CONCEPT OF OPERATIONS (CONOPS) for end-to-end agrometeorological actionable advisory service

Ideally, the **development of a Concept of Operations (CONOPS) is the first step in the integrated agrometeorological hazard early warning system** engineering life cycle or any system, or modernization of NMHS. It will form part of the Roadmap, which is a more detailed and comprehensive document that includes a diagnostic assessment and a phased implementation plan covering short-, medium-, and long-term stages to achieve the overall goal. The CONOPS is a higher-level document, typically no more than 15–20 pages, designed for policymakers. It provides an overview of the key steps and includes a snapshot of the current and proposed systems. Not only does the development of CONOPS facilitate systems engineering for any needed infrastructure, it also provides a methodology with which to validate the success of that effort once the system is operational. A well-developed CONOPS helps to lower the risk of technical, political, and economic failure by conceptualizing the fully integrated, end-to-end systems operations as a means to guide the implementation of equipment, hardware, software, and training packages. As we consider the advances in AI-based technologies to support the forecast and communication of information for agricultural use cases, a CONOPS can help guide us to discuss where these technologies may fit within the larger early warning system (EWS) and additionally support us to collaborate more broadly across organizations with different standard operating procedures.

A CONOPS describes the desired operation of a system by using the terminology of its users, and it provides essential information for the acquisition and/or development of new components. Given that a CONOPS answers the who, what, when, where, why, and how for a system, it should be a document accessible and useful to all stakeholders, regardless of their technical background or role within the system.

A CONOPS for an agromet advisory system should provide a clear picture of the EWS, describing its operation in the terminology for different perspectives (forecasters and users). The CONOPS consists of a description of the configuration of data networks, database, modelling, communications, forecaster and communicator (e.g., extension agent) education and training, dissemination approaches, products issued, etc. It answers the questions of who, when, where, why, what, and how of the future EWS as shown in Figure 1. Frequently, much of this information is already documented in the existing “Operations Manual” of both NMHS and the Ministry of Agriculture and may be supplemented and/or modified to reflect the future system.

It may include identification and discussion of the following:

1. Why the new system is needed (such as observing systems, risk and vulnerability assessments, Impact Based Forecasting, forecasting systems, and a brief overview of the system itself;

2. The full system of systems life cycle (every component of the system) from deployment through disposal or replacement.

3. Different aspects of system use, including operations, maintenance, support, and disposal;
4. The different classes of users, including operators (forecasters), maintainers (technicians), supporters (such as Disaster Managers and the media), and their different skills and limitations;
5. The environments (Forecast Workstation at an NMHS) in which the system is used and supported;
6. The boundaries of the system and its interfaces and relationships with other systems and their environments;
7. When the system will be used, and under what circumstances;
8. How and how well the needed capability is currently being met (typically by existing systems);
9. How the new system will be used, including operations, maintenance, and support;
10. What specific products will be provided and to whom:
11. How forecasts and warnings will be disseminated and to whom; and
12. Scenarios illustrating specific operational activities involving the use of the system.

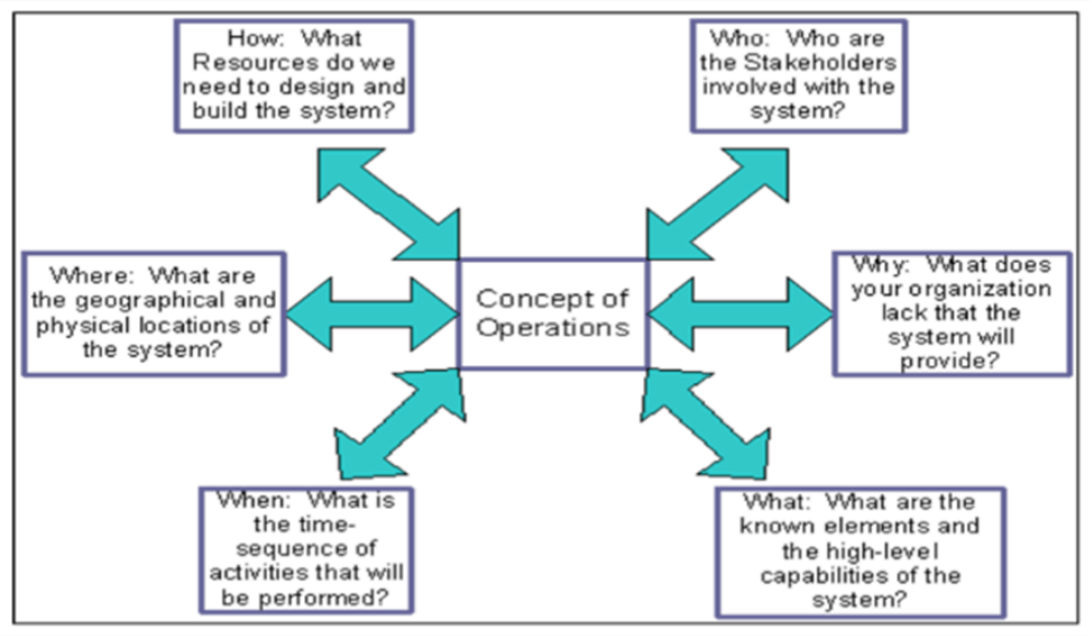
The process of developing a CONOPS should ensure that there is consensus among all stakeholders so that everyone among them understands and supports the proposed system; risks are reduced by ensuring every aspect of the system is determined before it is developed, procured or implemented; and quality improvement is built in by taking every opportunity to leverage existing and new infrastructure to increase system performance. The CONOPS developed for a country defines the design, implementation, and end-to-end operation and maintenance of the system and its components. These include observing networks, data collection, analysis, management and archiving, forecasting, warning product generation, Information and Communications Technology, and delivering products and services that meet users' requirements. The CONOPS identifies the products and services required for various decision makers and the necessary infrastructure, processes, and human and financial resources to support the systems and provision of those services, as well as the dissemination of the products, including warnings to users.

The EWS CONOPS needs to be a readable, comprehensive, and guiding document that enables all stakeholders – both strategic and operational – to understand the who, when, where, why, what, and how of the EWS. The CONOPS also identifies which agency has lead responsibilities for each activity and which are supporting efforts.

The responsibilities and activities should be clearly and unambiguously defined in a series of standard operating procedures (SOPs). A SOP is a set of step-by-step instructions used by staff

to carry out a complex set of operations. SOPs aim to achieve efficiency, quality output, and uniformity of performance, while reducing miscommunication, errors, and failure. A significant benefit of a well-constructed SOP is that it ensures continuity with staffing changes, so that successful completion of tasks does not depend on corporate memory or knowledge held by a few key individuals. SOPs, if followed, provide a level of protection to a hydrometeorological centre in the eventuality of unanticipated events arising. The procedures outlined in an SOP should be invariant, regardless of the nature of the event, that is, whether the cause is natural or human in origin.

Figure 1. Sample CONOPS questions



Annex 1. CONOPS Checklist

The following suggested checklist is not intended to be exhaustive or prescriptive, but only an example of good practices for the CONOPS development.

At a minimum, agromet hazard EWS CONOPS should include the following elements:

Documentation

- ☐ Distribution List: every person who must receive a copy of the CONOPS
- ☐ Revision List: addenda and revised drafts that have been released since the original draft was released
- ☐ Associated Documentation: all manuals, guidelines, or policies that support the CONOPS
- ☐ References and Sources: who and what were consulted in the preparation of the CONOPS

Introduction

- ☐ Scope: the vision, purpose, and scale of the system
- ☐ Description: an understandable and straightforward definition of the system
- ☐ Priorities: the priorities to be addressed by the system
- ☐ Method: the process used to develop the CONOPS
- ☐ Contributors: names and affiliations of all those involved in developing the CONOPS
- ☐ Glossary of Terms: the meaning of all key terms used within the CONOPS
- ☐ List of Acronyms: the complete spelling of all terms abbreviated within the CONOPS

Strategic Framework

- ☐ Mission Statement: clear, succinct articulation of the ultimate deliverables of the system
- ☐ Policy Mandate: basis for the NMHS to deliver the mission requirements
- ☐ Goals & Objectives: specific, measurable, attainable, realistic, and time-bound
- ☐ System Definition: the system's description, in simple and understandable terms.

Operational Framework

- ☐ Facilities: identification of all existing and new infrastructure required for the system to become "operational"
- ☐ Roles and responsibilities: description of each subsystem operator's contribution at an operational level
- ☐ Staffing: listing of all staff required to operate the system successfully, in both the short and long-term
- ☐ Skills Development: description of the training, exercises, and drill regimen necessary to ensure long-term system sustainability
- ☐ Communications: description of the primary and redundant channels through which information will flow between and beyond each subsystem
- ☐ Data: inventory of the information requirements of each subsystem, including the need for historical data for model calibration as well as real-time data for agromet forecasting
- ☐ Models: description of hydrometeorological models used to generate various agromet forecasts

- ☐ Products and services: definition of the various outputs generated by the system
- ☐ Hardware: description of the system's technological infrastructure and hydrometeorological sensors, including gauge, radar, and satellite networks
- ☐ Software: description of the application and operating packages used by each subsystem
- ☐ Maintenance and replacement: prediction of the maintenance requirements and longevity of each subsystem
- ☐ Research and development: provision of the framework for involving system operators and other partners in the development of applications
- ☐ Outreach and public education: identification of the strategy for ensuring strong community-level participation in the success of the EWS

Appendices

- ☐ Overall System and Subsystem Diagrams
- ☐ Operational, Maintenance, and Replacement Budget Plans

Important Points to Remember about CONOPS Development

- Development of a Concept of Operations is the first step in the Integrated agromet hazard early warning system engineering life cycle that will become part of the EWS ROADMAP.
- Every CONOPS is a unique and "living" document that requires input from all stakeholders and regular maintenance.
- A CONOPS attempts to answer, using relatively simple language, a system's who, what, why, where, when, and how.
- Don't take shortcuts with developing a CONOPS – it requires serious, devoted attention by strategic and operational personnel in order to be effective.

Annex 2. Interoperability Framework

When implementing the project, at the next stage, it is necessary to ensure that the implemented technical, scientific, and operational solutions of absolutely all components of the system are functionally compatible, that is:

- The ability to function freely without technical support from the software manufacturer,
- The use of the software must not be limited by a commercial contract,
- The software must allow technical support to be provided by IT specialists of NMHS or another third-party organization,

The program code (or modular structure) of the software must allow a specialist to make changes if necessary; that is, there must be either open program code or a modular structure that provides the user with various options for using the software.

The basic principles of interoperability for methods, models, and platforms used to solve operational agrometeorological problems based on the basic criteria for the use of models and platforms for agrometeorological advisory service are:

- Used in the operational practice of agrometeorological forecasts,
- Freely available (non-commercial products),
- Competitive organizations with the computing resources they require,
- Availability of training materials,
- Technical support is available if needed,
- There is an interface for interaction with other software tools,
- Reliability and stability of operation
- There are quality control results and examples of software implementation.