

An International Agenda for Education and Training in Meteorology and Hydrology

(A discussion document for the Thirteenth WMO Symposium on Education and Training, Barbados 30 October – 1 November 2017)

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Preambular Comment

Inaugural decision of WMO to hold symposium on education and training dates back to 1970 through decision of Executive Council (EC-XXII). The idea of holding the symposium hinged on the need to address the limited opportunities provided by other mechanisms to bring together senior managers in the WMO education and training community to discuss and debate issues related to the implementation and future direction of the WMO Education and Training Programme. In 1974 EC-XXVI reconfirmed the decision of EC-XXII and recommended that SYMET should be held at approximately four-year intervals. Twelve of the symposia have been held so far with each and every one having its own theme aimed at addressing critical issue of importance to WMO from the perspective of education and training.

Recent SYMET events have provided increased opportunity for all participants to contribute to the discussions related to education and training addressing aeronautical meteorological issues, competency implementation, update to the Basic Instruction Packages and introduction of the WMO Global Campus concept through plenary sessions, small group discussions and workshops. The current responsibilities and future challenges of the WMO Regional Training Centres, can be effectively assessed from education and training perspective through wide spread consultation with the WMO Education and Training community and groups providing education and training of interest. So as to adequately accomplish these endeavours, it is also important to commensurately take into account the recurrent and keep abreast of emerging challenges and opportunities for the Education and Training Programme in the rapidly evolving socio-economic environment worldwide.

In deciding to hold the thirteenth symposium on education and training, therefore, the WMO Executive Council underscored the need to engage wider communities and better prepare participants for discussion, taking advantage of information and communications technology prior to, during, and after the Symposium. It was on this basis that the WMO Secretariat, through a prudent measure, with the support of Members of the EC Panel of Experts on Education and Training and the COMET Group, embarked on a process of garnering thoughts, views and programme related materials as input to preparation of what will potentially feed into the Symposium.

Essentially, the first step in the process of preparing the Agenda began with examination of WMO priority areas as set by Members. This was followed by a review of the programme activities in the Secretariat as they are relevant to education and training and a synthesis of issues highlighted by the International Advisory Committee of the Thirteenth Symposium on Education and Training. The ensuing outcome of the synthesis, herewith for review, has been consolidated as substantive input to the Symposium, that will culminate into "An International Agenda for Education and Training in Meteorology and Hydrology" which contains non-prescriptive, non-binding three-part synthesis, conclusions, recommendations and as section on implementation and future actions for the education and training communities, academia, governments, international organizations, private sector and other interested stakeholders.

Part I : Synthesis of Issues

Section I of Part I:

Service-specific Education and Training Needs

1. Introduction

One of the missions of WMO is to promote the application of new science and technology in operational meteorology, climate services, hydrology, and related service areas to enhance Members' capabilities to meet their responsibilities to better serve and safeguard populations and their activities. It does this through collaborative development and implementation of innovations by the WMO Technical Commissions and the Secretariat Technical Programmes, and by establishing standards of improved practices through competency frameworks and guidance material. Implementation includes the coordination required to meet the education and training requirements these innovations bring about. In addition to addressing innovations, WMO also develops educational guidelines for foundational qualifications and service-area competency standards.

Ultimately, through education and training opportunities aligned with these innovations and standards, the personnel within WMO Members' services will be better equipped to meet evolving service needs.

This thematic paper is offered to increase awareness of WMO initiatives and standards with significant impacts for education and training providers, offer a structure on the implementation of training in their support, and to generate discussions leading to recommendations for effective ways facilitate their diffusion into courses and curricula.

2. Situational Analysis

In recent years, WMO members have agreed to focus attention on several key initiatives that are deemed necessary to strengthen Members' services and enable developments for continued and increased effectiveness of NHMSs into the future. The list below briefly describes a few of the broad initiatives and their impacts for education and training providers. In addition to these emerging learning needs to address service improvements, ongoing core training for basic qualifications and skills must also continue.

2.1 WIGOS

The WMO Integrated Global Observing System (WIGOS) is a framework for integrating all WMO observing systems, as well as co-sponsored systems, into a common regulatory and management structure. The goal is to achieve full interoperability of data from all sources, e.g. those describing weather, water, climate, air quality, oceans, cryosphere, and water resources. This potential has come about through advances in observing technologies and telecommunications, and new mechanisms for data management,

metadata standards, and quality monitoring. This synergy will reduce budget pressures by making more data available through dissolving boundaries between organizations, disciplines, and technologies. Through WIGOS and improved numerical models and data assimilation, services for user decision making will be greatly enhanced. Key components of WIGOS implementation are the WIGOS Data Quality Monitoring System (WDQMS) and the OSCAR/Surface (Observing Systems Capability Analysis and Review tool) and OSCAR/Space systems for cataloguing observations metadata. Each of these has planned training initiatives to prepare people for using the metadata and tools required for establishing the WIGOS. In addition, and in concert, directors of NMHSs need to learn the impacts of WIGOS, OSCAR, and WIS on operations to ensure effective implementation. *Related to:* WIS, S/GDPFS. (See WMO Manual on WIGOS, WMO-No. 1160)

2.2 WMO Information System (WIS)

The goal of the WIS is to rapidly integrate real-time and non-real-time (archive) data to better interpret weather events in a climatologically context, to better integrate data from all observation sites, to harmonize data formats, transmission standards, archiving and distribution mechanisms in support of inter-disciplinary use of data and products, to establish standard practices for collection, electronic archival and exchange of metadata, and to provide industry standards for protocols, hardware and software. Training providers should look to infuse WIS processes within their existing and future courses to. *Related to:* WIGOS, S/GDPFS. (See Manual on WMO Information System, WMO-No. 1060 and Guide to WMO Information System (WIS) WMO-No. 1061)

2.3 Impacts-based Forecasting and Warning Services

While traditional weather forecasting focused on describing expected weather conditions, impacts-based forecasting goes a step further to provide information on the impacts of associated hazards and how to ensure safety and protect property. Such information allows users of forecasts and warnings to take effective action. Impacts-based forecasting applies to all ranges of forecasts, from nowcasting, to short-range, to the medium- and long-range, in both weather and climate applications. The changes in operational practices brought about by impacts-based approaches introduce training needs in the understanding of impacts for various users, impact thresholds of various hazards, methods for coordinated warning delivery to ensure consistent messages, use of the Common Alert Protocol, forecast communications with graphical products depicting hazard areas and levels, developing customized products that might merge weather and other data, communication of uncertainty, and other customer-driven modes of communication. Involvement in the development of warning response plans with other responsible organizations is also required. *Related to:* S/GDPFS, MHEWS. (See WMO Guidelines on Multi-hazard Impact-based Forecast and Warning Services, WMO-No. 1150; Guidelines on Early Warning Systems and Application of Nowcasting and Warning Operations, WMO/TD No. 1559; and PWS, 27; Guidelines for Nowcasting Techniques, WMO-No. 1198 (in preparation); Guidelines for Implementation of Common Alerting Protocol (CAP)-Enabled Emergency Alerting, as well as http://www.wmo.int/pages/prog/amp/pwsp/publications_en.htm)

2.4 Multi-hazard Early Warning Systems (MHEWS) and Disaster Risk Reduction

The concept of Multi-hazard Early Warning Systems is a shift away from a reactive response to weather, climate and other natural disasters to one that includes preparedness and preventative strategies to analyse and reduce risk. Four components of effective early warning systems include:

- 1) detection, monitoring and forecasting the hazards;
- 2) analyses of risks involved;
- 3) dissemination of timely and authoritative warnings; and
- 4) activation of emergency plans to prepare and respond.

In addition, there is a need to coordinate each of these components. While traditional training goals related to detection, monitoring and forecasting hazards are still valid, new training needs arise related to impacts-based forecasting and warnings (see 2.3 above). In addition, capacity for risk analysis and collaboration with emergency response agencies in developing plans and response mechanisms is needed. An example of a developed training programme related to component (1) is the Flash Flood Guidance System Training Programme (<http://www.wmo.int/pages/prog/hwrrp/flood/ffgs/training.php>). *Related to:* Impacts-based Forecasts and Warning Services, Climate Services. (See https://www.wmo.int/pages/prog/drr/projects/Thematic/MHEWS/MHEWS_en.html, https://public.wmo.int/en/programmes/disaster-risk-reduction-programme_including_the_DRR_Roadmap.)

2.5 Seamless Global Data Processing and Forecast System (S/GDPFS)

GDPFS describes the world-wide network of operational centres operated by WMO Members. The GDPFS, which relies on WIGOS and WIS, is made up of Global, Regional, and National-level Centres that produce a variety of products related to weather, water, climate, and environment. This is done by

- a) sharing high-quality data, products, and services,
- b) seamless integration of products at all spatial- and temporary-resolutions (i.e., both weather and climate models), and
- c) smooth translation of weather and climate extremes and their mutual influences to impacts and mitigation strategies.

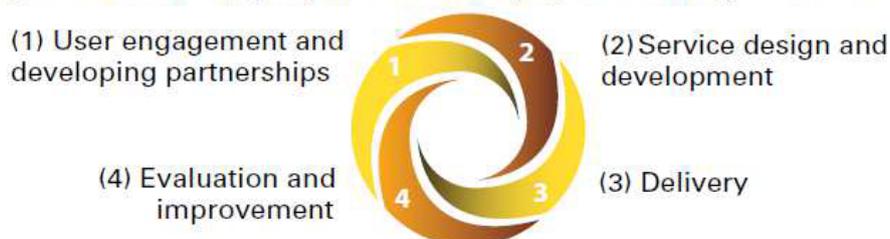
The S/GDPFS will greatly enhance impact-based and risk-based warnings. Seamless processes are important because, to users, the distinction between weather, climate, and environment are less important than impacts, and because overlap exists in their methodological approaches and content. Seamless prediction creates a shared infrastructure, so that weather and climate forecasts improve hand-in-hand. It also ensures that research is more seamlessly transferred to operations.

The seamless nature of the GDPFS will necessitate training to develop skills in utilization of NWP (including the often underutilized ensemble products) and remote sensing products (in addition to conventional data) that enhance the forecast process for impacts-based forecasting at all time scales, and assimilation of global and regional NWP data for local area modelling where necessary. Awareness and skills for using regional products are also required. *Related to:* Impacts-based forecasting and warnings, WIGOS, WIS. (See Manual on GDPFS, WMO-No. 485, revised)

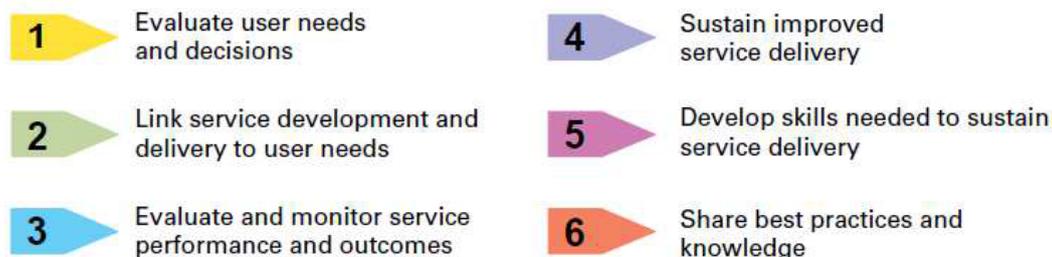
2.6 WMO Service Delivery Strategy

The WMO Service Delivery Strategy has been developed to offer existing and emerging weather, climate, water, and environment services the standards necessary for offering high quality services that meet the needs of their customers. It includes movement towards a service- or customer-oriented culture and the implementation of quality management approaches. The recommended development and delivery processes and their components are succinctly depicted in the illustration below:

The four stages of a continuous, cyclic process for developing and delivering services are:



The six elements necessary for moving towards a more service-oriented culture are:



Because the Service Delivery Strategy is based on an impacts-based forecasting model, many of the training needs that arise overlap with those described above in 2.3, including understanding of needs, local context, and impacts for various users, as well as the impact thresholds of various hazards and good forecast communications. Moreover, the strategy calls for increased capacity in programme evaluation and monitoring, quality management practices and QMS implementation, and methods for developing and maintaining partnerships. *Related to:* Impacts-based forecasting and warnings, S/GDPFS. (See The WMO Strategy for Service Delivery and Its Implementation Plan, WMO-No. 1129 and Guide to Public Weather Services Practices, WMO-No. 834. Also see https://library.wmo.int/opac/index.php?lvl=etagere_see&id=41#.WUzbjuQSgjY)

2.7 Climate Services

The Global Framework for Climate Services (GFCS) intends to provide a worldwide mechanism for coordinated actions to enhance the quality, quantity and application of climate services. Capacity Development is the fifth of five pillars, but it is a cross-cutting one that enables the implementation of the other four, including

- 1) User Interface Platform (training on interactions with users),
- 2) Climate Services Information System (training on using tools and climate information sources),
- 3) Observations and Monitoring enhancements (training in observations and data management), and

4) Research, Modelling, and Prediction infrastructure.

Research and model development and validation will need to be conducted by a well-educated research community, and the additional pillars will require a competent operational workforce with specialized skills and knowledge developed for this substantially new and evolving service area. The approved Competencies for Provision of Climate Services, will guide the latter. These competencies include

- 1) Create and manage climate datasets,
- 2) Derive products from climate data,
- 3) Create and/or interpret climate forecasts, climate projections and model output,
- 4) Ensure the quality of climate information and services, and
- 5) Communicate climatological information with users.

Training is required in each of these areas, and implementation will additionally require targeted training for providing services to specific user communities and industry sectors, as well as larger scope training that aids countries to develop national frameworks for climate services. Special attention will need to be paid to critical users of climate information such as agriculture, water resources, and disaster risk reduction. Climate services have relationships to each of the other innovation areas. (See WMO Guide to Climatological Practices, WMO-No. 100, Guidelines on Capacity Development for Climate Services [in preparation], and Guidelines for the Assessment of Competencies for Climate Services Provision [in preparation].)

2.8 Hydrology and water resources

All of the above initiatives have a clear hydrological component. In addition to above, needs that have been specific to the National Hydrological Services (NHSs) are related to:

- hydrological seasonal prediction based on climate outlooks;
- the selection, operation and maintenance of the appropriate hydro-acoustic instrumentation for streamflow and sediment measurements;
- hydrological data sharing;
- and the development of Quality Management Systems (QMSs) for NHSs.

2.9 Emerging and related service areas

While the above represent broad-scale changes in service delivery, improvements in practices in many existing and increasingly important areas call for specialized training.

- The Global Atmospheric Watch (GAW) programme has developed guidelines and procedures for making observations and predictions of a number of atmospheric composition variables, and has developed analysis and modelling tools. These observations and applications are critical for helping reduce societal risks from climate change, urban air pollution, ecosystem and agricultural impacts, and high-impact weather and events. They also support environmental conventions and treaties. WMO GAW Measurement Guideline Reports that can support training, as well as the GAW Implementation Plan (WMO-No. 228) are available at the WMO E-Library. (For example, see https://library.wmo.int/opac/index.php?lvl=notice_display&id=19823#.WW8am-QSgjY)

- Since 2006, the Severe Weather Forecast Demonstration Project (SWFDP) has been helping developing countries improve forecasts and warnings of severe weather, improving lead-times and reliability for alerts and warnings for high impact events such as heavy precipitation, strong winds, and high waves. The SWFDP employs a cascading forecast process made possible by the S/GDPFS, and integrated MHEWS and Impacts-based forecast and warning services principles, and collaborates with the Public Weather Services programme. *Related to:* Impacts-based forecasting and warnings, S/GDPFS, MHEWS, and Climate Services. (See Guidebook on Planning Regional Subprojects, available at <http://www.wmo.int/pages/prog/www/swfdp/>.)
- The Global Cryosphere Watch programme has been formed due to the increased attention given the cryosphere as a useful indicator of climate variability and change, and its impacts to transportation, infrastructure, wildlife, and recreation. Training is needed on improved cryospheric monitoring and integration of the resulting data into the WIGOS. (See WMO Global Cryosphere Watch Implementation Plan, https://library.wmo.int/opac/doc_num.php?explnum_id=3538)
- Integrated Urban Hydrometeorology, Climatology and Environment Services are growing in importance due to the fact that 50% of the world's population lives in urban areas, and will likely increase to 70% by 2050. Guidelines in this area were called for by an EC-69 decision. Training will be required in areas such as micrometeorology, boundary layer meteorology, surface based observations, and atmospheric pollution processes in urban environments.
- Sand and dust storms monitoring and prediction remains a priority area for research and training to contribute to risk reduction for many WMO Members. The Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) mission is to achieve comprehensive, coordinated and sustained observations and modelling capabilities of sand and dust storms to improve monitoring and enhance dust prediction capabilities.
- In addition, traditional service areas require updated training. Examples include
 - recent Aeronautical Meteorology competency requirements,
 - next-generation satellite skills,
 - changes in NWP capabilities,
 - including ensemble prediction systems,
 - radar training for developing countries obtaining new systems,
 - integrating guidance products for nowcasting,
 - quality management systems for NMHSs, and
 - management training for NMHS managers.
- Underlying many services areas are also the Basic Instructional Packages (BIP) that describe the curricula required to meet WMO-defined basic qualifications, such as WMO Meteorologist, Meteorologist Technician, Hydrologist, and Hydrologist Technician. These are also reviewed on a regular basis, and in the case of Aeronautical Meteorology Forecasters, the BIP-M represents and new international requirement.
- Continued research in these emerging areas will require a growing pool of scientists educated to perform research that can inform service enhancements in the areas mentioned in this section, including research on new operational products and methods.

2.10 WMO Competency Frameworks

The World Meteorological Congress (CG-16) has requested the WMO Technical Commissions to place a high priority on developing the competency requirements for the core job-tasks in their areas of specialization and to incorporate these activities into their work programmes in the 2012 to 2015 financial period. By 2018, the number of competency frameworks approved by Executive Council is expected to grow to 15. Additional frameworks are in planning. Adoption of the competency frameworks will require efforts at the national level. Table 1 provides a list of service areas with approved or very mature frameworks, as well as supporting or enabling knowledge and skill frameworks.

Competency Frameworks	Aeronautical Meteorology (2 frameworks, approved) Public Weather Services (5, in revision) Marine Weather Forecasters (approved) Climate Services (approved) WIS (approved) Education & Training Providers (approved) Observation Systems (4, not approved) Hydrology (in preparation)
Knowledge and Skill Frameworks (Enabling skills)	Satellite Observations (approved) NWP Data and Products (in review) Radar Observations (in review)

Table 1: WMO Competency Frameworks

The implementation of competency frameworks require efforts to

- 1) adapt the framework to local climatological conditions, regulations, requirements, and procedures,
- 2) putting in place a national competency assessment programme,
- 3) developing competency-based training processes to fill gaps, and
- 4) creating competency documentation that supports institutional quality management practices.

The implementation of competency frameworks itself creates training needs, and WMO has anticipated these needs through the introduction of a WMO Guide on Competency (in preparation). However, even more critical is a need for training institutions to become thoroughly familiar with the frameworks in the areas for which they have training responsibilities and to modify their curricula and courses to be in alignment with the frameworks. In this way WMO Members can be assured that all training that is conducted leads to learning outcomes for participants that relate to international standards and recommended practices. In addition, links to the frameworks should be clearly defined in the course descriptions and announcements, and documented in certificates. Accordingly, the WMO Global Campus initiative is requiring, when applicable, metadata describing the competency framework and competency units addressed in the events that will advertised in the WMOLearn Events Calendar and the resources collected in the WMOLearn Learning Resources Catalog. (See the WMO Guide on Competency (In preparation), WMO Technical Regulations (WMO-No. 49), <https://www.wmo.int/pages/prog/dra/etrp/competencies.php>, and WMOLearn at <https://public.wmo.int/en/resources/training/wmolearn>)

3. Challenges, trends, and emerging issues: A general process for implementation of current innovations

All training providers for WMO Members are critical partners in the implementation of the initiatives being driven by the Technical Commissions and guided by the Secretariat technical departments. The following process is suggested for implementation of the new and updated training courses and programmes being driven by the initiatives outlined in section 2. The elements are similar to those in the training cycle described in the WMO Guidelines for Trainers in Meteorological, Hydrological and Climate Services, WMO-No. 1114, and depicted below. As shown in the diagram, the elements are not a prescribed sequence, but systemic.

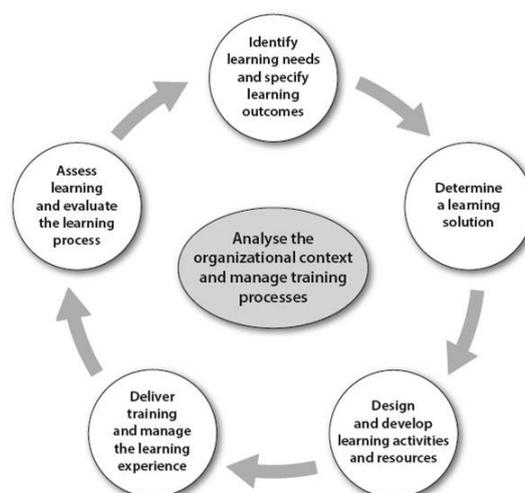


Figure 1: The Training Cycle

3.1 Awareness of standards and guidance material

Becoming fully aware of the appropriate guidance material produce by WMO is the first step to successful implementation. This includes the Technical Regulations (WMO-No. 49), WMO Guides, Manuals, Guidelines, and Competency Frameworks. Responsibility for detailed knowledge of their contents can be distributed among appropriate personnel. Currently, this guidance material is available in a variety of locations on WMO Websites and accessible through the WMO Library online. However, SYMET might want to consider recommendations on improvements to communication and accessibility to guidance material. (Steps 3.1-3.3 are part of the continuing analysis of the organizational context.)

3.2. Reviewing WMO implementation strategies

The initiatives describe in section 2 are likely linked to strategies proposed either in the guidance material itself, or in the decisions reported in the WMO Executive Council and Congress papers. The strategies might include recommended course topics, training events or resources, and modes of delivery. WMO ETR will endeavour to make RTCs and SYMET participants aware of these initiatives as they become available. SYMET participants may have recommendations in regards to dissemination of implementation strategies as well.

3.3 Review and adaptation of the relevant competency frameworks

Awareness of the competency frameworks is just the beginning. As mentioned in section 2.9, a key step in the process is to review the relevant competency framework(s) and adapt them to national or regional needs, and then to adapt training curricula and training plans to address the learning outcomes suggested in the frameworks. Comparing the contents of the frameworks, including both top-level and second-level information, to existing or planned courses and resources, will help ensure compatibility and regional appropriateness.

3.4 Training needs assessment

WMO guidance and competency frameworks go a long way in defining training needs as they reflect the goals agreed to by WMO Members. However, regional and local needs assessment will help to prioritize those needs based on current levels of performance and available infrastructure. For new personnel entering into service, training needs will be more extensive, perhaps beginning with an assessment of the extent to which basic qualifications have been reached.

National needs are easier to identify, but still require substantial effort. National needs can be uncovered by examining performance records, education and training records, feedback from customers, and training requests by staff and supervisors, as well as national needs assessment surveys. Providers of training for regional audiences can review national needs assessment results, if available, and needs assessments conducted by the WMO Secretariat or Regional Associations. They can also conduct new, focussed needs assessments in specific service areas with countries typically served, include questions about training needs in course nomination forms to adapt courses proactively, and use post-course evaluation forms to guide future course planning.

3.5 Developing learning pathways

The path to expertise most often requires many steps, and a professional development curriculum path composed of multiple learning opportunities may be needed to bring learners to desired levels of performance. A curriculum path may include a series of courses, or a blend of self-directed learning using online learning resources in conjunction with classroom courses and follow-up on-the-job experiences or ongoing connections with online communities of practice, which could extend regionally or globally.

3.6 Identify learning solutions, including alternative methods

Professionals learn their skills in a wide variety of ways, but when creating training plans, too often these can be forgotten as potential modes of professional development. The WMO Secretariat is currently suggesting an increasing variety of approaches to meeting Members' training needs in cost-effective ways. These include:

- Traditional face-to-face courses focused on information sharing
- Courses with increased workshop components (higher ratio of practical sessions)
- Distance learning courses that are time-constrained and instructor-led
- Distance learning courses and online resources to be used in self-directed ways and to augment other forms of training
- Blended combinations of face-to-face events and distance learning events and resources

- Fellowships for longer-term training opportunities
- Regional training desks and other forms of on-site coaching for long-term periods of a few weeks to months
- Training of trainer approaches to prepare experience trainers to disseminate good practices through their local training activities
- Roving seminars in which the required travel is limited to trainers and nearby participants
- Regional weather briefings conducted remotely by regional centres in support of the NMHSs in their region
- Training weeks composed of a series of topic-focused Webinars
- Experiential learning approaches such as participation in special projects, special assignments and secondments, etc.

Often, a combination of these is required to reach the intended learning outcomes, and for providing flexible pathways for learners and institutions.

3.7 Developing training plans, including activities and assessment methods

Effective training outcomes require planning for activities for practicing skills and receiving feedback, and methods for conducting both formative (mid-course) and summative (end-of-course) assessment. Using a process that begins with well-defined needs and learning outcomes, a useful training plan will include a definition of scope, analysis of constraints, justification of learning solutions, an assessment plan, course evaluation plans, learning activities mapped to the learning outcomes, and specification of the human and technical resources required, as well as time constraints and milestones. (See The Trainer Resources Portal at <http://etrp.wmo.int/moodle/course/view.php?id=30>, *in development*.)

3.8 Conduct impacts evaluation

Without some level of investigation on the longer term outcomes of training, it is difficult to state with confidence that it was successful. Impacts assessment can be formal and thorough, or less formal and lighter, but still highly useful. Some methods can include:

- Providing questionnaires or checklists that allow supervisors to evaluate if the participant's performance has improved
- Providing checklists to participants to self-assess during or following significant events, and requiring these to be shared with the training provider
- Providing 6-month to one-year follow up questionnaires for participants and managers on benefits of the training
- Using follow-up online seminars to refresh learning and share application experiences
- Using online discussion forums for continued sharing of application experiences
- Providing action plan or report templates to participants to be shared after on-the-job experiences within their institution

3.9 A note on working with diverse learner audiences

Particularly when training learners from throughout a region or from other parts of the globe, it can be difficult to know how to follow the preceding guidance. When needs are diverse, it can be more difficult to determine what skills to address and how to conduct the training to have the highest impact for the most learners. Learners may vary in terms of culture, climate regimes, level of background knowledge, native language, national capacities and procedures, and technological capabilities. Yet competency-based training, in particular, requires practice, coaching, discussion, and feedback. Even when using active learning approaches, diversity can be accommodated in several ways.

First, a variety of examples and cases can be included, demonstrating how what is being learned can be used in a variety of climate regimes, within a variety of technological environments, and with more or less complex procedural constraints.

Second, a focus on general problem solving, analysis, decision-making, and communication independent of the specific set of tools they will eventually use will help to build transferable higher-order skills. Allowing learners to perform problem solving in conditions that best match their work environments will also ensure a higher degree of applicability.

When teaching highly technical skills, at times it is necessary to choose a technical training platform best suited conditions required for learning, even if it is not a platform that learners have immediate access to. In these cases, it is important to at least discuss how the technology differs from what they may have available, and how they might alter their procedures when applying them outside the training. It is good to prepare learners for technologies they expect to have available in the near future, but they will lose those skills if they cannot practice them in the meantime.

(Note: All numbered WMO documents are available at <https://library.wmo.int/opac/>)

4. Conclusions

From the above discussion, one can draw several key conclusions that might lead to recommendations from SYMET participants.

- a) A number of WMO initiatives point to paradigm shifts occurring in the way NHMS services are being delivered, including an increased focus on impacts, a higher degree of data integration, and seamless forecast delivery at multiple spatial and temporal scales.
- b) WMO competency frameworks are being put in place to guide training providers to develop training that will address critical skills and knowledge for staff members in many service areas.
- c) While these initiatives have a degree of overlapping training needs, they suggest that a wide range of training must occur if WMO Members are to keep pace with changing methodologies and technologies.
- d) SYMET participants are critical training partners in WMO initiatives, and must be engaged to disseminate knowledge and skills in service areas.
- e) The number of WMO publications that contain guidance material for these initiatives is high, and clearer direction on their access would be useful. Training providers offering training in related areas must be aware of this material.

- f) The scope of training that must occur in the short term suggests a need for careful prioritization, planning, and choice of training delivery modes.
- g) Training needs assessments are important to help prioritize training efforts and define the scope of training events and resources.
- h) Guidance on recommended learning pathways to develop expertise in each service area will be useful.
- i) To ensure learning- and cost-effective training, all potential learning solutions should be considered, particularly blended solutions.
- j) Model plans or example training plans could guide good training practice in the various content areas.
- k) Training impacts evaluation is essential for guiding and improving training practices.
- l) Working with diverse international audiences brings special challenges, but these can be mitigated or overcome.

5. Recommendations

SYMET should consider the following recommendations based upon the conclusions drawn from the preceding outline of evolving service-specific education and training requirements. Additional recommendations or revision of these is expected to result from online and symposium discussions.

- 6) Recommendations for training institutions include:
 - i. Regularly reviewing WMO guidance material and competency frameworks as they are approved and published, and updating existing curricula as required.
 - ii. For each service area, sharing learning resources with other training providers to help meet the immense global training needs.
 - iii. Indicating their expertise and willingness to contribute to training in each of the training areas.
 - iv. With WMO guidance, developing effective planning methods to ensure maximum results for each training effort.
 - v. Developing and sharing recommended learning pathways to develop expertise required in each service area.
 - vi. Considering all potential learning solutions, particularly blended solutions, when developing training plans. Sharing guidance and experiences with different learning solutions.
 - vii. Offering courses and course descriptions for review by the WMO Secretariat if they will seek co-sponsorship of participants by WMO. Sharing post-course reports.
 - viii. Conducting the best skills-based training possible, even when working with diverse international audiences.
 - ix. Encouraging communications and partnerships with NHMSs and local and regional universities to ensure seamless information exchange and strong connections between research, education and training and operations.
- 7) Recommendations for the WMO Secretariat and Technical Commissions include:
 - i. Providing clear direction on which WMO publications are most critical to each service area and consolidating access to them

- ii. Making available training resources for all areas for access by WMO Members and WMO training providers.
 - iii. Announcing its training initiatives and strategies, along with calls for participation in training initiatives.
 - iv. Developing model or example training plans to guide good training practice for each service area.
 - v. Providing guidance on performing training impacts evaluations.
 - vi. Evaluating progress on SYMET recommendations each year, making revisions as necessary.
 - vii. Sharing guidance and experiences on the use of different learning solutions.
 - viii. Developing and sharing potential learning pathways to develop expertise required in each service area.
- 8) Recommendations for NMHSs or Regional Associations include:
- i. Putting in place appropriate competency assessment systems and reporting to the WMO Secretariat on their status.
 - ii. Developing effective methods of performing training needs assessment, and sharing the results for use by the Secretariat, Regional Training Centers, and other training providers.
 - iii. Encouraging communications and partnerships between RTCs, NHMSs and local and regional universities to ensure seamless information exchange and strong connections between research, education and training and operations.
- 9) Recommendations for development partners and international organizations:
- i. Reinforcing WMO qualifications and competency standards in capacity development efforts.
 - ii. Promoting the sharing of training resources and best practices to promote successful capacity development.

Section II of Part I

Increasing Education and Training Capacity for the WMO Members

1. Introduction

This paper is designed as a thought piece that provides an overview of the current research and activities associated with training and education focussing on education and training for WMO Members. This paper also provides the results of the World Meteorological Organization workforce assessment highlighting the demand for training and demographics of members and of the next generations of learners we must tailor training for.

We review: 1) the WMO Workforce Assessment, 2) challenges and emerging issues for learning and development, including assessment of learning needs, alternative learning sources, cultural changes in learning, online and self-directed learning, gamification and simulations, and competency based learning, before 3) drawing conclusions and making 4) recommendations for directions in education and training for WMO Members. The goal of this paper is to stimulate a discussion focused on applying the emerging ideas outlined in this paper and collaborations between organizations to increase the global meteorology training and education capacity available to support the WMO global workforce.

2. Situational analysis: WMO Member Workforce Assessment

2.1 Recent survey conclusions

Based on a 2017 survey of WMO Members administered by the WMO ETR Office:

- The total number of NMHS workers across the globe is at least 170,409 people, based on 80% of Members responding. (when counted by age brackets)
- Almost one-third (31%) of global NMHS staff are more than 50 years old. Only 17% of global NMHS staff are less than 30 years old.
- 45% of global NMHS staff are women and 55% are men.
 - o There is considerable variation in gender balance by Region and by individual Member states.
 - o It is not possible to determine from this survey in which job categories the men and women in the NMHSs are working. The men and women may be represented in different balances among the various job categories.

Job categories A: Numbers of staff

Table 1. Global number of NMHS staff by job category

Job Category	Number of workers	Percent among the 9 job categories	Percent of total NMHS workforce
Managers	14,016	10%	8%
Meteorologists	30,088	21%	18%
Met Techs	41,130	29%	24%

Hydrologists	2,492	2%	2%
Hydro Techs	2,955	2%	2%
Climatologists	10,684	8%	6%
Researchers	15,286	11%	9%
Support Staff	13,430	10%	8%
Other	11,163	8%	7%
<i>Uncategorized</i>	29,165	N/A	17%
Total	170,409	100%	100%

The WMO Global Workforce numbers that indicate a need for training are depicted in the following table.

Table 2. Global NMHS staff in job categories, and the number and percentage that require training

Job Category	Global Staff Numbers	Number That Need Trained	Percent of Current Staff
Managers	14,016	3,678	26%
Meteorologists	30,088	9,835	33%
Met Techs	41,130	12,253	30%
Hydrologists	2,492	724	29%
Hydro Techs	2,955	603	20%
Climatologists	10,684	3,195	30%
Researchers	15,286	4,464	29%
Support Staff	13,430	3,041	23%
Other	11,163	1,512	14%
Totals	141,244	39,305	28%

As indicated in Table 2, the training demand is quite large for the National Training Centres, the WMO Regional Training Centres and the Affiliated Training Institutions. Based on current performance, the existing training infrastructure does not have the capacity to meet all the training demands specified in the above table. In appendix A, there is a detailed discussion of the funding expectations for supporting the training demand globally and regionally. The combination of the rising expectations for extra-regional funding and the limited capacity within the RTC network will limit the ability to provide needed training. Thus, additional training capacity is needed to ensure that each training requirement for NMHS personnel is met. Additionally, the rapid advances in numerical weather prediction, remote sensing capabilities and the ever-increasing volume of observation data require continual updates for training materials and the operational NMHS workforce.

One of the primary challenges for learning and development in National Meteorological and Hydrological Services (NMHSs), National and Regional Training Centres and other training institutions that serve WMO Members is to keep up with the pace of change in the tools, techniques and services available to the WMO workforce. It goes without saying that the modern NMHS work environment is continually under the stress of integrating innovative technology. In many locations, employees can access alternative sources of information and training instantly.

For many years, the lack of internet access in developing countries led to significant investments in training for personnel outside the home country. Table 3: shows the increasing availability of internet within the developing regions and the more substantial increases that have occurred in Africa and the Asia Pacific region over the past five years. If we extrapolate these trends, the restrictions to learning options due to lack of internet access will decrease dramatically by 2025.

Table 3: Table showing the growth in internet access by region over the past ten years

	2005	2010	2016 ^a
Africa	2%	10%	25%
Americas	36%	49%	65%
Arab States	8%	26%	42%
Asia and Pacific	9%	23%	42%
Commonwealth of Independent States	10%	34%	67%
Europe	46%	67%	79%

^a Estimate.

Source: [International Telecommunication Union](#).^[7]

The national training centres, RTCs and Affiliated Training Institutions are making some headway toward implementing new learning technologies, but some organizations are still limited in their ability to respond. They may be bound by decades-old training approaches involving lengthy, one-off courses delivered using antiquated tools. Training centres may rely on lecture and recorded lectures to deliver training combined, in the best cases, with lab exercises and perhaps homework for their distance courses. Many of these courses are organized around topics rather than the competencies their staff are supposed to possess. As a result, trainees find it difficult to see how their training will relate to the job they are expected to perform

2.2 The changing training landscape

To meet the growing training demands, a recent survey in the United States (Axonify, 2017) indicates that the training landscape is changing and training process must adapt

to the new learning demands and learning delivery requirements. While these statistics reflect only the current population in the USA, similar trends are occurring throughout the world. The survey asked workers which elements of formal workplace training are most important to them:

- 90 percent place training that is easy to complete and understand at the top of their list.
- 85 percent say it should also be engaging, fun, personalized and relevant.
- 72 percent want training that is regular and frequent.
- 63 percent say training should be short and that they should have the option to participate on a range of devices, including their smartphone.
- 64 percent want the choice to pick training times that work best for their schedule.
- 64 percent desire ready access to information anytime and anywhere they need it.

To expand training capacity, we must explore new methods for training delivery, yet national and Regional Training Centres are often bound by training approaches involving lengthy, one-off courses delivered in person to a limited number of participants, or online through learning management systems (LMS), without carefully considering or measuring if these courses effectively meet well-defined learning needs. As a result, there is no way for participants or their managers to know which training will improve forecast quality and services. Any increases in training capacity must be accompanied by quality assurance processes and guidance on learning paths.

In the Axonify survey (2017) half of the respondents reported that training made no difference to their performance of their job. Clearly, there is a wasted opportunity and investment if half of those who do receive scarce training opportunities find them a waste of time. The results of the Axonify survey give WMO members some insight into future modifications needed to make critical training available to more learners, developed and delivered by qualified training staff, not just in one-off courses, but at any location and at any time to enable employees to develop a continuous learning culture.

Imagine the potential impact of a near future in which:

- Prioritize learning needs are defined at regional and national levels to guide training decisions.
- Developing professionals are told clearly what new skills and background knowledge will help them progress in their careers.
- Learners have guided access to resources for self-study to help them progress down this path and to prepare them for more in-depth study. These are available on many platforms, at work, at home, in transit, and on desktop and mobile devices.
- By using pre-course online resources or online courses phases, learners come prepared for training events, either in person and online, having sufficient common background knowledge to engage at similar levels.
- Learners have the means to maintain continuous communications with fellow professionals at all levels to ask questions and to share their growing knowledge and work experiences.
- Learners and their managers know effective paths to follow for continuous learning and where to access the resources, including training events and self-directed resources, to help them.
- Training providers have guidance and resources that help them decide what to teach and recommendations on how to teach it, what and how to

assess, and how to use a variety of methods to reach their training goals in all service areas.

- Assessments and certificate information tell learners and their managers what skills their staff members have learned in a training event.
- Training evaluations are administered to help improve resources and courses, both immediately following events and at a delayed interval to measure long-term retention and application of learning.

2.3 Meeting the challenges ahead

As shown in this section and in Appendix A, there are demographic, funding and training capacity challenges that require WMO members to apply new learning methods and technologies to increase the training available to our workforces. The funding challenges further increase our need to work collaboratively and to find innovative ways to leverage others learning content and methods. The increasing competency-based training requirements, the adoption of learner-centred training methods and training available on many types of learning platforms creates new opportunities. We must continue to improve classroom-based instruction as well as increase our use of alternative learning solutions.

The recent efforts within WMO ETRP to support a demonstration project for the WMO Global Campus can help with some of these issues. However, a thorough review of the issues discussed in current literature will provide a good basis for evaluating and making appropriate recommendations for ways to improve and increase the training capacity available to WMO members.

3. Challenges, trends, and emerging issues

In this section, a summary of relevant research and conclusions associated with increased access to high quality training is provided. The conclusions are focused on being prepared for the coming changes needed to support education and training over the next decade.

3.1 Investment in learning and development

At the national and international level, NMHS's in most WMO Regions believe that most of their training needs will be funded (See Appendix B). There are over 19,000 individuals worldwide that require training and there are expectations for funding to meet most of this training demand. However, the planned funding sources are all facing fiscal pressure to reduce spending which may require delays in training and increase the training gap within WMO Member workforces.

It is important to realize there is a training gap in current WMO NMHS workforce. It is also important for each National, Regional or supporting training institution professional to promote training and request their organisation to invest in training development and delivery to close this gap.

Consider the relevance to WMO Members of these US statistics quoted by O'Donnell (2017):

- The 2015 Manpower Talent Shortage Survey indicated that only 20 percent of

organizations in the United States of America offered training to their employees.

- In the latest PricewaterhouseCoopers survey of nearly 1,350 CEOs, 73 percent ranked skill shortages as the greatest threat to their companies, a 10 percent jump from the 2014 results.
- Deloitte's 2015 Global Human Capital Trends report found that 85 percent of the 3,300 business and HR executives surveyed rated the talent challenge as "very important" or "important," a 21 percent increase from 2014's results. However, only 28 percent of those surveyed said their businesses are prepared to deal with this talent deficit.

In WMO meetings in all regions, the shortage of investments in training, skill or competency are recognized. NMHS's must see investment in human capital as a key management strategy that will improve productivity, performance and quality.

3.2 An Engaged Workforce

Effective training engages and motivates employees by showing them that their NMHS values them. Accordingly, organizations who invest in employees' education usually have a lower turnover rate. According to Ashley (2015), employee engagement is "the extent to which employees feel passionate about their jobs, are committed to the organization and put discretionary effort into their work." Maximum employee engagement should be every NMHS leader's goal. Employees who are passionate about their job are committed to the organization and put the most effort possible into their work will produce a higher quality and quantity of work, translating to an increase in quality and services provided by the NMHS's.

Developing engaged employees begins with helping them understand how training will benefit them, and the NMHS, in the long run. Stressing the personal value of what employees need to learn, such as the potential for future promotion, can increase their willingness to become active learners.

Within WMO Member organizations, resources to support training are continually stressed beyond the demand, yet retaining trained staff is critical to maintaining competency within Member NMHSs. In NMHS's, investments often take several years before showing a return; however, NMHSs could see the return on their training investment much sooner if the right metrics are collected and monitored. An engaged and competent workforce has unlimited potential for producing top quality forecast and warning services, if the workers continue to stay passionate and committed to the mission. Training professionals must also stay engaged, dedicated and passionate about their job and profession to help their NMHS's stay current in times of constantly changing tools and services to the public.

3.3 Assessing learning needs

Needs assessments are a critical step in determining where the largest training gaps and highest priorities are within NMHS's. WMO Member NMHS's must determine the gaps are in the knowledge and competencies of their employees. Needs assessment help to identify weak areas and determine what training is necessary to develop competencies at WMO standards. Reviewing each employee's performance on a regular basis (annually

or semi-annually) will provide additional information related to gaps in skill. Once you are aware of those gaps in the context of organizational priorities, job duties, and personal development, you can then determine the best education and training options within available budgets.

A critical first step in increasing training capacity is to determine the regional and national training needs and focus the investments in training on the most critical gaps. Morris and Kemp (2001), suggest that needs assessments are “a tool for identifying the problem and then selecting an appropriate intervention. If the (instructional) designer fails to identify the problem properly, then the intervention may address only the symptoms, with no resultant change in the target audience’s performance.” According to Morris and Kemp, needs assessments should perform four functions:

1. Identify problems affecting performance jobs or tasks
2. Identify critical needs that have a significant fiscal impact, affect safety, or disrupt the work or educational environment.
3. Set priorities for selecting an intervention, such as a training event or programme or on-the job coaching.
4. Provide baseline data to assess the effectiveness of the Intervention.

Without needs assessments reports that describe the required performance outcomes and standards to properly perform the tasks, instructional designers must rely solely on subject matter experts to define training requirements, which may lead to the unnecessary expense of developing training materials that go beyond the training required to meet the performance gap.

A complete training needs assessment process should determine who needs training, what kind of training they need, where they need it and how much it will cost.

There are nine steps to a training needs assessment:

1. Determine the desired performance outcomes.
2. Link desired business outcomes with employee behaviours.
3. Identify trainable competencies.
4. Evaluate current competencies.
5. Determine performance gaps.
6. Prioritize training needs.
7. Determine how and where to train.
8. Conduct a cost-benefit analysis.
9. Plan for training evaluation (to determine if needs are met).

A critical step in the process is to determine how and where the training should occur. To make this determination, we need to answer questions such as:

- Who is the audience?
- Where are they located?
- Are they entry-level, mid-level, experts or managers?
- What is the subject matter?
- What is the budget available?

The answers to these questions can help determine whether to train locally, at a national centre, online, with self-directed online resources, or using a mixture of these. With

improvements in technology, it's now easier to use a variety of training models that cater to a variety of learning styles.

3.4 Alternative sources for learning

In the tight funding environments in most NMHS's, selecting the right training approach to meet the identified gaps is critical. As technology, tools and forecast and warning processes change and the amount of data available to the forecaster grows, training methodologies must evolve as well.

3.4.1 Learning Outside the NMHS or National Training Centre

There are many training options to pursue outside the NMHS or National Training Centre. For example, national meteorology societies and other industry trade associations often offer free or low-cost training. Participation in conferences, seminars and meetings also present venues for learning, albeit at cost. WMO Regional Training Centres and Other International Training Organizations supporting the WMO provide opportunities for training and offer models for NMHS to use to conduct their own training.

3.4.2 Pairing Employees –

In the 1980's, McCall, Lombardo and Eichinger (1996) developed the 70- 20-10 model for learning and development in the workplace (McCall, Lombardo and Eichinger (1996) and Wikipedia, (2017)). The model suggests that 70 percent of professional learning occurs through application on the job, 20 percent occurs through peer coaching and collaborative learning in the workplace and only 10 percent of learning occurs through formal instruction. Exploiting this model, in-house, employee-led training can produce significant learning at a low cost. A peer coaching model will add further learning for employee development and helps to build a team approach to developing forecast and warning services. Employees with specific skills can transfer their knowledge to others, and when leaders, managers and staff members attend training programs, they can be asked to pass on what they learn to their team members.

3.4.3 Exploring Service Provider Packages –

Following the WMO Capacity Development goals, when new tools and products are provided to members, the supplier should offer training offer training packages to the national and regional training centres to help the recipients understand their proper utilization and to maintain the systems once the supplier's contract ends. This technical training could involve training away from the office, online training or webinars.

3.5 Cultural and technological transformation

Because of the large expense associated with some of the more progressive learning approaches, many learning institutions must become more collaborative in the way they approach training development. A cultural transformation is needed to both accept the new learning approaches and to increased collaboration for national and regional training

centres. Additionally, new tools are required to enable these centres to identify needs assessment gaps and share existing content and tools for rapid integration of existing content from multiple sources. To promote the development of new teaching approaches, processes for working collaboratively must be structured in ways that promote the exchange of new ideas and successful models and reward successful teaching innovations.

3.5.1 Competency frameworks and competency assessment

The WMO move toward competencies and Certification of Competencies, according to standards first called for by the International Civilian Aviation Organization for Aeronautical Meteorology personnel, is focused on augmenting academic knowledge with training to develop real-world skills that bolster NHMS capacity development. Training Institutions supporting WMO Members have a responsibility to deliver deeper, more active learning experiences and competency-based training that integrates the technology that the students will use in the workplace in meaningful ways.

But first, WMO Members need to develop and share competency assessment best practices and tools that identify competency gaps of the workforce. A WMO Guide on Competency (in preparation) will be published in 2017 that good practices on competency assessment, but each Member will be responsible for establishing its own systems and priorities. Together, we should work collaboratively to ensure a focus on competency assessment in addition to training.

3.5.2 Competency-based learning

Once competency gaps are defined, training that addresses these gaps is required. Competency-based training is focused on directly improving the organization's ability to provide services and products. A focus on competency is different than the dominant educational paradigm of structuring training around topics.

Competency is skills & knowledge applied in job contexts. For example, in meteorology, students learn about moisture, condensation, temperature, air masses and fronts, forecasting, thunderstorms and tornadoes and so on. With performance providing the structure, we use the tasks that need to be performed to organize the content. To make a forecast one needs to monitor the moisture, temperature, and stability; analyse air masses and fronts, and issue forecasts for tornadoes and t-storms. The knowledge is embedded within the real-life problem the learners are solving.

Allen (2012) suggests that in competency based learning design, training must be concise, meaningful, memorable, motivational, and measurable. The design must include placing the learner within a performance based scenario that is similar to what will be experienced on the job and aligned to organizational practices and objectives. The learning must be challenging and aligned to the real-life activities. The learning must provide feedback to learners through both consequences of their actions and decisions in practical situations. Consultation with operational experts is required during development of the training to ensure that real-world skills are being taught and assessed.

In many contexts, training technologies that focus on ongoing learning measurement and are adaptable to individual learning needs and speeds, are personalizing student

learning experiences. Such technologies will help training providers evaluate the acquisition of competencies.

These days, competency-based learning also begins during formal education. Competency-based education (CBE) awards academic credit based on mastery of clearly defined competencies. CBE stands in contrast to education in which learning is structured around seat time and the credit hour. With CBE, learners take as much or as little time as they need to understand the material and master skills. Competency-based programs can recognize prior learning and learning outside the scope of a course, regardless of where, when, or how that learning took place. CBE shifts the focus from grades to learning, emphasizing frequent, meaningful feedback that empowers students to take more responsibility for learning than in conventional models Educause (2014).

3.5.3 Online self-directed and just-in-time learning

Developing training under austere budgets requires utilizing all available training resources. The internet provides access to learning opportunities that can be very effective, as well as inexpensive or free. Of course, all such open educational resources (OERs) were developed at a cost by their originating institutions, with institutional or grant funding, or by individual experts expending their own time to offer them. But with open copyright licenses, such as those developed by the Creative Commons, they can be made widely and freely available. Such free offerings can benefit developers by a promoting their reputation, demonstrating their offerings, or for the altruistic reward of contributing to the discipline.

In areas where reliable internet is not available, online learning can be provided via DVD, CD-ROM and thumb drives that require only a computer to access learning. The key advantages to this style of learning are 24/7 availability, flexible timing, the option to meet various levels of need, and, in some cases, the ability to monitor progress and performance through verification of course completion certificates and pre- and post-test scores. The key disadvantages are the lack of real-time answers to questions or clarifications of content, but this can be mitigated through peer- and trainer-led discussion forums. This style of learning can also allow near real-time application on the job to ensure retention and relevance. Workplace learners want training content that is relevant and specific to the daily tasks performed and can be immediately applied. On-demand training models that allow learners to “pull” training content when and where it is required should be fundamental to future training design. Institutions must have robust strategies for integrating the online, mobile, and blended learning approaches now pervasive in many countries. A key ingredient is tracking how these approaches are actively enriching learning outcomes. Within developing countries, least developed countries and small island developing states, gaps still exist in access to reliable internet services. We must be flexible enough to support both the connected and unconnected training world. We need innovative practices that allow for both online and local access to training materials, yet also be prepared as the internet gaps close over the next decade and the potential of online, mobile and blended learning grows. –

In using open content and applying tools and training delivery platforms like LMS, educators will want to unbundle and adapt them in unique and compelling ways. To meet this desire, we should provide new tools and processes that allow for dynamic reuse, and develop shared resources with reuse in mind.

3.5.4 Online education and training environments

When a high degree of interaction is essential, facilitated online instruction can be used to save costs but preserve the required feedback potential. Facilitated online instruction has several key activities facilitators must undertake to ensure success;

1. Build an active learning team: Motivate learners to work together.
2. Be the leader of the learning team: Model what a good team participant should do, as well as take leadership to move if forward.
3. Maximize communication: Work actively to avoid feelings of isolation.
4. Deal with learning team conflicts immediately: Resolve the problems with interpersonal relations that can occur online.
5. Monitor student progress and provide frequent feedback: Just as you would in a face-to-face environment

Many useful resources on the online teaching experience can be found in the WMO Trainer Resources Portal at <http://etrp.wmo.int/moodle/course/view.php?id=30> (in preparation).

3.5.5 Blended learning solutions

By utilizing many types of training and focusing your resources on the highest priority gaps, learning needs can be met more efficiently. Classroom training offers clear benefits for addressing many learning needs, but facilitated online learning and self-directed learning offer benefits that can complement those of the classroom. Training providers should consider all potential learning solutions to find the most effective and affordable methods for reaching those in need of training.

3.5.6 Increasing learning motivation through games, simulations, and gamification

A growing trend in training for competency-oriented learning outcomes is learning through simulations. The use of case study-based simulations reinforces competency development by offering practice that calls for the same level of analysis and decision-making required on the job. These simulations can be simple paper based exercises that review forecast processes and are conducted under very short timelines. More complex online simulations can also be conducted that utilize computer software to simulate numerous aspects of NMHS forecast office simultaneously. Tools for developing low-cost simulations in meteorology should be made available in the near future.

Simulation can also be used in assessment. For example, both the KMNI and the Australian Bureau of Meteorology uses a severe weather forecast process simulator to certify their NMHS staff. The simulator allows someone in Melbourne to logon to a learner's computer in another city in Australia and to conduct a learning simulation based on historical cases that are shared electronically.

Learning through games is also a growing trend in training and higher education. Games can also be, and indeed the concepts overlap. The wide-spread popularity of games (larger even the movie industry) has led educators to examine the qualities of games that lead to such high levels of engagement, and find ways to include games oriented to learning content and skills among their learning activities. The key is to make the learning fun, but to also align the game outcomes toward practical learning outcomes. Learning through games and simulation can improve learner engagement and retention and provide instant feedback and self-diagnostics. Games and simulation, if done offline,

do not required large investments but do require an understanding of instructional design and game theory to design well sequenced learning events.

Gamification is a term used to describe the application of game-design elements and game principles in non-game contexts. The goal is the improve engagement through the use of techniques that utilize motivation and engagement strategies similar to those used in games. Educators can use gamification by creating friendly competition among learners, issuing badges for incremental achievements, using online avatars as support, defining learning paths with levels to be achieved, rewards and many kinds of challenges. (Oesch, 2017).

There are a growing number of gamification platforms such as Badgeville, BigDoor or GetBadges, which have a wide range costs, depending on their clients' needs. Moodle, Zero and User Infuser are free open-source learning platforms with gamification capabilities.

4. Conclusions: Promoting a learning culture transformation

In Section 3 we explored challenges, trends and issues associated with the changing training landscape. In this section, we will draw several key conclusions.

- a) MO Members should work to increase the visibility and recognition of the value of training for continuing to develop and deliver their services. Investment in training is often not sufficiently considered.
- b) NMHS workforces show a high and increasing demand for training with increased development and changing work processes, tools and services.
- c) The growth in internet access around the globe is creating new avenues to help meet training needs.
- d) Investments in training to develop a competent workforce is critical to service delivery.
- e) Needs assessments and competency assessments are critical for determining training priorities, especially under the constraints of limited budgets and timeframes.
- f) Competency based training that is aligned to WMO Member NMHS performance requirements is critical for increasing the impacts of training.
- g) Training institutions now have available new and alternative training sources and alternative processes that include integration of new learning technologies, simulations and competency-based learning activities.
- h) Utilizing online learning increases the numbers of students that can access critical courses and resources.
- i) The use of learning games and gamification strategies can enhance and sustain learning engagement.
- j) Collaboration is key for scaling effective solutions to serve many Members. - The WMO Global Campus initiative can be used to develop an ETR Community of Practice to foster collaboration and sharing.

In fact, many of the conclusions in this section are reasons behind the development of the WMO Global Campus initiative, current in feasibility study.

The WMO Global Campus Feasibility Study is being conducted to investigate methods to increase training capacity within the WMO through expanded support for the WMO Regional Training Centres and other WMO training partners. The vision of the Global Campus Concept was defined in the first year of the study:

The 'Global Campus' is a collaborative network of education and training institutions and NMHSs involved in the development and delivery of training in meteorology, climatology, hydrology and other related sciences. It is built on the synergies, sharing and cooperation between these institutions and will address global priorities and the growing and changing requirements and needs for training of the community.

The concept behind the WMO Global Campus is to have a coordinated and collaborative network of institutions that work together to meet the education and training needs of WMO Members. It will build upon the existing network of RTCs, but expand this network to further recognize other contributing national and international organizations and academic institutions, promote the use of new training delivery mechanisms, and focus on new and emerging training needs. The WMO Global Campus framework will provide a coordination and communication system, as well as associated information and data tools that will enhance the sharing of resources, knowledge and expertise, and the efficiency and effectiveness of the overall network.

A future WMO Global Campus could offer a catalogue of learning content resources in multiple languages that is searchable and available for:

- Developing locally produced instructor lead courses
- Refresher material at point of application
- Competency assessment or refresher material supporting competency assessment
- Foundational materials for academic institutions
- Learning content to be available on mobile and handheld devices to all learning opportunities.

One of the missions of the WMO ETR Office is dissemination of good practices through human resource exchanges and promotion of stronger connections with WMO technical and research programme. These strategic partnerships are critical to the expansion of training capacity throughout WMO Members. The WMO Global Campus initiative is itself a partnership supporting innovation and new partnerships.

The WMO Global Campus initiative will assist the WMO Secretariat in its work to ensure all Members meet the standards and practices described in WMO Technical Regulations by offering more avenues for guidance and training. It will support the WMO Technical Commissions and Technical Programmes by providing greater access to the courses and resources they promote to meet their strategic objectives. In addition, the strengthened collaborative training network that is created can aid in identifying training needs, creating effective training solutions, and generating cost-saving partnerships for meeting these objectives.

5. Recommendations

SYMET should consider the following recommendations based upon the conclusions drawn from the preceding discussion. Additional recommendations or revision of these is expected to result from online and symposium discussions.

- a. Recommendations for training institutions include:
 - i. Engaging with their regions to understand the outcomes of regional needs assessments, and aligning training appropriately.
 - ii. Participating in innovation projects that seek to utilize new and alternative training methods.
 - iii. When appropriate, aligning training with WMO competency frameworks, as described in the WMO Guide on Competency (in preparation).
 - iv. Exploring increased utilization of online learning, blended instruction and self-directed study.
 - v. Seeking opportunities to implement simulations and games to support attainment of WMO competencies.
 - vi. Participating in the WMO Global Campus initiative by sharing and utilizing shared resources and promoting courses through the WMO Learn Events calendar.
- b. Recommendations for the WMO Secretariat and Technical Commissions include:

- i. Helping members in the utilization of learning needs assessments and aligning its investments in training courses and fellowships with documented needs.
- ii. Working with WMO Boards and Commissions to sponsor projects that seek to utilize new and alternative training methods.
- iii. Working to ensure that training courses and resources are designed as competency-based training, when appropriate.
- iv. Supporting training organizations to increase their utilization of online learning, blended instruction and self-directed study.
- v. Working to ensure sponsorship for innovation projects that support increase use of simulations and games to support attainment of WMO competencies.
- vi. Expand the ETR community of practice through further development of the WMO Global Campus initiative and other multidisciplinary leadership groups to help keep pace with the rapidly changing training context.
- vii. Working with WMO Members and Donors to engage with tool providers to provide the training necessary to implement new technologies by recipient NMHSs

c. Recommendations for development partners and international organizations:

- i. Supporting development goals that are aligning with documented learning needs.
- ii. Sponsoring innovation projects that seek to utilize new and alternative training methods.
- iii. Sponsoring capacity development projects that include helping countries become aligned with WMO Qualifications and Competency Standards, as defined in the WMO Technical Regulations.
- iv. Including the WMO Global Campus initiative as a potential aid for meeting capacity development needs.
- v. Asking tool developers to provide the training necessary to implement new technologies by recipient NMHSs

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Appendix B: Global and Regional Training Funding Assessment Discussion

The following table shows the global number of people that respondents anticipate will train in 2017, with the support of one of four funding sources: government, project funds, WMO, and other scholarships.

Table 1. Global expectations for training support, 2017

Funding source	Number of Staff Anticipating Training	% of the Total Nr of Staff Anticipating Support
Government	16,072	84%
Project Funds	1,421	7%
WMO	1,162	6%
Other Scholarships	536	3%
Total	19,191	100%

The following figure shows this information graphically.

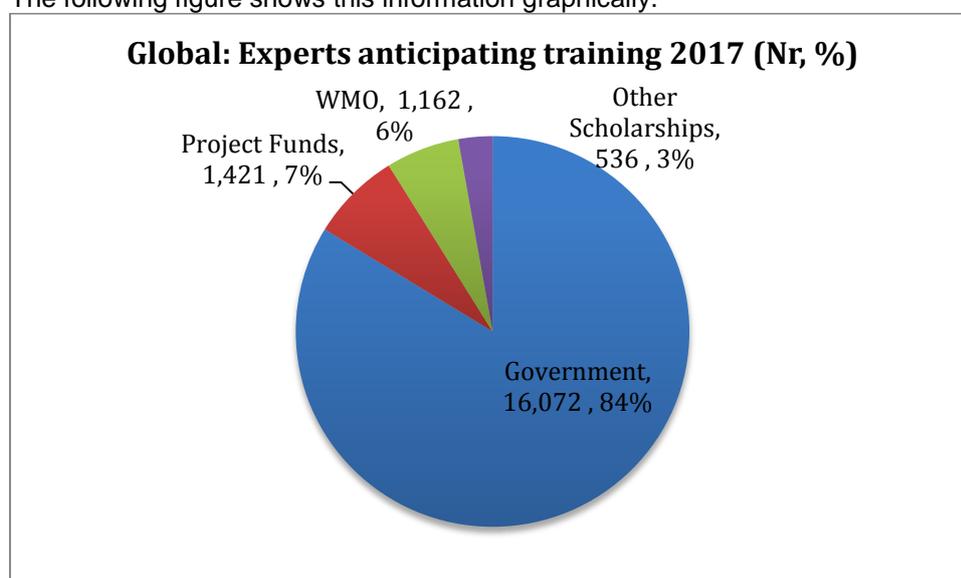


Figure 2. Global number and percentages of experts anticipating training in 2017, by funding source

About 19,000 people hope to train in 2017. Funding for the large majority (84%) of these 2017-trainees is expected to come from government sources. Project funds are expected to cover the training for about 1,400 people, or 7% of the 2017-trainees. The WMO is expected to fund about 1,200 people's training (6% of those anticipating training). Finally, other scholarships are expected to provide funds for an additional 540 people (3% of the 2017-trainees).

When the average global percentages are calculated based on the Members' national percentage distributions, the resulting patterns of funding-source distribution are quite different, as shown in the following figure. (Respondents that did not enter numbers for experts anticipating training in 2017 were omitted from the averaging calculation.)

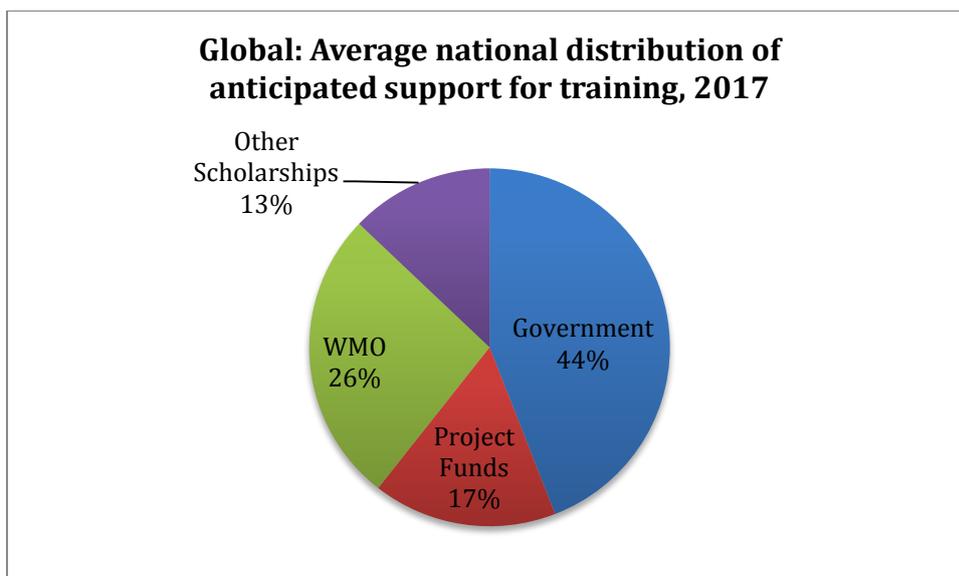


Figure 3. Global: Average distribution of anticipated support for training for 2017, based on Members' national distributions

On average, respondents anticipate that 44% of their 2017-trainees will receive their funding from government sources, 26% from the WMO, 17% from project funds, and 13% from other scholarships.

Regional numbers of 2017-trainees

The following table shows the total numbers of people anticipating training in 2017 in each Region.

Table 2. Regional numbers of staff expecting to be trained in 2017

Region	Number of People Anticipating Training	Percent of global total
I	3,101	16%
II	5,046	26%
III	846	4%
IV	4,734	25%
V	1,035	5%
VI	4,429	23%
Global total	19,191	100%

- 5,000 people in RA II are hoping to train in 2017. This is 26% of the 19,000-people hoping to train.
- 4,700 people in RA IV are hoping to train in 2017. This is 24% of the 19,000-people hoping to train.
- 4,400 2017-trainee hopefuls work in RA VI (23% of the global group).
- (Thus, about one-quarter of the 2017-trainees work in each of RA II, RA IV, and RA VI, totaling to almost three-fourths of the 2017-trainees.)
- 3,100 of the 2017-trainee hopefuls work in RA I (16% of the global group).
- 1,000 people in RA V hope to be a 2017-trainee (5% of the global group).
- Finally, 850 2017-trainee hopefuls work in RA III (4% of the global group).

Regional 2017-trainees and funding sources

The following table shows the number of 2017-trainees in each Region that are anticipating support from each funding source.

Table3e. Regional numbers of staff anticipating training in 2017, by funding source

Funding Source	Region						Total by Source
	I	II	III	IV	V	VI	
Government	1,966	4,047	458	4,603	898	4,100	16,072
Project Funds	401	606	194	28	45	147	1,421
WMO	518	264	135	87	62	96	1,162
Other Scholarships	216	129	59	16	30	86	536
Regional Totals	3,101	5,046	846	4,734	1,035	4,429	19,191

The following figure shows this information graphically.

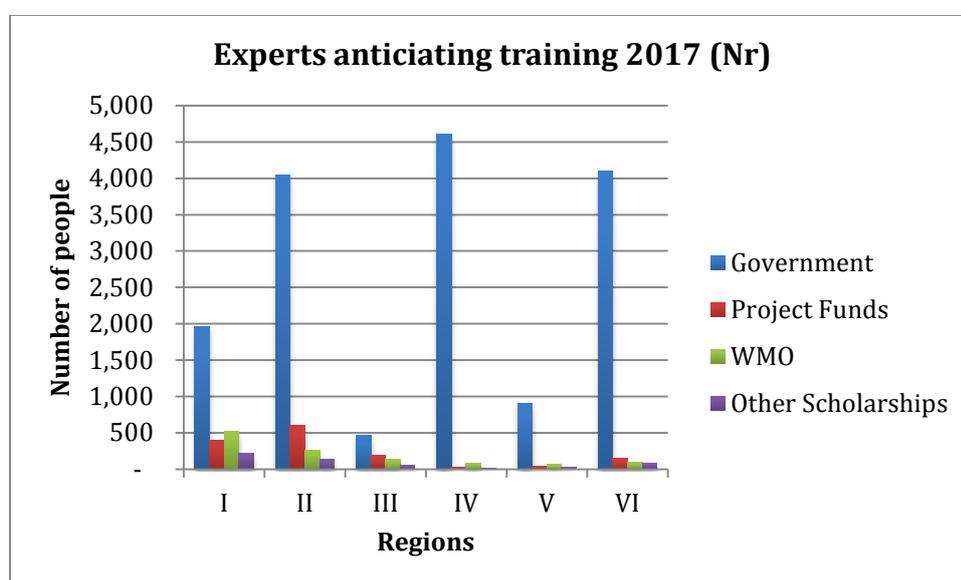


Figure 4. Regional numbers of staff anticipating training in 2017, by funding source

The next table shows the percentages of each Region's 2017-trainees that are anticipating support from each funding source. The information in this table provides insight into the balance of funding-source support each Region is anticipating. In other words, it provides insight into the mix of funding sources each Region is relying upon to fund their 2017-trainees.

Table3. Percentage of each Region's 2017-trainees anticipating funding from each source

Funding Source	Region						Global
	I	II	III	IV	V	VI	
Government	63%	80%	54%	97%	87%	93%	84%
Project Funds	13%	12%	23%	1%	4%	3%	7%
WMO	17%	5%	16%	2%	6%	2%	6%
Other Scholarships	7%	3%	7%	0.30%	3%	2%	3%
Total	100%	100%	100%	100%	100%	100%	100%

The following figure shows this information graphically.

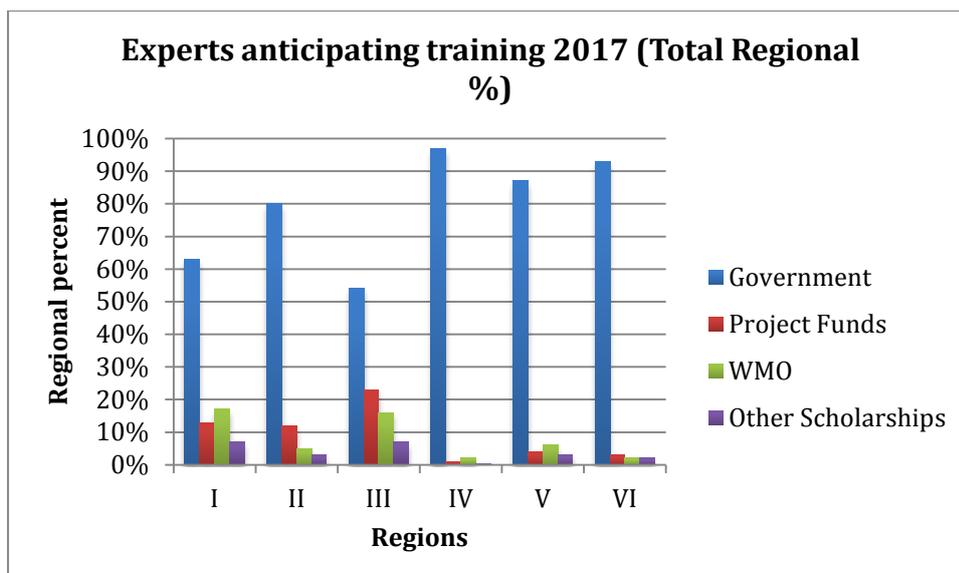


Figure 5. Regional percentages of experts anticipating training in 2017, by funding source

The above percentages, calculated based on the Regions' total numbers of experts anticipating training in 2017, are heavily influenced by the funding patterns anticipated by Members with large NMHSs. Several of these large NMHSs anticipate their governments to supply all or nearly all their training funding, thus raising the overall Regional percentages of funding expectations. Members that are included in this category include China in RA II (82% anticipated government funding), the United States in RA IV (100% anticipated government funding), Australia in RA V (100% anticipated government funding), and the Russian Federation in RA VI (100% anticipated government funding).

When the average Regional percentages are calculated based on the Members' national percentage distributions, the resulting patterns are quite different from the Regional totals, as shown in the following table.

(Respondents that did not enter numbers for experts anticipating training in 2017 were omitted from the averaging calculation.)

Table 4. Average percentage of Members' 2017-trainees anticipating funding from each source

Funding Source	Region						Global
	I	II	III	IV	V	VI	
Government	34%	54%	36%	44%	41%	52%	44%
Project Funds	17%	17%	16%	14%	12%	19%	17%
WMO	39%	19%	30%	26%	26%	17%	27%
Other Scholarships	10%	10%	17%	16%	21%	13%	13%
Total	100%	100%	100%	100%	100%	100%	100%

The following figure shows this information graphically.

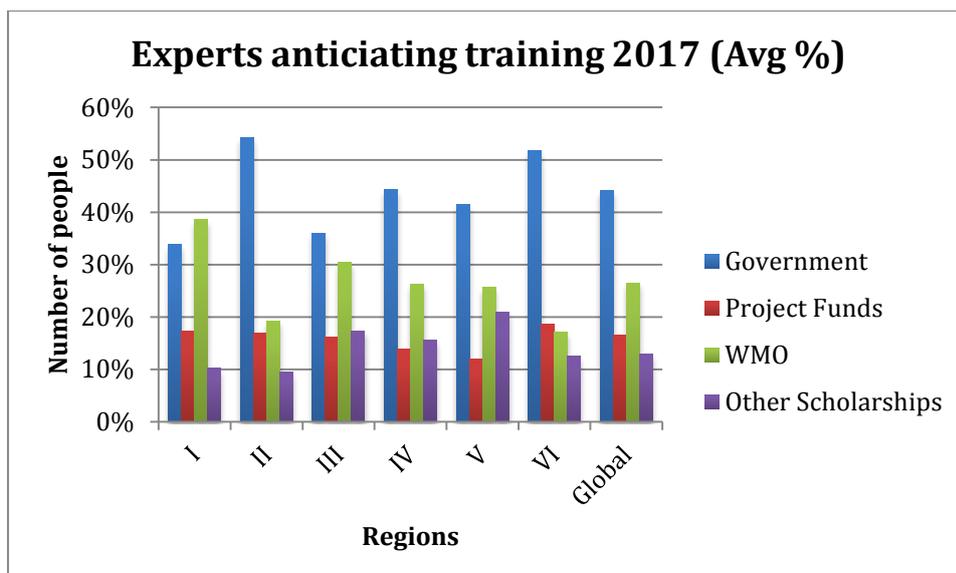


Figure 5. Average regional percentages of experts anticipating training in 2017, by funding source

The above table and figure show that on average, the Regional Members are supporting 34% to 54% of their 2017-trainees with government funds. The global average is 44%.

The governments of RA II and RA VI are supporting more than half of their experts anticipating training in 2017—the highest ratios among the Regions.

The governments of RA IV and RA V are both supporting more than 40% of the experts anticipating training in 2017.

The governments of RA I and RA III are both supporting more than 30% of the experts anticipating training in 2017.

The percentage of 2017-trainees anticipating support from project funds is well balanced among the Regions, when viewed from this perspective: on average, between 12%-17% of 2017-trainees in all Regions anticipate support from project funds.

On average, the WMO is anticipated to support a larger percentage of 2017-trainees in most Regions than it appears when viewed by the total Regional percentages. On average, more than 25% of 2017-trainees in RA I, RA III, RA IV, and RA V anticipate support from the WMO. The percentages of 2017-trainees in the other two Regions, RA II and RA V, are just under 20%.

The contribution other scholarships are anticipated to make to the support of 2017-trainees is also higher when viewed according to Member averages rather than by Regional totals. Based on the averages of their Members, all Regions anticipate 10%-21% of their 2017-trainees to find support from other scholarships¹.

¹ “Research prepared for the United Kingdom government found that companies with a highly engaged workforce experience a 19.2 percent growth in operating income over a 12-month period. Conversely, unengaged workers can cost an organization. McLean & Company found that a disengaged employee costs an organization approximately \$3,400 for every \$10,000 in annual salary. Disengaged employees cost the American economy up to \$350 billion per year due to lost productivity.” O’Donnell, 2017.¹

Appendix C: Needed Attributes of Competency-Based Education and Training

Concise, effective learning events, whether delivered through e-learning or not, are meaningful, memorable, and motivational. And they achieve measurable results, too.”

“Meaningful - Meaningful learning events are those that assure learners can connect additional content to their current knowledge and skills. They make sure learners recognize 1) how do current skills may not be sufficient in certain circumstances and 2) what tasks they will be able to perform after skill enhancement.”

“Memorable - What good is instruction if it is not remembered when the need to perform arises? Good learning events provide learners the ability to perform effectively at the time of most value.” (p.22)

” Motivational - Motivated people find ways to learn what they need to learn to be successful. The hurdles they jump are proportional to their motivation, while there may be a fair amount of time lost to trial and error and they may not learn best practices, motivated people learn. Lesser motivated people have a rougher time, since learning depends on what learners do— what they attend to, what they think about, what they practice. They may just complete the minimum of what is expected of them, if that, and move on, greatly forgetting whatever learning occurred.”

“Measurable - Effective learning events produce skills that can be observed. Of course, we all have skills we don’t use or don’t used enough. We can’t know easily if an individual has the skill and isn’t applying it. But we shouldn’t assume people have acquired skills when we can’t observe their abilities” (p.23), For learning to be meaningful, memorable, motivational and measurable, Allen suggests the following components of interactive learning:

Context - Context is the relevant situation and conditions a learner must consider when performing a task... Contexts are strong when they have relationships to real situations the learner will encounter, have fascinating attributes in them, and invite exploration for important but not so obvious details... without context, learners can be unsure of the personal relevance of the training to themselves. Enthusiasm and motivation decrease. Context is critical for meaningfulness. (p.24-25)

Challenge - Challenges spur learners to action and provide a wonderfully effective way of heightening motivation... effective challenges spur learners to re-examine the context and consider fully the probable outcomes of various responses. Just this in real life, we choose responses based on previous experience and knowledge. Will use the skills we presently have, and as we learn, modify them in hopes of achieving better results. Making mistakes and observing the consequences is a fundamental learning cycle, and by building challenges on relevant and authentic contexts, we enable this effective process.

Activity - **If we are teaching our learners to do things, they need to be doing things while they are learning...** Effective activities look and feel to learners like the real tasks they expect to be performing post training.

Feedback - There're two primary types of feedback: consequences and judgments. Consequences revealed two learners what would really happen in response to their actions or inactions. Feedback in the form of consequences complements authentic activities to make the event feel realistic... In general, good instruction events offer consequences in the most realistic ways possible and put forth judgments only after it has become apparent that the learner needs direction. (p. 26-27)

Link to competency and performance goals - When it comes to training, you need to define what your employees need to do to meet performance outcomes and links to KPIs and NMHS organizational objectives.

Consult with Subject Matter Experts - Subject matter experts (SMEs) are a valuable resource and through consultation, you can uncover what learners really need to know to improve competency.

Real-world skills are needed to ensure competence and employee development - The WMO move toward competencies and Certification of Competencies by the International Civilian Aviation Organization, is focused on aligning academic knowledge development with workplace learning to develop real-world skills and bolster NHMS capacity development. Learners expect that their investments in learning enable them to apply what they learn to their jobs (T&DM, 2017). Training Institutions supporting WMO Members have a responsibility to deliver deeper, active learning experiences and skills-based training that integrates the technology that the students will use in the workplace in meaningful ways.

Section III of Part I

Partnership and Resource Mobilization

1. Introduction

1.1 Overview

This paper discusses two interrelated topics, namely partnership and resource mobilization. Partnerships and resource mobilization have become essential elements for organizations to implement their programmes and projects in a world faced with competing priorities and limited resources. The current drivers for partnerships and resource mobilization include:

- (a) **Transforming our world: the 2030 Agenda for Sustainable Development:** - In 2015, the UN General Assembly adopted a plan of action for people, planet and prosperity with 17 Sustainable Development Goals and 169 targets. It provides a foundation for decision making at national and international levels on issues of sustainable Development and related policies;
- (b) The **Sendai Framework** for Disaster Risk Reduction 2015-2030 was adopted at the Third UN World Conference in Sendai, Japan in 2015. In 15 years, it aims to substantially reduce disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. It recognizes the need to strengthen Multi-Hazard Early Warning Systems by enhancing hydro-meteorological warning services and improving emergency plans and operations to better prepare for hydro-meteorological and climate-related hazards.
- (c) The **Paris Agreement:** The Paris Agreement, under the UN Framework Convention on Climate Change, aims to strengthen the global response to the threat of climate change in the context of sustainable development and efforts to eradicate poverty.
- (d) The **Istanbul Programme of Action** charts out the international community's vision and strategy for the sustainable development of least developed countries (LDCs) for the Decade 2011-2020, with a strong focus on developing their productive capacities.
- (e) **Samoa Pathway:** The Small Island Developing States (SIDS) Action Platform, the SAMOA Pathway, endorsed during the Third International Conference on SIDS (Samoa, 2014) calls attention to efforts of SIDS to : a) build resilience to the impacts of climate change and to improve their adaptive capacity through the design and implementation of climate change adaptation measures appropriate to their respective vulnerabilities and situations; b) improve the baseline monitoring of island systems and the downscaling of climate model projections to enable better projections of the future impacts on small islands; c) raise awareness and communicate climate change risks, including through public dialogue with local communities, to increase resilience to the longer-term impacts of climate change.

- (f) The **Global Framework for Climate Services (GFCS)**: The GFCS aims to enable better management of the risks of climate variability and change, and adaptation to climate change, through the development and incorporation of science-based climate information and prediction into planning, policy and practice. The GFCS and its implementation Plan, supported by a strong corporate approach to Branding, Marketing and Communications, constitutes a strong platform for the National Meteorological and Hydrological Services (NMHSs) to demonstrate to their political leaders the social and economic benefits of weather, climate and water products and services in support of resource mobilization.
- (g) The decision of Cg-17 on the need to build new partnerships;
- (h) The future role of the private sector in meteorology;
- (i) The **International Air Transport Association** 20 year Passenger Forecast, indicating that passenger numbers were expected to reach 7.3 billion by 2034. China is projected to overtake the US as the largest passenger market by 2030; and by 2034 the fastest-growing markets in terms of new passengers per year would be China and Indonesia, and eight of the ten fastest-growing markets would be in Africa (the top five being Central African Republic, Madagascar, Tanzania, Burundi and Kuwait). This will require improvements in infrastructure and human resources to enable NMHSs in developing countries and LDCs to provide high quality services to address the projected increase in flights;
- (j) The demand for specialized skills to provide high quality, user oriented services to enhance the resilience of society to the impacts of extreme climate events; and
- (k) Priorities in WMO strategic Plan

1.2 Partnership

Rather than act individually to satisfy the rapidly evolving needs of society, organizations have been compelled to come together and form partnerships to address issues of common interest. Fundamentally, effective partnerships built upon principles, and shared goals where the contribution of each partner is respected by all contributors. Partnerships enable organizations to share their diverse competencies and resources to address issues collaboratively in the realm of their respective mandates. Partnerships and alliances are undoubtedly essential in helping organizations pursue their development priorities and engage all those in a position to make a difference.

Several partnerships have been established over the years worldwide, with some being active for only a short time. It should be noted that partnerships face several challenges, including the difficulty of setting them up and maintaining them, the need for political will and resources, and inability to realize results in a short time. Factors influencing partnerships include external drivers, partner motivations, partner and partnership characteristics and process issues.

Important characteristics to consider when choosing a partner are resource profile, previous partnership experience, area of focus, stakeholder representation, exchange of protocols and understandings, power dynamics, cultural fit, time horizons for the activities, and reputation. The process issues to consider for the success of a partnership include exploring differences, shared vision, agreeing on norms, building trust, handling conflict, reaching consensus, devising accountability criteria, sharing power, ensuring voice and cultivating effective leadership.

To address complex challenges partnerships can, and often do, function boundaries of geography, economic sector or technical background. This can involve complicated phases of partnership building, where the potential partner need to develop an understanding of each other's boundaries, needs and competencies.

Changes in the membership of a partnership or the tasks for which the partnership was established may require a review of the partnership.

1.3 Resource mobilization

Resource mobilization is a process of mobilizing financial and non-financial resources from external or internal sources to support the implementation of an organization's activities. It should be considered as a way of nurturing lasting relationships with donors as partners. In the context of international capacity development, it is crucial to consider the international funding partners as actual partners with goals and an agenda, rather than as donors. Fundamental to any resource mobilization approach whether from international partners, national governments or the private sector is

1. a **plan** for a change,
2. with a specifically intended **benefit**
3. that is backed by **evidence**

The reasons why resource mobilization is essential to any organization include:

- (a) Enabling continued provision of services to stakeholders;
- (b) Enabling an organization to sustain its services in a world of limited resources;
- (c) Providing resources to improve or enhance services;

Factors that influence the success of resource mobilization include:

- (a) Clarity and commitment to the vision and mission;
- (b) Availability of competent staff
- (c) Having programmes with the potential to yield results;
- (d) Good previous achievements;
- (e) Evidence of effective management and leadership;
- (f) Having in place financial systems to manage the resources raised;
- (g) Having a good reputation and credibility;
- (h) Demonstrating mutual respect and knowledge sharing with stakeholders and
- (i) Ability to attract, create, and sustain new resources.
- (j) Having or establishing an evidence base that supports the requirement and process for the intended change.

It is often the case, particularly for national funds, that resources are limited and organizations have to compete for them, being able to justify the investment is crucial

2. Situation analysis

2.1 International Context

2.1.1 Partnerships

The partnerships announced at the World Summit on Sustainable Development in 2002 were recognized as a sharp departure from traditional conference practice, since they represented an innovative mechanism for moving from paper commitments to joint action on the ground by governments, business and civil society actors.

Achieving the ambitious 2030 Sustainable Development Goals and their targets requires a revitalized and enhanced global partnership that brings together Governments, civil society, the private sector, the UN and other actors, and mobilizes all available resources. The 2030 Agenda for Sustainable Development includes, under Sustainable Development Goal 17 entitled “Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development”, a call for enhanced global partnerships for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources to support the achievement of the Goals.

2.1.2 Resource Mobilization

In 2014 the Joint Inspection Unit analysed the resource mobilization function within the UN in a study that looked at practices in twenty-eight organizations. They noted that there was no universal approach to resource mobilization across the UN System. They indicated that elaborating a strategy helps to avoid sending different messages to donors and to forestall “in-house” competition; helps to avoid piecemeal efforts; creates a sense of ownership and accountability, thus leading to better-planned, up-front pipeline resources; helps in allocating resources where they are most needed; and ultimately leads to comprehensive programme delivery and impact.

The UN global partnership for financing sustainable development has the objectives to:

- (i) ensure coherence and coordination between different policy processes, organizations and stakeholders at the systemic level, and
- (ii) help increase the mobilization and improve the allocation of resources for sustainable development across all relevant areas, stakeholders and processes of the post-2015 development agenda, while at the same time providing a framework for development cooperation.

2.2. WMO Context

2.2.1 Overview

WMO has an office dedicated to resource mobilization and partnerships. The Resources Mobilization and Development Partnerships (RMDP) coordinates efforts to identify investment mechanisms and partnership opportunities for development of weather and climate services in all Member States and Territories.

The assistance can be in the form of direct financing, by a transfer of technology and expertise, and by leveraging strategic partnerships with major development partners such as international development banks, overseas aid agencies, other UN agencies and NMHSs in developed countries. This work is undertaken in close cooperation with the Regional Offices and Technical Programmes.

The main objectives of RMDP include:

- (a) Identifying development needs at the regional and national levels with Members and Regional Offices;
- (b) Establishing strategic partnerships with development agencies and setting-up multi-annual collaborative arrangements;
- (c) Coordinating the elaboration of proposals within the Secretariat for funding of development projects;
- (d) Coordinating project implementation across Technical Programmes;
- (e) Coordinating Climate Funds accreditation and submission of funding proposals (e.g. Green Climate Fund, Adaptation Fund);
- (f) Coordinating and streamlining the Voluntary Cooperation Programme to expand its support base and accelerate fund allocation processes and timelines;

2.2.2-Partnerships

The complexity of the Earth system, the atmosphere, oceans, freshwater bodies, land and biosphere, and how it shapes environmental processes, make it a challenge for scientists and operational services to improve the quality of related information and products. No single government or agency has the necessary resources, financial or intellectual, to address all the challenges on its own. Consequently, the success of WMO depends on its ability to partner with internal stakeholders and external organizations to meet its objectives.

WMO partners with international agencies, other organizations, academia, the media and the private sector to improve the range and quality of critical environmental information and services. Strategic partnerships at WMO are designed to:

- Heighten understanding of weather, climate and water information and service capabilities of NMHSs of WMO Members and other international and national organizations. This is part of building and communicating the evidence base for the potential of NMHSs to deliver public good. Enhance the ability to use the capabilities and information of other organizations in developing and improving WMO information and services. The expectation is that the scope of services and the responsiveness of Members' agencies to emerging requirements will increase by leveraging capabilities of partners to develop and sustain service improvements. This leads to partnerships between members that deliver at the national level.
- Broaden partnerships between developed, developing and least developed countries, involving relevant national agencies. The expectation is that the capabilities of countries to acquire and exploit information for the public good will be enhanced and that all countries will benefit from closer cooperation.

- Maintain a proactive role in ensuring a coherent, science-based approach within the UN and among other stakeholders to implement international environmental conventions. The expectation is that WMO activities will be mainstreamed into agendas for action by the international community.

Education and training is essential for realizing effective implementation and sustainability of development initiatives. Over the past several decades, WMO, in partnership with UN Agencies, has been in the forefront in developing human resources capacities of the NMHSs through training, provision of educational materials and awarding of fellowships. This has enabled NMHSs, especially those in developing countries, to optimise staffing to provide high quality services and contribute to national development and global cooperation. Over the next decade, WMO will place greater emphasis on education and training activities and issues that will continue to bridge the gap and build local capacities in science and technology. This will require enhanced partnerships and mobilization efforts.

Educational and training is often an integrated part of a development program. It is important that training actors are proactive in working during the program development phase. We do this to ensure that training is an integrated part of the program that supports the change, rather than some kind of add on activity. It is often the training partner that will bring their knowledge of competency based education to make the training more focused on what is really needed.

WMO is a founding member of the UN Alliance on Climate Change Education, Training and Public Awareness. The UN Alliance, launched in 2012, boasts 13 members and is led by the Secretariat of the UN Framework Convention on Climate Change (UNFCCC). It supports Parties in their efforts to initiate and undertake activities related to the implementation of UNFCCC Article 6 on Education, Training and Public Awareness and the closely related Article 12 of the Paris Agreement ².

The objectives of the UN Alliances are to maximize synergies and coherence of activities; avoid duplication of effort and utilize available expertise and resources through enhanced coordination; promote a clear link between the work of its member organizations and the UNFCCC process; and support Parties to the UNFCCC in their efforts to design, initiate and undertake activities related to climate change education, training, public awareness, public participation and public access to information. Specific activities include organizing multi-stakeholder workshops on Article 6 to facilitate a regular exchange of views, good practices and lessons learned; supporting the development of national strategies on Article 6 of the Convention; and disseminating information and resource materials on the six elements of Article 6;

This UN-wide collaboration offers WMO, its Members and bodies such as the Regional Training Centres an opportunity to expand their cooperation with other organizations and to strengthen their links with the Convention and the broader climate community. The WMO Secretariat, for example, contributes to the UN Alliance through its work with

² Article 12 reads: "Parties shall cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions under this Agreement."

NMHSs and television stations on engaging weather presenters as climate communicators.

The WMO Secretariat reports on the various activities of WMO and its Members to the annual sessions of the Conference of the Parties (COP). These reports could include information on relevant training activities, thus raising awareness of this vital work. NMHSs may also wish to encourage their delegations to the UNFCCC sessions to include information on meteorological, climatological and hydrological training and education in the national communications that they submit periodically to the COP.

2.2.3 Resource mobilization

Resource Mobilization at WMO Secretariat is guided by a strategy approved by the World Meteorological Congress. WMO recognizes the mobilization of financial and in-kind resources to undertake development efforts as a key financial management issue for many NMHSs. Extra-budgetary resources are often the only means to fund new equipment, modernization, training of staff and other initiatives essential for the NMHS to carry out its mission. In recognition of the importance of resource mobilization and the challenge faced by many NMHSs in developing countries in implementing a strategy, WMO has a dedicated Resource Mobilization and Partnership Office (RMPO) to assist NMHSs in developing countries.

During the financial period 2016-2019, WMO will seek to mobilize resources for the implementation of the WMO Strategic Plan, which has Capacity Development as a priority. This entails mobilization to both augment regular budget in “normative areas” such as research, and to enhance the full service delivery capacity of NMHS. This will be achieved through:

- Sourcing direct financing to and through the WMO Secretariat to support and promote the development of Weather, Water and Climate Services in all countries, but especially LDCs and SIDS;
- Supporting where possible NMHSs of Member countries, States and Territories to enhance direct funding to address their needs in line with Global and Regional Strategic Plans;
 - Helping Members identify needs and gaps, suggesting the best approaches to addressing these gaps and working with their governments and other partners to source funds;
 - Assisting with the preparation of long-term NMHS development plans, to comply with WMO standards and best practices;
 - Guidance on project proposal development and project implementation;
 - Partnering with international organizations to ensure NMHSs are included in project development in coordination with WMO regional offices;
- Leveraging partnerships to influence the design and implementation of relevant programmes / projects of UN and other development agencies;

- Seeking partnerships with the private sector;
- Increasing focus on research funding mechanisms; and
- Maintaining a leadership role for meteorology, climatology, hydrology and other geophysical variables and promoting the development of observational networks.

The rapidly evolving needs of society and the increase in the frequency of extreme weather events call for more efforts in education and training to develop skills for providing high quality weather, climate, hydrological and related environmental services.

3. Challenges and emerging issues

3.1 International context

The challenges and opportunities associated with partnership and resource mobilization include:

- (a) The complexity of setting up formal partnerships and potential delays in initiating activities and realizing impacts;
- (b) Political support and legislative backing
- (c) The ability to bring together all relevant actors, some of whom had been competitors;
- (d) The proliferation of partnerships resulting in more complex and fragmented resourcing processes;
- (e) The need for partners to have equal rights;
- (f) The need for partners to have ownership;
- (g) Ensuring effective oversight and accountability
- (h) Establishing how activities implemented through partnerships complement the programmes of partner organizations;
- (i) How the partner organizations establish what is achieved through the partnership;
- (j) The risk of partner organizations being preoccupied with protecting their mandates and setting unrealistic goals;
- (k) The ability to demonstrate mutual respect amongst the partners; and
- (l) Conditions attached to partnerships influencing the ability of organizations to deliver on the tasks.

3.2 WMO Context

The major challenges for WMO include:

- (a) The ability to attract resources to invest in infrastructure and human resource development (which are the most expensive elements in delivering weather, climate, hydrological and related environmental services);
- (b) Convincing partners to invest in WMO programmes and explaining the link between the WMO mandate, and the various socio-economic sectors;
- (c) Having a coordinated approach in developing weather, climate, hydrological and related environmental services in a world where many organizations are attempting to do something in the form of improving or providing services;
- (d) Maintaining standards of observations in a world where many organizations are deploying stations without involving NMHSs of the host country nor WMO; and

- (e) The ability to contribute to the increasing number and range of partnerships.

Conclusions

Partnerships and resource mobilization have become essential elements for organizations to implement their programmes in a world faced with competing priorities and limited resources. Partnerships and alliances are the wave of the future in helping organizations pursue their development priorities and eliciting the engagement of those able to make a difference. Partnerships enable organizations to share their diverse competencies and resources to address issues that an individual organization cannot address individually. Care should be taken when establishing partnerships to ensure that they achieve the intended outcomes and do not affect the reputation of the organizations participating in the partnership.

In a world where priorities are escalating, resource mobilization becomes an essential element in successful programme implementation. The ability of an organization to attract resources is highly dependent on the ability to achieve the intended outcome and prudent management of resources.

More investment should be directed to education and training, and modernisation of infrastructure, to enable NMHSs to provide high quality services to meet the current and future needs of society.

5. Recommendations

The following are recommendations related to thematic areas addressed in this paper.

- (a) Recommendations for training institutions include:
- i. Working with other service delivery institutions to ensure that education and training needs are factored into service delivery projects as an essential element for success and sustainability;
 - ii. Developing education and training programmes focused on the skills required to provide services in a world faced with rapidly evolving societal needs and advances in technology and based on the Congress approved competencies;
 - iii. Forming partnerships to resource for shared education and training needs;
 - iv. Investing time to develop capacity in building partnership
- (b) Recommendations for the private sector include;
- i. Partnering with WMO and NMHSs to invest in the improvement of skills for providing weather, climate, hydrological and related environmental services and in modernizing infrastructure required for high quality services;
 - ii. Working with WMO and NMHSs to come up with a cost-recovery policy that would sustain the infrastructure required for gathering and sharing meteorological observations, data and products;
- (c) Recommendations for national governments include:
- i. Increasing investments in infrastructure and human resource development to enable NMHSs to provide high quality services and enhance the resilience of society to extreme climate events;

- ii. Developing policies that would facilitate formation of partnerships and implementation of shared initiatives;
- (d) Recommendations for development partners and international organizations include:
- i. Recognizing mutual respect in establishing and implementing partnerships;
 - ii. Avoiding proliferation of partners that may result in high competition for resources and duplication of efforts;
 - iii. Recognizing education and training, and modernization of infrastructure, as essential elements for improving weather, climate, hydrological and related environmental services for the benefit of society and economic development.

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- 1) Report of the Seventeenth World Meteorological Congress 25 May – 12 June 2015 (WMO-No 1157) http://www.wmo.int/aemp/sites/default/files/wmo_1157_en.pdf
- 2) WMO Strategic Plan 2016 – 2019 (WMO no 2261) https://library.wmo.int/opac/doc_num.php?explnum_id=3620
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https://www.wmo.int/pages/prog/dra/.../WMO_Resource_Mobilisation_Strategy.doc

Part II: Conclusions and Recommendations

Section I: Conclusions

From the discussions on service-specific education and training needs, the following conclusions could be drawn from the analysis.

- m) A number of WMO initiatives point to paradigm shifts occurring in the way NHMS services are being delivered, including an increased focus on impacts, a higher degree of data integration, and seamless forecast delivery at multiple spatial and temporal scales.
- n) WMO competency frameworks are being put in place to guide training providers to develop training that will address critical skills and knowledge for staff members in many service areas.
- o) While these initiatives have a degree of overlapping training needs, they suggest that a wide range of training must occur if WMO Members are to keep pace with changing methodologies and technologies.
- p) SYMET participants are critical training partners in WMO initiatives, and must be engaged to disseminate knowledge and skills in service areas.
- q) The number of WMO publications that contain guidance material for these initiatives is high, and clearer direction on their access would be useful. Training providers offering training in related areas must be aware of this material.
- r) The scope of training that must occur in the short term suggests a need for careful prioritization, planning, and choice of training delivery modes.
- s) Training needs assessments are important to help prioritize training efforts and define the scope of training events and resources.
- t) Guidance on recommended learning pathways to develop expertise in each service area will be useful.
- u) To ensure learning- and cost-effective training, all potential learning solutions should be considered, particularly blended solutions.
- v) Model plans or example training plans could guide good training practice in the various content areas.
- w) Training impacts evaluation is essential for guiding and improving training practices.
- x) Working with diverse international audiences brings special challenges, but these can be mitigated or overcome.

With respect to efforts aimed at increasing education and training capacity, the following conclusions could be reached.

- k) WMO Members should work to increase the visibility and recognition of the value of training for continuing to develop and deliver their services. Investment in training is often not sufficiently considered.
- l) NMHS workforces show a high and increasing demand for training with increased development and changing work processes, tools and services.
- m) The growth in internet access around the globe is creating new avenues to help meet training needs.
- n) An investment in training to develop a competent workforce is critical to service delivery.
- o) Needs assessments and competency assessments are critical for determining training priorities, especially under the constraints of limited budgets and timeframes.
- p) Competency based training that is aligned to WMO Member NMHS performance requirements is critical for increasing the impacts of training.
- q) Training institutions now have available new and alternative training sources and alternative processes that include integration of new learning technologies, simulations and competency-based learning activities.
- r) Utilizing online learning increases the numbers of students that can access critical courses and resources.
- s) The use of learning games and gamification strategies can enhance and sustain learning engagement.
- t) Collaboration is key for scaling effective solutions to serve many Members. - The WMO Global Campus initiative can be used to develop an ETR Community of Practice to foster collaboration and sharing.

In fact, many of the conclusions in this section are reasons behind the development of the WMO Global Campus initiative, current in feasibility study.

The WMO Global Campus Feasibility Study is being conducted to investigate methods to increase training capacity within the WMO through expanded support for the WMO Regional Training Centres and other WMO training partners. The vision of the Global Campus Concept was defined in the first year of the study:

The 'Global Campus' is a collaborative network of education and training institutions and NMHSs involved in the development and delivery of training in meteorology, climatology, hydrology and other related sciences. It is built on the synergies, sharing and cooperation between these institutions and will address global priorities and the growing and changing requirements and needs for training of the community.

The concept behind the WMO Global Campus is to have a coordinated and collaborative network of institutions that work together to meet the education and training needs of WMO Members. It will build upon the existing network of RTCs, but expand this network to further recognize other contributing national and international organizations and academic institutions, promote the use of new training delivery mechanisms, and focus on new and emerging training needs. The WMO Global Campus framework will provide a coordination and communication system, as well as associated information and data tools that will enhance the sharing of resources, knowledge and expertise, and the efficiency and effectiveness of the overall network.

A future WMO Global Campus could offer a catalogue of learning content resources in multiple languages that is searchable and available for:

- Developing locally produced instructor lead courses
- Refresher material at point of application
- Competency assessment or refresher material supporting competency assessment
- Foundational materials for academic institutions
- Learning content to be available on mobile and handheld devices to all learning opportunities.

One of the missions of the WMO ETR Office is dissemination of good practices through human resource exchanges and promotion of stronger connections with WMO technical and research programme. These strategic partnerships are critical to the expansion of training capacity throughout WMO Members. The WMO Global Campus initiative is itself a partnership supporting innovation and new partnerships.

The WMO Global Campus initiative will assist the WMO Secretariat in its work to ensure all Members meet the standards and practices described in WMO Technical Regulations by offering more avenues for guidance and training. It will support the WMO Technical Commissions and Technical Programmes by providing greater access to the courses and resources they promote to meet their strategic objectives. In addition, the strengthened collaborative training network that is created can aid in identifying training needs, creating effective training solutions, and generating cost-saving partnerships for meeting these objectives.

As regards partnerships and resource mobilization, it is noteworthy that these issues have become essential elements for organizations to implement their programmes in a world faced with competing priorities and limited resources. Partnerships and alliances are the waves of the future in helping organizations pursue their development priorities and eliciting the engagement of those able to make a difference. Partnerships enable organizations to share their diverse competencies and resources to address issues that an individual organization cannot address individually. Care should be taken when establishing partnerships to ensure that they achieve the intended outcomes and do not affect the reputation of the organizations participating in the partnership.

In a world where priorities are escalating, resource mobilization becomes an essential element in successful programme implementation. The ability of an organization to attract resources is highly dependent on the ability to achieve the intended outcome and prudent management of resources.

More investment should be directed to education and training, and modernisation of infrastructure, to enable NMHSs to provide high quality services to meet the current and future needs of society.

Section II : Recommendations

Recommendations

- 1) Recommendations for training institutions include:
 - i. Regularly reviewing WMO guidance material and competency frameworks as they are approved and published, and updating existing curricula as required.
 - ii. For each service area, sharing learning resources with other training providers to help meet the immense global training needs.
 - iii. Indicating their expertise and willingness to contribute to training in each of the training areas.
 - iv. With WMO guidance, developing effective planning methods to ensure maximum results for each training effort.
 - v. Developing and sharing recommended learning pathways to develop expertise required in each service area.
 - vi. Considering all potential learning solutions, particularly blended solutions, when developing training plans. Sharing guidance and experiences with different learning solutions.
 - vii. Offering courses and course descriptions for review by the WMO Secretariat if they will seek co-sponsorship of participants by WMO. Sharing post-course reports.
 - viii. Conducting the best skills-based training possible, even when working with diverse international audiences.
 - ix. Encouraging communications and partnerships with NHMSs and local and regional universities to ensure seamless information exchange and strong connections between research, education and training and operations.

- x. Engaging with their regions to understand the outcomes of regional needs assessments, and aligning training appropriately.
- xi. Participating in innovation projects that seek to utilize new and alternative training methods.
- xii. When appropriate, aligning training with WMO competency frameworks, as described in the WMO Guide on Competency (in preparation).
- xiii. Exploring increased utilization of online learning, blended instruction and self-directed study.
- xiv. Seeking opportunities to implement simulations and games to support attainment of WMO competencies.
- xv. Participating in the WMO Global Campus initiative by sharing and utilizing shared resources and promoting courses through the WMO Learn Events calendar.
- xvi. Working with other service delivery institutions to ensure that education and training needs are factored into service delivery projects as an essential element for success and sustainability
- xvii. Developing education and training programmes focused on the skills required to provide services in a world faced with rapidly evolving society needs and advances in technology and based on the Congress approved competencies
- xviii. Forming partnerships to resource for shared education and training needs
- xix. Investing time to develop capacity building in partnership

2) Recommendations for the WMO Secretariat and Technical Commissions include:

- a. Providing clear direction on which WMO publications are most critical to each service area and consolidating access to them
- b. Making available training resources for all areas for access by WMO Members and WMO training providers.
- c. Announcing its training initiatives and strategies, along with calls for participation in training initiatives.
- d. Developing model or sharing example training plans to guide good training practice for each service area.
- e. Providing guidance on performing training impacts evaluations.
- f. Evaluating progress on SYMET recommendations each year, making revisions as necessary.
- g. Sharing guidance and experiences on the use of different learning solutions.
- h. Developing and sharing potential learning pathways to develop expertise required in each service area.
- i. Helping members in the utilization of learning needs assessments and aligning its investments in training courses and fellowships with documented needs.
- j. Working with WMO Boards and Commissions to sponsor projects that seek to utilize new and alternative training methods.

- k. Working to ensure that training courses and resources are designed as competency-based training, when appropriate.
- l. Supporting training organizations to increase their utilization of online learning, blended instruction and self-directed study.
- m. Working to ensure sponsorship for innovation projects that support increase use of simulations and games to support attainment of WMO competencies.
- n. Expand the ETR community of practice through further development of the WMO Global Campus initiative and other multidisciplinary leadership groups to help keep pace with the rapidly changing training context.
- o. Working with WMO Members and Donors to engage with tool providers to provide the training necessary to implement new technologies by recipient NMHSs

3) Recommendations for NMHSs:

- a. Putting in place appropriate competency assessment systems and reporting to the WMO Secretariat on their status.
- b. Developing effective methods of performing training needs assessment, and sharing the results for use by the Secretariat, Regional Training Centres, and other training providers.
- c. Encouraging communications and partnerships between RTCs, NHMSs and local and regional universities to ensure seamless information exchange and strong connections between research, education and training and operations.
 - a) Increasing investments in infrastructure and human resource development to enable NMHSs to provide high quality services and enhance the resilience of society to extreme climate events;
 - b) Developing policies that would facilitate formation of partnerships and implementation of shared initiatives;

4) Recommendations for development partners and international organizations:

- a. Reinforcing WMO qualifications and competency standards in capacity development efforts.
- b. Promoting the sharing of training resources and best practices to promote successful capacity development.

- c. Supporting development goals that are aligning with documented learning needs.
- d. Sponsoring innovation projects that seek to utilize new and alternative training methods.
- e. Sponsoring capacity development projects that include helping countries become aligned with WMO Qualifications and Competency Standards, as defined in the WMO Technical Regulations.
- f. Including the WMO Global Campus initiative as a potential aid for meeting capacity development needs.
- g. Asking tool developers to provide the training necessary to implement new technologies by recipient NMHSs
- h.
- i. Recognizing mutual respect in establishing and implementing partnerships;
- j. Avoiding proliferation of partners that may result in high competition for resources and duplication of efforts;
- k. Recognizing education and training, and modernization of infrastructure, as essential elements for improving weather, climate, hydrological and related environmental services for the benefit of society and economic development.

5) Recommendations for the private sector include;

- a) Partnering with WMO and NMHSs to invest in the improvement of skills for providing weather, climate, hydrological and related environmental services and in modernizing infrastructure required for high quality services;
- b) Working with WMO and NMHSs to come up with a cost-recovery policy that would sustain the infrastructure required for gathering and sharing meteorological observations, data and products;

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