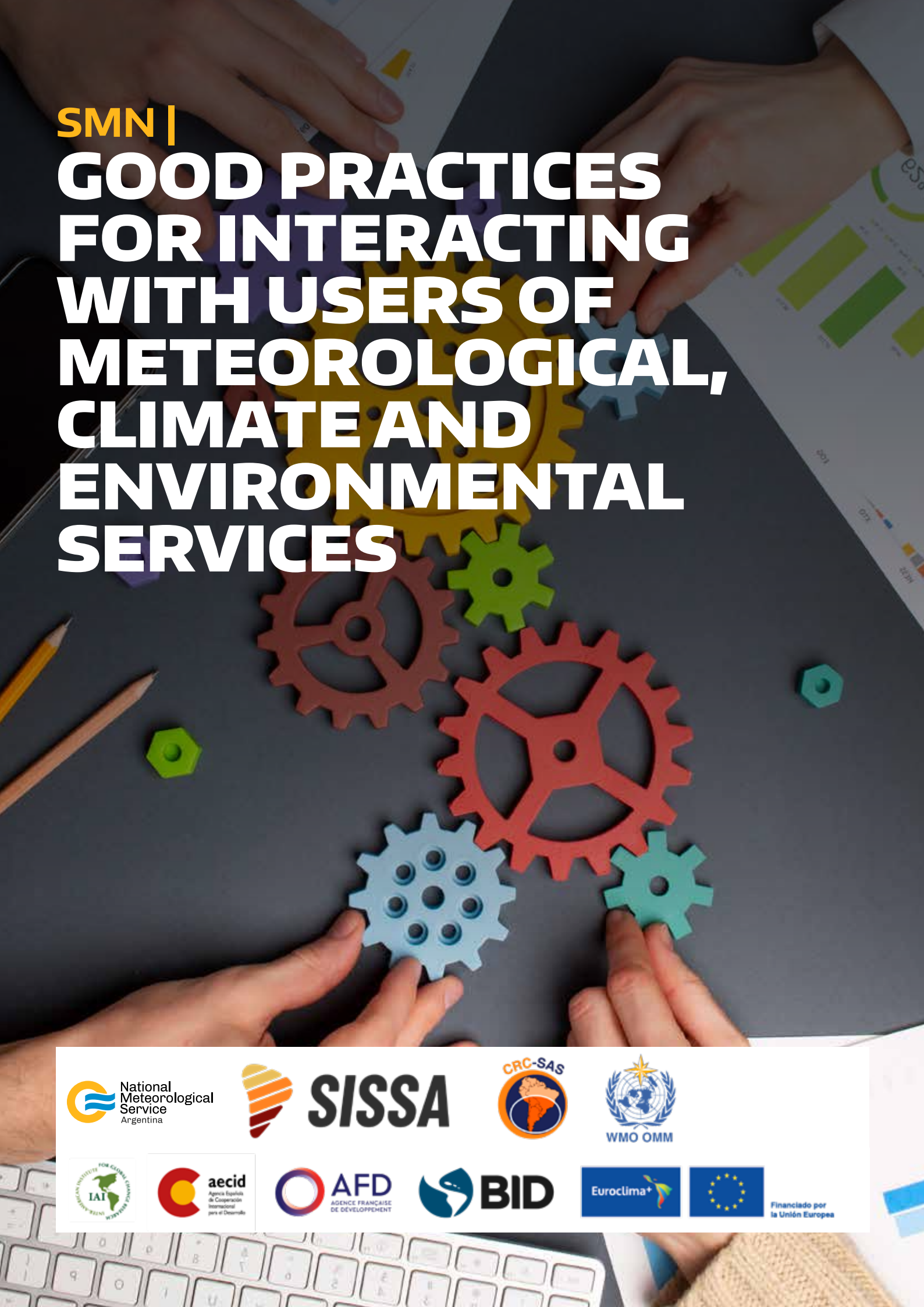

SMN |

GOOD PRACTICES FOR INTERACTING WITH USERS OF METEOROLOGICAL, CLIMATE AND ENVIRONMENTAL SERVICES

National Meteorological Service Argentina

SISSA

CRC-SAS

WMO OMM

IAI

aecid

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

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Financiado por la Unión Europea

SMN |

GOOD PRACTICES FOR INTERACTING WITH USERS OF METEOROLOGICAL, CLIMATE AND ENVIRONMENTAL SERVICES

Produced by
Meteorology and Society Department

Team Leader:
Daniela D'Amen (SMN)

Work Team:
Priscila Sosa, Julián Goñi and Matias E. Menalled (SMN)

External collaborators:
Pamela Scanio (FFyL-UBA), María Inés Carabajal (FFyL-UBA)

Reviewers:
Claudia Campetella (SMN)
Cecilia Hidalgo (FFyL-UBA; SISSA)
Lorena Ferreira (SMN)
Alejandro Godoy (SMN)

Translation:
Muriel Morgan (UNLZ)

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Guadalupe Cruz Díaz (SMN)

Introduction

One of the most relevant challenges currently faced by operational and scientific institutions is producing meteorological, climatic and environmental information to assist strategic decision making by various users. Despite great advances in atmospheric sciences, there is still a gap between the production of information, its use and social appropriation. The magnitude of the challenge requires new approaches that include social and human dimensions in the production, circulation and use of information, integrating different experiences with the horizon of knowledge co-production. This is illustrated in the following figure of the 'Value cycle and co-design of weather and climate services", which is currently widely disseminated (Figure 1).

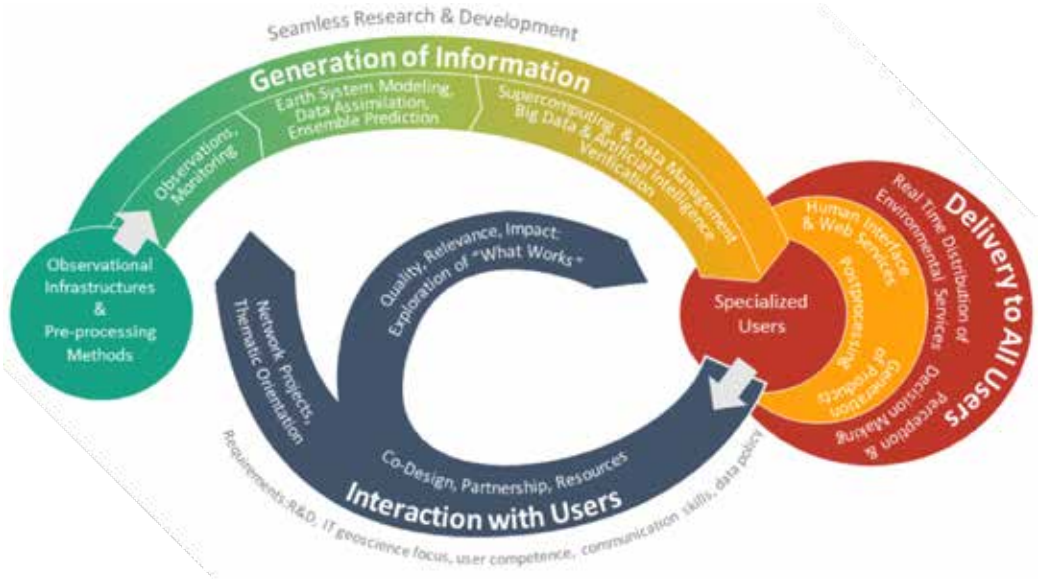


Figure 1: Value cycle and co-design of weather and climate services. Adapted from "Advancing Research for Seamless Earth System Prediction" (p. 27), by P.M.Ruti et al, 2020, Bulletin of the American Meteorological Society 101, 1; 10.1175/BAMS-D-17-0302.1.

Over the last few years, a user approach has become one of the central links in institutional work agendas for improving weather and climate services. The category 'user' is broad, heterogeneous and currently under review. In general terms, they are classified into 'intermediate' users -those who use the available information and translate it to a particular sector or territory- and 'final' users -the decision-makers. A distinction can also be made between 'external' and 'internal', depending on requests and exchanges of information taking place between an agency and other institutions or between departments of the same agency.

However, one of the most highlighted limitations for employing the user category, according to reference bibliography, is its suggestion of an asymmetric and unilinear producer-user relationship. Meaning an asymmetric relationship between those who generate and process weather and climate information and those who use it. On the contrary, we wish to demonstrate throughout this document the multiplicity of interactions (interdisciplinary, interinstitutional and intersectoral) and roles that converge in knowledge co-production to generate products and provide for services. Currently, new denominations have emerged, such as 'partners' or 'collaborators' that reflect and encourage more horizontal and symmetrical work dynamics with social, sectoral and institutional actors involved in the process. How to define users, their needs and expectations, how to generate sustained dialogue frameworks over time and exchange information on the use of available products and services are central questions for producing timely and tailored information, promptly and relevantly.

The present document: 'Good practices for interacting with users of meteorological, climate and environmental services' is the result of one of the initiatives included in the Strategic Plan 2020-2023 of the National Weather Service (SMN) . It emphasizes the importance of producing services tailored to users, the contribution to informed decision making and the strengthening of the entire value chain of meteorological, climate and environmental information. The paradigm of co-production currently permeating the National Meteorological and Hydrological Services (NMHSs) of the World Meteorological Organization (WMO) proposes a substantial change with respect to the traditional model, by considering interaction with users as a key element for improving the quality of products and service provision. The renewal and update promoted by the WMO aims to leave behind a linear model, in which scientists and professionals of atmospheric and hydrological sciences generate developments that are simply transferred when finished to the recipients. Also, both products and services are common to a wide range of recipients. As the generation of new developments and technologies needs to overcome the gap between producers and final recipients, a relational

perspective is growing and wide spreading. It postulates the need to involve a multiplicity of actors during the different stages of co-production, from co-design to co-implementation. This change in the way scientific-technological development and knowledge production is conceptualized, seeks to strengthen collaborations, reinforcing and validating those official institutions responsible for forecasts and warnings, by providing timely and usable services. In a context of climate change and in line with ongoing transformations, the SMN incorporated in its strategic vision the promotion in society of information about weather and climate. Thus, the intention is that the population will be able to make decisions by knowing risks and carrying out actions which will contribute to achieve sustainable development objectives. In part, this is possible with the incorporation of interdisciplinary work between sciences that study the Earth and social and human sciences, combined with intersectoral work between institutions and decision-makers. These interactions and collaborations open the possibility of answering central questions for a national weather service: how to improve the quality of meteorological, environmental and climate information? In what ways can the use of weather and climate forecasts in decision-making be increased? What strategies can be used to integrate users and increase knowledge of their needs and the way they use the information?

The given mission of NMHSs is not limited exclusively to generating accurate, quality and reliable information, but also involves the responsibility of understanding the needs of users in order to improve a service oriented to decision making. So, it is essential to have the appropriate capabilities to meet these objectives. The fact that Argentina's SMN has a document on 'Good practices for interacting with users of meteorological, climate and environmental services' favors the dissemination and consolidation of this perspective of knowledge co-production, by improving processes as well as products and services.

Throughout the text, a conceptual approach is proposed, capable of facing the current challenges faced by the SMN, of improving the quality of the information and its appropriation by different sectors of society. At the same time, it presents a wide range of strategies, resources and successful cases to provide practical and useful tools for designing and planning of initiatives that consider intermediate and end users in a transversal manner at all levels.

'Good practices for interacting with users of meteorological, climate and environmental services' takes into account the complexity of a user approach, by applying an interdisciplinary perspective between social and human sciences, atmospheric sciences and environmental sciences. In this sense, it emphasizes that no discipline or social sector can address knowledge co-production and decision making in isolation, nor are there specific procedures that guarantee success. Therefore, this document provides techniques and tools to promote interdisciplinary and inter-institutional reflexivity to increase social ownership of knowledge. It should also be noted that this work process necessarily requires the intervention and direct involvement of professionals from different disciplines who have the capacity to contribute with their knowledge and experience. Each case involving the interaction between different social and institutional actors whose goal is to coproduce knowledge has its own particular characteristics. They may connect different departments, social and/or institutional actors, so it is suggested to refer to specialists and professionals with experience and who can provide the necessary support each context requires.

The structure of the text consists in an introduction, four chapters and final comments. The first chapter presents a recap of the state of affairs in Argentina's SMN. It is based on a survey made in 2021 regarding the Agency interaction with different users that employ weather and climate forecasts and services. Chapter 2 deals with various methodological tools for approaching and working with users in accordance with their specificities and their needs. Chapter 3 proposes strategies to produce information and systematize relevant data as inputs to define a work and coordination agenda. The last chapter consists of guidelines for the analysis of the information and the presentation of results, to facilitate evidence-based decision making. The final comments provide a synthesis of the content and reinforce the documents' perspective for future applications. At the same time, throughout the text, informative boxes are presented in a transversal way with concrete cases, outstanding work experiences and lessons learned in Argentina's SMN. These sections are part of the results produced during the diagnostic survey presented in the first chapter.

We hope that these guidelines and work proposals will contribute to improve the quality of services, favoring an integral and complex approach to the multiple dimensions and points of view which converge in the generation and communication of weather and climate services.

[1] The Spanish acronym 'SMN' (Servicio Meteorológico Nacional) will be used hereafter.

Chapter 1. Diagnosis

As the first step in 'Good practices for interacting with users of meteorological, climate and environmental services', a diagnostic report was prepared on the current status (2021) of the SMN and its users, regarding the production and circulation of climate and meteorological products and services. The work was carried out in collaboration with fourteen departments of the SMN and its objective was to build a baseline that would allow the design of this document, drawing on the extensive experience that the organization has had in liaising with users.

During the first months of 2021, virtual workshops were held with each of the departments. Before the synchronous meetings, participants filled out a brief survey which was used as the initial input to create, during video conference, a summary of products and/or services, identification of users (internal deparments of the SMN and external users) and interaction modalities (channels, frequencies, intensity, type of products and services circulating).

Once the workshops were completed, a file was created for each departments, based on the gathered information. The significant results of the exchange were summed up and the type, directionality and intensity of the interactions with users and collaborators were characterized. In order to provide qualitative results with a graphic dimension, a strategy of Social Network Analysis (SNA) was applied, in collaboration with each of the departments, to represent the web of internal and external interactions involved in obtaining data, generating products and providing meteorological and climate services. The information gathered was organized in databases of actors and interactions. Graphs of the work networks of each one were constructed, obtaining the institution's total network when integrating them.

In the following, we will show a synthesis of qualitative results and the analysis of the graphic representation of relationships, highlighting some issues around the current interaction between internal and external users of the institution such as: the complexity of the user category, the way in which relationships are built and sustained, the inter-institutional impacts of co-production, the design of 'tailor-made' products, and the importance of feedback.

1.1 THE COMPLEXITY OF THE USER CATEGORY IN THE DEPARTMENT'S WORKING NETWORKS

The "user" category is complex and heterogeneous. Each department of the institution establishes working and collaborative relationships of various characteristics with a wide range of actors. Differences were identified between qualified users (often from academic sectors), companies, public organizations, the media and the so-called 'general public' (an even less known user and more difficult to characterize). Depending on the relationship established with each of them, their frequency, intensity and reciprocity, they are classified into different roles: clients, requesters, collaborators, suppliers, historical partners, intermediate users, decision-makers, internal users, external users, interdependent actors. A distinction is also made between effective users who are already in contact and identified by the departments, and potential or unknown users who are more difficult to reach but who are also to be included in the network. This heterogeneity accounts for the complex interdisciplinary, interinstitutional and intersectoral interactions aimed at the co-production of timely and useful knowledge.

[2] Internal document: "Interactions between SMN departments and internal and external users of meteorological and climate products and services" (2021).

[3] Directorate of Aeronautical Meteorology (DMA), Directorate of Technological Infrastructure (DIT), Directorate of Observation Networks (DRO), Press and Citizen Communication (PCC), Directorate of Meteorological Operations and Communications (DOC), Directorate of Meteorological Information Processing and Support (DPS), Volcanic Ash Warning Center (VAAC), Directorate of Sectoral Services (DSS), Meteorological Information Center (CIM), Directorate of Environmental Modeling and Remote Sensing Products (DMSR), Central Climate Monitoring Directorate (DCMC), Directorate of Weather Forecasts and Warnings (DPTA), Coordination of Regional Forecasts (CPR), Coordination of Immediate Forecasts (CPI) and Meteorology and Society (MyS).

[4] Theoretical-methodological approach to social sciences that applies elements of graph theory and matrix algebra to the study of the social world (Molina & Schmidt, 2003; Knoke & Yang, 2008).

Collaborative network mapping showed that to adequately represent the institution's experience it was necessary to assign directionality to the connections (arrows with an origin and a destination) based on the direction of circulation of the information (back and forth or only in one direction), as well as a differential weight (thickness) depending on their intensity and frequency (Figure 2). By visualizing as a whole the entire constellation of different types of interactions in the daily work of the institution, the mapping of relationships gave volume to the user category.

The databases of actors and the interaction maps (networks) obtained, allowed in a first instance:

→ To characterize the interactions of the different departments of the SMN with internal and external users of meteorological, climate and environmental information products and services.
→ To easily view the number of relationships that are established in the departments' daily work, as a result of their tasks and functions: departments dedicated to data systematization and development of meteorological and climate products do not usually have as many relationships as those in charge of public communication.
→ To determine whether they are departments with an internal coordination role (most of their relationships are inward - cyan color), external coordination (most of their relationships are outward - magenta color) or intermediary (parity between external and internal relationships) (Figure 2).

We thus corroborated that each department has its own particularity, determined by multiple factors, such as the type of tasks they carry out, the working team, their objectives and history: there are departments especially in charge of receiving information requests and assembling products on demand, other departments specially created to strengthen contact with users, others dedicated to the improvement and maintenance of internal processes, others to monitoring, others to the development of forecasts. This diversity of characteristics among its participants represents an institutional capital for the fulfillment of the organization's tasks and objectives. Knowing the specificities of the relationship map and its participants allows one to design strategies that will take into account the strengths and weaknesses of the organizational structure, the different roles and functions, and the complementarity between them.

1.2 HOW ARE RELATIONSHIPS WITH USERS BUILT IN THE INSTITUTION'S NETWORK

Another significant element identified by this diagnosis, is that on many occasions relationships with users, both internal and external, are often initiated as a result of a problem or malfunction of a product or service; in these cases we speak of 'on-demand interaction'. Among the problematic situations that build or strengthen relationships are the impacts produced by meteorological or climatic events, as can be observed in the case of a drought, which led to the construction of new tools, new instances of collaboration and knowledge co-production.

Relationships may be eventual, periodic, permanent, standardized or ad hoc. Channels used between di-

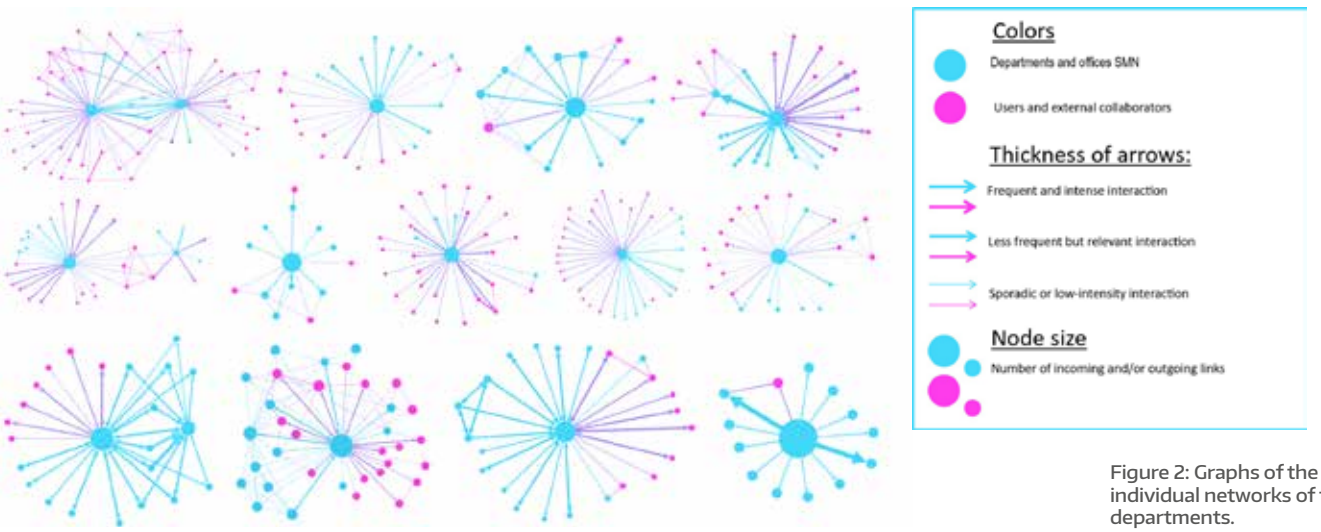


Figure 2: Graphs of the 14 individual networks of the departments.

fferent actors also influence the frequency, intensity and sustainability of relationships. It is recognized, for example, that frequent virtual contact, because of Covid-19 pandemic, has strengthened relationships, especially with meteorological stations and offices distant geographically.

A central objective for the SMN is to guarantee the availability of high quality information. For this reason, the channels to circulate information are extremely relevant and many of the departments aim towards the consolidation of quality criteria and processes standardization. Although different departments have their tasks highly standardized and protocolized by international organizations (WMO, ICAO), others do not have structured procedures. They consider it essential to build them in order to improve services to users' requests.
It is possible to reconstruct the total flow of information, products and services, by aggregating and unifying the departments' graphs into a single network (Figure 3). This general map makes it possible to view and measure: the structure and logic of the network through which meteorological, climatic and environmental information circulates, the density of interactions, the volume of external and internal users, the magnitude of external users shared by more than one department, the key or central actors, the most connected sub-regions, the differential distribution of stronger relationships in the center of the network and of weaker ones in its periphery, the robustness of the relationships or resilience to the loss of relationships. It also complements the analysis of each department's networks by placing them in a general context, where it is possible to observe the subgroup they are most involved with, their role within the flow of interactions and their relationship with external actors (whether it is direct or mediated through other departments).

1.3 CO-PRODUCTION AND COMMUNITIES OF PRACTICE IN THE INSTITUTION'S NETWORK

The department gave testimony of multiple and varied experiences of co-production of products and services. The most successful experiences are those in which actors know and interact with each other, and are sustained over time. Generally, a new project or initiative generates new ties and, at the same time, strengthens those previously established. Successful co-production also tends to predispose to the joint undertaking of new projects and initiatives, consolidating those stable work subgroups which achieve useful results.

Once the map of relationships has been completely reconstructed, it is possible to apply a clustering algo-

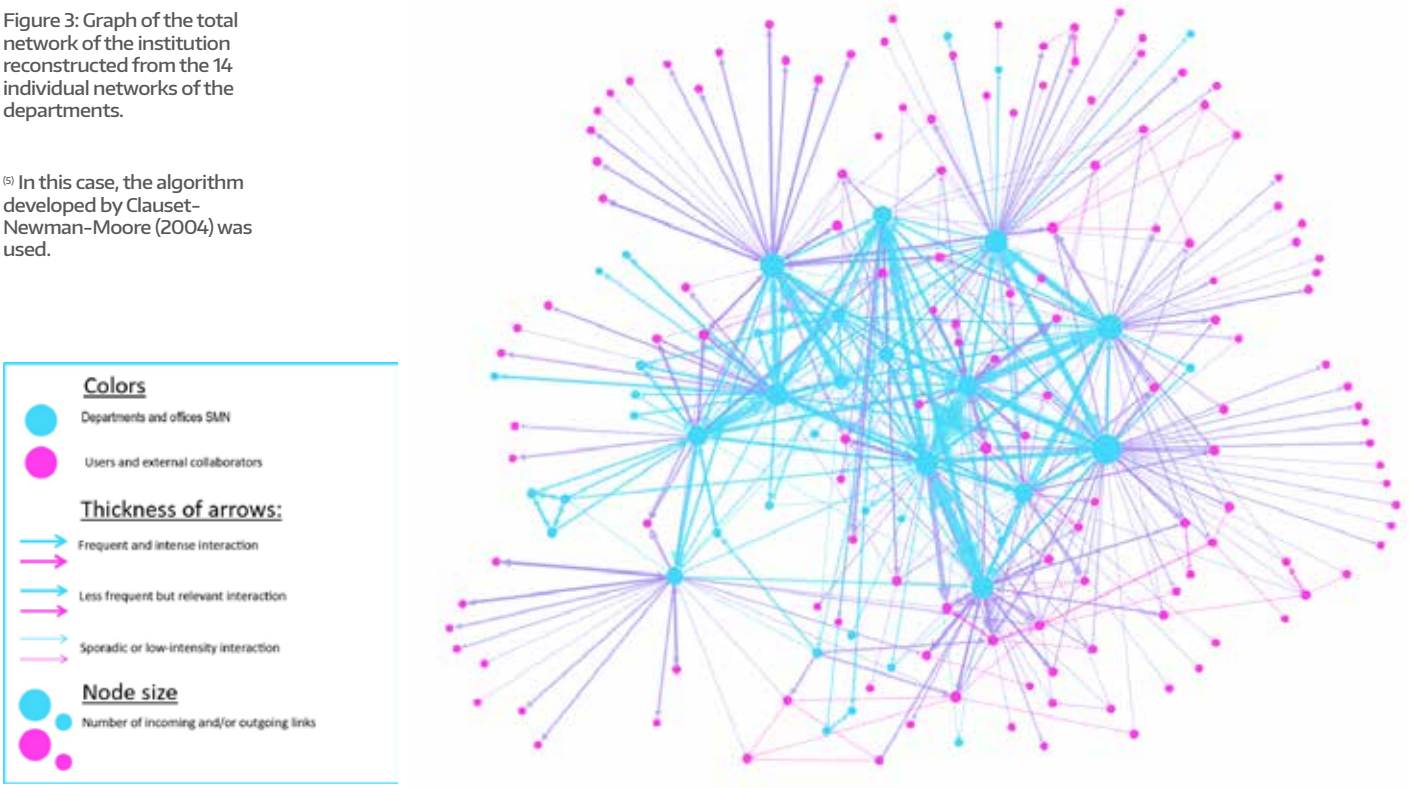


Figure 3: Graph of the total network of the institution reconstructed from the 14 individual networks of the departments.

[5] In this case, the algorithm developed by Clauset-Newman-Moore (2004) was used.

rithm: a mathematical procedure that detects regions in the general structure of the network that are more connected to each other than, i.e. communities or subgroups. It is possible, with this strategy, to identify the enclaves of stable work and exchange in the organization's daily life, the communities of practice (Étienne Wenger, 2001), which go beyond the formal structures established by the organization chart.

The network of the institution is composed of 7 communities (represented with different colors in Figure 4) gathered around the 14 departments of the SMN (internal users) that were mapped (represented as larger nodes). As it can be seen in the graph, some of these communities include one of the departments, others two, and another one four. On the other hand, 5 of these subgroups are located on the periphery, working with specific sectors of external users, while the other 2 groups are located in the center of the network, fulfilling a role of coordination and intermediation for the institution and its internal and external users.

1.4 'TAILORED' KNOWLEDGE

Addressing different types of users is a central issue in the agendas of the SMN's units, as they are all committed to improving the provision of weather and climate services on a daily basis. The institution's workers express interest and concern for knowing and adapting to the needs of specific users, they seek to understand decision making contexts, to determine which are considered key moments to receive information and which are the temporal and geographical scales of interest.

Making customized products for different users requires frequent interactions. This implies a greater vo-

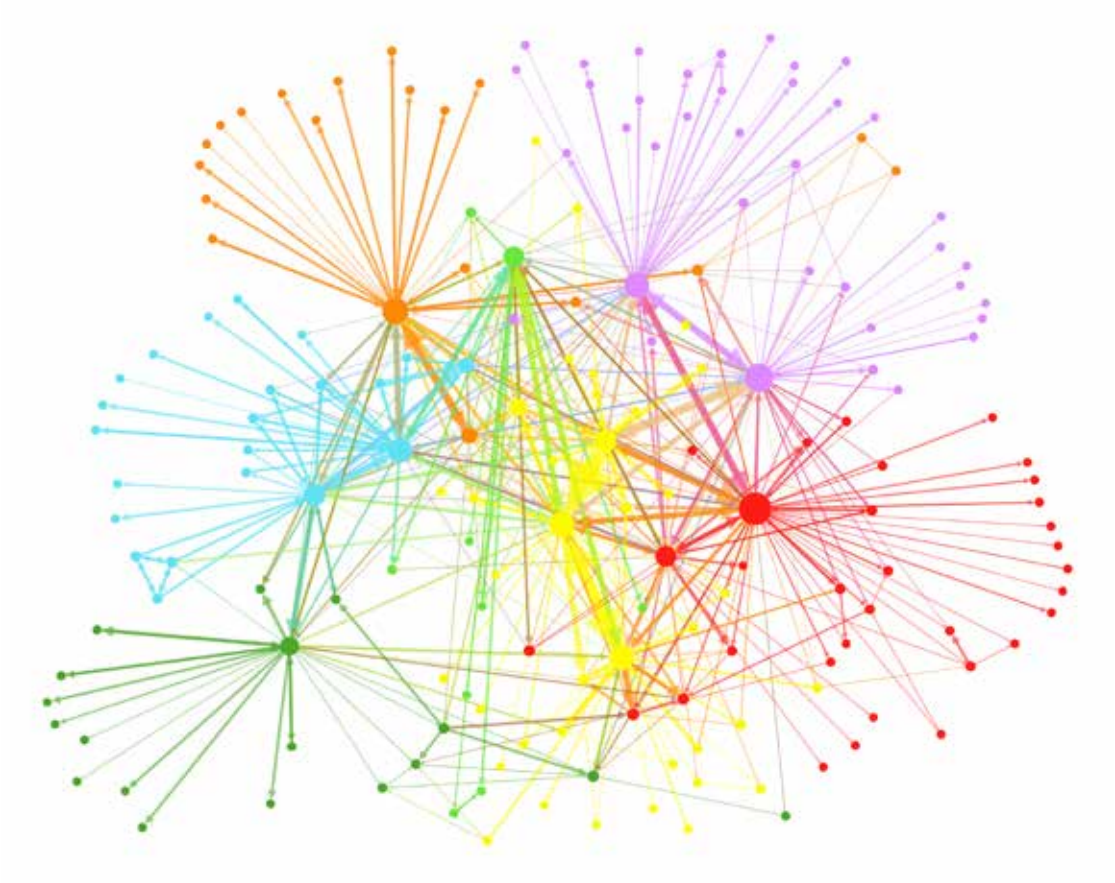


Figure 4: Graph of the institution's total network colored according to the subgroups identified through clustering algorithm.

lume of work, since not only information is provided, but also support and advice beforehand so that the applicant can specify his or her request. Building a common language is important, given the frequent problems of interpretation, as well as the adaptation of generic products to the needs of specific territories and users. As we will see in some experiences throughout the document, workshops are held to pursue these objectives, to refine products in line with various needs, and/or to communicate the product's usefulness.

An analysis on how the network is related to each user category can be obtained by superimposing the general map of the institution with nodes classified according to different criteria, such as the sector to which they belong (public, private, intergovernmental or NGOs) or the activity they are engaged in. The SMN is related to users engaged in 22 types of activities in different sectors such as: agriculture, disaster risk management, aeronautics, energy, water resources, health, transportation, security, judicial, public and private works, and academic research and/or training to communicate the usefulness of the products.

The maps colored by activity and sector, analyzed in conjunction with the map showing the communities or clusters, allow a deeper understanding of the structure and logic of information circulation between the SMN and its users. For example, the total network colored by department (Figure 5) shows how the "Cycle of value and co-design of weather and climate services" (Figure 1) works in the institution's practice. The part of the model which refers to "information production" corresponds to the center of the network, where the actors involved in meteorological data and infrastructure are located; "interaction with users" can be seen in the network's core, where the relationships between internal and external collaborators dedicated to the different activities are strong, while "reaching all users" can be seen in the peripheral links that account for collaborators less involved in the co-design and co-production process.

Additionally, the graph makes it possible to distinguish between regions of the network with a predominance of the same color, focused and specialized in a specific activity (aeronautics, disaster risk management, agriculture and livestock, and water resources) and regions that include mainly the departments of media and communication, which function as disseminators/spreading of information to users of multiple activities, detectable in regions of nodes of various colors.

1.5 "KEY" PARTICIPANTS IN THE INSTITUTION'S NETWORK AND THE IMPORTANCE OF FEEDBACK

A recurring concern of several network participants is the receipt of feedback from the different users. Often this feedback is absent and communication is unidirectional, unless there is a problem with a particular

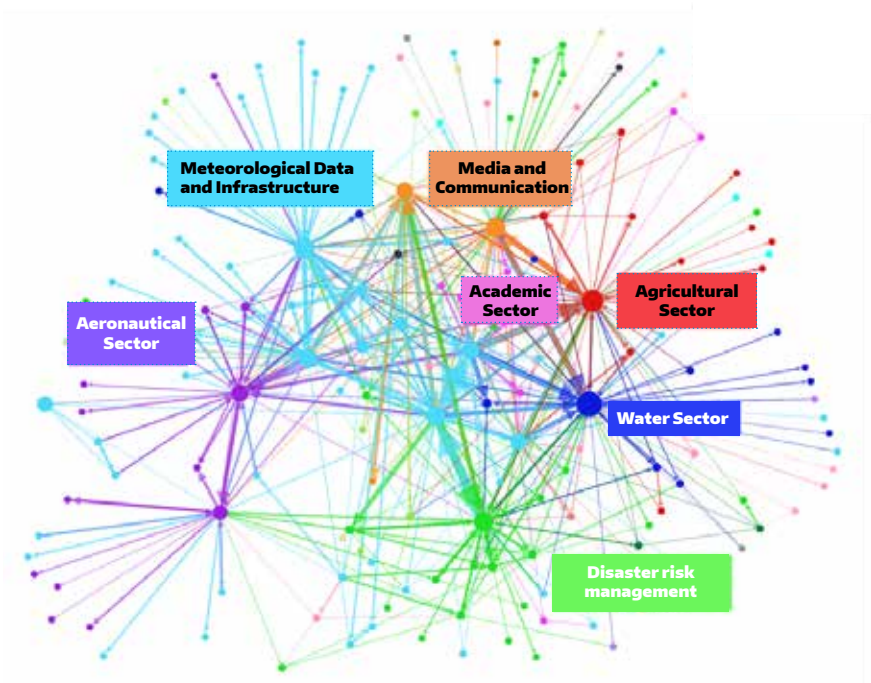


Figure 5: Graph of the institution's network colored according to which sector the users belong to.

product or with the access to it. In general, it is not known if the information is used or even received. It is frequently expressed by the departments that they need to "go out to look for feedback", by means of surveys, forms, communications. In this sense, the need to move towards more standardized communication procedures is also highlighted.

Through the displays it is also possible to assess the level of feedback in the network, identifying users with whom there are assiduous and bidirectional relationships, and regions in which information circulates in only one direction. In the institution's network (Figure 6), on the one hand, there are key sectors, critical users, who receive little feedback and who, if removed, would cause breaks in the network (as they are the only intermediaries between different regions) or would have a strong impact on its connectivity. Central nodes are also identified, concentrating the largest volume of feedback links and playing the role of coordinators or nodes. In addition, it is easy to recognize the group of external allies that not only collaborate assiduously with the institution, but also maintain bidirectional relationships with more than one department of the institution.

This type of diagnostic mapping gives the departments the possibility of viewing the institution's action scenario, identifying and recognizing their own position, which projects, initiatives or events strengthen or weaken the network, and defining strategies of action and intervention. Once the mapping has been reconstructed, the relational needs of the institution can begin to be recognized. Then, decisions can be made about the new relationships it should establish, which should be strengthened and how to prioritize these interventions.

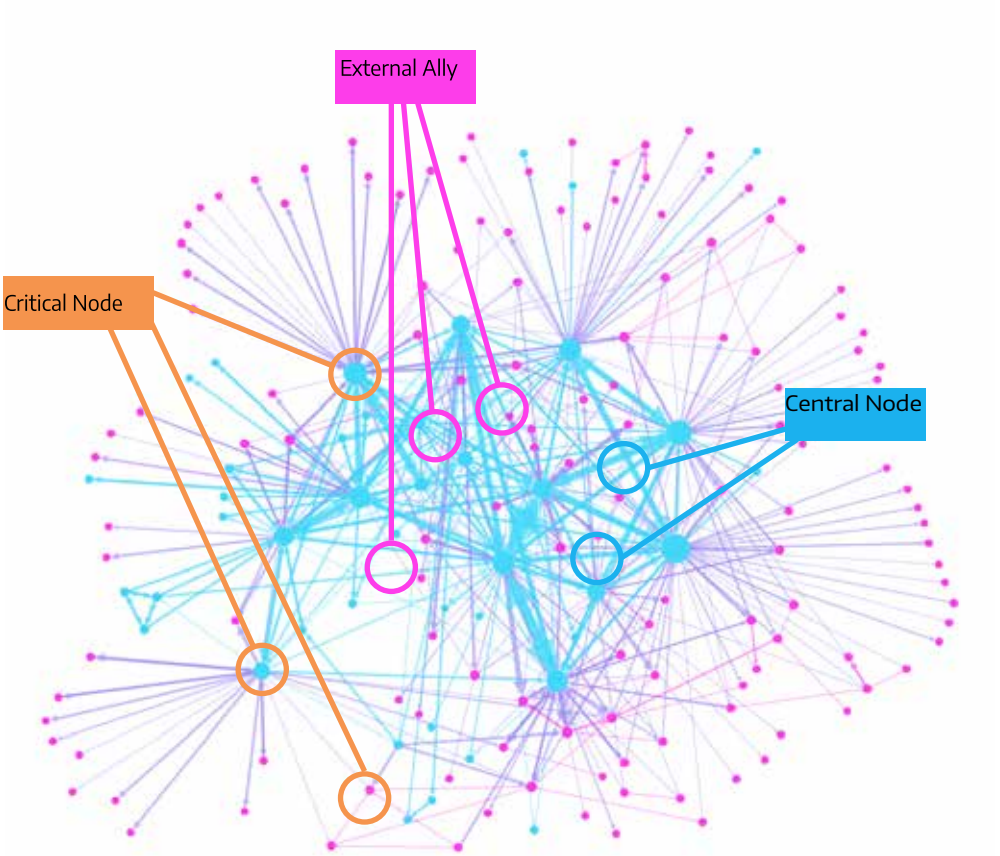


Figure 6: Graph of the institution's network colored according to which sector the users belong to.

LESSONS LEARNED
1. Coordination initiatives improve services and 'open the door' for new guidelines.

The positive impact of user interaction is often not limited to the scope or objectives of a particular project in question, but gives rise to new initiatives that had not been thought of. Such was the case of the strong interaction developed between the Central Climate Monitoring Directorate (DCMC) and the public health sector. First, a group was established between the National Weather Service and the Ministry of Health to analyze the exposure to heat waves and the conditions for the propagation of dengue vectors. As a result of this interaction, significant results were achieved: relevant variables were identified for the case study (such as humidity associated with vectors), spatial and temporal scales of the products were adjusted according to epidemiological criteria and the needs of the sector, and the Early Warning System for Heat Waves and Health (SAT-OCS) was implemented.
The implementation of the SAT-OCS was a process that involved several stages and the participation of different actors. Initially, DCMC collaborated in the study that established the relationship between health and climate in order to develop the necessary criteria. However, to carry out the development, implementation and operation of the product, it was necessary to count on the participation of the Directorate of Weather Forecasts and Warnings (DPTA) and the Directorate of Meteorological Information Processing and Support (DPS). These internal relationships made it possible to complete the service and broaden its scope.
As a result of this initial collaboration, the relationship was steadily strengthened and important advances were made in connection with the initial problems. Also, new guidelines were identified, broadening the scope of the association. It is worth mentioning the connection with the Association of Hygienists of Argentina, with results such as categorizing the risk related to time exposure to UV radiation, the publication of the situation diagnosis "Climate and health" in 2019 and the joint analysis of data during the Covid-19 pandemic, in order to estimate the influence of meteorological, climatic and environmental variables in spreading the virus. Some guidelines have even been identified, though not been put into practice yet, such as the prevention of diseases associated with rodents or the implementation of a permanent Climate and Health Observatory. The amount of activities and initiatives arising from joint collaboration demonstrates the positive impact of co-producing products and services together with the users. As this experience teaches us, not only does it improve the offer but also makes it possible to develop new guidelines, improving strategic, public functions held by partner organizations.

| CHAPTER 2. Strategies for user interaction

To multiply the benefits that products and services can bring to different sectors of society it is essential to engage the user community at all stages of the process. Strategic partnership between the SMN and users/partner-collaborators provide quality meteorological information and build fluent communication. This may have a positive impact on the users' appreciation of services provided by official institutions. User participation, far from being an exceptional or isolated instance, is part of an ongoing process for developing and providing meteorological and climate services. According to the WMO's strategy (2014), service development and delivery should be characterized by the following stages and elements:

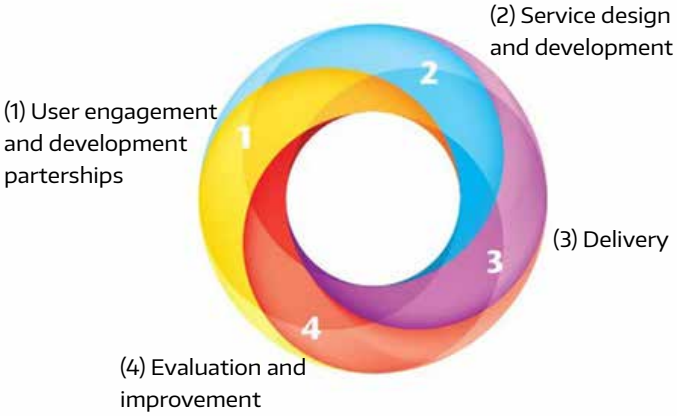


Figure 7: "Guide to climatological practices" (p.141 and p. 144), by World Meteorological Organization, 2018.

Figure 5.1 Four stages of a continuous, cycle process for developing and delivering services

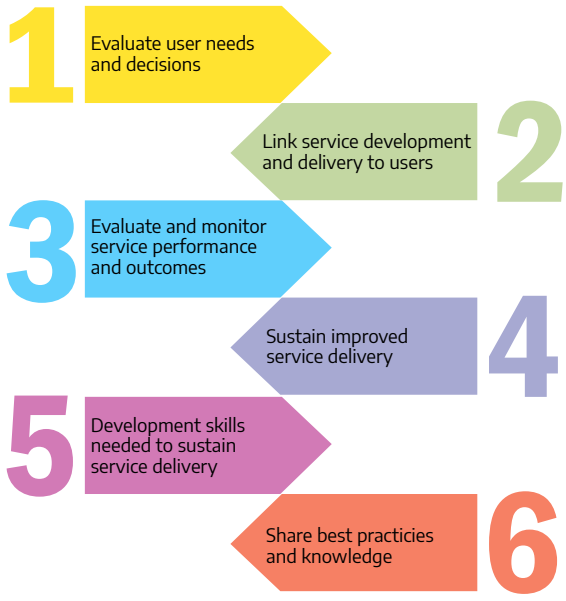


Figure 5.2. The six elements needed for moving to a more service-orlented culture

MARINE SECTOR

CASE: To answer the needs of users in the marine sector

SMN's Objective: To characterize the needs and requirements of the marine sector with emphasis on the use and appropriation of data by those sectors sensitive to weather conditions at sea. Entities responsible for ensuring safety in maritime navigation (Naval Prefecture, the Navy, technicians and harbor masters), as well as private actors in commercial and sport navigation (transport companies, nautical companies and yachtsmen, ship captains, etc.). To learn about the role played by products and services offered by the SMN in managing meteorological information to support decision making in the sector. To include the report obtained from users in order to improve the marine services provided by the SMN.

Context: Argentina's Naval Prefecture has the task of providing Maritime Safety Information, for which it has a network of coastal stations strategically located along the maritime coastline.
These facilities allow communication with ships sailing in the Argentine Sea, broadcasting the daily forecasts stipulated by international regulations, through radiotelephone systems and the NAVTEX system. Through this system, the ANP rebroadcasts the information from the SMN to the ships.

→ Transition to a Bidirectional Communication: The key outcome of the interaction is the transition from a one-way communication modality
to a bidirectional process. This involves an active exchange of information between the parties.
→ Exchange of Information and Needs: The exchange of information and needs among actors is now encouraged. This allows for a more
complete understanding of service expectations and requirements.
→ Service Utility Feedback: In addition, a space has been provided for users to provide feedback on the usefulness of the service. This is critical to keep adapting and improving the offer of services.

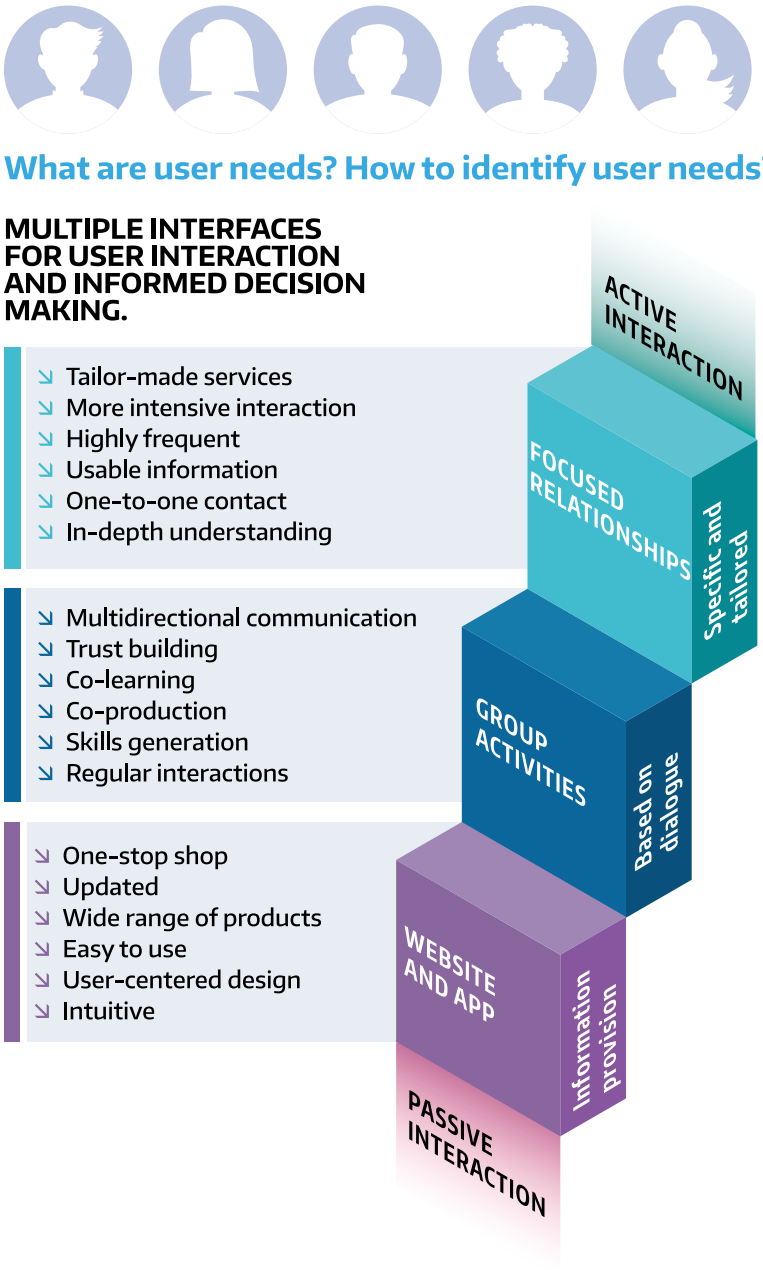
Lessons learned

2. One-way communication and lack of feedback restrict opportunities for product and service improvement.

One of the difficulties we often encounter is the lack of feedback or knowledge about the assessment and use that users make of the product and/or service provided. Without knowing the users' experience, it is common to be unaware of the usefulness of the provided information or of opportunities for improvement. In some cases, we only learn that a certain sector of users value or use a particular product when it is discontinued or modified in some way. Some statistics, such as navigation flow or number of downloads from the website, can provide useful information about user interest. Other questions may require using data collection tools to help us answer them, such as those presented in this guide. Conducting surveys, interviews or workshops will allow us to know not only the users' interest in the products but also what decisions are taken on the basis of these products, what difficulties arise in accessing and understanding the information or what opportunities exist to improve or adapt the product according to their needs.

Although this co-production paradigm stresses the importance of generating interaction between users and providers of climate and weather services at every stage, it should be kept in mind that this interaction cannot be carried out in the same way with every type of user. Among the different users, it is possible to identify a great diversity of specific needs, different spatial and temporal scales or distinct ways in which the information is used. For this reason, the engagement strategy we choose to use will depend not only on the objectives of the interaction, but also on the specific user or sector with which we intend to do so .

Following specialized literature (WMO, 2018) we could think of a continuum of involvement that goes from a passive and unidirectional user participation to an active and multidirectional participation, based on focused relationships and the specific needs of each user or sector. For example, certain strategies -such as interaction through the SMN website- imply a more passive user involvement, but allows to reach a large number of recipients efficiently. In contrast, when the intention is to interact with a group or sector of users with specific needs, it is necessary to appeal to other types of strategies to build a two-way relationship and a more intense user involvement. This will necessarily require more resources and efforts to carry out targeted projects. These considerations should be kept in mind in order to establish the most appropriate user approach strategies for each case in question. Throughout the text, a wide range of situations is presented to illustrate the complexity and diversity of scenarios that scientific and technical organizations must face in their operational tasks.



[6] Figure 8: Guidance on Good Practices for Climate Services User Engagement Expert Team on User Interface for Climate Services Commission for Climatology 2018 edition WMO-No., p. 3 (design by SMN)

The SMN's own experience not only illustrates the heterogeneity of the user category, but also shows the complexity of interactions that develop simultaneously. These relationships contribute to questioning the unilinear producer-recipient approach of meteorological information as the only possible strategy of interaction with the user. The survey conducted for the purpose of this document shows that it is possible to recognize interdisciplinary, interinstitutional and intersectoral co-production experiences . This document provides methodological tools that may be useful to some frequent challenges such as developing coordinated relationships between different departments and the same user, knowing the specific needs of each actor, establishing an initial contact or sustaining interaction with users over time and without discontinuity.

This chapter proposes an approach to some of the challenges frequently faced by the SMN and social sciences' contributions to deepen the interaction and articulation with users. This necessarily requires interdisciplinary collaboration between different branches of science, respecting each one's expertise, the specificity of each method of knowledge building and valuing that the result of collaborative work is qualitatively superior to knowledge compartmentalization. This document is neither a recipe nor a standardized procedure that can be applied in an isolated or fragmented manner. It presents a set of approaches and perspectives, based on valid and rigorous scientific knowledge, which may be useful for its application in the institution's ongoing projects.

2.1 APPROACH AND INITIAL ENGAGEMENT

For the relationship to be more meaningful and sustainable over time, it is important before starting the interaction with a user, to design the methodological strategy that best suits our objectives. First of all, it will be necessary to consider the general characteristics of the project which acts as a background to the interaction. Some relevant aspects to analyze are: the purpose and objectives of the project, target audience, products or services on which the initiative focuses, planned stages, work schedule, budget or available resources, and expected results.

Starting from questions like these, and from the lack of answers to some of them, we will have more elements to define an interaction strategy aligned with our objectives, with the users' needs and considering the existing interaction experiences.
Some preliminary questions that may be useful when starting a project are:

- → Which are the initial target groups associated with the project?
- → What is the objective of the interaction with this user or group of users?
- → What information do we expect to obtain from this exchange?
- → What products or services can be expected by the user?
- → What other providers of weather and climate information does the user interact with?
- → What departments of the agency have already interacted with this user?

INTERSECTORAL EXPERIENCE (QUARTERLY CLIMATE OUTLOOK)

CASE: Quarterly Climate Outlook Meetings

SMN's objective: To improve the provision of services on a seasonal scale based on the co-production of knowledge. To generate a quarterly forecast by consensus, incorporating intermediate institutions in its elaboration.

Context: This is a space for dialogue and encounters for the main operational and academic institutions related to the generation of meteorological, climatic and environmental information: SMN, INTA, FAUBA, INA, CIMA, DCAO, COREBE.
Initiated in 2007, after the SMN was transferred to civilian orbit, this space has been operating uninterruptedly for almost 15 years.

Interaction results:

- → Strengthening of relationships: Holding consensus forecast meetings, for such a long period of time, has strengthened the ties between the participating institutions.
- → Improved Forecast Quality: These meetings improved the quality of the forecasts.
- → Openness to Interaction with Downstream Users: The SMN's receptiveness to interact with user institutions has strengthened its position as a meteorological authority.
- → Increased Trust and Credibility: The participation of intermediate users in forecast discussion and preparation has contributed to increase trust in the institution and its credibility.

LESSONS LEARNED

3. Constant communication is a prerequisite to sustain the relationship and to have a successful co-production.

As we have seen, avoiding one-way communication is one of the most important ways for getting feedback from users. Also, to stimulate new interactive projects. However, some of the SMN's experiences have shown that it is not possible to successfully sustain every relationship with the users. In some of these cases, the lack of response from some of the users or poor feedback on the product are obstacles to sustain the interaction.

Based on their experience, some of the SMN's departments have highlighted these valuable lessons:

→ The periodicity and constancy of meetings is fundamental to keep a relationship going.
→ Knowing each user's or collaborator's work methodologies helps to understand their needs and achieve efficient communication.
→ Planning a schedule of meetings and objectives helps clarify the work.
→ Short meetings with a previously agreed upon agenda can be useful to speed up the discussion.

Another central aspect in developing a successful process is to build mutual trust between partners and to ensure that it can be sustained over time. In order to achieve this, some general guidelines may be necessary:

→ To consider the history of interaction with the user sectors one intends to approach as well as learned lessons in previous processes.
→ To clearly establish roles and assign responsibilities among all associated parties which are collaborating in a project.
→ To avoid overlapping tasks and relationships between different departments of the agency and the same user or sector.
→ To allocate institutional resources for evidence-based communication in order to convey that uncertainty is inherent to all weather or climate forecasts.

2.2 PRELIMINARY CONSIDERATIONS: SCOPES AND LIMITATIONS

A series of methodological tools provided by social sciences for developing user interaction projects will be proposed in the next chapter. As mentioned before, the objective is to present some elements that should be considered when designing a specific methodological strategy, which should be adjusted according to the purposes of each particular project. The implementation of each of these methodological tools requires that different resources are available, such as funding to carry out the plan, appropriate personnel to carry out the planning, availability of all departments or the definition of work deadlines according to the scope, results and priorities established.

For this reason, when designing a methodological strategy it is very important to consider -besides its pertinence with the purposes to be achieved- the resources and time available. It is also necessary to keep in mind that, when using these tools, the results reflect the situation at the specific moment in which they were implemented. However, user perception is dynamic and changing, and therefore it is necessary to collect periodic information in order to analyze the evolution of products, services and appraisals over time.

In the following chapters, possible alternatives for engaging with external users are presented, according to their characteristics, the lack of knowledge or mutual knowledge that may exist, and the institutional needs and interests of the parties involved. The order is structured in a non-sequential manner, beginning with the presentation of techniques and instruments used to produce qualitative and quantitative information in chapter 3. Chapter 4 presents tools for analyzing the information obtained and communicating the results of a project or research.

| Chapter 3. Methodological tools to produce information

3.1 SURVEYS

DESCRIPTION

Surveys are one of the most efficient and versatile ways of collecting useful information for a provider of weather and climate services. In comparison to other techniques, this methodology has the advantage of collecting a large amount of information from various users, with a lower work time requirement. Also, it has greater possibilities of data systematization and data processing. It can also be implemented through different means (telephone contact, e-mail, web page, in person, etc.), adapting to the time and human resources available.

A survey uses a single list of questions arranged to systematically collect information of interest. It allows to gather information and perceptions from a sample of users in relation to a particular topic, product or event, through specific and targeted questions, the results of which may have a direct application (NOAA, 2010). In addition to surveying user perceptions and appreciations, a survey can, by adapting its design, generate skills in users and inform on new products and/or services (Hernández Sampieri, 2014).

By using surveys, it is possible to achieve several goals:

- → To obtain information on the extent to which the products and/or services meet the needs of the users and their degree of satisfaction with them.
- → To identify opportunities for improving the effectiveness and usefulness of products and services.
- → To contribute to build a positive public image by increasing the credibility and support of users.
- → To benefit users by improving the provision of products and services they use daily (WMO, 2010).

SAMPLE DESIGN AND REQUIREMENTS

The design of the survey, the mode of execution and the size of the sample depend on the objectives and the information to be attained (NOAA, 2010). The sample definition focuses on "what or who", i.e., the participants, objects, events or collectivities of study (the sampling units), which depends on the approach and scope of the research. In a quantitative process, the sample consists of a subgroup of the population you are interested in, which has to be precisely defined and delimited beforehand.

The samples can be categorized into two large branches:

- → Probability samples: any element of the population has the same possibility of being chosen for the sample. They are obtained by defining the characteristics of the population and the size of the sample, and by means of a random or mechanical selection of the sampling/analysis units.
- → Non-probabilistic samples: the choice of the elements does not depend on probability, but on characteristics related to the research or the researcher's purposes.

Once the appropriate research design and sample have been selected according to the survey objectives, the next step is to collect relevant data on the attributes, concepts or variables of the sampling/analysis units or cases. Any measurement or data collection instrument must meet three essential requirements:

- → Reliability: refers to the degree to which repeated application to the same individual or object produces the same results;
- → Validity: indicates the degree to which an instrument actually measures the variable it is intended to measure;
- → Objectivity: refers to the degree to which it is permeable to the influence of biases and tendencies of the researcher(s) who administer, score and interpret it.
- → Starting with the identification of the variables to be measured and their indicators, the aim is to accurately identify the components, dimensions or factors that theoretically make up the variable. Similarly, the indicators for each dimension should be established. This stage involves generating all the items, indicators and/or categories of the instrument, as well as determining their levels of measurement, coding and interpretation.

HOW TO STRUCTURE A QUESTIONNAIRE?

A questionnaire consists of a set of questions regarding one or more variables to be measured, which must be congruent with the approach and objectives of the project. The survey questions should be arranged in a logical or chronological sequence that allows the information to be organized. They may include two types of questions:

Closed-ended questions: are easier to code and prepare for analysis. Also, these questions require less effort on part of the respondents, who do not have to write or verbalize thoughts, but only select the alternative that best summarizes their answers.

Open-ended questions: provide broader information and are particularly useful when we have insufficient or no information about people's possible answers. They are also useful in situations where you want to deepen an opinion or the reasons for a behavior.

Some of the questions that can serve as a reference to design a questionnaire could be:

- → How accurate do you think forecasts and warnings are?
- → Are warnings and forecasts received in a timely manner?
- → How do users receive forecast information, warnings and alerts?
- → Do people understand what the forecasts and warnings mean?
- → What are the most important weather and climate-related decisions made?
- → What weather phenomena are people most interested in?
- → Which products or services are most useful and which are rarely used?
- → What new products or services would be of interest to users?

ENERGY AND WATER RESOURCES SECTOR

CASE: Collaborations with public and private organizations in the water and energy sector.

SMN's Objective: To co-design products adjusted to the operational needs of the sector and to exchange data for the improvement of products applied to energy production and supply.
Context: The National Weather Service maintains a strong interaction with different actors in the energy and water sectors. Some of the users with which it has collaborated are: Compañía Administradora del Mercado Mayorista Eléctrico SA (CAMMESA - Wholesale Electricity Market Management Company), Consejo Hídrico Federal (COHIFE - Federal Water Council), Universidad Nacional de Tucumán (National University of Tucumán), Instituto Nacional del Agua (National Water Institute), Entidad Binacional Yaciretá (Yaciretá Binational Entity) or Embalse Cabra Corral (Cabra Corral Dam), among others. Experiences and information have been exchanged among different actors to co-design products and services in response to specific needs.

Results of the interaction:

- → Feedback: Despite the fact that in some cases the relationship's sustainability and feedback did not meet the expectations, valuable scopes and learnings have been obtained from working with this sector of users.
- → Product Validation and Adequacy: It has been observed that in certain cases, if the initial product did not fully meet the user's expectations, it was difficult to maintain the relationship or to get the user to provide data to validate the product.
- → Successful Data Source Integration: The integration of data sources has been much more successful in other cases, making it possible to tailor the information to each user's individual needs and move forward with joint improvements.

LESSONS LEARNED
4. Work processes and information access channels should be adapted, when possible, to the needs and expectations of the users.

Meeting the needs and expectations of users is essential both for the improvement of standardized products and services and for the joint development of new products to meet the specific demands of certain users or strategic partners. From this interaction it is possible to identify the user's needs, their priorities, the scale of the product, the required viewing and/or format of the information or the resources available to both the department and the users.

For example, the interaction between the Directorate of Sectoral Services and users in the agricultural sector revealed an interest in receiving information on a local scale, adjusted to the size of the productive land. In addition, there was demand for information accessible by cell phone, since this is the most widely used and accessible device in the sector. Although not all the demands of a user will correspond to the department's capabilities or the state of the art and not all of them may be satisfied, it is also clear from these experiences the need to know in depth both the demands and the resources available to each user in order to continue developing products and services that are increasingly beneficial to their activities.

CHANNELS FOR CARRYING OUT SURVEYS:

CHANNEL	ADVANTAGE	DISADVANTAGE
IN PERSON OR BY TELEPHONE	→ Focused interaction with the user → Highly detailed information	→ High demand for working time → Allows to address a smaller number of users or only in case of specific events.
EMAIL OR ONLINE FORMS	→ As it is self-administered, it allows a larger sample to be covered. → It is possible to target specific users according to the survey's goals.	→ It reduces focused interaction associated with personal or telephone contact.
WEBSITE	→ Allows to address a quantitatively larger sample → Provides valuable information on general public usage and perceptions	→ To ensure completion, the length must be reduced. → Reduces the possibility of accessing more specific information
PAPER	→ Allows access to information during the course of face-to-face activities with specific actors → Can be used in areas without internet access	→ Its processing requires more working time → It raises economic and environmental costs.

GENERAL CONSIDERATIONS FOR CONDUCTING USER SURVEYS

→ Adapt the survey channel and its frequency to the target user and the information to be obtained.
→ Use clear terminology in accordance with the survey's intended user.
→ When rating scales are consulted, use even response options in order to reduce the margin of ambiguity.
→ Communicate to the user at the beginning of a survey its purpose, the estimated response time and thank the user for his/her participation.
→ Provide access to the overall results to demonstrate the value of the provided information and to contribute to a positive public image.

HOW DO WE USE SURVEYS AT THE SMN TO ANALYZE PERCEPTIONS AND USES OF THE PRODUCTS AND SERVICES WE PROVIDE?

Survey of uses and opportunities for improving the Early Warning System in disaster risk management and emergency sector for the period 2021-2022.

This survey was carried out to analyze the uses and assessments during the first year of implementation of the Early Warning System (Sistema de Alerta Temprana - SAT), with particular emphasis on the institutions that make up the National System for the Comprehensive Management of Risk (Sistema Nacional para la Gestión Integral del Riesgo - SINAGIR). To achieve the objectives, a methodological strategy was established, combining quantitative and qualitative information by using a mixed questionnaire that included open and closed questions. Based on a segmented strategy, three surveys were carried out, adapting each one to the information needed by the users:

→ First, a survey was conducted to assess uses and perceptions of the Weather Warnings, Very Short-Term Warnings, Extreme Temperatures, Heat and Provincial Product by users of the disaster risk management and emergency sector.
→ In addition, a second survey was designed in order to assess aspects to improve Extreme Heat Temperatures, through the analysis of use and perception of the SMN's SAT by a segmented sector of specific users of Extreme Heat Temperatures: the provincial referents of the Argentine Red Cross and the National Parks Administration.
→ Finally, a third questionnaire was designed to survey aspects to improve Meteorological Warnings, Provincial Product, Very Short-Term Warnings and Extreme Heat Temperatures through the analysis of use and perception of the SMN's SAT by those responsible for the Response Directorate, belonging to the National Directorate of Civil Protection Operations, of the Undersecretariat of Risk Management and Civil Protection, under the Ministry of Security of the Nation.

In some cases, it was necessary to conduct in addition telephone surveys or semi-structured interviews to gather more information, given the small number of units of analysis or the difficulty for certain users to complete a self-managed virtual form. This experience illustrates the need to design interaction strategies that fit the identified objectives and the characteristics of the users with whom we are interacting.

Once the data collection stage was completed, we proceeded to review the available information, systematize the data and carry out the quantitative-qualitative analysis. The quantitative data was entered into an analysis matrix to be examined on the basis of frequencies and bivariate tables. The qualitative data was examined in a data matrix based on a narrative analysis, coding open-ended questions into categories of analysis.

3.2 WORKSHOPS

DESCRIPTION

Participative workshops are a favorable resource for creating spaces of interaction and semi-structured exchange. Unlike individual surveys, they allow us to learn simultaneously about different points of view and opinions, through interactive dynamics that favor dialogue and direct interaction between subjects.

These types of instances are useful to generate meetings where people can talk face to face, sharing a common space and time. This allows to strengthen ties and relationships between the parties, while supplementing other instances of deferred or unidirectional communications. A great advantage of this type of strategy is to highlight the wide network of people who support the supply of products and services and connect them with decision-makers. Another positive aspect of this strategy is to bring social actors around the same table, who may participate in the same system but do not always maintain fluid or direct ties. In this way, it is possible to strengthen trust between people, establish agreements between institutions, resolve differences, build joint criteria or define common perspectives.

It is usually appropriate to implement this type of dynamics when there is a previous relationship, since they require a high degree of commitment from the involved parties. In addition, the subject matter must be attractive to the target audience in order to capture their attention and have a good attendance. It is therefore advisable that the main topics should take into account the needs and concerns of the target audience. In order to achieve success in such activities, it is advisable to consider all factors which affect the process. Participatory workshops, like any other user approach strategy, require planning and organization at all stages of the process.

PLANNING AND IMPLEMENTATION STAGES

Design: this phase includes all preparatory actions to ensure the activity's correct execution. Some of the most important aspects we can mention are: defining objectives, setting up the structure or agenda of the workshop, planning each moment of the workshop, defining roles and tasks. To outline the activity's objectives and contents, it may be useful, before designing the workshop, to conduct a brief survey with participating users to identify specific demands. At the same time, it is important to ensure both attendance and necessary conditions, such as the liaison with representatives, the selection of a suitable location, the availability of necessary equipment, the summoning of participants and confirmation of their attendance, the possibility of anticipating unforeseen events or identifying risks.

Execution: this phase refers to the activity's implementation. In other words, the workshop in situ. In this instance, everything that has been previously planned is carried out. Therefore, the plan should be put into practice as tightly as possible. However, it is sometimes necessary to make adjustments during the execution. It is important to keep in mind that these adjustments must be justified and all members of the coordination team must be made aware to avoid confusion. A person defined in advance, with a profile of good communication and interpersonal skills, should be in charge as a moderator to respect the previous planning and make adjustments that may not be foreseen. These meetings train the target audience, while at the same time make each institution's work visible. An important aspect to consider in this type of meeting is the convenience of implementing strategies for surveying needs and characteristics. A highly recommended practice is to do practical exercises or some of the other strategies mentioned in this document, to generate material that may be processed and analyzed later on. This way, it is possible to build new inputs and provide feedback to continue the process of networking and coordination.

Conclusion: it is usually the most neglected phase, though a participative workshop is not only its execution, but that there is a before (the design) and an after or post-workshop. Since a workshop is part of a broader relationship, it is not an isolated action or disconnected from other activities. For this reason, it is always advisable to have a plan to define how to continue once the meeting has taken place. Some ideas that may be useful: send a thank you message, set up contact channels, send a recording or a report with the highlights of the meeting so participants can have a record, share additional or reference material, etc. This helps to strengthen the relationship and sustain the exchange continuity. In addition, it is usually very productive for addressing aspects that may have been left out of the workshop. It should also be kept in mind that if practical exercises or surveys are implemented during the workshop, this material should be processed and introduced in a work cycle to take advantage of the richness of the material. The usefulness of this information will be strongly influenced by the efforts and achievements made in the previous phases.

Considering this scheme, the internal relationship between the three phases previously defined becomes evident, so we should not lose sight of the process and relational dimension of the phases. So, they should not be dissociated by carrying them out in isolation. It is convenient that the process should be in charge of a defined and stable group, who should have a comprehensive knowledge of it and of the roles and tasks assigned for each stage.

HOW DOES VIRTUALITY AFFECT A WORKSHOP?

The Covid-19 pandemic resulted in major changes in the functioning of institutions. In particular, the incorporation of "teleworking" or "remote work" in processes that traditionally were carried out exclusively in person. Similarly, although technological solutions were previously used for virtual communication, their use has since increased significantly as a means of day-to-day interaction. Acquiring familiarity with these tools has allowed us to incorporate them into our work dynamics, facilitating and enhancing interaction and relationships with users who are geographically distant or who would find it difficult to attend face-to-face activities.

However, we should not underestimate the impact of not having face-to-face encounters on effective communication between subjects. Consequently, it should be considered that the use of mediated interaction does not guarantee better communication. On the contrary, forced digitalization of participatory and interactive situations (such as workshops) is associated with less richness in meetings. This is a consequence of low participation, lack of attention to the content because of an inappropriate context, lack of adequate devices or lack of connectivity. So, these factors should be taken into account when planning and executing participative workshops and, if possible, supplement them with asynchronous communication channels and face-to-face meetings, to ensure fluid communication and effective participation of the largest amount of users.

DISASTER RISK MANAGEMENT AND EMERGENCY SECTOR

CASE: "Flash Flood Event Forecasting and Warning" Project (PREVENIR)

SMN OBJECTIVE: To develop an early warning system for flash floods in the pilot basins Sarandí-Santo Domingo (Buenos Aires) and Suquía (Córdoba). The objectives include the expansion of existing hydrometeorological monitoring capabilities and the development of forecasting systems with a special focus on urban floods. It also seeks to raise public awareness of this problem, broadcast preventive measures for the population, and increase the capabilities of the agencies responsible for disaster risk management by promoting collaboration with forecasters, decision-makers and emergency managers.

CONTEXT: It is an initiative of joint research between the Japan International Cooperation Agency (JICA), the Japan Science and Technology Agency (JST), the National Weather Service (SMN), the National Water Institute (INA) and the National Council for Scientific and Technical Research (CONICET) in coordination with the provincial governments of Buenos Aires and Córdoba as well as local governments of the basins under consideration.

INTERACTION RESULTS:

→ Results through Workshops and Training: Achievements from conducting workshops and training days in collaboration with government institutions.
→ The PREVENIR Project is currently in progress. Significant progress has been made during the first year.
→ Specific Knowledge: These actions have contributed significantly to increase specific knowledge and generate knowledge about contexts related to disaster risk management.
→ Identification of Needs: Identification of the needs of the actors involved in the project.

3.3 INTERVIEWS

DESCRIPTION

In the WMO Service Delivery Strategy and Implementation Plan (2014) there is a description of a cyclical and continuous process, which is composed of four stages: user participation and partnership building, service design and development, service delivery, and service evaluation and improvement. Conducting individual interviews with users or groups of users can be very useful in fulfilling different elements of this strategy such as assessing their needs and understanding their decision-making processes, assessing the performance of provided products and services, developing new products or improving existing ones (OMM, 2014).

Even though other tools also allow us to obtain this information, interviews have a differential component. While surveys or workshops allow us to approach the general public or a specific sector of users, interviews allow us to access specific information from a smaller scale or from actors which are particularly relevant to the research. Unlike other techniques, an interview is based on a direct dialogue with the user and, consequently, can fulfill more than one objective at the same time. By engaging in this focused interaction with a particular user, it is possible to gain an in-depth understanding of his or her specific needs, as well as to communicate the agency's capabilities regarding these needs and/or develop products and services in mutual collaboration on the basis of this dialogue.

This research technique is intended to address specific interests. Deciding what, whom and how to survey are the first fundamental steps. This type of strategy usually requires a previous contact and adequate preparation, since it is necessary to have an appropriate context, sufficient time and recording materials consistent to the type of interview. It can adopt different characteristics according to its objectives and different modalities, such as: individual, group, structured and controlled or free (in-depth) interviews. The characteristics, advantages and disadvantages of each of these variants are discussed below.

TYPES	ADVANTAGES	DISADVANTAGES
OPEN-ENDED, UNSTRUCTURED OR IN DEPTH These terms usually refer to interviews that do not follow a closed pattern of questions and are more akin to a conversation between parties led by an interviewer. Most of the time, the objective of this type of interview is the generation of an interviewer-interviewee(s) bond, and they are useful for preliminary identification of common interests and possibilities for collaboration. In this case, unlike a closed-ended questionnaire, the interviewer plays the role of "explorer", so that the limits of the study must be known beforehand so that the dialogue fits into the specific framework and objectives of the project underway.	→ Given its informal nature, it is possible to access valuable qualitative information that is not reflected in other interview formats and to cross-examine the information provided. → The interviewee(s) has the opportunity to ask questions or clarify doubts. → By not composing a standardized format, there is no "obligation to answer", which facilitates interaction and flexibility.	→ Requires more time both for the execution and analysis of the information. → Requires caution with over-interpretation or generalization of individual responses, especially if the number of respondents does not represent a significant sample. → The limits are more implicit than explicit, so an experienced interviewer is required to develop this type of tool.
CLOSED OR STRUCTURED In this case, the researcher plans in advance the questions to be asked sequentially. In this case, the interviewee should only answer the standardized scheme of questions and not make any additional appreciations or queries. Due to their characteristics, their focus is on the information requested during the design, so they tend to be less suitable for obtaining new information and are generally used for quantitative rather than qualitative analysis.	→ Data can be collected in an organized fashion. → Responses can be grouped and analyzed by sets of related questions. → All respondents have different answers to the same questions. → Can be used for large samples. → It is easier to systematize because of its standardization. → Allows for periodic comparisons because of its standardized structure.	→ Limited scope of qualitative assessment. → Prevalence of brief or not very detailed information. → Prevalence of prefixed answers and limited response options. → Requires more time to prepare this type of interview to consider all possible variables. → It prevents access to unexpected information not taken into account by the interviewer.
SEMI-STRUCTURED This is the type of interview most frequently used in social research. The interviewer has a flexible role, being the one who directs the interview. It uses a previously designed set of open-ended questions that can be complemented with other questions that emerge from the dialogue that develops between the parties. Through this technique it is possible to obtain both quantitative and qualitative data, while also allowing the use of the same set of questions as a starting point for dialogue with different interviewees.	→ It is more flexible than closed interviews, allowing to adapt its development outside the initial script depending on the emerging information during the course of the interview. → It allows us to relate questions to each other or to access new information about the interviewee's considerations.	→ Requires experience on part of the interviewer to both respect the previously designed structure and also to pay attention to relevant information that may emerge from the dialogue. → The systematization and analysis of the information is more complex when compared to closed interviews.
GROUP In a group interview, in which three or more people are involved, the goal is to encourage a group discussion that allows access to users' perceptions of a product or service. They are often open-ended or in-depth, with a verbal dynamic in which the interviewer asks specific questions to guide the discussion of the participants. They require forming groups suitable to the purposes of the research, i.e., taking into consideration the size of the groups, a representative participation of different users and different group interviews to be able to compare the results. They can be very useful, for example, in testing and/or evaluating the use and understanding of new products or services.	→ It allows access to a larger number of users in less time. → The group dynamic allows respondents to interact with each other and provide information that they might not feel able to express in a survey or individual interview.	→ Some individual perceptions may be affected or homogenized by the influence of a group setting. → The group setting may not be appropriate for addressing issues specific to a particular user or collaborator. → It may be difficult to carry it out due to the challenge of coordinating agendas with different users or having resources such as an appropriate space, transportation, etc.

As we have seen, interviews are a fundamental tool for obtaining information from groups or individuals and producing data. In addition, it is a flexible tool that can be adapted to the needs of evaluation and context, allowing to resolve possible conflicts or misunderstandings, improving communication and favoring the strengthening of the link with users. To a large extent, the interviewer's experience is an important asset in order to collect not only the expected information but also to lead the interview to relevant issues for both parties that may emerge during the course of the interview.

Finally, the analysis of the information and its application for evidence-based decision making, is as important as the interview itself. To this end, it is essential to follow standardized procedures for recording and systematizing interviews which, according to the specific interests of each project, can then provide information to be used with different analysis tools.

| Chapter 4. Information analysis

4.1 MAPPING OF ACTORS

WHAT IS KEY ACTOR MAPPING?

Mapping key actors is one of the most widely used tools when making a diagnosis and developing a project. Similar to other techniques known by some authors as social maps, sociograms or stakeholder analysis, actor mapping is a tool that graphically represents the relationships between social actors, allowing to understand them and develop intervention strategies in projects. It is used to identify involved parties, understand their relationships, interests and potential contributions to the collaboration process. In this sense, mapping actors is not an end in itself, but rather a tool for gathering information and, as such, it should work directly with the project's objectives.

This methodology seeks to graphically represent a social reality, and the web of relationships that constitute it, by means of diagrams that make it possible to understand it and develop intervention strategies based on this information. By drawing up a stakeholder map, we will obtain not only a mere list of the parties interested in an initiative, but we will also be able to know their relationship with each other, their interests, the actions they take or the contributions they could make to the collaborative process.

WHAT DO WE MEAN BY KEY ACTORS?

When we speak of key social actors, rather than individual actors, we refer to groups, organizations or institutions that are influential or relevant to the project. Although every group or organization is led by specific individuals who can influence its functioning, the focus here will not be on the individual dimension of these connections, but rather on the structural relationships built between institutions.

The actors may be considered relevant, for example, because of the impact the project would have on their activities, their power to influence the actions of others, the relation between their functions and the project's objectives, their experience and capabilities, or the information and resources they have at their disposal. Identifying different views on an issue is a necessary first step in developing consensus-building strategies to address conflicts that may emerge and hinder a project. In this way, viewing the social scenario of a project's implementation will allow us to identify its potential risks and assign those who will be responsible for its management.

HEALTH SECTOR

CASE: Improve weather and climate services with an impact on health, allowing appropriate prevention and response measures during the Covid-19 pandemic.

SMN'S OBJECTIVE: To improve the generation of weather and climate services with have an impact on health, in order to allow the population, as well as health and civil protection agencies, to take appropriate prevention and response measures.

CONTEXT: Initially, a task group was formed between the National Weather Service and the Ministry of Health with the objective of analyzing exposure to heat waves and conditions for the spread of dengue contagion vectors. This led to the implementation of the Heat Wave and Health Early Warning System (SAT-OCS).
During the summer 2017-2018, SAT-OCS was launched for 57 locations, automating early warning.

From 2020, epidemiological and climatic data were crossed to evaluate meteorological influence during the Covid-19 pandemic, generating weekly reports for the Ministry of Health. In other words, not only was cross-referencing of climatic and sanitary variables carried out, but it also made it possible to generate a service for the user.

RESULTS OF THE INTERACTION:

→ Collaborations opened up new opportunities and improved existing products.
→ Variables and scales relevant to the vector-borne disease sector were identified, strengthening relationships and expanding collaboration.
→ Successful implementation of the SAT integrating Extreme Temperatures for Heat or Cold.

HOW TO DEVELOP KEY ACTOR MAPPING?

Within this methodology, different approaches and different graphic tools or resources can be found to organize and synthesize the information. In general terms, it can be said that all actor mapping should comply with at least the following four stages:

1. Determine its objectives.
2. Establish the variables to be considered when analyzing the relationship between actors and design a graphic scheme to represent them.
3. Collect the necessary information from each actor.
4. Analyze the resulting actor map in order to design an interaction strategy according to each of the users (Ortiz et al., 2016).

In particular, the methodology proposed by Tapella (2007), structures the following general steps to elaborate an actors' map:

1. Initial proposal for actor classification.
Identify -by means of a preliminary list- the social actors relevant to the project. Depending on the initiative, these could be: public agencies (national, provincial or municipal), private organizations, sectoral user groups, educational institutions, intergovernmental organizations, among others.

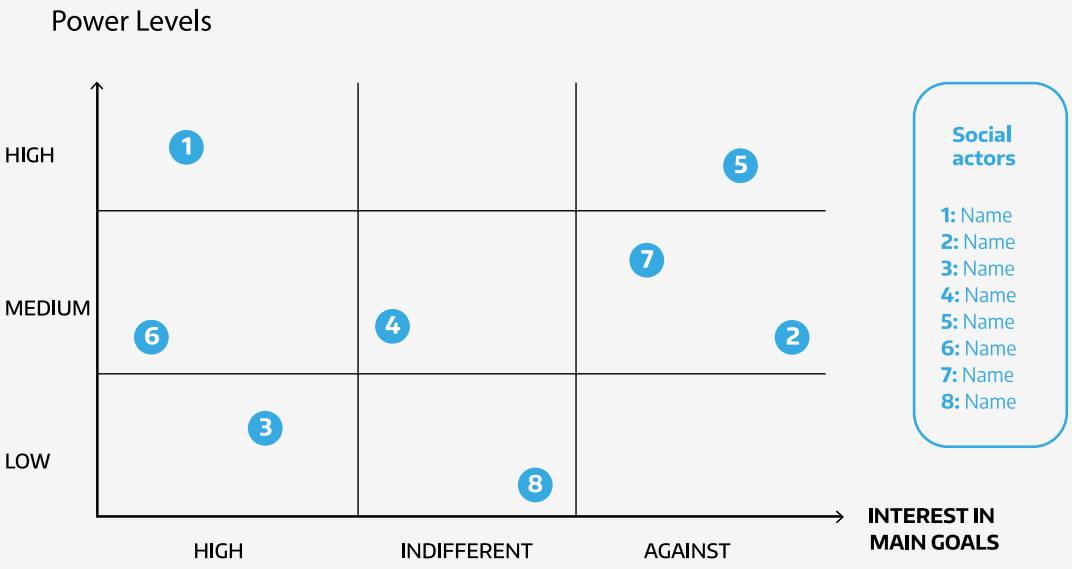
2. Identification of functions and roles of each actor
The important thing here is to recognize each actor's functions and needs in relation to the project, identify the actions that each one could take and the possible multi-actor alliances that could be established between the different project participants to achieve the proposed objectives.

3. Qualitative analysis of the actors
This analysis will be based on categories best suited to the case. These could be, for example the predominant relationships between actors, the degree of interest in the initiative, or levels of power and influence over other actors.

The classification categories could be grouped for example into:
- collaboration/indifference/conflict,
- disinterest/indifference/commitment, or
- high/medium/low influence on others.

HOW TO DEVELOP KEY ACTOR MAPPING?

4. Elaboration of the key actors mapping matrix Systematize the information available for each actor. This can be done in different formats. The most usual is to make a double-entry grid or a matrix inwhich the actors are placed according to a previous qualitative analysis. Here we can see an example



5. Recognition of social relationships
This step seeks to identify and analyze the type of relationship that exists between different social actors. According to the variables and categories of analysis that we have proposed, in this step it will be possible, for example, to identify which actors maintain collaborative relationships and which conflictive relationships.

6. Recognition of existing social networksFinally, this step consists of identifying existing networks between actors and groups of actors. Also, to design a set of strategies and actions to strengthen weak relationships and enhance the benefit of consolidated ties.

[8] Some of these can be found here: https://naturalsciences.ch/co-producing-knowledge-explained/methods/td-net_toolbox

4.2 SWOT

DESCRIPTION

After gathering information through surveys, workshops and interviews, it is possible to systematize the information through actor mapping, which is a fundamental step.

To obtain an analysis of the characteristics to help design strategies and assess existing situations, the information can be weighted by means of a SWOT analysis. This is an analysis of Strengths, Weaknesses, Opportunities and Threats, used as a technique to study the strategic situation of an organization, department or project.

This approach is based on the assessment of internal characteristics (Strengths and Weaknesses) and external situations (Opportunities and Threats) through a matrix. The objective of this analysis is to maintain or enhance strengths, take advantage of opportunities and develop strategies to address the identified external weaknesses and threats.This tool is mainly used to identify an institution's or an organization's competitive advantages and to develop strategies to achieve its objectives, keeping in mind its own characteristics and its operational environment.

INTERNAL ANALYSIS

In an internal analysis, the focus will be on the institution's own strengths and weaknesses, which differentiate it from other public or private organizations in the context in which it operates. It is looked at in terms of its capabilities, and which can be modified or taken advantage of to achieve its objectives. This analysis will enable the identification of the quantity and quality of resources available and the processes carried out by the organization, including elements such as technological equipment, staff training, quality of service, and user perception, among others. Depending on the situation under analysis, both strengths and weaknesses may be based on elements such as infrastructure, the agency's track record, institutional culture, available human resources, products and services offered, among others.

STRENGTHS:
A strength is a positive attribute that the organization has in relation to the context in which it develops. These special capabilities will allow the organization to obtain a comparative advantage over other actors.

WEAKNESSES:
Weaknesses are those internal aspects of the organization that represent an obstacle to achieve its objectives and must be identified and addressed through an appropriate strategy to eliminate or minimize them.

EXTERNAL ANALYSIS

This aspect of the analysis refers to the fact that an organization's performance is inevitably influenced by its context. These factors, external to the organization, cannot be controlled completely, but by identifying elements which can facilitate or restrict the achievement of the institution's objectives, we will be in a position to develop an appropriate strategy to face the threats and explore the opportunities.

OPPORTUNITIES:
In a SWOT analysis, opportunities are the result of combining strengths and weaknesses with external factors. They are situations or circumstances in the environment that can be exploited to improve the organization's position and achieve its objectives. It is important to note that opportunities do not guarantee success, as they can also present challenges ahead.

THREATS:
Threats are negative external factors that can harm the performance of the institution or agency and threaten its position in the field of activity. These threats may include changes in the economic or political environment, the emergence of new competitors, the appearance of disruptive technologies, among others. It is important to identify and evaluate threats in order to be able to be prepared and take measures to mitigate them.

This analysis can be enriched as long as several actors of the organization and external collaborators can participate and contribute with their vision. By gathering information on strengths, opportunities, weaknesses and threats, it is possible to cross-reference the data in a matrix that will allow an adequate design of strategies focused on each of the analyzed aspects. It is very useful for decision making and as a basis for planning, identifying goals and objectives of an organization and an department or project. It is suggested to use a diversity of perspectives, consult multiple actors, maintain periodic updates and determine deadlines and assigned roles that allow the execution of the resulting strategic planning.

	STRENGTHS F1 F2 F3	WEAKNESSES D1 D2 D3
OPPORTUNITIES O1 O2 O3	S-O STRATEGY Use strengths to take advantage of opportunities	W-O STRATEGY Improve weaknesses by taking advantage of opportunities
THREATS A1 A2 A3	S-T STRATEGY Use strengths to address threats	W-T STRATEGY Improve weaknesses to avoid threats

LESSONS LEARNED
5.It is important to have an in-depth knowledge of one's own capabilities and of the offered products (scale, format, usefulness, etc.).

In order to achieve a successful interaction and co-production with users, it is useful to be aware of previous experiences, available resources, state-of-the-art limitations or lack of infrastructure, as well as the diversity of products and services that are already available to users, even if they are not aware of them. This is essential to ensure that service co-production is based on solid foundations that allow the intended objectives to be defined from the outset, within the framework of what is possible. This will also avoid duplicating efforts by devoting time and resources to initiatives that are already being undertaken by other departments or organizations or that are not feasible due to limitations outside the department. Some of the aforementioned tools, such as Key Actors Maps or SWOT analysis, can be useful strategies to meet this objective, as they allow to identify relevant users within a thematic field and their capabilities in relation with the project. Likewise, the preparation of service charters could also be useful for communicating these capabilities. This type of document, similar to a catalog, is intended to publicly inform and explain to users the availability of products and services at their disposal and the quality commitments agreed upon.

AERONAUTICAL SECTOR

CASE: Transition from a deterministic volcanic ash forecast to a probabilistic one.

SMN Objective: Following volcanic eruptions such as Iceland (2010) and Cordon Caulle (2012), which resulted in very long periods of ash in the airspace and the consequent disruption of flight traffic flow, ICAO began to move from "zero tolerance" to the establishment of thresholds to increase the chances of flying in cases of non-severe ash concentration. From this, the VAAC department received a request to develop a new probabilistic ash concentration product for the aeronautical sector in accordance with the new standards.

Context: Departments related to monitoring and forecasting for the aeronautics sector are strongly standardized by the International Civil Aviation Organization. Unlike the relationship with other sectors, products and communication are routine and stable, which organizes the interactions considerably, but does require constant follow-up and improvement. Specific problems arise as a result of international standardization, which often treats institutions from different regions and very different technical capabilities as homogeneous.

Results of the interaction:

→ Technical Challenge due to Product Changes: Changes in ICAO standards have led the VAAC department to develop and implement a new product, which is no longer a "light" file in plain text and easily accessible, manipulable and interpretable. It is now a much heavier file that requires specific systems to open it and visualize ash concentrations. In addition to the technical challenges, the new set up implies changes in decisions and responsibilities. Users will no longer receive a polygon indicating the area of ash concentration, but probabilistic airspace concentration data. They will have to define the polygon and identify the thresholds above which flying does not imply a risk, using their own human resources.
→ Resistance from Some Users and Acceptance Challenge: Some users have expressed their dissatisfaction with this change, arguing that they "do not want to receive the uncertainties of the SMN in their decision making". This resistance poses an additional challenge in adapting to the new information mode.

4.3 RESULTS REPORT

DESCRIPTION

A results report is a document that provides a descriptive synthesis of characterization related to a specific topic or process. This type of document consists of a partial or final synthesis that provides a clear and concise interpretation of the results obtained from a survey or study. A report presents the synthesis of work processes or interventions sustained over time with a considerable degree of detail. It generally consists of an introduction, presentation of results, analysis and interpretation of the information, conclusions and definition of next steps. It is recommended that a report should present - in a systematized fashion- the qualitative information and the metrics and statistics obtained from daily work. The importance of a report is to leave a written record of the processes, progress and results to contribute in the accumulation, transmission and construction of specific knowledge. It is also a good practice for government institutions to ensure accountability and sharing work and achievements.

TYPES OF REPORTS

There are different types of performance reports that can be classified according to their length and need, and according to their content. In terms of length and necessity, we can distinguish between short reports, known as executive summaries (short and concise, with a maximum of a few pages) and extended reports, which present the information developed in greater detail, depth and detail of information, including analysis and conclusions.

In terms of content, there are several types of reports: popular reports, which are easy to read for anyone without the need for prior knowledge; scientific reports, which are used in the field of research or science and use rigorous language and contain technical information; and technical reports, which maintain scientific rigor but focus on more specific objectives, such as the evaluation of a situation before making a decision. The latter type is often used for reporting to both public and private organizations or entities.

A report with results has multiple functions and benefits, such as tracking progress and planning necessary adjustments, providing a comprehensive and internal view of an institution's goals and alternatives for achieving them, and informing and guiding management on the current status of a project's follow-up. In addition, they are useful tools for collecting and documenting information on performed activities and assessing the potential success of future initiatives.

There are different types of result reports, depending on their focus:

→ Descriptive: they give an overview of accomplished goals.
→ Action: they focus on specific actions that have been undertaken as a result of the conclusions obtained.
→ Results: they measure whether or not the project's objectives have been achieved.
→ Oriented: they provide specific information on the performance of several elements of a project. Finally, there is a mixed type of result report, which can be used both for briefing the general public and to present in institutions. It is always advisable, for this type of report, to provide a graphic display to go with the conclusions. The most common options are bar charts or radar graphs.

Some of the general purposes should be fulfilled by all result reports:

→ To explain the reasons that motivated the project or research, as well as the relevance of the topic and the users on whom the activities were focused.
→ Give an account of previously existing information on the topic or problem as well as background information on work and research in similar projects.
→ Describe in detail the methodology used, the participants and beneficiaries of the project, the actions carried out and their impact.
→ Analyze the results obtained and provide general conclusions useful to guide strategic decision making.

ADVANTAGES AND DISADVANTAGES OF USING PERFORMANCE REPORTS AS A WAY TO COMMUNICATE ACHIEVEMENTS

ADVANTAGES:

→ Clarity and conciseness: Outcome reports are intended to be clear and concise to present data effectively.
→ Easy to understand: Because they are generally accompanied by graphs, performance reports are easy to understand for both experts and non-experts.
→ Pattern identification: Results-based reports can help identify patterns or trends in data, which may be useful later for decision making.
→ Time: Concise presentation of performance reports (e.g., through digital presentations that summarize their content) could save time in analysis, detailed reading, and decision making.

DISADVANTAGES:

→ Limitations in the details: Concise reports may not include all details needed to fully understand the data.
→ Difficulties in interpretation: Outcome reports can sometimes be difficult to interpret if the context in which the data is presented is not understood.
→ Limitations in comparison: Outcome reports that present information in the form of numbers and graphs may make it difficult to compare the data with other sets of information.
→ Possible bias in presentation: The data presentation may have some degree of bias, especially if it is prepared by project leaders, for example. This could affect the objective interpretation of the results.

AGRICULTURAL SECTOR (OPERATIONAL WATER BALANCE MODEL FOR AGRICULTURE)

CASE: Operational Water Balance Model for Agriculture in collaboration between FAUBA, SMN and INTA.

SMN's OBJECTIVE: To improve the provision of services for the agricultural sector by providing an operational tool for estimating soil-water balance and generating a soil-water database for all users.

CONTEXT: The Operational Water Balance for Agriculture (BHOA) model was developed within the framework of the Chair of Agricultural Climatology and Phenology of the Faculty of Agronomy of the University of Buenos Aires (FAUBA), in collaboration with SMN staff. It is currently implemented jointly by three institutions (FAUBA INTA SMN). The SMN is in charge of operations and INTA is in charge of the national level. It is used for monitoring soil water conditions permanently. Maps are published on the website and in bulletins and periodic reports with their respective analyses.

→ Success in Capturing Spatial and Temporal Variability of Water in Soil: The development of the tool has yielded very positive results in capturing the spatial and temporal variability of water stored in soil, particularly in rainfed crops at the departmental level.
→ Prospects for Improvement: It is expected to advance in the development of improvements in several aspects, including the spatial definition and the quality and quantity of the data it requires.
→ Strengthening of Interinstitutional Work: At an institutional level, this collaboration has led to a greater strengthening of interinstitutional and interdisciplinary work between the SMN, FAUBA and INTA.

Final Comments

This document has presented - in an accessible manner - a conceptual approach that seeks to promote good practices for the interaction between NMHSs and users of meteorological, climate and environmental information. This approach, which is innovative in the field of meteorological and climate service provision, constitutes a specific contribution to strengthen the perspective of co-production through strategies and concrete work guidelines based on the contributions of social sciences in connection with atmospheric and environmental sciences.

We hope that this document will be useful to readers, particularly to anyone interested in incorporating, strengthening or deepening approaches, strategies and concrete tools to contribute to the continuous improvement of meteorological and climate services. We also hope that it will meet the needs of the multiplicity and heterogeneity of sectors and social actors that make decisions based on the meteorological, climate and environmental information produced by the NMHSs. From our experience, built over years at the Argentine National Weather Service, we can assert that interdisciplinary and intersectoral work presents substantial improvements to ensure that meteorological and climate information is socially appropriated by end users, according to their uses and needs. At the same time, the integration of social science professionals within scientific-technical organizations is essential to produce knowledge and consolidate specific initiatives. This allows for a positive impact in terms of benefits for the users of the product and/or service.

This road is not simple or linear in nature. It demands a strategic perspective, as it is a transitional component designed to update meteorological services for the 21st century, in a context of significant global transformations.

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We extend our special acknowledgment to Julia Chasco, who was the driving force behind this project in its early stages from the Meteorology and Society department of the National Meteorological Service.

We are also grateful for the collaboration of Santiago Moya (CONICET), who was part of the first stage of this collaboration between the academic sector and the National Weather Service. This partnership strengthens and promotes good practices in the interaction between meteorological, climatic and environmental services and their various users.

The preparation of the Diagnostic Report "Interactions between SMN departments and internal and external users of meteorological and climate information products and services" (2021) was the starting point which allowed the development of this document. This particular document was possible thanks to the collaboration of numerous departments of the National Weather Service which participated in synchronous workshops and provided valuable information. The achievements and lessons learned in various interactions with users of meteorological, climate and environmental information, mentioned in this document, were made possible thanks to the indispensable collaboration of strategic partners from other scientific and technical organizations, academia and civil society actors, which allowed to achieve the objectives of these projects and to gain valuable experiences. The continuous strengthening of the interdisciplinary approach has enriched the projects with a diversity of perspectives of analysis and action, enhancing the importance of involving users in all instances of weather and climate service provision.

This is undoubtedly a result of the strategic institutional decisions adopted by the National Weather Service, and in particular from the Directorate of Sectoral Services and the National Directorate of Forecasts and Services for Society which are committed to this perspective. We would like to thank all of them for their indispensable collaboration and we hope to continue to work together in this sort of initiative.

| GLOSSARY

Weather: The state of the atmosphere at a given instant, as defined by various meteorological parameters.

Climate: The synthesis of meteorological conditions at a given location, characterized by long-term statistics of meteorological parameters at that location. For example, temperature, precipitation, atmospheric pressure, humidity and wind, or by combinations of elements.

Meteorological data: records, measurements and observations of atmospheric variables.

Meteorological/weather information: data and analysis related to atmospheric variables at a given location or region.

Product: A product, in the context of NWSs, refers to information that includes observations, data sets or information derived from an analysis or prediction process. The development of a product can be the result of co-design with a user, which is essential as it is used as an input for decision making.

Co-production: It has multiple meanings in national and international scientific literature. Broadly speaking, it refers to a theoretical and methodological concept that emphasizes the importance of dialogue, collaboration and the inclusion of different scientific and non-scientific perspectives in the production of knowledge. Collaboration and sustaining dialogue over time can increase the use, usefulness, relevance and legitimacy of information in decision making.

Co-design: A collaborative methodology that brings together different social and/or institutional actors from the beginning of a project/program/activity to jointly define priorities, research and action topics, implementation and potential results in addressing a specific problem or issue.

User: A "user" in the context of Meteorological and Hydrometeorological Services refers to a person, organization or intermediary that receives a meteorological product or service and bases its decisions on it.

End User: The end user is the one who relies on weather or climate information to make decisions and take actions based on it.

Downstream User: The downstream user acts as an intermediary between the providers of meteorological services and/or products and the end users.

Collaborating Partner / Collaborating or Partnering Organization: A "collaborating or partnering organization" is an entity, such as a university, specialized non-governmental center or government agency that provides complementary or additional information related to weather and climate services and is governed by terms and conditions established by mutual agreement between the parties.

Service provision: Refers to a continuous process encompassing the design and service provision to users. This process involves the participation of users, the design and development of services, as well as the evaluation and continuous improvement of the quality of the whole process.

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| ACRONYMS

ASN: Analysis of Social Networks
BHOA: Operational Water Balance for Agriculture
CAMMESA: Wholesale Electricity Market Management Company S.A.
CIMA: Sea and Atmosphere Research Center
COHIFE: Federal Water Council
CONICET: National Council of Scientific and Technical Research
COREBE: Regional Commission of the Bermejo River
DCAO: Department of Atmospheric and Oceanic Sciences
FAUBA: Faculty of Agronomy - University de Buenos Aires
FFYL: Faculty of Philosophy and Letters - University de Buenos Aires
INA: National Water Institute
INTA: National Institute of Agricultural Technology
JICA: Japan International Cooperation Agency
JST: Japan Science and Technology Agency
NAVTEX: Text Messaging System for Navigation
NOAA: National Oceanic and Atmospheric Administration (U.S.A.)
ICAO: International Civil Aviation Organization
WMO: World Meteorological Organization
NGO: Non-Governmental Organization
PNA: Argentine Naval Prefecture
PREVENIR: Flash Flood Event Forecasting and Warning System
SAT-OCS: Early Warning System for Heat Waves and Health
SAT-TE: Early Warning System - Extreme Temperatures
SAT: Early Warning System
SINAGIR: National System for Integral Risk Management
SISSA: Drought Information System for South South America
SMHN: National Meteorological and Hydrological Services
UBA: University of Buenos Aires
UNLZ: National University of Lomas De Zamora

DEPARTMENTS OF THE NATIONAL WEATHER SERVICE ARGENTINA

CIM: Meteorological Information Center
CPI: Coordination of Immediate Forecasts
CPR: Coordination of Regional Forecasts
DIT: Technological Infrastructure Directorate
DMA: Directorate of Aeronautical Meteorology
DOC: Directorate of Meteorological Operations and Communications
DPS: Directorate of Meteorological Information Processing and Support
DRO: Directorate of Observation Networks
DSS: Directorate of Sectoral Services
DMSR: Directorate of Environmental Modeling and Remote Sensing Products
DCMC: Central Directorate of Climate Monitoring
DPTA: Directorate of Weather Forecasts and Warnings
MyS: Meteorology and Society
PCC: Press and Public Communication
VAAC: Volcanic Ash Advisory Center

SMN | GOOD PRACTICES FOR INTERACTING WITH USERS OF METEOROLOGICAL, CLIMATE AND ENVIRONMENTAL SERVICES

National Meteorological Service Argentina

SISSA

CRC-SAS

WMO OMM

IAI

aecid

AFD Agence Française de Développement

BID

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