IT services and the observations networks, substantially dependant and utilising IT systems, are required to adopt the same practice. Figure 6 shows the ITIL concept for the life-cycle of a service, linking the design, transition and operations in a cycle, along with all the key components that feed in and influence that process.

Figure 6 – ITIL life-cycle of an IT Service.

For the European wind profiler network a number of areas are being developed and discussed as follows, any of which would need to go through the change process should they be required to become part of the operational service:

- Inclusion of other instrumentation in the data-hub.
- Change to the BUFR code.
- Improved quality management including blocking of data from onward transmission.
- Redundancy of hub service across different physical locations.
- The Met Office has initiated a software convergence project, which is looking at a common IT solution for all 'Observations data-hubs' and creating a standard method for data ingestion and dissemination.