WORLD METEOROLOGICAL ORGANIZATION

INTER-COMMISION COORDINATION GROUP ON THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM

First Session

Geneva, Switzerland, 26-30 September 2011

FINAL REPORT

DISCLAIMER

Regulation 42

Recommendations of working groups shall have no status within the Organization until they have been approved by the responsible constituent body. In the case of joint working groups the recommendations must be concurred with by the presidents of the constituent bodies concerned before being submitted to the designated constituent body.

Regulation 43

In the case of a recommendation made by a working group between sessions of the responsible constituent body, either in a session of a working group or by correspondence, the president of the body may, as an exceptional measure, approve the recommendation on behalf of the constituent body when the matter is, in his opinion, urgent, and does not appear to imply new obligations for Members. He may then submit this recommendation for adoption by the Executive Council or to the President of the Organization for action in accordance with Regulation 9(5).

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EXECUTIVE SUMMARY

The first session of the Inter-Commission Coordination Group on the WMO Integrated Global Observing System (ICG-WIGOS-1) was held at the WMO Secretariat in Geneva, Switzerland, from 26 to 30 September 2011. The session was chaired by Mr Fred R. Branski (USA), Chair, ICG-WIGOS, President of CBS.

Based on the decisions by Cg-XVI and EC-LXIII, ICG-WIGOS addressed all key components of WIGOS implementation under relevant Agenda Items. Specifically, the following key WIGOS implementation issues together with the documents developed by the Secretariat were considered:

(a) WIGOS Concept of Operations - Functional Architecture (CONOPS-2) (Appendix II);

(b) Manual on WIGOS (Appendix III);

(c) WIGOS Communications and Outreach Strategy (Appendix IV);

(d) WIGOS Capacity Building Strategy (Appendix V);

(e) WIGOS Implementation Plan (Appendix VI);

(f) Guideline on WIGOS activities to be implemented by Members (Appendix VII).

Based on a general discussion on the Agenda Items in a plenary and by the more detailed consideration by the targeted breakout groups, ICG-WIGOS formulated its recommendations and guidance on the further Implementation and development of the above documents, in some cases through establishment of the relevant Task Teams. ICG-WIGOS highlighted also some urgent issues and milestones for its Future Work Programme and Action Plan of ICG-WIGOS (see Appendix VIII).

During consideration of the individual Agenda Items, particular attention was given to the draft WIGOS Functional Architecture that is a main reference for the WIGOS Implementation Plan to be submitted to EC-LXIV for consideration and recommendations as well as for the Manual of WIGOS.

GENERAL SUMMARY

1. ORGANIZATION OF THE SESSION

1.1 Opening of the meeting

1.1.1 The first session of the Inter-Commission Coordination Group on the WMO Integrated Global Observing System (ICG-WIGOS-1) was opened by its Chair, Mr F. R. Branski, President of CBS, at 09:00 hours on Monday, 26 September 2011, at the WMO Headquarters in Geneva, Switzerland.

1.1.2 J. Lengoasa, the Deputy Secretary-General, welcomed by his opening remarks the participants to Geneva. He recalled the role and responsibilities of ICG-WIGOS in steering and coordinating WIGOS implementation, in accordance with decisions by Cg-XVI and EC-LXIII to implement WIGOS in an active and prudent manner. He underlined the responsibilities of all regional associations and technical commissions, as well as all WMO Programmes; all these should be actively involved in and contribute to this process. He also mentioned that the recent session of GCOS Steering Committee (UK, 19-23 September) recognized the integration of the WMO observing systems as an urgent issue.

1.1.3 F. Branski, Chair, noted that the WIGOS implementation would have a significant impact on many different areas and specifically on the quality of services provided by Members. He underlined the need for the intensive work especially during the first two years after Cg-XVI to successfully initiate and coordinate the implementation process at both, high decision-making and technical levels.

1.1.4 The list of participants is given in Appendix I.

1.2 Adoption of the agenda

ICG-WIGOS adopted the Agenda for the meeting, which is reproduced at the beginning of this report.

1.3 Working arrangements

1.3.1. ICG-WIGOS agreed on its working hours and adopted a tentative work plan to consider individual Agenda Items. It agreed with the proposal of Chair that the session would start with general consideration and discussion of all Items by the whole group; then, the session would continue with its work in the breakout groups on the specific topics indicated by Chair - the breakout groups on: (1) CONOPS-2, WIGOS Functional Architecture (Item 3.2.2); (2) Metadata (Item 3.2.5); (3) Manual on WIGOS (Item 3.2.7); (4) WIGOS Implementation Plan (Item 3.3); (5) Communications and Outreach & Capacity Development (Item 3.2.8, 3.2.9), and (6) Regional Associations matters (Item 3.4).

1.3.2. In this regard, at the beginning of the work in groups, Chair provided chairs of the breakout groups with his notes from general consideration of all Items, guidance and a template for reporting, and he requested them to follow the guidance and the reporting template. The key recommendations of Chair were incorporated under corresponding Agenda Items of General Summary.

1.3.3. The outcomes of the breakout groups were presented in a plenary and updated incorporating additional comments made; ICG-WIGOS agreed that recommendations and proposals specified by the breakout groups should be taken into account for implementation activities and further elaboration of relevant documentation later on, in due course;; therefore, all breakout groups outcomes (with no editorial chances, but formatting) were posted on the web and are available at: www.wmo.int/pages/prog/www/WIGOS-WIS/meetings/ICG-WIGOS-1_Geneva2011/DocPlan.html (under “Breakout Groups - Outcomes”) for the purpose of reference in the future.

1.3.4. The major outcomes of the breakout groups were incorporated into General Summary under corresponding Agenda Items.

2. REVIEW OF GUIDANCE AND RECOMMENDATIONS ADOPTED BY CG-XVI AND EC-LXIII

2.1 ICG-WIGOS reviewed the guidance and recommendations by Cg-XVI and EC-LXIII (Geneva, May-June 2010) on the implementation of WIGOS. ICG-WIGOS underlined that WIGOS implementation was determined by Cg-XVI as the one of priority activities of Organization. It is a challenging task to be implemented at the global, regional and national levels with full involvement of all Members, WMO constituent bodies and partner organizations.

2.2 ICG-WIGOS noted that one of the most urgent tasks will be development of the draft WIGOS Implementation Plan (WIP) to be submitted to EC-LXIV for consideration. Another urgent task is an early development of the Manual on WIGOS.

2.3 ICG-WIGOS recalled the importance of a comprehensive communications strategy to ensure that Members, regional associations, technical commissions and partners are all informed on their roles in implementing WIGOS; also to provide documentation on benefits, efficiency and cost-effectiveness of WIGOS, as well as technical guidance on the implementation activities by Members and the Regional Associations.

2.4 ICG-WIGOS reiterated the statement of Cg-XVI that an effective capacity-building strategy is an essential component of the WIGOS implementation. Specialized education, training activities and improvement of necessary observing infrastructure ***should*** be reflected in the regional, sub-regional and national WIGOS implementation plans, especially for NMHSs of LDCs, LLDCs and SIDS. Hence, capacity building is not to be limited to scientific and technological concerns, but also to strategic and management consideration including human resources development, resource mobilization and communications and outreach activities.

2.5 ICG-WIGOS also noted that Congress had stressed the importance of the development of an implementation plan for the evolution of the WIGOS beyond 2015, including technical guidance. In this connection ICG-WIGOS ***recommended*** that these activities should involve the Implementation plan for the evolution of the global observing systems, relevant GCOS, GAW and WHYCOS strategic and implementation plans.

3. WIGOS IMPLEMENTATION

3.1 WIGOS Implementation Concept

3.1.1 ICG-WIGOS reviewed the “WIGOS Implementation Concept”, including Key Implementation Components and Major Activity Areas/Tasks, prepared by the Secretariat and provided its guidance as reflected below.

3.1.2 In accordance with the WIGOS Development and Implementation Strategy (WDIS), ICG-WIGOS agreed that WIGOS key implementation components ***should*** include:

(a) Integrated governance;
(b) Data delivery and information services through WIS;
(c) Quality management, including monitoring and standardization;
(d) Planning and optimization of observing systems;
(e) Capacity building;
(f) Communications and outreach.

3.1.3 ICG-WIGOS recalled the timeframe for WIGOS implementation decided by Congress, which is the next financial period. WDIS specifies key tasks, activities and milestones for this period.

3.1.4 Taking into account recommendations and guidance by Congress as well as WDIS, ICG-WIGOS agreed that ***the following principles and approaches should*** be applied during the WIGOS implementation:

- Two driving perspectives/viewpoints of consideration should betaken into account:
  - the implementation of WIGOS as a self-sustaining evolving observing system within four years (2012-2015), and
  - the implementation plan for the evolution of WIGOS beyond 2015 (see paragraph 2.5 above);

- Implementation should be undertaken in an active and prudent manner to achieve a smooth transition from the current situation to WIGOS to be operational; WIGOS implementation should cause no harm or limitation to the existing WMO or co-sponsored observing systems;
- All implementation principles and approaches should be considered from the services delivery perspective, how to satisfy the multifaceted requirements of end-users for the benefit of society, sustainable development and environmental protection;
- Implementation of WIGOS should build upon and add value to the existing WMO observing systems; building on, and leveraging existing mechanisms;
- Emphasis should be given on integration of surface- and space-based observations in an evolutionary process;
- In this regard, observing system interoperability[1)] is key to turning observations into effective data/products that meets real needs of users;
- Present and emerging requirements of all WMO and WMO co-sponsored Programmes should be satisfied; requirements of GFCS and other WMO priorities needed to be reflected;
- All WMO Programmes should actively participate and contribute their own expertise and resources in implementing WIGOS;
- Regional/subregional/national requirements needed to be reflected in the relevant implementation plans for global, regional/sub-regional and national levels to be developed by the WMO Secretariat, RAs and NMHSs, respectively; in this regard, the urgent issues of RA I – the implementation of a Quality Management System (QMS) was given as an example how WIGOS can help through a dedicated project with such a clear target;
- Doing that, different levels of development, diversity of Member's capabilities, their specifics, needs, priorities as well as available resources will have to be considered and taken into account at regional, subregional and national levels;
- Basic principles guiding the WIGOS implementation must be specified;
- Certain minimum Critical Success Indicators (CSI) must be defined in order to measure the stages of the WIGOS implementation and the progress;
- Sessions of all WMO constituent bodies (EC, RAs, TCs, PTC) should be used to present and document the progress in the WIGOS implementation as well as for the purpose of their close and active involvement;

3.1.5 ***Implementation priorities*** ***should*** be set up from the following perspectives:

- urgent/critical issues, especially those having fixed deadlines for accomplishment;
- technical issues:
  - Metadata
  - QMS (incorporated accordingly into the Manual and Guide on WIGOS);
  - WMO Technical regulations, including Manual on WIGOS;
- Communication and outreach:
  - communication and advocacy of WIGOS benefits;
  - engagement of stakeholders and regional/subregional intergovernmental and economical groupings & funding organizations;
  - engagement of partners/co-sponsoring agencies;
  - development of strategy for communications & outreach, and resource mobilization;
- capacity development:
  - development of capacity building strategy, specifically but not only for LDCs, LLDCs and SIDS (fast-track projects to target needs of those countries in accordance with their priorities);

3.1.6 ICG-WIGOS stressed that close coordination with, and contributions from WMO Partners co-sponsoring GOOS, GTOS and GCOS are ***needed*** for implementation activities. It also agreed that urgent actions ***should*** be identified and prioritized (see Annex to this paragraph); the sequence of

[1)] Interoperability is a property referring to the ability of diverse systems to work together (inter-operate)

implementation activities ***should*** be also prioritized from Members' and regional perspectives. In this regard, a nomination process of National and Regional Focal Points, respectively (WIGOS-NFP/RFP) on WIGOS ***should*** be initiated by the Secretariat early.

3.2 Issues to be addressed

3.2.1 Integration Needs of WMO Programmes and Technical Commissions

3.2.1.1 ICG-WIGOS noted WIGOS related requirements of WMO Programmes and Technical Commissions as considered by Cg-XVI. It agreed that those and many others ***should*** be taken into account during a further elaboration of the WIGOS Implementation Plan (WIP) (see Item 3.3).

3.2.1.2 It was further noted that there are many research observational data/products that would deliver genuine value to other applications beyond the research community. Conversely, it was also noted that in some instances observations relied upon to support operational systems and services are sustained solely on research funding. The ICG-WIGOS agreed that WIGOS implementation should support and encourage higher usability of all relevant observational data/products and make them largely available. This requirement ***should*** be reflected in WIP.

3.2.1.3 ICG-WIGOS recognized that Congress had underlined the important role the WMO Programmes, RAs and TCs would play in the implementation of WIGOS and that Congress provided a specific instruction concerning their work programs and activities that would be undertaken. ICG-WIGOS agreed that those activities ***should*** be core components of the WIGOS implementation; in this regard, it requested that all RAs, TCs and relevant WMO Programmes should provide an annual status report on how WIGOS was embedded in their plans and what were their WIGOS achievements, for ICG-WIGOS for the subsequent reporting to EC.

3.2.2 WIGOS Concept of Operations – Functional Architecture (CONOPS-2)

3.2.2.1 ICG-WIGOS reviewed a draft WIGOS Functional Architecture (CONOPS-2) (Appendix II). It agreed with the general layout of CONOPS-2 as recommended by EC-WG/WIGOS-WIS-4 (February 2011). It further reiterated that the WIGOS Functional Architecture will be a main reference for the WIGOS Implementation Plan and the Manual on WIGOS. Therefore, its further development ***should*** be considered as an urgent matter and close engagement of all TCs and RAs in this process is important to their commitment to WIGOS. It also noted that, following the guidance from Cg-XVI to ensure consistency and effectiveness, the updated CONOPS ***should*** reflect adequately requirements of GFCS and the other WMO priorities.

3.2.2.2 ICG-WIGOS considered the draft WIGOS Functional Architecture as an initial approach to how WIGOS should be organized and function as an operational system when implemented. It acknowledged the value of a graphical presentation of all WIGOS basic processes and components; however, it ***recommended*** that, in general, diagrams ***should*** bring added value, be logical, not complicated and easy to understand. Also, the text ***needs*** to be improved and consistent with the corresponding diagrams.

3.2.2.3 ICG-WIGOS ***recommended*** that basic (high-level) WIGOS functional principles and processes ***should*** be specified as the first step; they ***should*** be flexible allowing incorporating emerging and new user requirements. It also noted that the current text referred mainly to the surface-based systems and ***should*** be complemented by adequate description of the space-based components. Both the surface- and space-based observing components must be covered and specified appropriately in all relevant parts of the document. Details could be elaborated in due course utilizing lessons learned from the implementation process.

3.2.2.4 ICG-WIGOS also noted that the WIGOS Functional Architecture ***should*** better clarify the role of CIMO in meeting of standards and traceability of measurements through engagement of RICs and RMICs. Also, the role and responsibility of all current WMO centres if they are incorporated into WIGOS architecture ***should*** be clarified.

3.2.2.5 ICG-WIGOS agreed that the interaction between research and operational observing communities was important for the continued evolution of observing systems and practices, in line with

new science and technology outcomes, and for the operational availability, and migration to operations where appropriate, of some research-based observing systems. The mechanisms to capture this interaction, including specification of appropriate interfaces, ***should*** be articulated in the CONOPS-2 and/or other WIGOS documentation.

3.2.2.6 The key ***recommendations*** of the breakout group on this matter are as follows:

- WIGOS Functional Architecture (WIGOS-FA) should describe the high-level technical requirements of WIGOS as an operational system (the end state), with concise statement of benefits;
- It provides the basis for the Manual on WIGOS and the WIGOS Implementation Plan;
- It has to be a document that TCs, RAs, Members, and sponsors can own;
- Therefore, their early engagement in a constructive way is needed; WIGOS-FA should be presented at all relevant RAs/TCs constituent body sessions, including meetings of presidents of RAs and TCs respectively; TCs and RAs focal points should provide feedback to WIGOS-FA;
- WIGOS-FA should be submitted to PTC 2012 for consideration and feedback;
- Each President of TC should nominate a WIGOS focal point (WIGOS-TCFP) (i.e. a real named person) to provide comments on WIGOS-FA, i.e., somebody who will own it and who will respond with concrete comments – not just editorial comments but in a way that makes the TC concerns clear and help ICG-WIGOS to help them;
- A small number of countries should be invited to provide comments on WIGOS-FA.
- The document must be readable, relevant, and as short as possible;
- Graphics need to be understandable and communicate the message;
- WIGOS-FA needs to be accepted by EC-LXIV in 2012 (the first draft with a right structure), noting that it is a living document and will return for further acceptance as it is refined;

For milestones and timetable: see Appendix VIII, Table 1: Milestones and timetable for CONOPS-2 (WIGOS Functional Architecture);

3.2.3 Quality Management System (QMS)

3.2.3.1 ICG-WIGOS noted a conceptual description of the WIGOS QMS drafted in CONOPS-2 (Section 1.3.2), developed in accordance with WDIS and decision of Cg-XVI.

3.2.3.2 Implementing QMS, WIGOS would ensure that observational data and products are compliant with the WMO QMF and its Quality Policy. In this regard, the key issue is to document all processes and procedures used and to strive where possible to guarantee traceability to international standards.

3.2.3.3 As QMS is relevant to the updating of the WMO Technical regulations (see also Item 3.2.7), ICG-WIGOS agreed that, instead of developing another self-standing document on QMS, as suggested by the Secretariat, it ***should*** be the Manual and Guide on WIGOS with a clear specification of standard practices and procedures (in the Manual) and those only recommended (in the Guide).

3.2.3.4 In this regard, ICG-WIGOS postponed a decision on establishing a task team on QMS.

3.2.4 WIGOS Standardization Strategy

3.2.4.1 ICG-WIGOS was briefed on a concept of WIGOS standardization process specified in CONOPS and CONOPS-2 (Section 1.3.5). It agreed that the standardization is a very complex issue; however CIMO Guide (WMO-No. 8) can provide a useful guidance on this issue how to proceed further.

3.2.4.2 ICG-WIGOS underlined that as a part of the implementation strategy, a successful WIGOS standardization process will have to adequately address the differences and inconsistencies in current technical specifications, data acquisition and management systems used by individual NMHSs and partner organizations before national and international observing systems can be regarded as truly

integrated. ICG-WIGOS stressed the essential role of communications and outreach activities together with capacity building in supporting the WIGOS standardization process. It was noted that the life-time and performance of observing instruments and techniques are also important issues to be reflected by this process.

3.2.4.3 ICG-WIGOS postponed a decision on establishing a task team on standardization.

3.2.5 WIGOS Metadata

3.2.5.1 ICG-WIGOS considered the standardization of WIGOS metadata, including its generation, editing and management as an urgent matter. It was noted that several WIGOS related implementation projects indicated the lack of metadata standards and guidance as a serious constraint preventing their progress.

3.2.5.2 Regarding the WIGOS metadata implementation process, the following three phases can be identified: (1) development of standards/best practices; (2) their implementation; and (3) reporting / updating WIGOS metadata. It was ***recommended*** that the first step ***should*** be an inventory of what has been already done in this area, including legacy and emerging metadata recording/documenting methods, by CBS and its OPAG/IOS and OPAG/ISS, and other relevant technical commissions. It will help to understand a scope of this issue, especially legacy and emerging metadata recording/documenting methods.

3.2.5.3 To ensure effective guidance in addressing metadata issues, ICG-WIGOS decided to establish its Task Team on WIGOS Metadata (TT-WMD). A close collaboration and coordination of TT with CBS-OPAG/IOS, OPAG/ISS and OBS/WIS Branch and their experts will be crucial in this development. It was also agreed that at the later stage the Task Team on Metadata ***should*** evolve into the CBS OPAG/IOS Inter-Programme Expert Team (IPET) on WIGOS Metadata.

3.2.5.4 . The key ***recommendations*** of the breakout group regarding the WIGOS metadata are as follows:

- WIGOS metadata must be considered from user point of view, taking into account user requirements;
- Current activities of Members, the Secretariat (e.g. WMO No. 9, Volume A - Observing Stations), as well as examples of successful metadata implementation and best practices (e.g. ESURFMAR, sensorXML, existing ISO standards, OGC) be taken into account;
- Task Team on WIGOS metadata be established (members with technical expertise); ToRs be specified urgently;
- User requirements be collected; development of the metadata tree be initiated early;

For milestones and timetable: see Appendix VIII, Table 2: Milestones and timetable for Metadata;

3.2.6 WIGOS Databases and Portal

3.2.6.1 ICG-WIGOS noted the basic descriptions of the WIGOS operational and standardization databases are specified in CONOPS (Sections 5.2.6, 5.2.7) and, together with the WIGOS Portal in CONOPS-2 (Section 1.4). It reaffirmed their role and importance as the basic tools for operational WIGOS.

3.2.6.2 In this regard, ICG-WIGOS recalled the requirement of IMOP and CIMO endorsed by Cg-XVI for the development of a user-friendly direct access and on-line search tool for the CIMO Guide and other related WMO regulatory material that would help Members in accessing the information needed to improve and standardize their networks according to WIGOS requirements.

3.2.6.3 Regarding the WIGOS Portal, ICG-WIGOS ***recommended*** that a clear description of relationship between the WIGOS operational and standardization databases and the databases used to support the existing RRR process for the GOS, specifically the WMO Observing Requirements Database (the original CEOS-WMO Database on Observing Capabilities) ***should*** be incorporated into CONOPS-2.

3.2.7 WMO Technical Regulations and the Manual on WIGOS

3.2.7.1 ICG-WIGOS was briefed on the development of the initial draft of Manual on WIGOS (Appendix III) as well as on existing rules and procedures related to the establishment and updating of the WMO Regulatory material. It noted that the standard and recommended practices for operation of major observing networks contributing to WIGOS are laid down in the WMO Technical Regulations (WMO-No. 49) and in the relevant Guides.

3.2.7.2 ICG-WIGOS underlined that development of the Manual on WIGOS as an overarching document (which should define WIGOS basic principles, requirements and functional architecture with references to other relevant WMO technical documents, where appropriate) would be an urgent task of the WIGOS implementation to ensure that WIGOS can be considered as a WMO operational observing system.

3.2.7.3 ICG-WIGOS reviewed the draft Manual. It noted that the draft had been built mainly on the current Manual on GOS (WMO-No. 544), but also taking into account other relevant Manuals and Guides, such as CIMO Guide and other relevant WMO technical documentation. ICG-WIGOS agreed with an approach that the Manual should reflect all relevant WMO technical documentation with a clear clarification of relationships and references when needed but with no duplication. Both, the surface- and space-based observing components must be covered and specified appropriately in all relevant parts of the document.

3.2.7.4 ICG-WIGOS agreed that all RAs and TCs ***should*** contribute to the development of the Manual and the international partner organizations ***should*** be kept abreast on the progress in the development. ICG-WIGOS agreed to establish Task Team on the Manual on WIGOS (TT-WM) with the first meeting in I.Q.2012.

3.2.7.5 The key breakout group ***recommendations*** regarding this issue are as follows:

- The aim of both Manual and Guide on WIGOS should be to contain all relevant information, structured appropriately in chapters;
- The review of the WMO Technical Regulations (WMO-No. 49) be done and proposal for updates be developed in close relation with the early development of the Manual on WIGOS;
- The CIMO Guide (WMO-No. 8) should be reviewed with a view of identifying mandatory sections that could be moved from it into the Manual on WIGOS. Proposal for updates of CIMO Guide be formulated;
- Differences between management of surface- and space-based components should be clearly specified;
- Mechanism for integration of research observational data and handling “third party” data (i.e. outside of WMO and NMHSs) should be specified;
- The “parent” WMO Programme should take the lead for the observing component under its responsibility and provide relevant contributions;

For milestones and timetable, see Appendix VIII, Table 3: Milestones and timetable for Manual on WIGOS.

3.2.8 WIGOS Communications and Outreach Strategy

3.2.8.1 ICG-WIGOS reviewed the outline of the WIGOS Communications and Outreach (C&O) strategy developed by the Secretariat (Appendix IV). It stressed that the early development and consequent implementation of such a Strategy ***should*** be one of an essential component of the WIGOS implementation plans at all levels. ICG-WIGOS agreed that there is a strong need to further elaborate and expand the presenting C&O concept. For its timely and complete realization, the WIGOS Project Office with appropriate project management functions, sufficient staffing and funding, as requested by Cg-XVI, is an absolute precondition.

3.2.8.2 ICG-WIGOS agreed that the Strategy ***should*** be a living document evolving with the WIGOS

implementation. The implementation of WIGOS through involvement of all relevant "units" will provide valuable feedback. It will change the programme. This ongoing process will improve the C&O Concept and the programme. Every effort ***should*** be made that all information on WIGOS implementation activities is easily accessible to all Members and stakeholders; they ***should*** be simple, clear and accurate. In this context, the availability of effective communication facilities such as conferences, meetings, conventional and electronic correspondence, the Internet, including the existing WIGOS website and later on the WIGOS Portal, would be indispensable to achieve its objectives and goals.

3.2.8.3 ICG-WIGOS ***recommended*** that WMO Regional Training Centres (RTCs) and WMO Regional Offices ***should*** be closely and actively involved in WIGOS communications activities, providing their full support to regional and national WIGOS Focal Points (to be nominated by the RA Management Groups and PRs, respectively).

3.2.8.4 It was also stressed that all forums (already ongoing/planned or upcoming/foreseen conferences, sessions, workshops, seminars, meetings at global, regional, national levels) ***should*** be used to promote understanding of the WIGOS concept and implementation, its role and benefits for Members from a service delivery perspective. For this purpose, ICG-WIGOS ***recommended*** a development of a special "high-level" package of information on WIGOS, including a standard PowerPoint presentation. Also, an idea of the regular WIGOS Newsletters to inform on the progress of the WIGOS implementation was suggested.

3.2.8.5 ICG-WIGOS further agreed that communications and outreach activities (such as regional/subregional seminars and workshops) **should** be focused on specific audiences (e.g. executives, senior managers and technical staff responsible for management of, and supervising observing networks/systems; funding organizations, etc.), respecting problems, needs, priorities and differences of individual RAs and their subregions. They ***should*** be flexible, build on and leveraging existing tools and mechanisms, including those related to GFCS and DRR, including multi-hazard early warning system (MHEWS). ICG-WIGOS further stressed the importance of such regional and subregional activities as a practical starting point for the WIGOS implementation and assistance given to national and regional projects.

3.2.8.6 ICG-WIGOS underlined that the regional and especially national events should be used to increase the visibility and to underline the importance of NMHSs and the WIGOS Project, also with regard to GFCS as another WMO high priority. Further, ICG-WIGOS agreed that the regional and national events in connection with World Meteorological Day (WMD) ***should*** provide a platform to promote the WIGOS implementation. It also ***recommended*** utilizing of positive experiences of the WMO Public Weather Services (PWS) Programme in this area and engaging PWS in WIGOS communications and outreach activities, especially at the national level.

3.2.8.7 Communications and Outreach activities ***should*** be one of the priority items in the terms of reference of national and regional focal points on WIGOS to be nominated. ICG-WIGOS requested the Secretariat to initiate appropriate arrangements, as required.

3.2.8.8 ICG-WIGOS underlined the strong relation between C&O and capacity building strategies. In general terms, C&O should be a part of all relevant WIGOS documents, e.g. CONOPS or WIP. 3.2.8.9 The key breakout group ***recommendations*** regarding C&O can be summarized as follows:

- C&O is an very complex task; a very well developed and working concept is absolutely needed for the success of WIGOS (marketing for WIGOS);
- C&O and the WIGOS Project Office are preconditions for the successful WIGOS implementation;
- C&O should be timely, easily understood, focused, providing message on benefits, opportunities, progress, challenges, opportunities, etc. to all key stakeholders; in this regard, WIGOS must be presented as an investment for the future, not an expenditure – it is important!
- "High-level" package of information on WIGOS should be also developed for co-sponsors and GEOSS;
- C&O should demonstrate to Members how WIGOS can help them (future benefit aspect);
- C&O should cover the collaboration with DRA, PWS, DRR and others relevant departments and divisions;

- It should help PRs to communicate with partners at a national levels (visibility aspect);
- "Message" from a global WIGOS level/perspective should be translated to the national level (what it actually means from the perspective of Members);
- The WIGOS **Project Office** (WIGOS-PO) should be the lead - the authoritative voice for C&O;
- It is important to mobilize voluntary resources from Members to support the work of WIGOS-PO; therefore there is a need to communicate the role and the value of WIGOS-PO for Members;

For milestones and timetable, see Appendix VIII, Table 4: Milestones and timetable for Communications and Outreach & Capacity Development.

3.2.9 WIGOS Capacity Building Strategy

3.2.9.1 ICG-WIGOS considered the draft outline of WIGOS Capacity Building Strategy developed by the Secretariat (Appendix V). It agreed in principle with the proposed objective, governance, major areas of planning and implementation of WIGOS Capacity Building. However, the submitted draft was considered as too generic and ICG-WIGOS ***recommended*** its further elaboration, with more specific-concrete activities. During the implementation of WIGOS, it ***should*** be focused directly on the key WIGOS components and individual Regions/subregions to be implemented during the next financial period.

3.2.9.2 ICG-WIGOS reaffirmed that an effective capacity-building strategy is an essential component of the WIGOS implementation. It underlined that the planning and implementation of capacity-building activities ***should*** be carried out in full compliance with the WMO Strategy for Capacity Development endorsed by Cg-XVI. ICG-WIGOS requested the Secretariat to ensure such compliance.

3.2.9.3 It was further agreed on the ***need*** to develop and implement an effective and sustainable mechanism for delivering WIGOS related education and training at the regional level. All Strategic and Operating Plans of individual RAs ***should*** be used for this purpose. ICG-WIGOS requested the Secretariat to initiate appropriate arrangements, as required.

3.2.9.4 ICG-WIGOS strongly ***recommended*** utilizing experiences gained from other capacity building activities, in particular those of Centres of Excellence (CoE) for training in Satellite Meteorology, and regional training seminars and workshops for national trainers. ICG-WIGOS considered that it would be beneficial to initiate special capacity building projects in selected regions/sub regions to demonstrate benefits of WIGOS. ICG-WIGOS requested the Secretariat (WMO Space Programme and the Regional Offices) to provide support and input to these activities.

3.2.9.5 More detailed consideration of WIGOS capacity building activities was done in a discussion on this subject with J. Wilson, D/ETR with the following ***recommendations***:

- GFCS approach to capacity development should be used;
- CB strategy needs to be linked with GFCS, DRR and other WMO priorities;
- The first focus should be on those countries having no observing capabilities or very limited ones (no data quality control, other significant constrains);
- Members must take ownership of CB activities;
- WMO RICs/RMICs and RTCs should be involved in the WIGOS implementation and CB;
- Clear specification of requirement for capacity development needs to drive the plans;
- DRA should integrate WIGOS into their capacity development strategy, nationally and regionally;
- Training programme for observing network management should be developed, using fellowship programme for secondments; attendees could become regional champions;
- Manual for PRs being revised now should contain WIGOS matters;
- WIGOS relevant technical documents (WMO Technical Regulations, manuals and guides) should also contain capacity development/building aspects;

3.3 WIGOS IMPLEMENTATION PLAN

3.3.1 ICG-WIGOS reviewed the updated version of the draft WIGOS Implementation Plan (WIP) (Appendix VI) and agreed with the proposed layout. It noted that, in accordance with the request by EC-LXIII, ICG-WIGOS have to develop, review and submit a high-level WIP for approval by EC-LXIV in 2012. Therefore, the further development of WIP must be considered as the high priority activity of ICG-WIGOS with active engagement of the Management Groups of all RAs and TCs, respectively; their active engagement and ownership of the WIGOS implementation is essential in this regard.

3.3.2 Based on the general discussion on this issue as well as on outcomes of the breakout group on this matter, ICG-WIGOS agreed on the following ***recommendations*** related to the content of WIP:

- It should contain a better clarification of the role of Members;
- It should specify clearly the role of RAs and TCs, their management groups and working bodies ensuring their ownership and direct engagement in implementation activities;
- It should incorporate RAs and TCs components and contributions to the implementation;
- It should specify collaboration activities between RAs and TCs to ensure the provision of technical guidance of TCs to the Region;
- Implementation plan of RAs should also propose bilateral or multilateral subregional projects, or inter-regional projects (e.g. between RA I and RA VI or RA III and RA IV, etc.);
- Active engagement of the WMO Regional Offices is needed;
- ICG-WIGOS should ensure coordination between a high-level WIP and regional implementation plans as well as with the Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP), the Implementation Plan for the Global Observing System for Climate (GCOS-IP), and the GFCS Implementation Plan (the Observations and Monitoring Component) being developed;
- Technical guidance on the WIGOS Implementation for Members and RAs respectively should be available as a matter of urgency;
- Global Cryosphere Watch (GCW) experts should contribute to the further development of WIP to ensure an appropriate integration of GCW into WIGOS;
- Activities related to archiving and retrieval of WIGOS data and products should be included;
- Early engagement of GCOS, GOOS and GTOS is needed;

For milestones and timetable, see Appendix VIII, Table 5: Milestones and timetable for a High-level WIGOS Implementation Plan;

3.3.7 ICG-WIGOS further agreed with a proposal of the Chair to establish Task Team on the WIP (TT-WIP) under his chairmanship with the first meeting in November 2011.

3.4 GUIDANCE FOR MEMBERS ON WIGOS IMPLEMENTATION

3.4.1 ICG-WIGOS considered the “Initial Guideline on WIGOS activities to be implemented by Members” (Appendix VII). It agreed with the layout and content of the Guideline that was developed utilizing experiences and lessons learned from the WIGOS Demonstration Projects; however, it requested that the Guidance ***should*** be consistent with WDIS (regarding the key implementation components).

3.4.2 It noted that Guideline provided efficient background information for Members and aimed to facilitate their efforts in developing national WIGOS implementation plans, improving national observing systems as WIGOS national observing component. ICG-WIGOS agreed that the Guideline ***should*** be included into the WIGOS High-level Information Package and distributed among Members and regional associations.

3.4.3 ICG-WIGOS ***recommended*** incorporating into Guideline some additional information, such as:

- why WIGOS should be implemented at national level as an operational observing system;

- for the Members that already implemented an integrated observing system or an integration is on the way, to verify whether their approach is consistent with the WIGOS concept and its key principles;
- more guidance on resources and involvement of different subregional funding groupings and consortia.

3.4.4 ICG-WIGOS requested the Secretariat to update the Guideline on WIGOS activities to be implemented by Members accordingly.

3.4.5 In this regard, the breakout group on RAs matters considered WIGOS implementation issues from a regional perspective and its recommendations are as follows:

- Regional strategies should:
  - categorize needs and requirements of the Members respecting different stages of their development,
  - be based on priorities incorporated in their Regional Strategic and Operational Plans,
  - be tailored to available resources,
  - promote and facilitate regional planning and the regional observing network,
  - be a clear roadmap for the Region;
- Services driven regional resource mobilization strategy is needed;
- More efficient WMO Regional Offices are needed;
- WIGOS National and Regional Focal Points should be nominated and then active;
- RA working structure (working/task teams) be adjusted to the WIGOS implementation;
- Guideline on the WIGOS implementation at a regional level is needed;
- RAs Management Groups should have representatives of the technical commissions;
- Regional priorities should be agreed upon by both the RAs and TCs;
- Profiles of experts of the Technical Commissions should be submitted to the WIGOS Project Office;
- Prior to each EC, the meeting of the Regional Association Presidents must include WIGOS Implementation as a priority.

4. FUTURE WORK PROGRAMME AND ACTION PLAN OF ICG-WIGOS *(major conclusions)*

4.1 Based on discussion, ICG-WIGOS agreed that the following urgent/major tasks should be accomplished by ICG-WIGOS-2 (IV.Q.2012):

- Urgent actions be identified and prioritized (see 3.1.6); (Responsible: D/OBS; Chair, ICG-WIGOS);
- Early initiation of a nomination process of WIGOS National, RAs and TCs Focal Points (WIGOS-NFP/RAFP/TCFP, respectively) (see 3.1.6); (Responsible: WIGOS-PO);
- All TCs and selected Members should provide comments on a new draft WIGOS-FA to be available for the updated version be submitted to PTC 2012; (see 3.2.2.6); (Responsible: P-TCs and PRs of Members);
- WIGOS-FA be submitted to PTC 2012 for consideration and feedback (see 3.2.2.6); (Responsible: D/OBS; Chair, ICG-WIGOS);
- WIGOS-FA be considered by EC-LXIV in 2012 (the first draft with a right structure); (Responsible: D/OBS);
- Early establishment of the Task Team on WIGOS Metadata (TT-WMD) (see 3.2.5.3); (Responsible: Chair, ICG-WIGOS);

- WIGOS metadata related user requirements be collected and development of the metadata tree initiated early; (Responsible: WIGOS-PO; Chair, TT-WMD);
- Early establishment of the Task Team on the Manual on WIGOS (TT-WM) with the first meeting in I.Q. 2012 (see 3.2.7.4); (Responsible: Chair, ICG-WIGOS);
- Early establishment of the Task Team on WIP (TT-WIP), chaired by Chair, ICG-WIGOS with the first meeting in November 2011 (see 3.3.7); (Responsible: Chair, ICG-WIGOS);
- WIGOS Communications and Outreach Strategy be developed early (see 3.2.8.1) (Responsible: WIGOS-PO);
- High-level packages on WIGOS for PRs and Partners, respectively, be developed early (see 3.2.8.4, 3.2.8.8; (Responsible: WIGOS-PO).

4.2 ICG-WIGOS further decided to postpone the following:

- Establishment of the task team on QMS (see 3.2.3.4);
- Establishment of the task team on standardization (see 3.2.4.3);

4.3 Several tasks and activities were ***recommended*** by the individual breakout groups; the corresponding "Milestones and timetables" were generated; they are reproduced in Appendix VIII.

5. ANY OTHER BUSINESS

5.1 Dr S. Barrell (BoM, Australia) and Ms M. Jiao (CMA, China) gave the presentations on observing systems integration activities in their respective countries. J. Dibbern (DWD, Germany) briefed the session on the EUMETNET Composite Observing System (EUCOS) Programme implemented by 26 European countries which already became operational. ICG-WIGOS appreciated the chance to share such experiences and lessons learned from ongoing integration activities; they provide a valuable input to the WIGOS implementation.

5.2 ICG-WIGOS requested the Secretariat to post these presentations on the WIGOS website as a part of communications and outreach activities.

(Note: all presentations are available at: http://www.wmo.int/pages/prog/www/WIGOS-WIS/meetings/ICG-WIGOS-1_Geneva2011/DocPlan.html)

6. CLOSURE OF THE SESSION

6.1 The session closed on Friday, 30 September 2011, at 12:35 hours.

Annex to paragraph 3.1.6

Table 1: Key Implementation Components and Major Activity Areas with corresponding deliverables and priorities

No.	Key Implementation Components and Major Activity Areas/Tasks	Deliverables	Priority
1. Governance			
1.1	WIGOS CONOPS – Functional Architecture	WIGOS Functional Architecture developed & approved by EC-LXIV	1
1.2	High-level WIGOS Implementation Plan (WIP)	WIP developed & approved by EC-LXIV	1
1.3	Regional WIGOS Implementation Plans (R-WIP)	R-WIPs developed & approved by the Presidents of RAs; implementation started	1
1.4	National WIGOS Implementation Plans (N-WIP)	N-WIPs developed; implementation started	1
2. Data delivery and information			
2.1	Metadata	WIGOS Core Metadata Standard developed; technical guidance available; the initial core standard implemented by 2015	2
3. Quality management, including monitoring, and standardization			
3.1	Quality Management System (QMS)	QMS procedures developed and incorporated in to the Manual and Guide on WIGOS accordingly; implementation started	2
3.2	Standardization process	Standardization process finalized; implementation started	2
3.3	WIGOS Databases & Portal	Databases and Portal established	1
3.4	Technical Regulations (TRs), Manual on WIGOS (Manual); Guide on WIGOS (Guide)	TRs updated and approved by Cg-XVII; Manual developed and approved by Cg-XVII; Guide developed and approved by Cg-XVII;	1
4. Planning and optimization of observing systems			
4.1	Evolution of WIGOS	Vision for WIGOS, E-WIGOS-IP & technical guidance developed and available; E-WIGOS-IP; implementation started	3
4.2	Integration of space & surface obs. components	Integration strategy developed; implementation started	3
4.3	Architecture for Climate Monitoring from Space	Architecture developed; implementation started	3
5. Capacity Building			
5.1	Capacity Building (CB)	CB strategy developed; a set of fast-track projects, especially for LDCs, LLDCs, SIDS under implementation;	1
5.2	Education & training (ET)	ET activities ongoing;	1
6. Communications and Outreach			
6.1	Development of Communications and Outreach (C&O) strategy	C&O strategy developed and under implementation	1
6.2	Communication and advocacy of WIGOS benefits	All stakeholders are fully aware of WIGOS benefits	1
6.3	Engagement of stakeholders and regional/subregional intergovernmental and economical groupings & funding organizations	Engagement achieved	2
6.4	Engagement of partners/co-sponsoring agencies	Engagement achieved	2

Note: The table matches together the "Key Implementation Components" and "Major Activity Areas" specified by WDIS with corresponding deliverables to be achieved at the end of the implementation process and priorities.

Appendix I

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Appendix II

WORLD METEOROLOGICAL ORGANIZATION

WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

DRAFT

WIGOS CONCEPT OF OPERATIONS (CONOPS)

Part: WIGOS Design and Functional Architecture

Version 0.2

DOCUMENT VERSION CONTROL

Version	Author(s)	Date	Description
0.1	WIGOS-PO	III.-VI.2011	Initial draft of CONOPS-2
0.2	WIGOS-PO	Sept 2011	Cg-XVI & EC-LXIII guidance incorporated

CONTENTS

INTRODUCTION

The aim of the current WIGOS Concept of Operations (CONOPS, version 5.2) has been to guide the development of the WIGOS concept and to help in preparation of the basic WIGOS documentation such as the WIGOS Development and Implementation Strategy (WDIS), and at the latter stage, the WIGOS Implementation Plan (WIP) and Manual on WIGOS. In reviewing the report on WIGOS implementation, Cg-XVI (Geneva, May 2011) requested, inter-alia, to further elaborate the WIGOS concept of operations with emphasis on the updating the concept of operation as a WIGOS functional architecture to be a main reference for the WIP and later on for the Manual on WIGOS. Accordingly, the relevant parts of the document (namely sections 5 and 7) have been elaborated and now constitute a new part of CONOPS, entitled “WIGOS Design and Functional Architecture”. Specifically, this part includes the following:

- High-level description of WIGOS process, associated tools and priorities, including core WIGOS operational activities illustrated by flowcharts that describe the system architecture and its environment;
- WIGOS organizational, programmatic, governance and procedural structures for standardization process and uniform implementation of WMO regulations and best practices to ensure data integration and interoperability across all WMO observing systems;
- Specification of WIGOS core services, associated components and procedure, as well as responsibilities of all relevant stakeholders.

Current arrangements for product delivery from observing systems operated by Members and Partner organizations to users are schematically shown in Figure 1. The diagram also presents a high-level description of WIGOS. As determined by Congress, WIGOS is envisioned as an evolving system that will continue to implement new solutions, adopt new technologies, and improve system processes to ensure that it remains capable of meeting evolving end-user needs. In this context, CONOPS is a living document, describing the concept of a fully operational WIGOS, consistent with evolving user requirements.

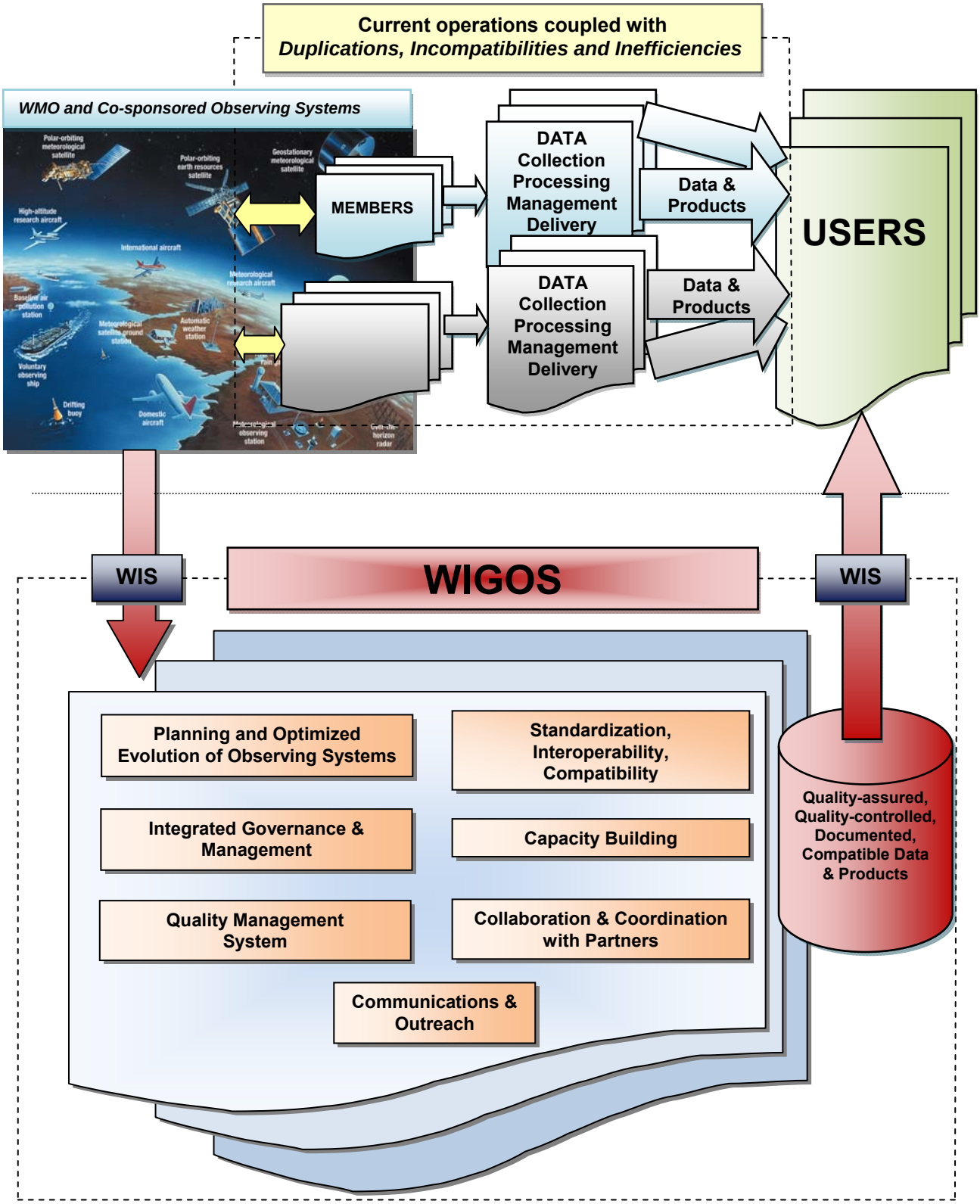

Figure 1: Current practices versus the WIGOS concept of operations

1. ORGANIZATION, DESIGN AND FUNCTIONAL ARCHITECTURE

1.1 Integrated Governance and Management

WIGOS meets high-level observing requirements by establishing the effective and sustained organizational, programmatic, governance and procedural structures. These structures enable a common standardization approach, uniform implementation of WMO regulations, data integration and interoperability across all WIGOS observing components. It also provides a single focus for integrated and coordinated operational management of the WMO Integrated Observing System and a mechanism for coordination with WMO co-sponsored and other non co-sponsored contributing observing systems. Specifically, WIGOS is governed by the following WMO constituent bodies:

1. Congress (supreme guidance)
2. Executive Council (general oversight & control, guidance, recommendations)
3. Regional Associations (implementation & coordination through WGs)
4. Technical Commissions (implementation & coordination through working bodies, e.g. OPAGs & ETs)
5. The Secretariat (overall support & central coordination, cooperation)

Following the guidance of Cg-XVI, EC-LXIII (May, 2011) established the Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) with representatives of regional associations, technical commissions and international partner organizations to coordinate the implementation of WIGOS.

WIGOS governance, management and organizational structures are presented in Figure 2.

Further, WIGOS centres are established to be operational to ensure WIGOS operations in a coordinated, effective and sustained manner. To reduce additional costs and avoid duplication, it is foreseen to make use of the existing WMO centres and eventually other centres of Partner organizations for calibration, data processing, data exchange and WIS Data Discovery, Access and Retrieval (DAR) services, Climate services with appropriate adjustments of their responsibilities.

Enhanced coordination is an ongoing activity at policy, technical, and Secretariat levels. This is supported by a high-level reconciliation mechanism defined in the WMO-UNESCO-IOC-UNEP-FAO-ICSU Memoranda of Understanding (MOU) in order to resolve possible problems and conflicts in data policy, and other governance issues. The Interagency Coordination and Planning Committee for Earth Observations (ICPC) continue to lead such coordination activities.

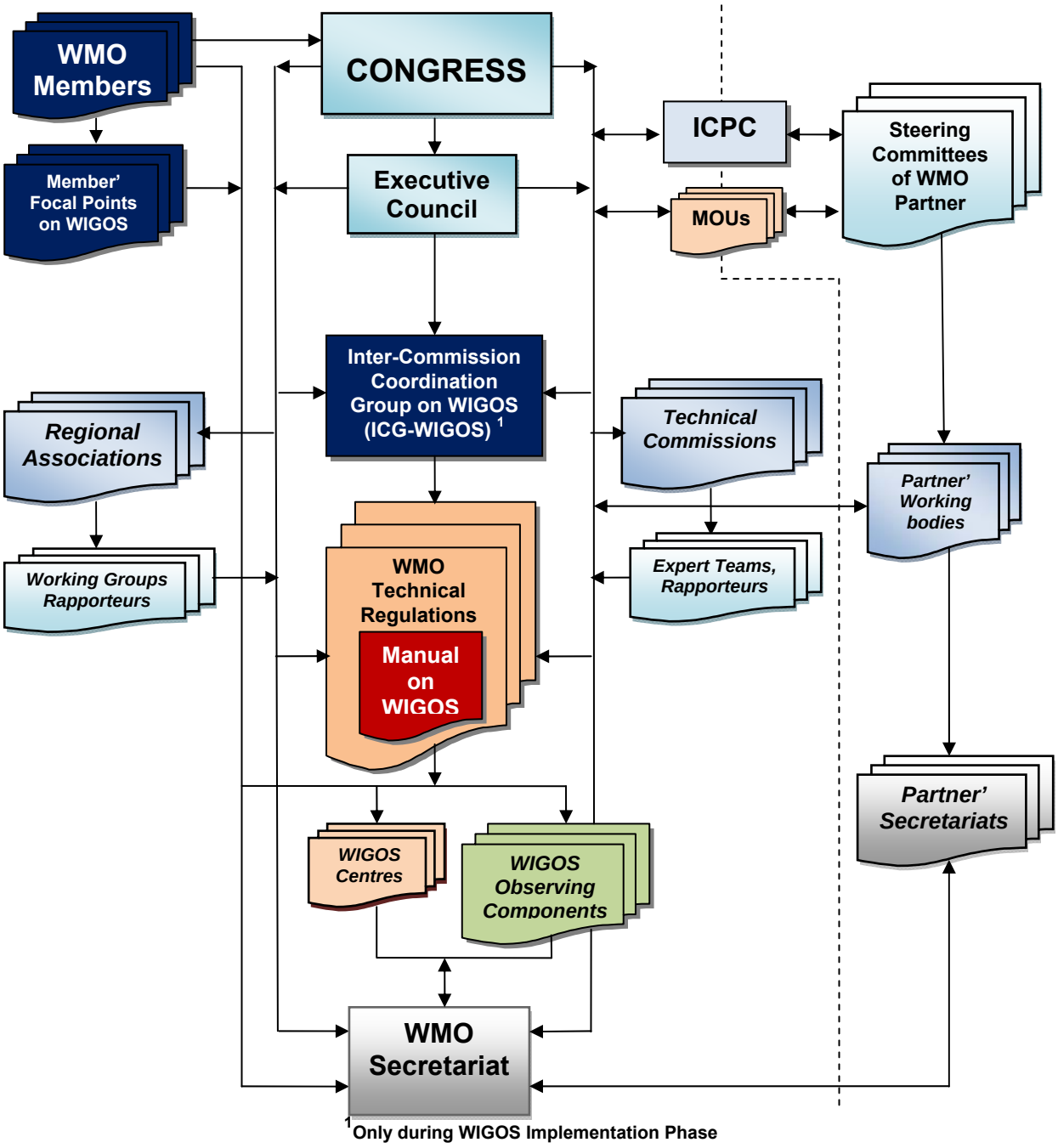

Figure 2: WIGOS governance, management and organizational structures

1.2 Roles and Responsibilities

WIGOS operations require long-term commitments and mutual understanding by all stakeholders to accomplish their current and planned observational activities in a coordinated, cost effective and sustained manner. Table 1 summarizes the role and responsibilities of WMO Entities for the key WIGOS operational components.

Table 1: The role and responsibilities of WMO entities for the key WIGOS operational components

Executive / WIGOS components	*Secretariat*	*EC*	*TCs*	*RAs*	*Members*
Planning & Optimized Evolution (Requirements & Capabilities, GAP analysis)			Provide technical guidance & advice;	Implement Cg / EC Resolutions & recommendations at a regional level;	Implement the RRR process; Ensure sharing of experiences and provide assistance to Members with specific needs;
Integrated Governance & Management	Overall support & central coordination, cooperation; Resources;	General oversight & control, guidance, recommendations	Provide technical guidance and advice in accordance with their TORs; Contribute to the regular updates of the Manual on WIGOS; Update the WMO Technical Regulations related to WIGOS;	Provide assistance and ensure coordination of WIGOS activities through relevant regional working bodies; Share experiences;	Ensure compliance of national observing system operations with the Manual on WIGOS & other WMO Technical Regulations; Provide: • Technical expertise; • Secondment services; • Resources
Quality Management *(including performance monitoring and evaluation)*			Update QMS technical documentation, provide guidance & advice on its use and implementation;	Ensure cooperation & coordination activities in accordance with regional plans; Promote sharing experiences & outreach in the field of QM;	Ensure implementation of QMS, incl. quality & performance monitoring & feedback; Provide, as appropriate: • Technical expertise • Resources; Ensure sharing of experiences and provide assistance to Members with specific needs;
Standardization, Interoperability, Compatibility			Specify recommendations on: • Observing systems interoperability; • Data/Metadata standards & best practices; • WIGOS databases and Portal Update technical documentation;	Ensure cooperation and coordination of RICs, RMICs, RCCs, DCPCs in WIGOS operations in accordance with regional plans;	Provide support to the operations of RIC, RMIC, RCC, DCPCs. Provide, as appropriate: • Technical expertise • Secondment services; • Resources; Ensure sharing of operational experiences and provide assistance to Members with specific needs;
Capacity Building			Provide technical guidance and assistance; Make recommendations on update/development of WIGOS training material;	Ensure / facilitate implementation of regional WIGOS Capacity building and assistance activities; Share experiences;	Implement and keep up-to-date the WIGOS Capacity building programme in accordance with national requirements;

1.3 WIGOS Processes

Process

WIGOS as an integrated, coordinated and comprehensive observing system ensures all processes needed to satisfy, in a cost-effective and sustained manner, the evolving observing requirements of WMO Members in delivering their weather, climate, water and related environmental services.

Through its organizational, programmatic, governance and procedural structures, WIGOS provides a framework for enabling the integration and optimized evolution of WMO observing systems, and

WMO's contribution to co-sponsored systems.

Together, WIGOS and WIS allow continuous and reliable access to an expanded set of environmental data and products and associated metadata, resulting in increased knowledge and enhanced services across all WMO activities. It significantly improves the availability, usefulness**,** quality and utilization of observational data and products.

Key WIGOS processes are presented in Figure 3. The overall WIGOS functions can be characterized in a following way:

- To facilitate standardization and interoperability and ensuring availability and utilization of, and access to, good-quality data and products, and associated metadata;
- To provide the mechanism for interaction and cooperation with the WMO co-sponsored observing systems, respecting partnership, ownership and data-sharing policies of all observing components and partner organizations. WMO works with partner organizations to achieve maximum commonality of standards and practices across the co-sponsored observing systems;
- To provide the partnership between WMO and international partner organizations with a shared responsibility for the design, operation, and coordinated and optimized evolution of observing systems under their responsibility, respecting the ownership.

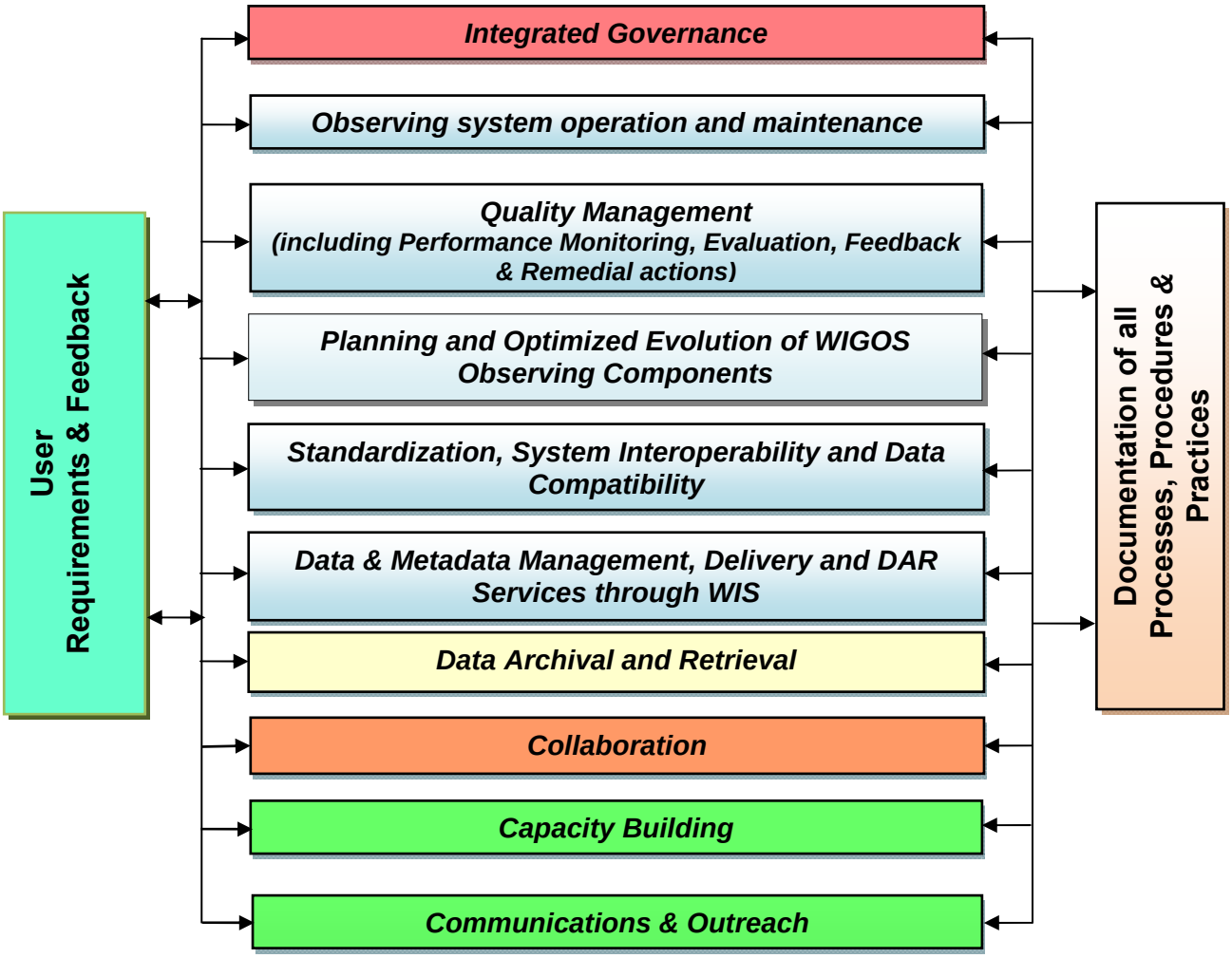

Figure 3: Key WIGOS processes

The flowchart of the WIGOS key processes to meet user requirements is shown in Figure 4.

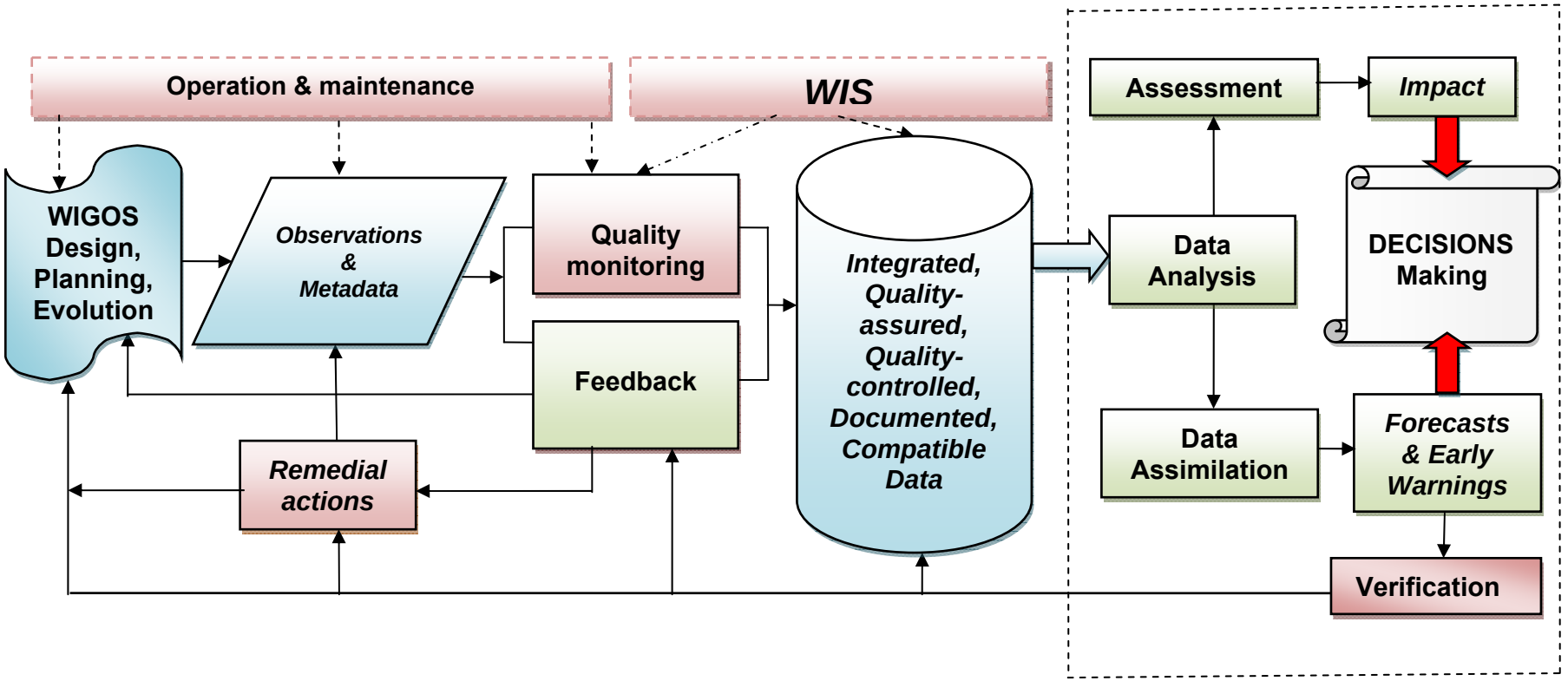

Figure 4: Flowchart of WIGOS key processes

1.3.1 Observing system operation and maintenance

WIGOS builds upon and adds value to the existing WMO observing systems with emphasis on integration of surface- and space-based observations in an evolutionary smooth process to satisfy requirements of WMO and WMO co-sponsored Programmes. The WIGOS concept of operation is based on the principle that the management, operation and maintenance of WIGOS observing components and related activities fall under the responsibility of the Members – their owners. When appropriate, assistance is provided through regional/subregional or bilateral cooperation programmes and mechanisms. The owners are also responsible for the availability of WIGOS observing component metadata to be included and up-to-date in the WIGOS Operational Database.

1.3.2 Quality management, including performance monitoring, evaluation, feedback and remedial actions

In accordance with the WMO QMF principles and its quality policy, WIGOS:

- ensures optimum affordable quality for all meteorological, climatological, hydrological, marine and related environmental data and products, especially those required for decision making that supports the protection of life and property, safety on land, at sea and in the air, sustainable economic development and protection of the environment;

- ensures that observations, records and reports on weather, climate, water and related natural environment needed for improved weather, water, climate and related environmental monitoring, warning and forecast services are quality-assured, of identified and well documented quality, and in compliance with relevant WIGOS joint standards agreed upon with other international organizations.

To meet this WIGOS requirement, an integrated Quality Management System (QMS) that specifies all quality assurance (QA) and quality control (QC) standards/best practices for the NOS should be developed and implemented by the owner of the WIGOS observing component. It will ensure reliability, quality and timeliness of data streams with adequate quality control and relevant metadata.

Some basic principles of an effective QMS are as follows:

- All QMS processes and procedures must be well documented;
- Data/product quality must be known and documented at any stage of data processing.

Developing and implementing WIGOS successfully also requires a systematic and rigorous performance monitoring and evaluation (PM&E) of WIGOS capabilities in terms of both the flow of observational data/products to models and provision of products/information for decision-support tools and services in accordance with requirements specified by end users. Figure 5 illustrates a framework of WIGOS Quality Management.

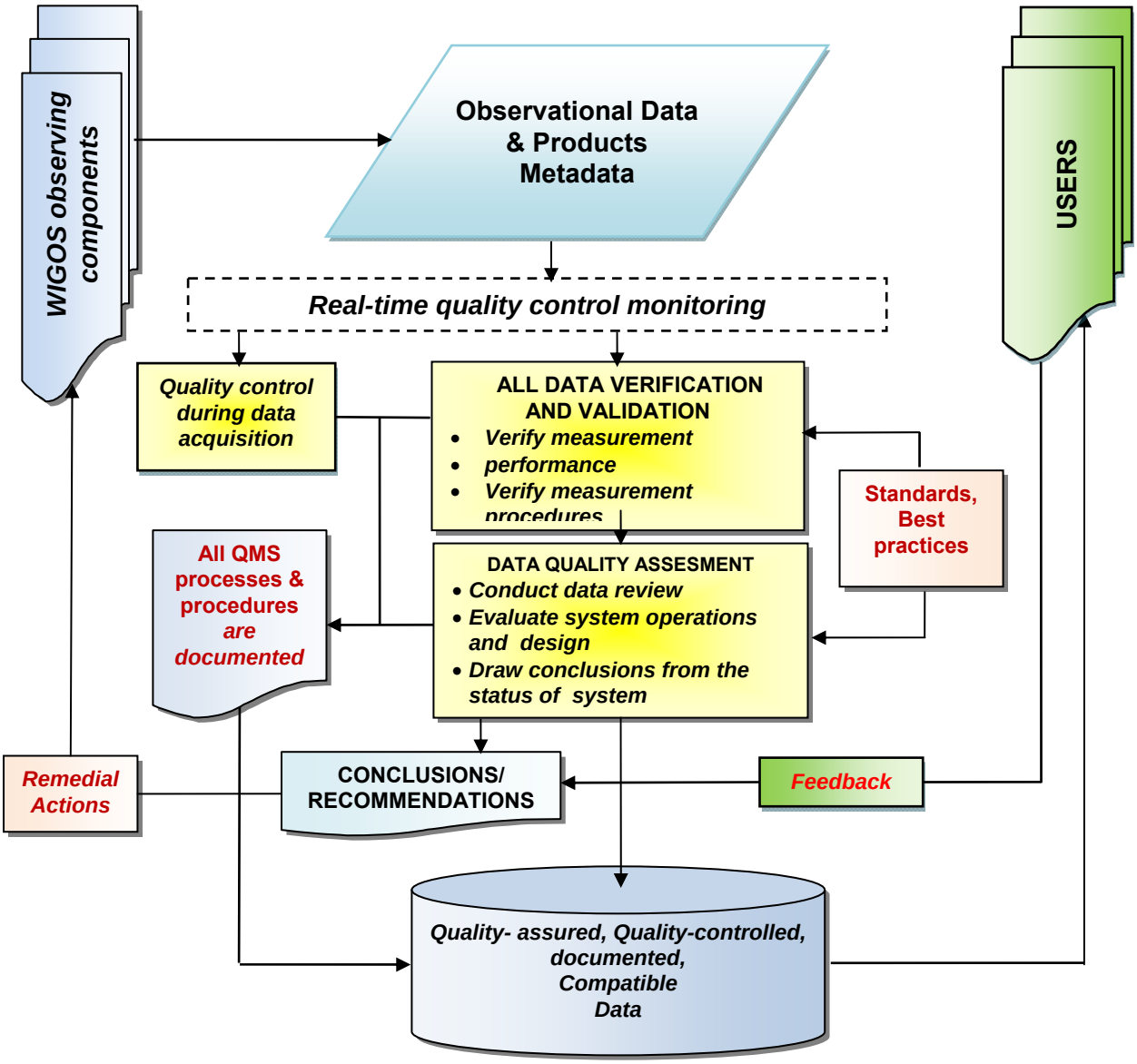

Figure 5: The WIGOS Quality Management Framework

1.3.3 Planning and optimized evolution of WIGOS and its national observing components

Coordinated strategic planning of the National Observing System (NOS) should be based on outcomes of the PDCA cycles**,** GAP analysis and the Rolling Review of Requirements (RRR) process outlined below.

1.3.3.1 Plan-Do-Check-Act (PDCA) cycles

- The PDCA cycle is an efficient tool for continual improvement. The methodology applies to both high-level strategic processes and to simple operational activities The PDCA cycle, promoted by ISO 9001:2000, comprises the following elements schematically shown in Figure 6:
- ***P***-Plan: plan the improvement (based on the GAP analysis: what is required to be done; where, when and how to do it; who should do it);
- ***D***-Do: implement the plan;
- ***C***-Check: monitor and measure the results against the plan, requirements, policies and objectives;
- ***A***-Act: take actions and measures to improve the process / performance.

The PDCA cycle is the never ending cycle that can be applied within any individual process or across a group of processes within the organization.

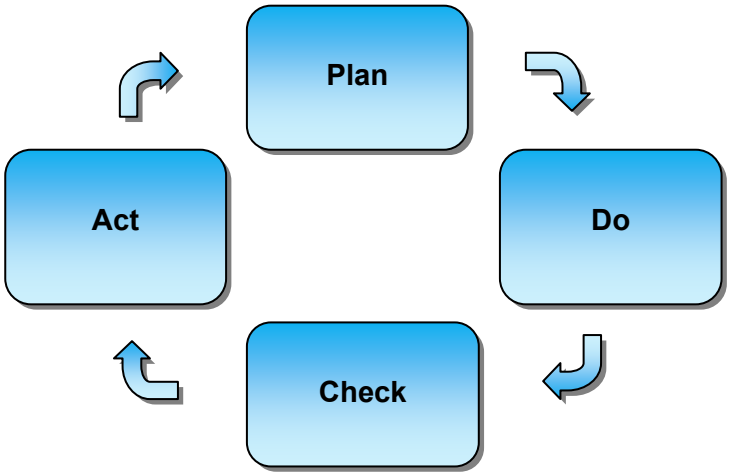

Figure 6: Plan-Do-Check-Act (PDCA) cycle

1.3.3.2 GAP Analysis

WIGOS operations require a continuous performance monitoring and evaluation of its observing components. In this context, GAP analysis is indispensable for organization/operator to compare an "as is" scenario with a desired "future state". As shown in Figure 7, GAP analysis generally follows 5 steps: (1) reviewing a current [as is] system, (2) determining requirements of the proposed [future state] system, (3) comparing these two states to determine the implications (4) and (5) requirements/recommendations involved in getting from current [as is] state to the other [future state]state.

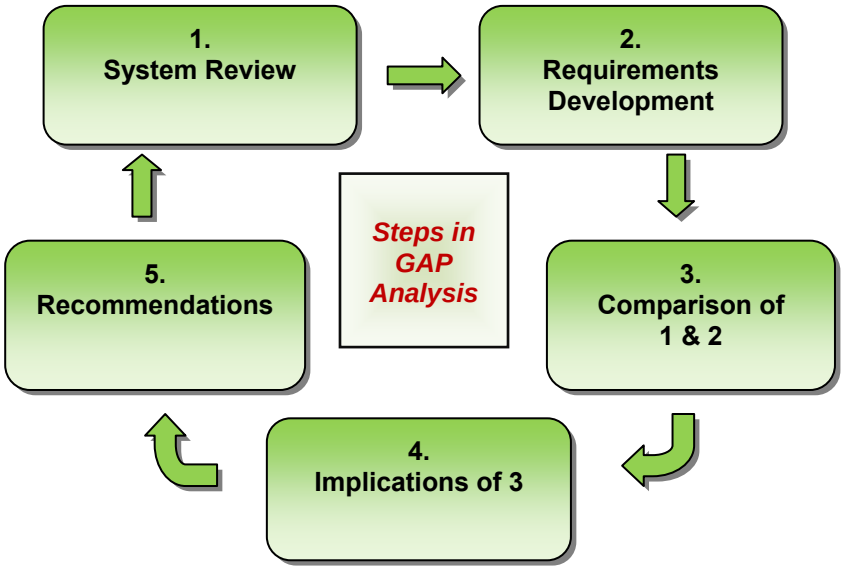

Figure 7: Gap analysis

1.3.3.3 Rolling Review of Requirements (RRR) process and evolution of observing systems

The RRR process described in the *Guide to the Global Observing System (WMO-No. 488)* allows Members to understand and assess requirements across key application areas, the characteristics of observations required and to design the system solutions that will deliver expected results and meet expectations (see Figure 8).

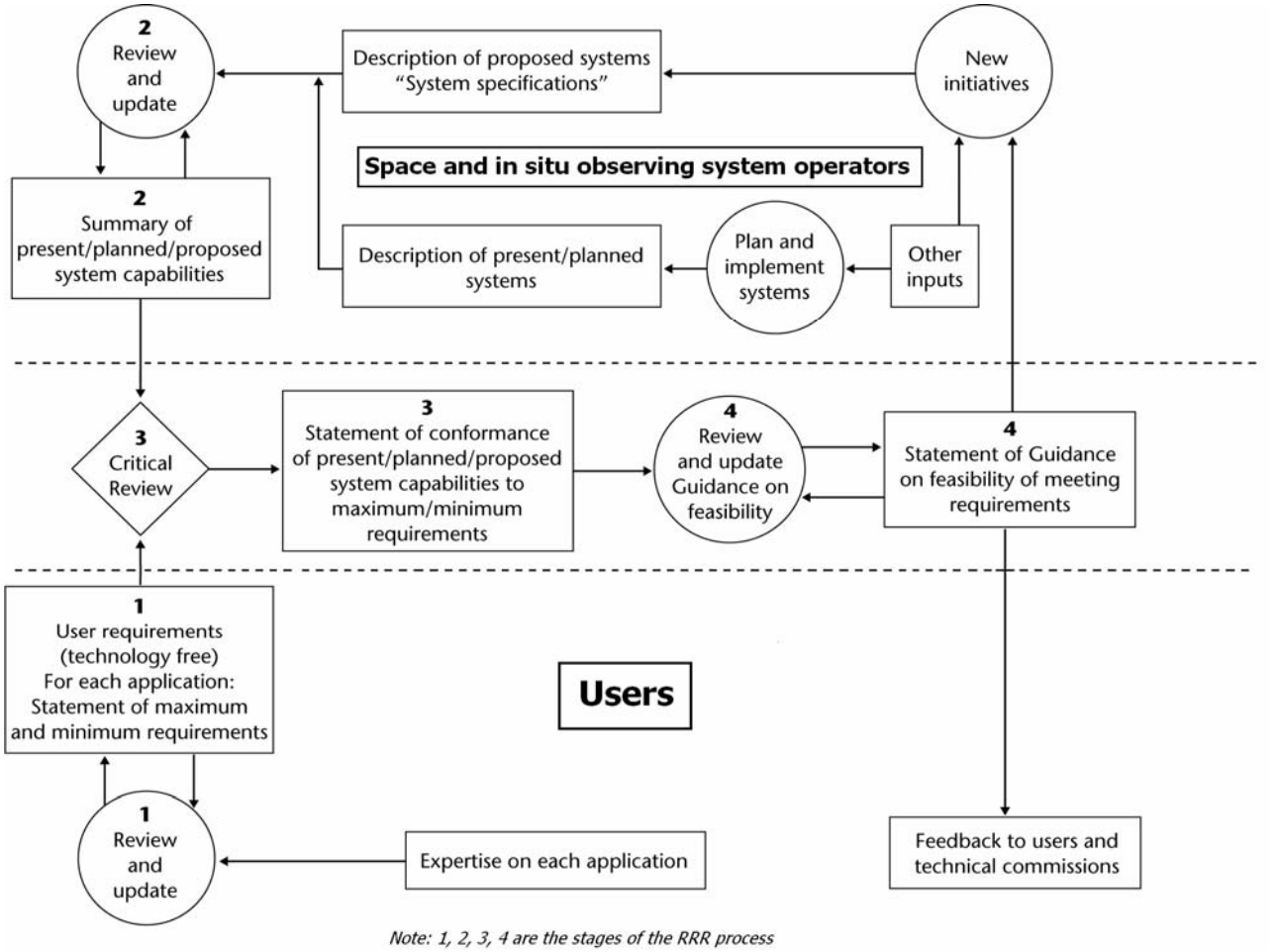

Figure 8: Rolling Review of Requirements Process

Joint application of GAP analysis, RRR process and PDCA cycle provide a principle input to the process of evolution of observing systems. These activities comprise a comprehensive strategic and operational planning aimed to develop staged approaches to the design and implementation of new and/or improved systems and networks, supported by the development of well-structured business cases and budget proposals. Selection of observing system solutions and network design is also assisted by observing systems experiments (OSEs), observing system simulation experiments (OSSEs) and various other model-based objective techniques.

1.3.4 Integration

WIGOS objectives for integration include:

- Improvement of WMO management and governance, including amendments to Technical Regulations;
- Increasing the interoperability of observing component with particular attention to the space-based and surface-based components of observing systems;
- Holistic approach to meeting user needs;
- Enhanced collaboration with Partners and effective coordination.

Process of integration is schematically shown in Figure 9.

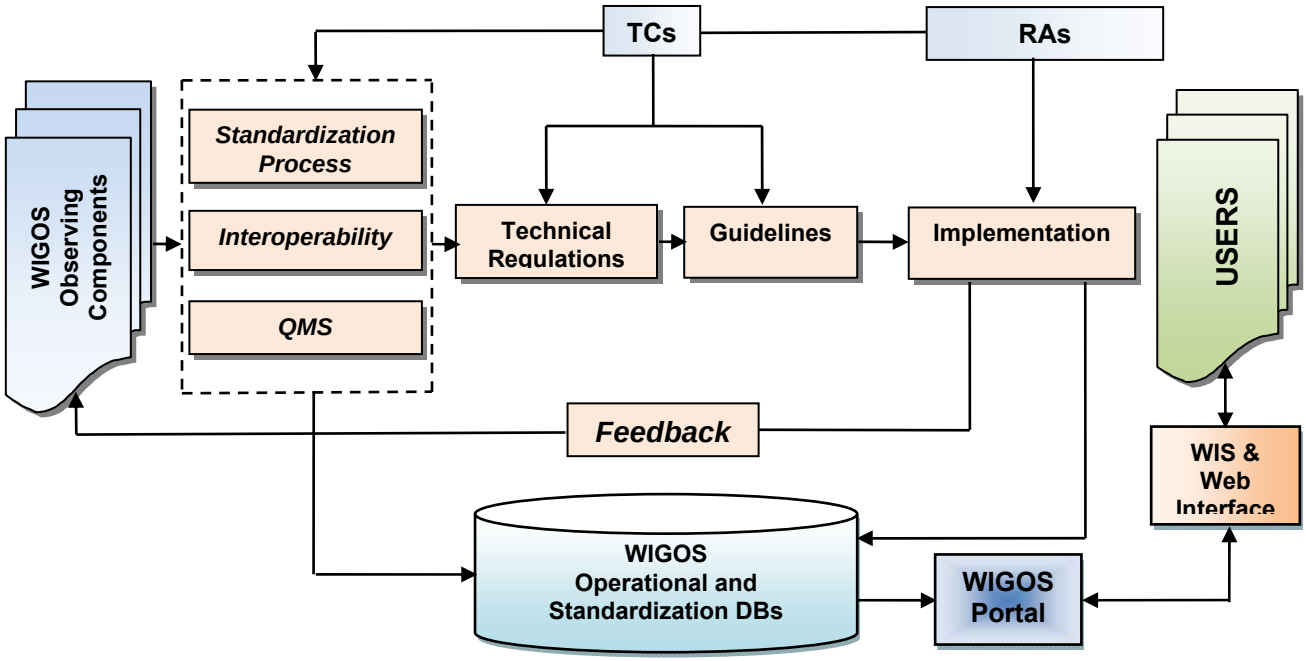

Figure 9: WIGOS Integration process

1.3.5 Standardization, System Interoperability and Data Compatibility

Key areas of standardization

As shown schematically in Figure 10, WIGOS process requires standardization in the following three key areas: A - Instruments and methods of observation; B - WIS information exchange and discovery and C - Quality management framework.

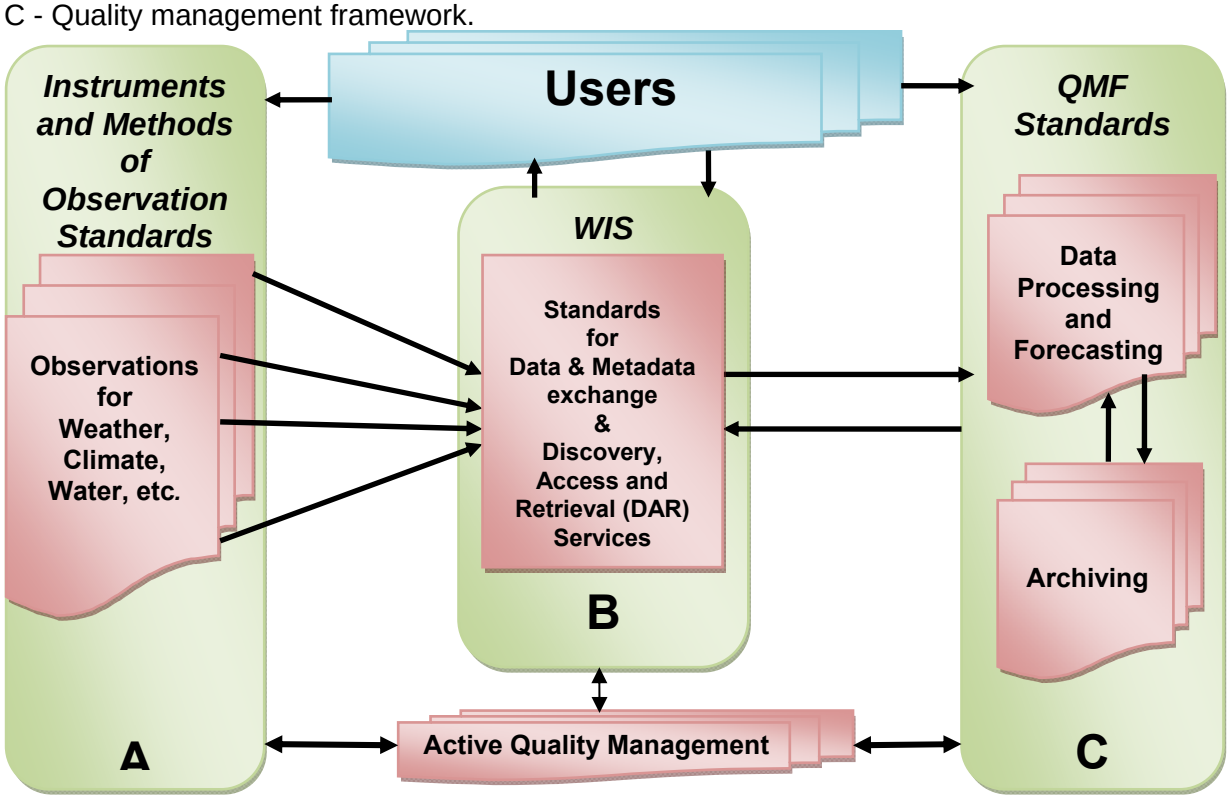

Figure 10: Key areas of WIGOS standardization

Standardization

Standardization is required for all observational data and associated metadata so that the measurements from individual observing systems can be integrated into accurate and coherent data sets. Figure 11 schematically illustrates principle stages of standardization process as determined by ISO. Ultimately, the outcomes of the standardization process must be reflected in the updated WMO technical regulations.

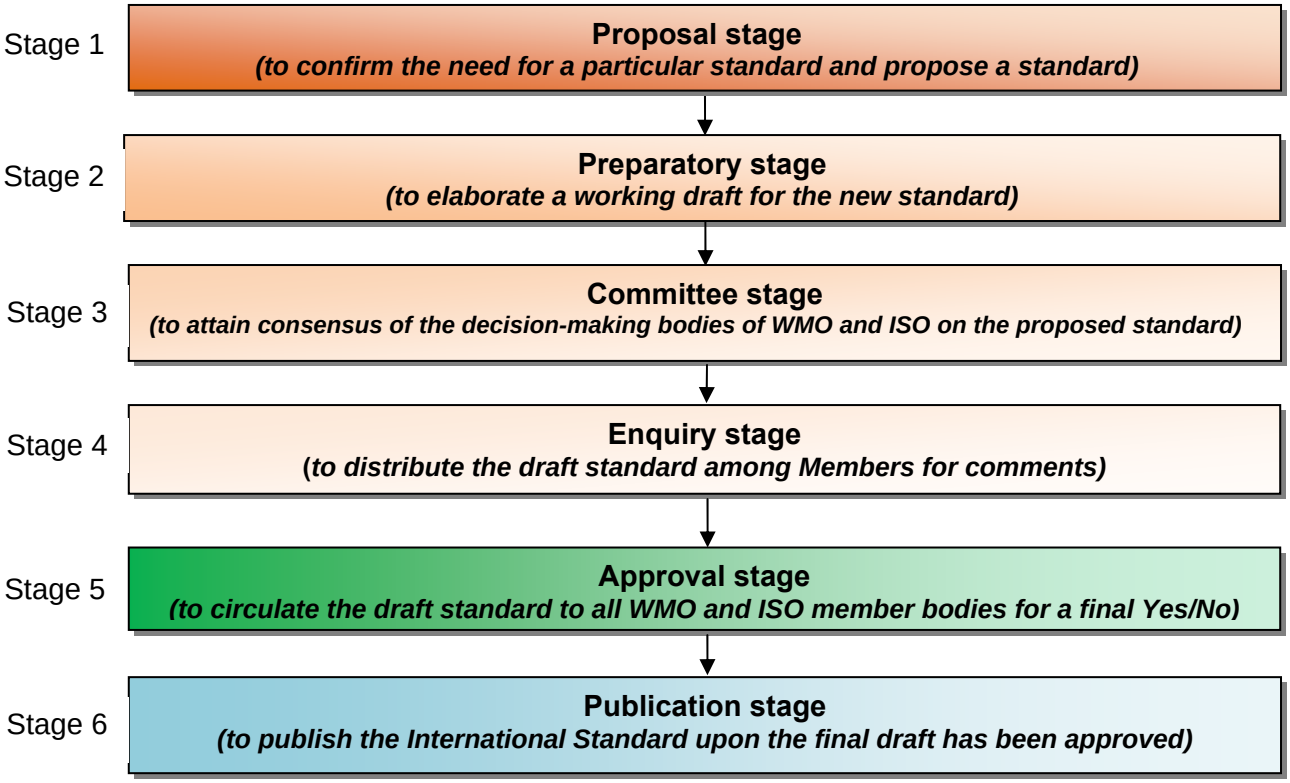

Figure 11: Stages of the Standardization process

Interoperability

The interoperability of WIGOS observing components is achieved through utilization and application of the same, internationally accepted standards and best practices. Major WIGOS interoperability interfaces are shown in Figure 12.

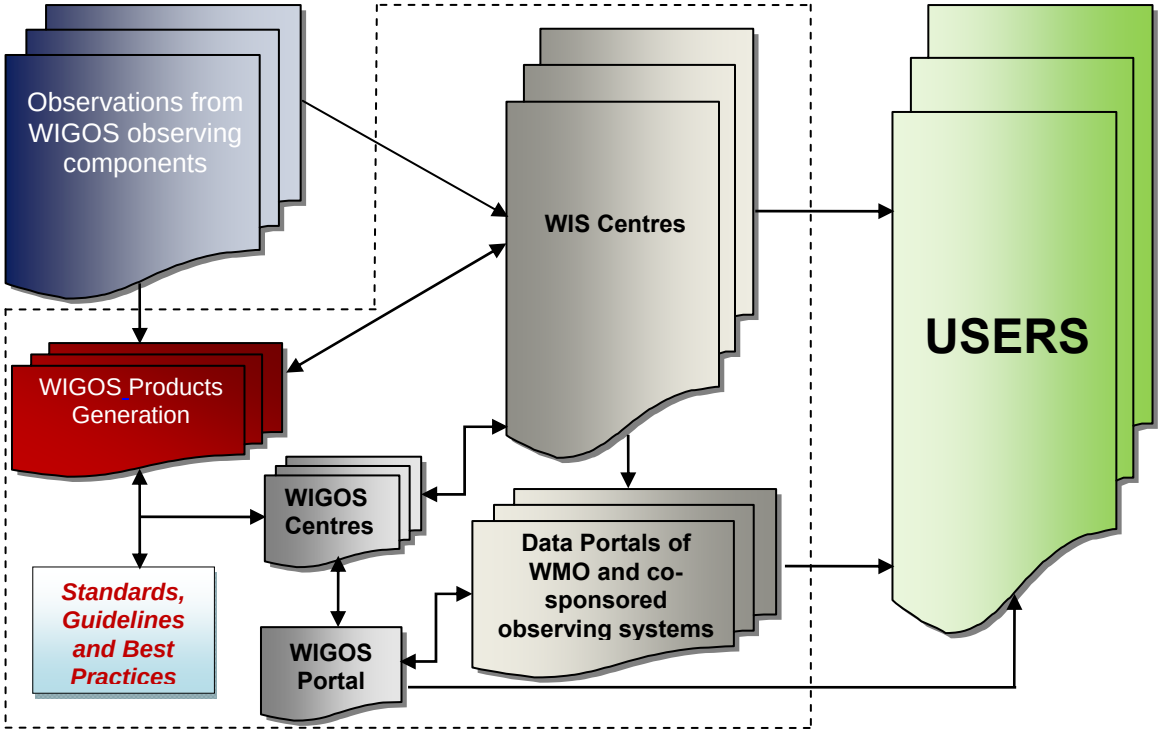

Figure 12: Major WIGOS-WIS Interoperability interfaces

1.4 WIGOS Tools

The WIGOS operational and standardization ***databases*** together with the ***WIGOS web portal*** constitute principle WIGOS framework support tools schematically shown in Figure 13.

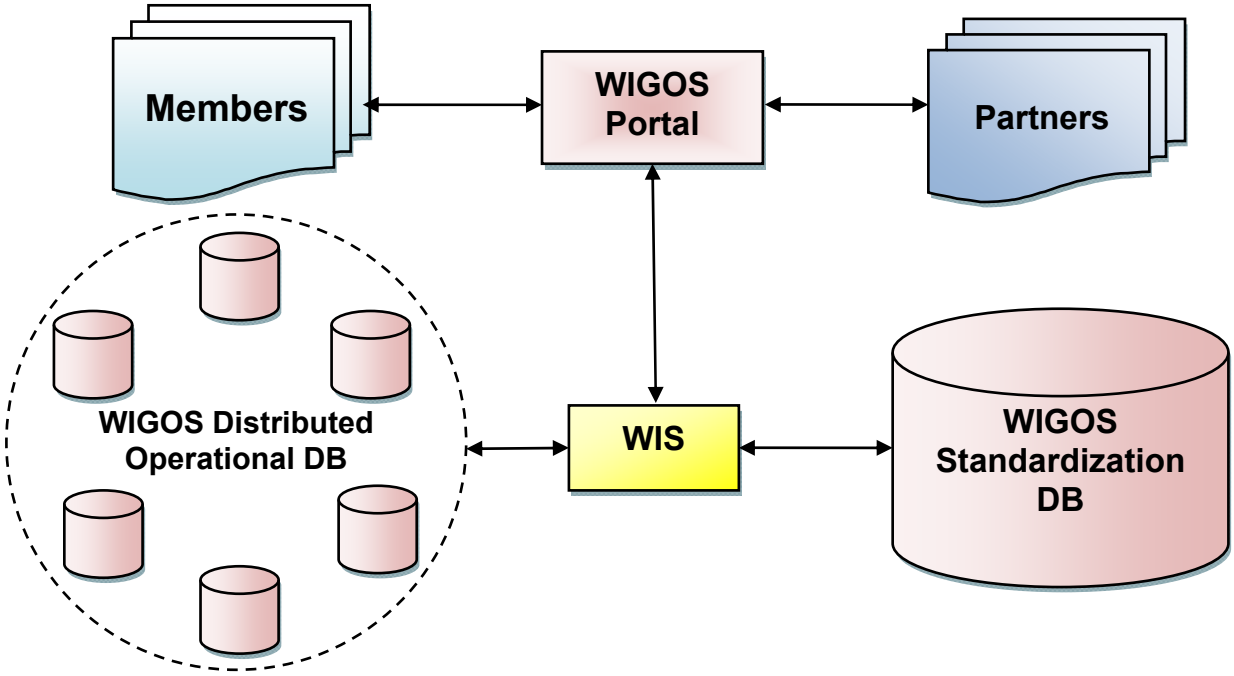

Figure 13: Key WIGOS support tools

1.4.1 Operational Database

A distributed operational database (DB) describes all WIGOS observing components providing the end users with relevant metadata. This DB also supports user activities on the network evaluation, redesign and optimization, system governance and management. Data Producers are responsible for providing detailed and correct metadata related to all parts of their observing systems and networks. Generally, the WIGOS operational database includes the following:

- Basic observing component characteristics (governance, management, observing programme, standard compliance information, data policy, etc.);
- Basic station characteristics (name, number/identifier, geographical coordinates, observing programme, etc.);
- Basic instrument characteristics (siting, exposure, sensor type, principle of operation, instrument performance); data-processing, handling, transmission, quality assurance information, etc.).

DB is also supported by WMO and Partner's catalogues on observing programmes, related statistics and standards.

1.4.2 Standardization Database

WIGOS Standardization database provides a single access point to all WMO standards, guidelines, best practices, procedures, etc., addressing all aspects of observations (instruments, methods of observation, metadata format, coding, etc.). This DB enables the network managers and operators to easily access the information they need to set-up and run their systems and to help the data users to understand the standards used in generating specific observations needed for their applications (see Figure 14).

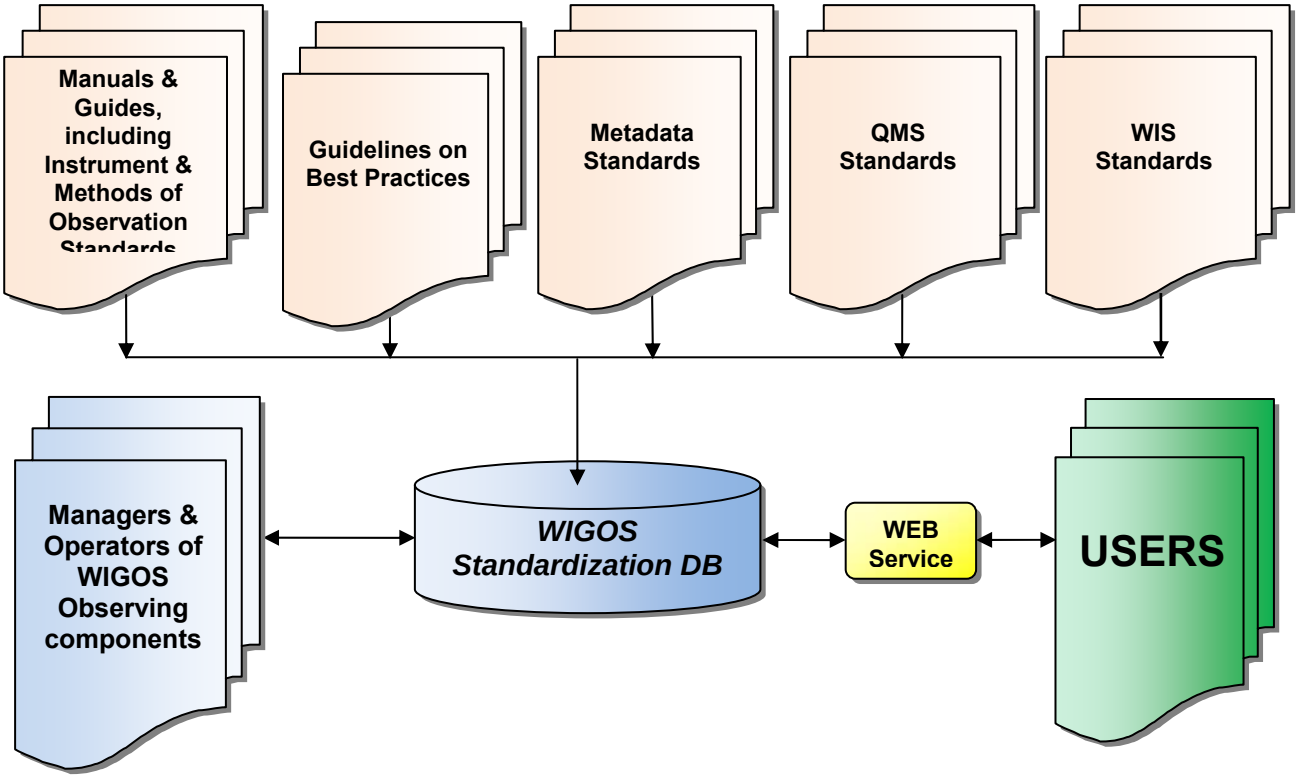

Figure 14: WIGOS Standardization Database

1.4.3 WIGOS Portal

The WIGOS portal (see Fig. 15) provides all WIGOS related information and services and access to the WIGOS Operational and Standardization Databases.

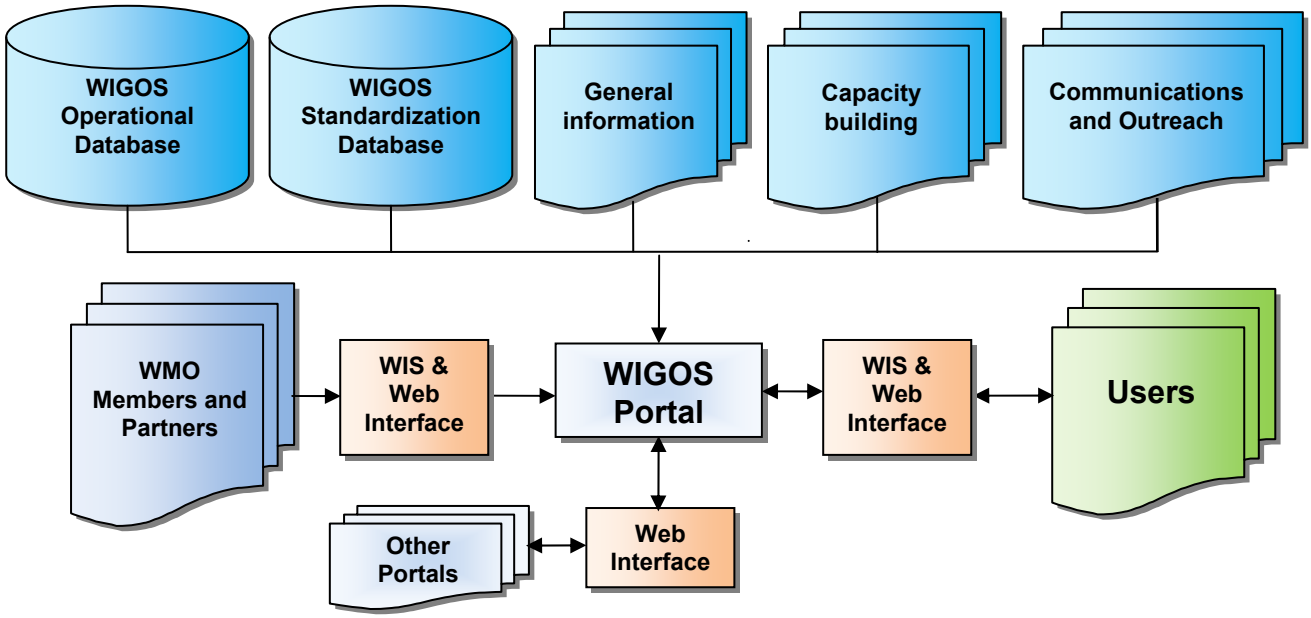

Figure 15: WIGOS Portal

1.5 Data delivery and information services through WIS, including data / metadata management

Within the WIGOS framework, WIS provides data and metadata exchange and DAR services as well as management of related metadata that is essential to meet the stringent traceability requirements of special users. The metadata also play an important role in the discovery and access to WIGOS observations and products. The functional architecture of WIS is shown in Figure 16. For further details, see Manual on WIS (WMO-No.1060).

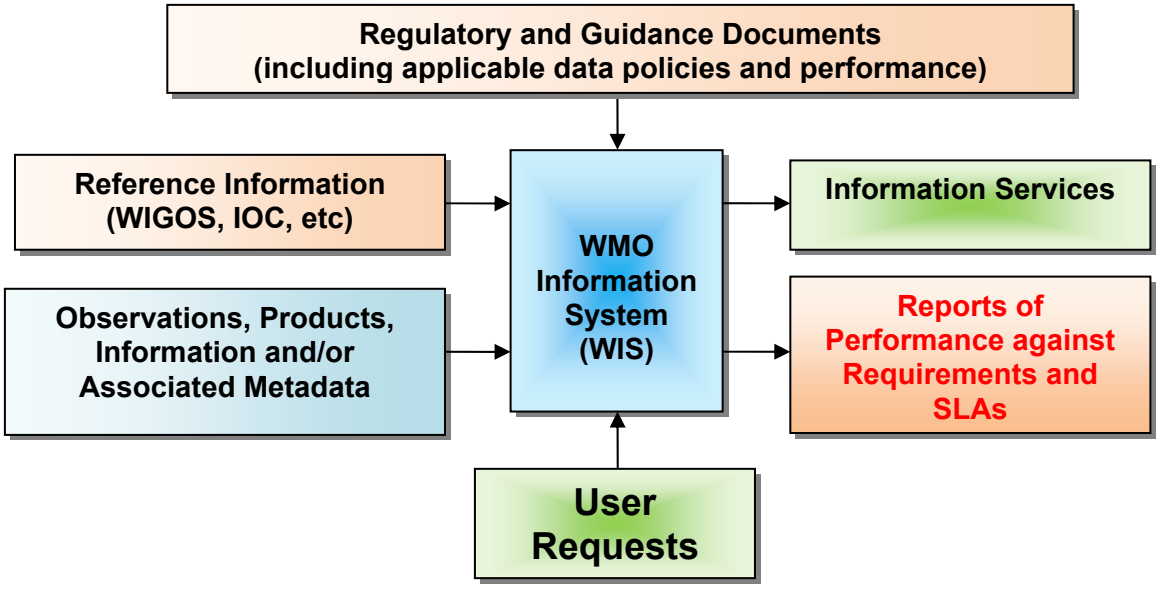

Figure 16: WIS Context Diagram

1.6 Data archival and retrieval

In WIGOS operations, the existing WMO and Partners archiving centres are used. These centres operate to agreed standards, providing seamless access to operational and archival data sets.

1.7 Collaboration

Close collaboration and cooperation among Members advances scientific knowledge and technical infrastructure to meet the WIGOS requirements. Within the Regions, plans are developed to strengthen cooperation and partnership through region-wide organizations or sub-regional groupings overseeing the WIGOS observing components. Specifically, these activities aim to enhance cooperation among meteorological, hydrological and marine/oceanographic institutions/services where they are separated at the national level. Interagency and inter-observing system cooperation and coordination mechanisms at the international level are complemented and supported through similar arrangements between the NMHSs and their counterpart national implementation mechanisms for GCOS, GOOS, GTOS and GEOSS at a national level.

1.8 Capacity building

Coordinated capacity-building effort is of paramount importance to the developing countries, especially for NMHSs of Least Developed Countries (LDCs) and Small Island Developing States (SIDS) to improve and sustain their contributions to WIGOS observing components, including access to and effective utilization of observations, data and products, and related technologies. The WIGOS capacity building activities at national and regional levels are focused on:

- Technological innovation, including decision-making tools to convert observational data and products into information for right and timely decision;
- Human skills development and training, including decision-support tools*;*
- Technology transfer and technical assistance for observing system/network managers;
- Infrastructure establishment and/or strengthening.

1.9 Communications and outreach

Communications and outreach activities are one of the key prerequisites to the success of WIGOS. The core areas are as follows:

- Interaction of the WIGOS Project Office with the secretariats of WMO and WMO-co-sponsored observing systems and user programmes. The Office also ensure coordination with related activities such as the Polar Observations, including the Global Cryosphere Watch, GCOS and GEOSS, and with the coordinated WMO contribution to the GFCS;
- Sharing of experiences, lessons learned, reaped benefits, and documentation on standards / best practices between the NMHS and other national partner agencies.
- Establishment and management of a WIGOS portal. This portal provides all relevant information to stakeholders on the WIGOS development, implementation and associated services;
- Proactive identification of new users as WIGOS evolves.

2. IMPACTS AND IMPLICATIONS

2.1 Impacts on WMO

There are several commitments for WMO and its constituencies to ensure WIGOS operations these include:

- An updated structures of relevant WMO Technical Programmes and TCs responsible for the WMO Observing Systems; appropriate structural changes in the Secretariat;

- The new level of partnership and collaboration between WMO and its Partners translated to the relationship between NMHSs and the national counterparts of WMO partner agencies;

2.2 Operational impacts

Operational impacts on the design, performance and required deliverables of the NOS include:

- An integrated approach to operations of the full suite of national observing systems with just enough redundancy and overlap to provide resilience and continuity to address diverse user needs as efficiently and effectively as possible;
- Adjusted management, governance and support activities aligned with WIGOS requirements;
- Changes in the NMHS administrative structure responsible for observations to coordinate WIGOS operations at the national level;
- Additional technical and administrative arrangements facilitating an integrated use of observations from various observing networks/systems;
- Introduction of a comprehensive operational data framework including data policies, all aspects of data acquisition, management and usage;
- Implementation of an integrated QMS that includes all quality assurance (QA) and quality control (QC) standards/best practices for the NOS operations;
- Operational performance monitoring and evaluation (PM&E) of the flow of observational data/products to models and provision of WIGOS products/information in accordance with requirements specified by end users;
- Implementation of a common standardization process to facilitate interoperability of WIGOS national observing components as well as compatibility of their observational data and products;
- Full use of WIS support and services in WIGOS operations.

LIST OF ACRONYMS

CONOPS	Concept of Operations
DAR	Discovery, Access and Retrieval
DB	Distributed Database
DCPC	WIS Data Collection or Production Centre
ET	Expert Team (of WMO Technical Commission)
FAO	Food and Agriculture Organization
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GISC	WIS Global Information System Centre
GFCS	Global Framework for Climate Services
GOOS	Global Ocean Observing System
GTOS	Global Terrestrial Observing System
PDCA	Plan-Do-Check-Act cycle
ICG-WIGOS	Inter-Commission Coordination Group on WIGOS
ICPC	Interagency Coordination and Planning Committee for Earth Observations
ICSU	International Council for Science
IOC	Intergovernmental Oceanographic Commission
ISO	International Standards Organization
LDCs	Least Developed Countries
MOU	Memorandum of Understanding
NMHS	National Meteorological and Hydrological Service
NOS	National Observing System
OSEs	Observing Systems Experiments
OSSEs	Observing System Simulation Experiments
QA	Quality Assurance
QC	Quality Control
QMF	Quality Management Framework
QMS	Quality Management System
RCC	Regional Climate Centre
RIC	Regional Instrument Centre
RMIC	Regional Marine Instrument Centre
RRR	Rolling Review of Requirements
SIDS	Small Island Developing States
SLA	Service Level Agreement
TC	Technical Commission
TOR	Terms of Reference
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WIGOS	WMO Integrated Global Observing System
WIP	WIGOS Implementation Plan
WIS	WMO Information System

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Appendix III

WORLD METEOROLOGICAL ORGANIZATION

MANUAL

on the WMO Integrated Global Observing System (WIGOS)

(Initial Draft, version - 15 September 2011)

VOLUME I
(Annex X to the WMO Technical Regulations)

GLOBAL ASPECTS

201X edition

WMO-No. XXXX

Secretariat of the World Meteorological Organization — Geneva —Switzerland
201X

CONTENTS

INTRODUCTION

PURPOSE AND SCOPE OF THE MANUAL

1. The Manual is designed:

(a) To facilitate cooperation between Members in operating present and future WMO and co-sponsored observing systems, data collection and management, and end-product quality assurance;

(b) To specify obligations of Members in the implementation of the WMO Integrated Global Observing System (WIGOS);

(c) To ensure adequate uniformity and standardization in the practices and procedures employed in achieving (*a*) and (*b*) above.

2. The first edition of the *Manual on the WMO Integrated Global Observing System* was issued in 201X in accordance with the decisions of Sixteenth Congress. Taking into account future developments in instruments, methods and programmes of observations, evolving requirements for data exchange and service delivery by NMHSs, revisions of individual chapters of the Manual will be made when warranted by significant changes.

3. The Manual is composed of Volumes I and II, which contain the regulatory material for the global and regional aspects, respectively. The regulatory material stems from decisions taken by Congress (Cg) and the Executive Council (EC), as well as from recommendations of technical commissions (TCs) concerned and resolutions of regional associations (RAs).

4. Volume I of the Manual – *Global Aspects* – forms part of the WMO Technical Regulations and is referred to as Annex X to the WMO Technical Regulations.

5. Volume II of the Manual – *Regional Aspects* – does not form part of the WMO Technical Regulations.

6. In essence, the Manual specifies what is to be accomplished in order to meet the principle requirements of the WMO Integrated Global Observing System. Detailed guidance on how to establish, operate and manage networks of stations is laid down in the *Manuals and Guides* of individual WIGOS observing components. Description of instruments, systems and techniques which are in regular use by WMO and co-sponsored observing systems is contained in *the Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8). Details for data collection and management for all WMO and related international programmes are given in the *Manual on the WMO Information System (WIS)* (WMO-No.1060). Further guidance on observations for various application areas is given in various publications of the WMO World Weather Watch Programme, Hydrology and Water Resources Programme, Global Atmosphere Watch Programme, World Climate Programme and WMO co-sponsored programmes GCOS, GTOS and GOOS.

TYPES OF REGULATION

7. Volume I of the Manual comprises *standard* practices and procedures and *recommended* practices and procedures. The definitions of these two types are as follows:

The *standard* practices and procedures:

(a) Are those practices and procedures which it is necessary that Members follow or implement; and therefore

(b) Have the status of requirements in a technical resolution in respect of which Article 9(*b*) of the Convention is applicable; and

(c) Invariably distinguished by the use of the term ***shall*** in the English text and by suitable equivalent terms in the French, Russian and Spanish texts.

The *recommended* practices and procedures:

(a) Are those practices and procedures which it is desirable that Members follow or implement; and therefore

(b) Have the status of recommendations to Members to which Article 9(*b*) of the Convention shall not be applied; and

(c) Are distinguished by the use of the term ***should*** in the English text (except where specifically otherwise provided by decision of Congress) and by suitable equivalent terms in the French, Russian and Spanish texts.

8. In accordance with the above definitions, Members shall do their utmost to implement the *Standard* practices and procedures. In accordance with Article 9(*b*) of the Convention and inconformity with the provisions of Regulation 127 of the General Regulations, Members shall formally notify the Secretary-General, in writing, of their intention to apply the "standard practices and procedures" of the Manual, except those for which they have lodged a specific deviation. Members shall also inform the Secretary-General, at least three months in advance, of any change in the degree of their implementation of a "standard practice or procedure" as previously notified and of the effective date of the change.

9. With regard to the *recommended* practices and procedures, Members are urged to comply with these, but it is not necessary to notify the Secretary-General of non-observance.

NOTES, ATTACHMENTS (VOLUME I) AND VOLUME II

11. Certain notes are included in the Manual for explanatory purposes. They do not have the status of the annexes to the WMO Technical Regulations.

12. A number of specifications and formats of observing practices, data collection and management, standardization and quality assurance procedures are included in the Manual. Taking into account the rapid development of observing techniques and the increasing requirements of the WMO and other international programmes, these specifications, etc., are given in "attachments" to the Manual and do not have the status of the annexes to the WMO Technical Regulations. This will enable the Commission for Basic Systems, Commission for Instruments and Methods of Observation, Commission for Hydrology, Commission for Atmospheric Sciences, and the relevant steering bodies of WMO co-sponsored observing systems to update them as necessary.

13. The words "shall" and "should" in the attachments, notes and Volume II have their dictionary meanings and do not have the regulatory character mentioned in paragraph 7 above.

PART I

GENERAL PRINCIPLES REGARDING THE ORGANIZATION AND IMPLEMENTATION OF THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM

1. PURPOSE AND SCOPE OF THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM

1.1 **The purpose of WMO Integrated Global Observing System (WIGOS) shall be to provide an effective and sustainable organizational, programmatic, governance and procedural structures that will significantly improve the availability, usefulness, quality and utilization of observational data and products through a single focus for the operational and management functions of all WMO observing systems as well as a mechanism for interactions with WMO co-sponsored observing systems.**

1.2 WMO and co-sponsored observing systems are organized as multiple systems comprising:

(a) Surface-based component of the Global Observing System (GOS) of the World Weather Watch (WWW) Programme;

(b) Space-based component of the GOS, including the geostationary meteorological satellite constellation, the core polar-orbiting meteorological constellation and R&D earth observation satellites;

(c) Aircraft Meteorological Data Relay (AMDAR) systems including expansions of aircraft measurement capabilities for atmospheric composition constituents;

(d) Marine meteorological and relevant oceanographic observing networks of the Global Ocean Observing System (GOOS);

(e) Relevant components of atmospheric, oceanographic and terrestrial observing systems contributing to the Global Climate Observing System (GCOS);

(f) Relevant terrestrial networks of the Global Terrestrial Observing System (GTOS);

(g) Regional, river basin and global hydrological networks such as the World Hydrological Cycle Observing System (WHYCOS);

(h) Global Atmosphere Watch (GAW) networks and systems for observation of atmospheric chemical composition and related environmental parameters;

(i) Various radiation networks;

(j) The observing component of the proposed Global Cryosphere Watch (GCW) approved by Fifteenth WMO Congress;

NOTE: Definition of stations (for surface-based component) and satellite constellation (for space-based components) for the above WMO and co-sponsored observing systems is given in the Manual on the GOS (WMO-No. 544), WHYCOS Guidelines (WMO/TD-No. 1282), etc.[2]

1.3 WIGOS should allow WMO Members' NMHSs and other relevant national and international institutions to better fulfil their mandates, including response to natural hazards, hydrological and environmental monitoring, climate observation, and adaptation to climate change and human-induced environmental impacts, provided this would not be detrimental to achieving the primary purposes of WMO and partner organizations[3].

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2 Text highlighted yellow means that appropriate information might be inserted, if required

3 The term "partner organizations" means: Intergovernmental, non-governmental and international organizations and groupings that operate, or co-sponsor, with WMO, observing systems that contribute to WIGOS. The main partner organizations are UNESCO and its IOC, UNEP, FAO and ICSU and the main co-sponsored observing systems are GCOS, GOOS and GTOS; partner organizations also include GEO.

2. ORGANIZATION AND DESIGN OF THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM

2.1 **WIGOS shall be organized as the framework enabling the optimized evolution and integration of all WMO and co-sponsored observing systems. Together with WIS, this shall allow continuous and reliable access to an expanded set of environmental data and products and associated metadata, resulting in increased knowledge and enhanced services across all WMO activities.**

2.2 **WIGOS shall be constituted as a coordinated system of methods, techniques and facilities used by WMO and co-sponsored observing systems for making observations on a worldwide scale, taking into account to the extent feasible the requirements of WMO and other international programmes.**

2.3 **WIGOS shall be based on existing observing, data processing, exchange and dissemination systems, fostering and accommodating new systems operated by Members and partner organizations for making observations at stations on land and at sea, from aircraft, from environmental observation satellites and other platforms.**

2.4 **The technical commitments of Members or partner organizations shall apply only to those contributions that they have identified for WIGOS.**

2.5 **Taking into account various criteria for observational data requirements, for convenience in the planning and coordinating of the system, WIGOS shall be considered as composed of three levels: global, regional and national.**

2.6 **WIGOS shall be designed as a flexible, integrated and coordinated system capable of continuous improvement, on the basis of the latest achievements of technological and scientific progress and in accordance with changing requirements for observational data and products.**

2.7 **The planning and coordination of WIGOS shall be steered by the Executive Council in collaboration and coordination with regional associations, technical commissions concerned and the relevant steering bodies of WMO co-sponsored observing systems.**

3. IMPLEMENTATION OF THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM

3.1 **WIGOS shall be implemented building upon and adding value to the existing WMO observing systems with emphasis on integration of surface- and space-based observations in an evolutionary smooth process to satisfy requirements of WMO and WMO co-sponsored Programmes. The Rolling Review Requirement (RRR) process as specified in Part II shall be utilized for this purpose.**

3.2 Implementation of WIGOS should be based on the principle that all activities connected with the establishment and operation of the WMO and co-sponsored observing systems, specific activities to meet the requirements for standardization and interoperability, WIS information exchange and QMF are the responsibility of the countries themselves and should be met to the extent possible from national resources. Where this is not possible, assistance may be provided through multilateral (regional) or bilateral cooperation programmes.

3.3 Implementation of WIGOS in regions outside the territories of individual countries (e.g. outer space, the oceans and the Antarctic) should be based on the principle of voluntary participation of countries that desire and are able to contribute by providing facilities and services either individually or jointly from their national resources or through collective financing.

3.4 **Existing elements of observing systems contributing to WIGOS, as defined in Part I, shall not be removed before the reliability of a new element has been proven, and relative accuracy and representativeness of the observational data have been examined and found acceptable**.

3.5 **Each Member shall designate a national focal point to communicate with the WMO Secretariat on WIGOS matters. The national focal point shall be authorized to act in these matters on behalf of the Permanent Representative concerned.**

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PART II

REQUIREMENTS FOR OBSERVATIONAL DATA AND PRODUCTS GENERATED BY WIGOS

1. CLASSIFICATION OF REQUIREMENTS

1.1 General WIGOS observing requirements

Observations generated by each of the WIGOS observing components (listed in Part I, paragraph 1.2) shall be consistent, of known and adequate quality (including adherence to the GCOS Climate Monitoring Principles), supported by associated standardized metadata, and sufficiently complete to describe, hydrometeorological and other environmental phenomena from Microscale (less than 100 m) to Planetary scale (larger than 3 000 km) with respect to spatial and temporal distribution.

1.2 Requirements for elements observed by WIGOS components

The requirements for elements to be observed according to the type of observing networks contributing to WIGOS (listed in Part I, paragraph 1.2) are detailed in the following WMO regulatory material and relevant publications:

Surface- and Space-based components of the GOS, including AMDAR

- Manual on the GOS (WMO-No. 544)
- Guide to the Global Observing System (WMO-No. 488)
- Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8)
- Guide on Meteorological Observing and Information Distribution Systems for Aviation Weather Services (WMO-No. 731)

Marine meteorological and relevant oceanographic observing networks of the GOOS

- Guide to Marine Meteorological Services (WMO-No. 471)
- Manual on the GOS (WMO-No. 544)
- Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8)
- Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010 Update) (GCOS-138, WMO/TD-No. 1523)

Global Atmosphere Watch (GAW) networks

- Global Atmosphere Watch Measurements Guide (WMO-No. 143)
- Manual on the GOS (WMO-No. 544)
- Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8)

Relevant components of atmospheric, oceanographic and terrestrial observing systems contributing to the GCOS

- Guide to Climatological Practices (WMO-No. 100)
- Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010 Update) (GCOS-138, WMO/TD-No. 1523)
- Manual on the GOS (WMO-No. 544)
- Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8)
- Guide to the Global Observing System (WMO-No. 488)

Relevant terrestrial networks of the GTOS

- Guide to Agricultural Meteorological Practices (WMO-No. 134)
- Manual on the GOS (WMO-No. 544)
- Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010 Update) (GCOS-138, WMO/TD-No. 1523)

WHYCOS networks

- Guidelines on the Role, Operation and Management of National Hydrological Services (WMO-No. 1003)
- WHYCOS Guidelines (WMO/TD-No. 1282)

1.3 **Observational requirements for application areas**

Observational data requirements for specific application areas such as

a) *Global Numerical Weather Prediction*

b) *Regional Numerical Weather Prediction*

c) *Synoptic meteorology*

d) *Nowcasting and Very Short Range Forecasting*

e) *Seasonal and Inter-annual Forecasts*

f) *Atmospheric chemistry*

g) *Aeronautical Meteorology*

h) *Ocean Applications*

i) *Climate monitoring*

j) *Climate applications*

k) *Hydrology*

l) *Agricultural meteorology*

should be regularly reviewed and updated as part of the Rolling Review of Requirements (RRR) Process as described in the Guide on the Global Observing System (WMO-No. 488).

1.4 **Requirements for environmental emergency response activities**

Special requirements for environmental emergency response activities are detailed in the Manual on the GOS (WMO-No. 544) and XXX

2. **PROCEDURE FOR ELABORATION OF REQUIREMENTS**

2.1 **Formulation of observational data requirements**

The Rolling Review of Requirements (RRR) Process as described in detail in the Attachment II.1 shall be used for this purpose.

2.2 **Evaluation of the feasibility of meeting observing requirements**

The primary responsibility for the evaluation of the feasibility of meeting stated observational data requirements through the RRR Process related to the application areas, mentioned in Part I, paragraph 1.3 (a) to (l) of this Manual and for the development of associated guidance material, shall rest with respective WMO technical commissions (CBS, CAS, CCl, CAeM, CIMO, CAgM, CHy, JCOMM) and the governing bodies of WMO co-sponsored observing systems (see Part I, paragraph 1.3 of this Manual).

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ATTACHMENT II.1

THE ROLLING REVIEW OF REQUIREMENTS (RRR) PROCESS

2.3.1 **Description of the RRR process**

The process jointly reviews users' evolving requirements for observations and the capabilities of existing and planned observing systems. Statements of Guidance describing the extent to which such capabilities meet requirements are produced as a result. Initially, the process was applied to the requirements of global numerical weather prediction and the capabilities of the space-based subsystem, but more recently the range of requirements has been expanded and the technique has begun to be applied successfully to surface-based observing systems and other application areas.

The process consists of four stages (see Figure II.2):

A review of user requirements for observations, within an area of application covered by WMO Programmes;

A review of the observing capabilities of existing and planned observing systems;

A Critical Review of the extent to which the capabilities (b) meet the requirements (a);

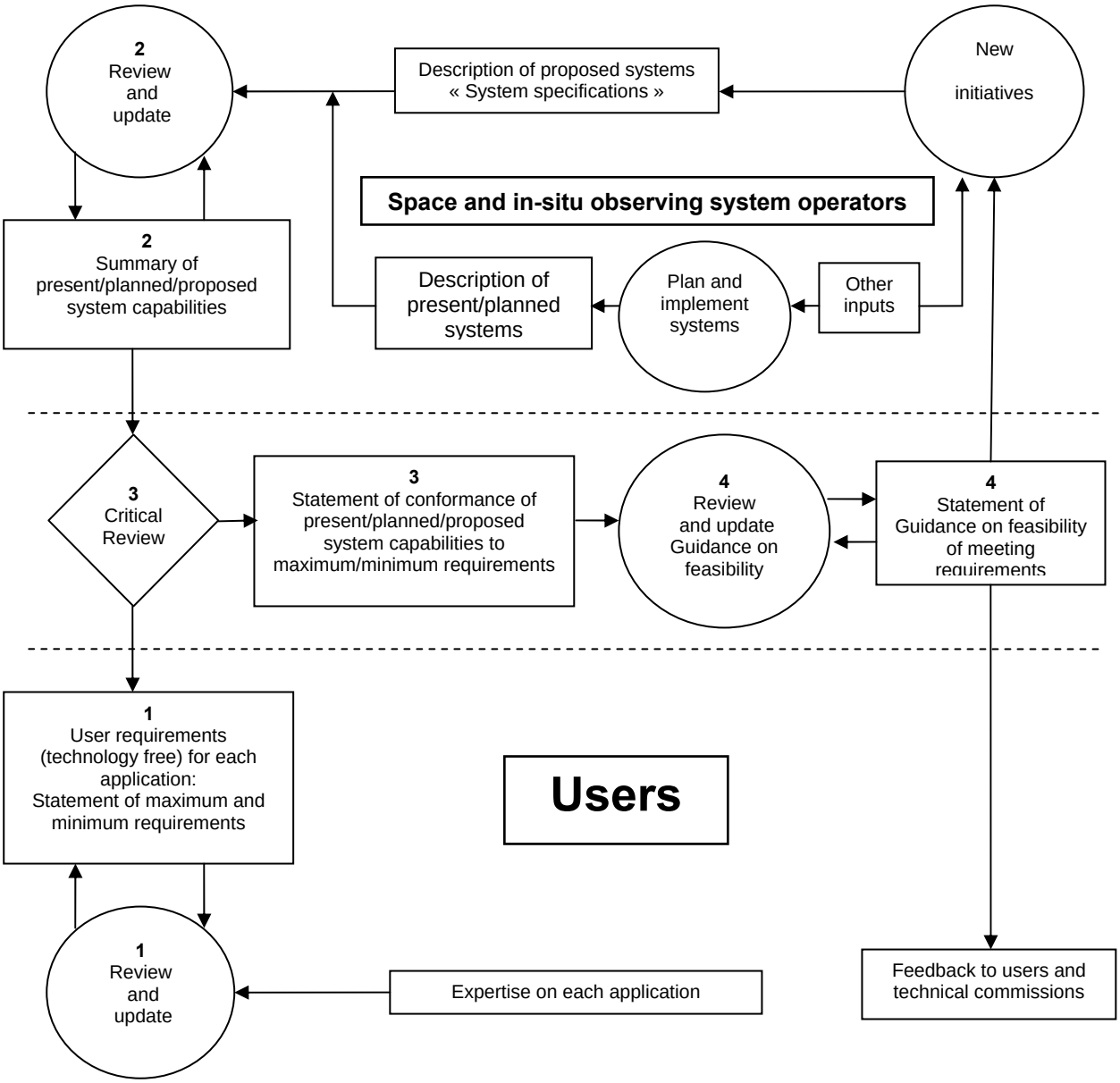
A Statement of Guidance based on (c).

The aim of the Statement of Guidance and the Critical Review is as follows:

(a) To inform WMO Members about the extent to which their requirements are met by present systems, will be met by planned systems, or would be met by proposed systems. It also provides the means whereby Members, through the Technical Commissions, can check whether their requirements have been correctly interpreted and can update them if necessary, as part of the Rolling Requirements Review process;

(b) To provide resource materials useful to WMO Members for dialogue with observing system agencies as to whether existing systems should be continued, modified or discontinued; whether new systems should be planned and implemented; and whether research and development is needed to meet unfulfilled user requirements.

Clearly, the Rolling Requirements Review process needs to be repeated periodically as requirements change and further information becomes available. Figure II.2 indicates the anticipated interactions with observing system agencies and user groups.



Note: 1, 2, 3, 4 are stages of the RRR process

Figure II.2 Rolling Review of Requirements Process

2.3.2 **User requirements and observing system capabilities database**

To facilitate the Rolling Requirements Review process, the World Weather Watch Department has been collecting the observation requirements to meet the needs of all WMO Programmes, based on techniques such as those listed in 2.2, and has been cataloguing the current and planned provision of observations, initially from environmental satellites and now extended to in situ observing systems. The resulting database is called the Database on User Requirements and Observing System Capabilities and is accessible via the WMO Space Programme web page: http://www.wmo.int/pages/prog/sat/Databases.html

2.3.2.1 **User requirements**

The user requirements are system independent: they are intended to be technology-free in that no consideration is given to what type of measurement characteristics, observing platforms or data processing systems are necessary, or even possible, to meet them. A 2005–2015 time frame has been set to meet those requirements. The database

has been constructed in the context of a given application, or use. The observation requirements are stated quantitatively in terms of a set of relevant parameters, of which the most important are horizontal and vertical resolution, frequency (observation cycle), timeliness (delay in availability), and uncertainty (acceptable root mean square error and any limitations on bias). For each application, there is usually no abrupt transition in the utility of an observation as its quality changes; improved observations, in terms of resolution, frequency or uncertainty, for example, are generally more useful, whereas degraded observations, although less useful, are on the whole not useless. Moreover, the range of utility varies from one application to another. The requirements for each parameter are expressed in terms of two values, a maximum or goal and a minimum, or threshold requirement. The maximum requirement or goal is an optimal value: if exceeded, no significant improvement in performance is expected for the application in question. Therefore the cost of enhancing the observations beyond this maximum requirement would not be matched by a corresponding increased benefit. Maximum requirements are likely to change as applications progress; they develop a capacity to make use of better observations. The minimum requirement is the threshold below which the observation is not significantly useful for the application in question, or below which the benefit derived does not compensate the additional cost involved in using the observation. Assessment of minimum requirements for any given observing system is complicated by assumptions concerning which other observing systems are likely to be available. It may be unrealistic to try to state the minimum requirement in an absolute sense because the very existence of a given application relies on the existence of a basic observing capability. The observations become progressively more useful in the range between the minimum and maximum requirements.

2.3.2.2 **Observing system capabilities**

Initially, attention was focused on the Global Observing System space-based subsystem capabilities. Each of the contributing space agencies has provided a summary of the potential performances of their instruments expressed in the same terms as the user requirements, together with sufficiently detailed descriptions of the instruments and tasks to support performance evaluations. Assessment of service continuity is based on the programmatic information supplied. Particular care has been taken to establish a common language in the form of agreed definitions for the geophysical parameters for which observations are required or provided and agreed terminology to characterize requirements and performances. At present, the performance Global Observing System surface-based subsystem components have also been characterized in a similar manner, taking into account their uneven distribution across the board in 34 homogeneous regions.

2.3.3 **The Critical Review**

The comparison of requirements to capabilities utilizes the database. As the database changes to reflect more effectively user requirements and existing and planned observing capabilities, the Rolling Requirements Review must be performed periodically. The process compares user requirements with observing system capabilities and records the results in terms of the extent to which the capabilities of present, planned and proposed systems meet stated requirements. This is a challenging process, and considerable work has been done to develop a process and presentation ensuring that the critical review meets the following criteria:

(a) The presentation must be concise and attractive, and understandable to senior managers and decision makers, whilst retaining sufficient detail to represent adequately the full range of observational requirements and observing system capabilities;

(b) The presentation of user requirements must be accurate; although it is necessarily a summary, it must be recognizable to experts in each application as a correct interpretation of their requirements;

(c) The presentation of the observing system capabilities must be accurate; although it is also a summary, it must be recognizable to expert data users as a correct interpretation of the system's characteristics and potential;

(d) The results must accurately reflect the extent to which current systems are useful in practice, whilst drawing attention to those areas in which they do not meet some or all of the user requirements;

(e) The process must be as objective as possible.

2.3.4 **Statements of Guidance**

Statements of Guidance are designed to provide an interpretation of the output of the Critical Review, draw conclusions and identify priorities for action. The process of preparing such a Statement is necessarily more subjective than that of the critical review. Moreover, whilst a Review attempts to provide a comp0rehensive

summary, a Statement of Guidance is more selective, drawing out key issues. At this stage, judgements are required concerning, for example, the relative importance of observations of different variables. Since the Preliminary Statement of Guidance was published by WMO in 1998, several updates and additions have been completed in order to extend the process to new application areas, take into account the evolving nature of requirements and include the capabilities of surface-based sensors (WMO, 1999, 2001). The latest Statements of Guidance can be found via the WMO Space Programme web page: http://www.wmo.int/pages/prog/sat/RRR-and-SOG.html

2.4 **NETWORK DESIGN AND NATIONALREQUIREMENTS**

In addition to the Global Observing System, observing networks may be required at the national level for the derivation of local weather parameters from forecast fields, verification of the quality of issued forecasts and warnings and other real or non-real-time applications. The observational data required for this purpose include surface and upper-air data obtained from land stations and ships, aircraft and buoys, as well as weather radar data and satellite information. National observing networks are designed by Members to meet their individual needs or in agreement with other Members, in accordance with WMO regulatory and guidance material. Network design should take into account special observational data requirements and forecast products of the end-user groups for whom the services are being provided. Much of the data requirements for individual services may often require additional data, denser networks or higher observation frequency.

PART III

REQUIREMENTS FOR OBSERVING SYSTEMS OPERATION AND MAINTENANCE

1. General

1.1 The frequency and spacing of observations generated by all observing systems contributing to WIGOS should be adjusted to the physical scales of hydrometeorological and other environmental phenomena to be described.

1.2 In implementing WIGOS, Members and WMO partners should ensure that operation and maintenance of their observing system continue to meet evolving user requirements.

NOTE: Details of established global and regional requirements for operations and maintenance of observing systems contributing to WIGOS are contained in the *Manual on the GOS* (WMO-No. 544), *Guide to the Global Observing System* (WMO-No. 488), … (to be completed)

1.3 **WIGOS data providers shall ensure that station metadata are published in *Weather Reporting (WMO- No. 9), Volume A – Observing Stations* in support of WIS, GDPFS and other WMO programmes, and are also available and accessible in the WIGOS Operational Database.**

2. Standardization of instruments and methods of observation

2.1 WIGOS, as an integrated system, should encompass homogeneity, interoperability, compatibility and traceability of observations from all WIGOS observing components (listed in Part I, paragraph 1.2). This should be based on guidance and studies provided by the WMO Instrument and Methods of Observation Programme (IMOP), WMO Satellite Programme and related programmes of partner organizations, and achieved through implementation of tests, calibration and intercomparisons.

2.2 **WIGOS standardization process shall adequately address the differences and inconsistencies in current technical specifications, data acquisition and management systems used by individual NMHSs and partner organizations before national and international observing systems can be regarded as truly integrated.**

Section may also contain WIGOS requirements and/or appropriate references related to the following operation and maintenance issues:

- Characterization of instrument performance (*Surface- and Space-based components)*
- Testing (*Surface- and Space-based components)*
- Acceptance (*Surface- and Space-based components)*
- Observing site location (*Surface-based components)*
- Observing methods (*Surface- and Space-based components)*
- Instrument maintenance (*Surface- and Space-based components)*
- Routine calibration (*Surface- and Space-based components)*
- Calibration campaigns (*Surface- and Space-based components)*

3. Station metadata

3.1 Detailed station history, including essential elements relevant to the thematic data stream, should be maintained by all WIGOS contributors for their stations or observing platforms.

3.2 Station history should contain reference to aspects of the observation platform or station affecting the homogeneity and quality of observations as described in the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8) or relevant instrument and methods of observing practices relating to the given thematic programme.

3.3 WMO should maintain a list of standard station history standard practices for differing thematic observing programmes.

4. Traceability of measurements to recognized world standards and measurement uncertainties

4.1 … … (to be completed)

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PART IV

REQUIREMENTS FOR OBSERVATIONAL DATA AND PRODUCTS MANAGEMENT

1. **General**

1.1 **In order to effectively and efficiently respond to user needs, WIGOS observing components shall use WIS as a data exchange, discovery, access, and retrieval mechanism.**

NOTE: Detailed description of WIS is presented in the *Manual on the WMO Information System (WIS)* (WMO-No. 1060).

1.2 Data policies of WIGOS observing components should be clearly stated, and are encouraged to comply with Resolution 40 (Cg-XII) and Resolution 25 (Cg-XIII).

2. **The role of WIS**

2.1 **Observational data and products generated by all WIGOS observing components, as well as associated metadata, shall meet a comprehensive, standardized set of WIS data and metadata exchange requirements. In the context of WIGOS, WIS shall:**

a) **be used in the collection and sharing of information for all WMO and related international programmes;**

b) **provide a flexible and extensible structure that will allow participating centres to enhance their capabilities as their national and international responsibilities grow;**

c) **provide communication facilities used within the World Weather Watch (WWW) for distribution of high priority real-time data;**

d) **utilize international agreed-upon standards for protocols, hardware and software**.

3. **WIS compliance**

3.1 **To ensure WIS compliance:**

a) **WIGOS data and information practices shall comply with the Manual on WIS (WMO-No. 1060);**

b) **WIGOS contributors' metadata shall be made available to WIS GISCs;**

c) **WIGOS contributors' shall make available information on how to access detailed station history related to the observations;**

d) Data custodians should ensure data providers include the necessary metadata for WIS;

e) WIGOS contributors are encouraged to take advantage of WMO data representation systems and practices and file naming practices.

4. **Data representation and formats (including station metadata)**

4.1 **Representation of observational data and products generated by all WIGOS observing components, as well as associated metadata, shall be in compliance with the *Manual on Codes* (WMO-No. 306).**

5. **Archiving of data (including metadata)**

5.1 WIGOS data and products should be archived according to the recommendations, practices and procedures described in the WMO technical documentation …

5.2 Metadata and related information on archived data sets should be made available through WIS.

6. Operational Database

6.1 WIGOS should allow WMO Members' NMHSs and other relevant national and international institutions to use and interact fully with a distributed database (DB) which describes all the observing systems components and respective networks contributing to WIGOS. Generally, the WIGOS operational database should include the following:

(a) Basic observing network/system characteristics (governance, management, observing programme, standard compliance information, data policy, etc.);

(b) Basic station characteristics (name, number/identifier, geographical coordinates, observing programme, etc.);

(c) Basic instrument characteristics (siting, exposure, sensor type, principle of operation, instrument performance), data-processing, handling, transmission, quality assurance information, etc.).

6.2 A database should allow users to make relevant recommendations in terms of network design, evaluation and optimization; system governance and management and all other aspects dealing with observing system operation and performance.

6.3 **All WIGOS data producers shall be fully responsible for providing adequate and sufficiently detailed data related to all parts of their observing systems and networks as specified in (a) to (c) above.**

7. Standardization Database

7.1 The WIGOS Standardization Database should provide a single access point to all the WMO standards, guidelines, best practices, procedures, etc., addressing all aspects of observations (instruments, methods of observation, metadata format, coding, etc.). It should support the network managers and operators in getting information required to set-up and run systems contributing to WIGOS and help the data users to understand the standards used in performing specific observations they needed.

8. Portal

8.1 ***(To be further elaborated).***

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PART V

REQUIREMENTS FOR END-PRODUCT QUALITY

Section should specify the basic definitions and requirements of WIGOS quality management system. In accordance with existing standards the document should include: organizational structure, the quality policy, a description of the general process, the quality management system scope (what processes or products are under the quality management system), a description of the interactions between the quality management system and the processes and the quality objectives. It will also include observing system performance monitoring and feedbacks with corresponding remedial procedures.

1. WMO Quality policy

1.1 WIGOS should embrace Quality Management Framework (QMF) procedures to ensure that observations, records and reports on weather, water, climate and other environmental resources, operational forecasts, warnings, related information and services are of identified quality, and in compliance with relevant joint standards agreed upon with other international organizations.

NOTE: *The Guide on the Global Data-Processing System* (WMO-No. 305) is the authoritative reference on the end-product quality management issues. It should be consulted for more detailed descriptions

1.2 To fully meet QMF requirements, WIGOS observing components should use an agreed-upon quality assurance and quality control standards to deliver reliable and timely data streams with adequate and known quality associated with relevant metadata.

NOTE: T*he Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8)* provides guidance on the quality management system to be introduced in NMHSs which operates observing systems contributing to WIGOS. Together with the *Guide on the Quality Management System for the Provision of Meteorological Service for International Air Navigation (WMO – No. 1001)* and XXX it should be consulted for QMF issues.

2. Organization and responsibility

2.1 **Within the framework of WIGOS, quality assurance (QA) shall be a real-time activity which has to be performed prior to the transmission of the surface-based and space-based observational data and products through WIS.**

2.2 **The primary responsibility for QA of all observational data and products shall rest with the Members and Organizations (data producers).**

3. Standards and best practices to be implemented

3.1. QM of observing systems (ISO 9001/9004)
3.2 QA and QC procedures at a station level
3.3 QA and QC at a network/product level

(The text for above sections 3.1-3.2 should be further elaborated)

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APPENDIX

WIGOS DEFINITIONS

The following terms directly associated with WIGOS, when used in this Manual, have the meanings given below. Other definitions can be found in the *Manual on the GOS (WMO-No. 544)*, *Manual on Codes* (WMO-No. 306), *Manual on the Global Data-processing and Forecasting System* (WMO No. 485), *Manual on the Global Telecommunication System* (WMO-No. 386), *Manual on the WMO Information System (WIS)* (WMO-No. 1060) and other WMO and Partner's publications.

A comprehensive list of terms and definitions should be compiled accordingly

APPENDIX IV

WIGOS COMMUNICATIONS AND OUTREACH STRATEGY

(Initial draft Outline)

Preamble

The WMO Integrated Global Observing System (WIGOS) is an all-encompassing approach to the improvement and evolution of WMO global observing systems. It will foster the orderly evolution of the present WMO global observing systems, in particular the Global Observing System (GOS), the Global Atmosphere Watch (GAW) and the World Hydrological Cycle Observing System (WHYCOS), into an integrated, comprehensive and coordinated system. It will satisfy, in a cost-effective and sustainable manner, the evolving observing requirements of WMO Members, while enhancing coordination of the WMO observing system with systems operated by international partners/co-sponsoring agencies. It will provide a coordinated WMO contribution to the cosponsored GOOS and GTOS and contribute to the successful implementation of GCOS in support of the UNFCCC, and in the development and implementation of the Global Framework for Climate Services (GFCS);

Together with the WMO Information System (WIS), WIGOS will be the basis for the provision of accurate, reliable and timely weather, climate, water and related environmental observations and products by all Members and WMO Programmes, which will lead to improved service delivery.

A top priority in the implementation of WIGOS will be to ensure a sustained and strong governance framework and improved management efficiency at all levels. WIGOS addresses an urgent need for strong collaborative mechanisms, and it will promote greater mutual commitment and expanded roles and responsibilities among all parties involved. All these, along with other tools and mechanisms, will require continuous and dedicated efforts to ensure efficient WIGOS Communications and Outreach.

Purpose

The main purpose of the Communications and Outreach Strategy is to effectively promote WIGOS implementation. It should assure that all stakeholders involved in WIGOS implementation will receive objective and timely information on WIGOS implementation that are needed for decision making and management activities. The strategy must include clear articulation and effective communications and advocacy of benefits, efficiency and cost effectiveness that WIGOS will bring to Members. Given numerous and geographically diverse stakeholders, development and implementation of a WIGOS communications and outreach strategy will be one of the key prerequisites to the success of WIGOS.

The communications and outreach activities have to clearly demonstrate to governments, regional/subregional intergovernmental and economical groupings and funding agencies the benefits of WIGOS for decision-making through provision of accurate, reliable and timely observations and products, establishment of an improved technical infrastructure and well trained staff, thus encouraging them to provide an adequate administrative and financial support for WIGOS implementation. Resource mobilization activities should be a part of the strategy.

Communications and Outreach Tools

A wide variety of communications methods and tools can be used within available resources. In order to reach key audiences effectively, tools such as regular letters to PRs, flyers, brochures, WIGOS presentations at different forums and conferences should be used. One of the key tools in the delivery of information delivery will be a WIGOS Portal.

This Strategy should comprise the following core activity areas:

- Interaction of the WIGOS Project Office with Members, providing them with flyers, brochures, leaflets, etc. on WIGOS, its benefits and implementation progress;

- Interaction of the WIGOS Project Office with the secretariats of the various WMO and WMO-co-sponsored observing systems and user programmes.

- Active engagement and involvement of RAs and TCs through providing expertise at the regional and technical commission levels;

- Establishment and management of a WIGOS portal. This portal will provide relevant information to stakeholders on decision of Congress and EC; on WIGOS implementation, and standardization processes, etc; it will be also a tool for sharing experiences gained and lessons learned from the implementation process.

- Proactive identification of new users as WIGOS evolves.

The highest attention should be focused on enhanced communications and advocacy of benefits WIGOS will bring Members and partners/co-sponsoring agencies. Communications should clearly indicate the importance of WIGOS and WIS as basic infrastructure for improved and enhanced services provided by Members through reasonable initial investment related to the WIGOS and WIS implementation at national and regional levels.

A comprehensive communications strategy will help Members to understand the challenges they face in implementing WIGOS at national and regional levels and increase awareness of the technical guidance and other mechanisms that will be developed to assist and support them.

Levels for delivery of information

To meet most effectively its objectives, WIGOS communications and outreach activities should be carried out at global, regional and national levels:

(a) At the global level, it should focus on the delivery information on WIGOS global issues, coordinating and supporting network performances and global data exchange, major capacity building initiatives, and establishing and maintaining WIGOS standards and best practices;

(b) At the regional level, it should support multilateral efforts to address regional/subregional needs and priorities to be addressed in regional/subregional WIGOS implementation plans. It should support regional data policy development, data and metadata exchange, infrastructure development, research, training and the provision of services regionally to meet agreed WIGOS regional requirements. It should also strengthen and enhance cooperation and partnership through region-wide organizations or sub-regional groupings overseeing the WIGOS observing components, specifically among meteorological, hydrological and marine/oceanographic institutions/services where they are separated at the national level;

(c) At the national level, it should focus on supporting user access to WIGOS integrated data and products. It should also ensure sharing the experience of individual NMHSs in implementing WIGOS, including validation of observational requirements using the RRR process; implementation QMS and standardization process; development the WIGOS national database and Web portal; implementation WIS requirements; development a national capacity building strategy; development a resources strategy; development a risk management plan. Sharing the experience on the provision of assistance and support to Members with specific WIGOS-implementation needs would be of paramount importance.

Organization and management

Communications and outreach activities should be supported and coordinated by the WIGOS Project

Office. The Communications and Outreach plan should be a part of the WIGOS Implementation Plan.

The plan should include:

- Identification of the target audience at the global, regional and national levels;
- The topics of communications;
- Identification of means and tools to deliver the information;
- Timeline for information distribution;
- Periodical surveys, feedback analysis and evaluation;
- Remedial actions, as required;
- Others as identified and needed.

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APPENDIX V

WIGOS CAPACITY-BUILDING STRATEGY

(Initial draft Outline)

Background

Recognizing the importance of capacity-building activities in a wide range of WMO Programmes, Cg-XVI noted that a coordinated and holistic approach for capacity development would be needed to enhance capabilities of NMHSs in developing countries. In the context of WIGOS Congress stressed that an effective capacity-building strategy is an essential component of its implementation.

To take advantage of WIGOS benefits and to ensure that information and services are used to the maximum extent possible, transfer of technological innovations and development of decision support tools will be essential. For this purpose, specialized education and training activities should be reflected in the Regional WIGOS implementation plans, especially for NMHSs of Least Developed Countries (LDCs) and Small Island Developing States (SIDS). Hence, capacity building is not to be limited to scientific and technological concerns, but also to strategic and management consideration including human resources development, resource mobilization and communications and outreach activities.

The objective

A coordinated and systematic capacity-building effort should assist NMHSs of LDCs, LLDCs and SIDS to enhance their national observing capabilities and sustain their contributions to WIGOS observing components, including access to, and effective utilization of observations, data and products, and related technologies. The essential element of the Strategy is to build the necessary capacity of countries in accordance with their needs and priorities. In this regard, the Strategy should specify those capacity building areas/activities needed for LDCs, LLDCs and SIDS to support the successful implementation of WIGOS (each implementation component identified by WDIS).

Capacity-building process

Cg-XVI determined principle steps for the capacity building process. It should be a continuous process, comprising at least the following five steps:

(a) Engage Stakeholders4;

(b) Assess capacity assets and needs;

(c) Formulate a capacity development response;

(d) Implement a capacity development response;

(e) Evaluate capacity development.

The overall process should be essentially supported by communications and outreach activities.

Technical and Management capacities

Cg-XVI determined that two types of capacities, ***technical capacities*** and ***management capacities*** are needed to sustain capacity development. While technical capacities have been well addressed during the long history of technical cooperation of WMO, management capacities are also required in the formulation of institutional arrangements to implement and review policies, strategies, programmes and projects. In the context of WIGOS, the capacity building activities should be focused on:

4 A detailed explanation of each step is given in the Annex to draft Resolution 11.2/1 (Cg-XVI) – Elements of a WMO Strategy for Capacity Development

(a) Human resources capacity – equipping individuals with the understanding, skills, information, knowledge and training to enable them to generate, communicate and use WIGOS observations, data and products;

(b) Infrastructural capacity – enabling access to the resources that are needed to generate WIGOS data and products, including observing networks operation, data and metadata management, manuals, guides and technical guidance;

(c) Procedural capacity – defining, implementing and advancing standards and best practices for generating WIGOS observations, data and products;

(d) Institutional capacity – elaborating management structures, processes and procedures that enable effective delivery of WIGOS data and products not only within NMHSs but also in managing relationships between different entities and sectors.

Governance

Under the overall EC guidance, ICG-WIGOS should provide coordination and oversight during the development and subsequent implementation of the Strategy supported by all WMO relevant departments, but specifically by the Development and Regional Activities Department, and the Observing and Information Systems Department.

Major domains of the WIGOS Capacity-building strategy

Recognizing the importance of continuing the capacity building efforts under each WMO Programme, especially, LDCP, TCOP, VCP, ETRP and Regional Programmes, the WIGOS Capacity Building Strategy should promote improvements in coordination between these programmes and thus better contribute to building and developing capacities and capabilities of NMHSs in developing countries. Following the guidance by Cg-XVI, the Strategy should encompass the following key areas:

(a) Assessment of the capabilities of Members to accurately identify existing gaps, non-compliance to WMO standards and assistance in the long-term monitoring of the success of the WIGOS Capacity Building Strategy. Cg-XVI recommended that this could be part of the Country Profile Database;

(b) Improvement of compliance to WMO standards. Stronger advocacy by RAs, TCs and the Secretariat (WIGOS PO) to encourage compliance and support should be an important aspect of the strategy;

(c) Improvement the quality of NMHSs products and services which would be relevant for national decision-makers, development agencies, civil society and the general public through WIGOS implementation.

(d) Introduction of measures to ensure that capacity development activities are scalable, based on the level of voluntary contributions from Members and support from other sources such as aid organizations;

(e) Recognition of the key roles of RAs (incl. RTCs), TCs, WMO co-sponsored Programmes and Regional Offices (ROs) in integrating the requirements of the Region, provision of advice from technical perspectives and realization of stronger regional presence in WMO fora;

(f) Encouragement of volunteerism and bilateral cooperation in WIGOS implementation in developing countries.

Planning and implementation

WIGOS Capacity Building Strategy should move toward a multi-level Plan that has to clearly articulate goals, actions, responsibilities, timelines and resource requirements. Plans should be developed by corresponding regional bodies and approved by regional associations through their management groups. Plans should address the issues (a) - (f) mentioned above and coordinated with the regional

development cooperation programmes and the Voluntary Cooperation Programme. RTCs should play a key role in organizing training activities and providing facilities as needed. In addition, the WIGOS capacity building plans at national and regional levels should be focused on:

- Institutional mandates and policies;
- Infrastructure establishment and/or strengthening;
- Human skills development and training;
- Technical assistance; and
- Technology transfer.

Resources

Adequate financial support for maintaining and strengthening the capacity of NMHSs and for establishing and strengthening national, regional and global observation and communication networks would rely on Member support. Members themselves must accept a major share of the challenge of implementing WIGOS and strengthening their own capacity. Developed and developing countries alike would need to commit to providing adequate support to maintain their national data collection, archiving and sharing networks. To enable global access to national and regional data and products through the WMO Information System (WIS) will require the NMHSs to have robust Internet Technology (IT) and telecommunication facilities. These improvements would come at a cost. Particular emphasis should be placed on the needs of developing and least developed countries including Small Island Development States (SIDS), and particularly vulnerable regions, such as Africa.

In order for WIGOS to succeed, governments should give high priority to financing their NMHSs, communications, power and other infrastructure. Those countries that are able to help others, particularly the Organization for Economic Co-operation and Development (OECD) members, could do so through bilateral arrangements and through WMO and other UN initiatives. Wherever possible, existing and proposed projects and observation-related initiatives aimed at building capacity should be harmonized with the activities within the WIGOS. In view of the benefits that would follow for society as a whole around the world, Members could encourage the funding and development agencies their countries support (e.g. World Bank and others), to give high priority to WIGOS implementation and ongoing operation (infrastructure, communications, etc.).

Cg-XVI indicated that there needs to be more balance between resources available in Regions or sub-regions and those at WMO Headquarters in order to plan and execute projects. Recognizing the importance of strategic partnerships and shared execution of capacity development activities, Cg-XVI stressed that the facilitative role of the Organization should be enhanced.

As the capacity development effort will require external resources, close collaboration should be established with funding agencies, such as the World Bank, UNDP, regional economic groupings, EU, and other multilateral, bilateral and national agencies with funding capacity to gain their support.

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Appendix VI

WORLD METEOROLOGICAL ORGANIZATION

WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

DRAFT ∗

WIGOS IMPLEMENTATION PLAN

(WIP)

Version 0.4

(7 September 2011)

∗ The Document presents the initial draft WIP with proposals for an additional text (highlighted in red)

DOCUMENT VERSION CONTROL

Version	Author(s)	Date	Description
0.1	**WIGOS-PO**	**Oct 2010**	**Initial draft**
0.2	**WIGOS-PO**	**Nov 2010**	**Feedback from SG-WIGOS-3**
0.3	**WIGOS-PO**	**Feb 2011**	**Ver. for EC-WG/WIGOS-WIS-4**
0.4	**WIGOS-PO**	**Sept 2011**	**Cg-XVI & EC-LXIII decisions incorporated**

CONTENTS

WIGOS IMPLEMENTATION PLAN (WIP)

EXECUTIVE SUMMARY

The Sixteenth World Meteorological Congress (Cg-XVI, Geneva, May 2011) confirmed that WIGOS will be the basis for all Members and the WMO Programmes providing timely, quality-assured, quality-controlled, and well-documented compatible long-term observations for enhanced and extended services. Congress agreed that WIGOS will significantly enhance observing capabilities of Members by maximizing their administrative and operational efficiencies, through a more coordinated, collaborative and cost-effective approach to the planning and operation of an integrated global observing system. Together with WIS it will enable Members to better respond to natural hazards, improve weather, water, climate, and related environmental monitoring, forecast and warning services.

Cg-XVI also agreed that WIGOS will provide a framework for improved collaboration and coordination between NMHSs and relevant national and regional organizations. Congress underlined that WIGOS will be essential for the Global Framework of Climate Services (GFCS), aviation meteorological services, disaster risk reduction, and capacity-building as WMO priorities. It will also ensure a coordinated WMO contribution to the co-sponsored GCOS, GOOS, GTOS, and to the Global Earth Observation System of Systems (GEOSS).

By adopting Resolution 11.3/1 (Cg-XVI) (see Annex I), Congress decided that the WIGOS implementation be undertaken in the sixteenth financial period and will focus on a framework for improved governance, management, integration and optimization of the multiple observing systems coordinated by WMO and no effort should be spared to make WIGOS operational by 2016. Congress emphasized that the implementation of WIGOS should build upon and add value to the existing WMO observing systems with emphasis on integration of surface- and space-based observations in an evolutionary process to satisfy requirements of WMO and WMO co-sponsored Programmes.

Cg-XVI agreed that in implementing WIGOS, it is imperative that the current management, governance and support activities be reviewed and aligned with WMO priorities. This alignment would promote cooperation and coordination at the technical, operational and administrative levels.

Cg-XVI also recognized that meeting the quality requirements and expectations of users will be critical to the success of WIGOS. This would require an in-depth examination of current practices used by WMO observing programmes, specific mission-related requirements that were already in place, and available technological opportunities. The WIGOS implementation strategy would specify all processes of the Quality Management System (QMS) for WIGOS observing components including guidance on effective management of such a component.

Taking into account the ongoing rapid progress in technology that will continue to provide a basis for further improvements in the capability, reliability, quality and cost-effectiveness of observations, WIGOS must utilize international standards and best practices set by WMO and partner organizations.

Cg-XVI agreed that the implementation of WIGOS must be reflected in the revised WMO Technical Regulations, documenting the WIGOS concept of operations and contributions of all observing components. In this regard, the Congress endorsed the inclusion of the Manual on WIGOS in the list of mandatory publications.

The objective of this Plan is to describe tasks and activities that WMO Members in collaboration and coordination with their partner organizations will follow to implement WIGOS in the light of Cg-XVI decisions. The WIP covers the period 2011–2015 addressing key processes and activities of WIGOS implementation.

1. WIGOS PROJECT DEFINITION

1.1 Background

The concept of WIGOS, as adopted by the Fifteenth World Meteorological Congress in 2007 (Resolution 30 (Cg-XV), was a strategic initiative of the Organization. The Sixteenth World Meteorological Congress welcomed a comprehensive report on the integration of WMO observing systems which contained consolidated overall assessment of results achieved during the WIGOS Test of Concept Phase (2007-2011) and noted the successful completion of most of the tasks specified in the WIGOS Development and Implementation Plan (WDIP).

Cg-XVI noted with appreciation the WIGOS documentation, in particular, the WIGOS Concept of Operations (CONOPS) specifying WIGOS basic characteristics, and the WIGOS Development and Implementation Strategy (WDIS) defining steps that WMO, in cooperation with partner organizations, will follow. These documents will provide guidance on how to improve governance, management, and integration of WMO observing systems and their contributions to co-sponsored systems, in order to satisfy evolving observing requirements of WMO Members and partner organizations in a coordinated, cost-effective and sustained manner.

Cg-XVI also noted the good progress achieved in the WIGOS Pilot and Demonstration Projects that provided unique lessons learned, experiences gained, feedback related to potential benefits, value and impact of the WIGOS implementation at the national and regional levels. Congress invited Members to take them into account when implementing WIGOS.

By adopting Resolution 11.3/1 (Cg-XVI) (see Annex I), Congress decided that the WIGOS implementation be undertaken in the sixteenth financial period and will focus on a framework for improved governance, management, integration and optimization of the multiple observing systems coordinated by WMO and no effort should be spared to make WIGOS operational by 2016. Congress emphasized that the implementation of WIGOS should build upon and add value to the existing WMO observing systems with emphasis on integration of surface- and space-based observations in an evolutionary process to satisfy requirements of WMO and WMO co-sponsored Programmes.

Cg-XVI requested the Executive Council to monitor, guide and support the implementation of WIGOS. Acting accordingly, EC-LXIII (Geneva, June 2011) through its Resolution 2/2 (see Annex II), specifically requested ICG-WIGOS to develop, review and submit the WIGOS Implementation Plan (WIP) for approval by EC-LXIV. The text hereunder constitutes principal parts of the WIP.

1.2 WIGOS Vision and Main objectives

The WIGOS Vision calls for an integrated, coordinated and comprehensive observing system to satisfy, in a cost-effective and sustained manner, the evolving observing requirements of WMO Members in delivering their weather, climate, water and related environmental services. WIGOS will enhance the coordination of the WMO observing systems with those of partner organizations for the benefit of society.

WIGOS will provide a framework for enabling the integration and optimized evolution of WMO observing systems, and of WMO's contribution to co-sponsored systems. Together with WIS, this will allow continuous and reliable access to an expanded set of environmental data and products, and associated metadata, resulting in increased knowledge and enhanced services across all WMO activities.

In accordance with a decision of Cg-XVI and the guidance by the WIGOS Development and Implementation Strategy, WIGOS together with WIS, will meet the following objectives:

- Enable WMO Members to better respond to natural hazards, improve weather, water, climate and related environmental monitoring, adapt to climate change and human-induced environmental impacts and meet expanding national mandates while achieving higher national visibility with other environment related agencies;

- Ensure a coordinated WMO contribution to the cosponsored GOOS and GTOS and contribute to the successful implementation of GCOS in support of the UNFCCC, and in the development and implementation of the Global Framework for Climate Services (GFCS);
- Strengthen WMO's contribution to GEOSS;
- Provide a basis for sound decision making and enhance delivery of benefits to society.

As integrated global observing system, supported by WIS, WIGOS will contribute to realizing the socio-economic benefits from a wide range of weather, climate, water and related environmental products and services based on WMO's core competencies.

1.3 Benefits for Members, Partners, End-users

WIGOS is expected to facilitate timely, quality-assured, quality-controlled and well-documented observations. Improved Quality Management procedures will be required to enable enhanced utilization of both existing and emerging observing capabilities. In meeting the evolving user requirements, WIGOS will:

- Enable the evolution and integration of WMO observing systems and enhance collaboration with its partner organizations. This will allow access to an expanded set of environmental data and products resulting in increased knowledge and enhanced services (across weather, climate and water domains) in a cost-effective manner;
- Result in enhanced observing capabilities by improving integration between its surface- and space-based components;
- Enable WMO Members to better respond to natural hazards, improve weather, water, climate and related environmental monitoring, and adapt to climate change and other human-induced environmental impacts;
- Enhance operational components of WMO Programmes, especially in Developing and Least Developed Countries and ensure essential WMO support for the observations and information components of GFCS and other WMO future priorities;
- Provide a basis for sound decision making and enhance delivery of services to society in all WMO applications areas;
- Contribute strongly to GOOS, GTOS, GCOS and GEOSS.

1.4 Purpose and Scope of this Plan

In meeting its objectives, WIGOS will not only serve WMO Members and partner organizations but will also make a major and unique contribution to United Nations agencies that are focused on environmental stewardship, and along with WIS, will be a core contribution of WMO to the GFCS as well as to GEOSS.

To achieve its objectives, the scope of WIGOS implementation should encompass the following:

- *Requirements:* Provide a mechanism to meet evolving observing requirements of WMO Members and WMO partner organizations building on the existing Rolling Review of Requirements (RRR) process;
- *Integration and interoperability:* Build upon and add value to the existing WMO observing components of Global Observing System (GOS), Global Atmosphere Watch (GAW), and World Hydrological Cycle Observing System (WHYCOS) with emphasis on integration of surface- and space-based observations;
- *Standardization:* Enhance observational data and products quality and homogeneity by introducing improved data quality and data management standards to better satisfy user requirements;

- *Access:* Improve access to, and utilization of, observations and products from WMO observing systems as well as those of co-sponsored systems.

- *Coordination:* Foster research and development activities and coherent planning for future observing systems and network optimization by working with all WMO Programmes and partner organizations.

The purpose of this Plan is to describe tasks and activities that WMO, in collaboration and coordination with partner organizations, will follow to implement WIGOS.

2. DELIVERABLES

2.1 Key WIGOS implementation components

This section should introduce the key WIGOS deliverables of the Implementation (IP) phase, major associated activities and allocation of responsibilities. For ease of reference they could be presented in the table form as given below.

The WIP covers the period 2011–2015 addressing key processes and activities of WIGOS implementation. Table 1 below presents key WIGOS implementation components1 during the Implementation (IP) phase mainly (if needed, also during the Operational (OP) phase), major associated activities and allocation of responsibilities.

2.2 WGOS Major Implementation Activities and Responsibilities

Key implementation components	Phase of completion	Activities	Responsibility	Comments
1. Integrated Governance	IP	1.1Develop Regional WIGOS Implementation Plans	*RAs*	Implementation & coordination meetings (ICM)on WIGOS will be held regularly for each Region
	IP	1.2 Facilitate active involvement of Members in regional WIGOS implementation activities	*RAs*	Will be discussed at regional ICM on WIGOS
	IP/OP	1.3 Provide technical guidance and assistance on WIGOS implementation	*TCs*	
	IP	1.4 Establish WIGOS PO	*Secretariat*	
	IP	1.5 In close collaboration with all WMO's constituent bodies and taking into account all WMO's priorities develop proposals for new/adjusted structures of: 1.5.1 WMO Programmes (WIGOS supporting programmatic structure), 1.5.2 WMO Technical Commissions (WIGOS supporting governance	*Secretariat* *Secretariat* *Secretariat &*	

1 Key WIGOS implementation components are specified in WDIS (version 1.2)

		structure), 1.5.3 WIGOS Concept of Operations (CONOPS) with special emphasis on WIGOS functional architecture 1.5.4 WMO Technical Regulations (WIGOS supporting procedural structure)	*ICG-WIGOS*	
	IP/OP	Update WMO Regulatory Material relevant to observation, including development of the Manual on WIGOS	*TCs*	
	IP	1.6 Provide necessary secretariat support to Members, RAs and TCs, and take appropriate activities for the implementation of WIGOS	*Secretariat*	
2. Data delivery and information services through WIS;	IP/OP	2.1 Develop rules and procedures for collection and sharing of observations and products within WIGOS using WIS	*ICG-WIGOS TCs*	
	IP/OP	2.2 Develop a strategy for the production, editing and management of metadata, for instrumentation/platform, incl. station history	*ICG-WIGOS TCs*	
	IP/OP	2.3 Develop a strategy for the production, editing and management of WIGOS metadata		
3. Quality management, including monitoring and standardization;	IP/OP	3.1 Provide assistance to Members with specific implementation needs and promote sharing experiences and collaboration of Members in all WIGOS standardization areas	*Secretariat* *TCs & RAs*	
	IP	3.2 Develop strategy for the standardization process (to guarantee systems interoperability, including development of documented standards for data quality of observing systems and instruments)	*ICG-WIGOS* *TCs*	
	IP/OP	3.3 Develop suitable quality-control and monitoring tools for observations	*TCs*	
	IP/OP	3.4 Provide quality and data/metadata management related technical guidance, advice and assistance	*TCs*	
4. Planning and optimization of observing systems;	IP	4.1 Develop strategy to satisfy observing requirements of WMO Programmes, international partner organizations and related programmes	*ICG-WIGOS* *Secretariat*	
	IP/OP	4.2 Review observing system	*TCs, RAs &*	Will be

		performance on a regional basis	*Secretariat*	discussed at regional ICMs on WIGOS
	IP	4.3 Implement the RRR process in all application areas	*TCs & RAs*	Will be discussed at regional ICMs on WIGOS
5. Capacity Building	IP/OP	5.1 Identify needs and priorities for WIGOS capacity building	*RAs*	Will be discussed at regional ICMs on WIGOS
	IP/OP	5.2 Coordinate existing and promote proposed regional projects and observation-related initiatives aimed at building capacity within WIGOS	*RAs & TCs*	Will be discussed at regional ICMs on WIGOS
	IP/OP	5.3 Develop WIGOS related guidelines and training materials and other relevant documentation	*TCs*	
	IP	5.4 Develop capacity building partnership with partners and co-sponsors	*Secretariat*	
6. Communications and Outreach	IP	6.1 Develop communication and outreach strategy in collaboration with partners and co-sponsors	*Secretariat*	
	IP/OP	6.2 Develop and manage a WIGOS portal	*ICG-WIGOS Secretariat*	

Table 1: WIGOS activities and responsibilities

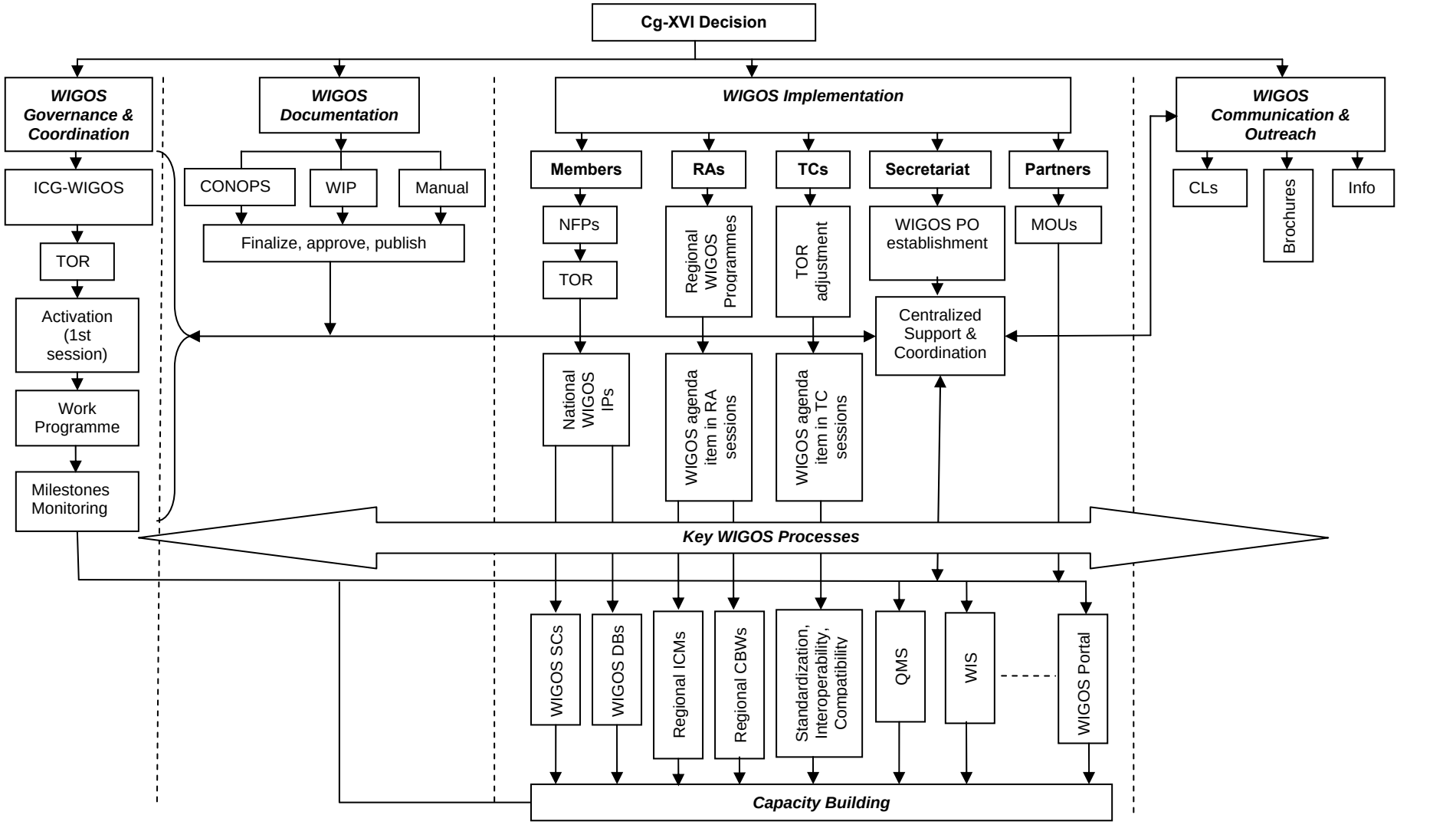
3. IMPLEMENTATION GOVERNANCE

3.1 General requirements

The successful implementation requires clear governance arrangements for all activities to be accomplished. In this regard, it should be mentioned that WIGOS implementation will be based on a common standardization approach, uniform implementation of WMO regulations, system interoperability and data compatibility standards across all WMO observing systems as specified by CONOPS and WDIS. Arrangements should also be made to provide a single focus for integrated and coordinated operational management of all WMO observing systems and a mechanism for coordination with WMO co-sponsored and contributing observing systems.

Therefore, in implementing WIGOS it is imperative that the current management, governance and support activities be reviewed and aligned with WMO strategic planning and results-based management. This alignment should enable collaboration and promote cooperation and coordination at the technical, operational and administrative levels.

A Schematic scope of priority actions to be undertaken to follow up the decision of Cg-XVI on WIGOS Implementation is presented in Figure 1.



Abbreviations used: TOR - Terms of reference ; NFPs- National Focal Points on WIGOS; IPs – Implementation plans; SCs – Specialized Centers; DBs – Databases; ICMs – Implementation Coordination meetings; CBWs – Capacity Building Workshops; MOUs – Memoranda of Understanding; CLs – WMO Circular Letters

Figure 1: Schematic scope of priority actions to be undertaken to follow up the decision of Cg-XVI on WIGOS Implementation

3.2 The role of EC

The WMO Executive Council will continue to monitor, guide, evaluate and support the implementation of WIGOS. In accordance with the governance by Cg-XVI, EC-LXIII established Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) with the Terms of Reference listed in the Resolution 2/2 (EC-LXIII) (see Annex II).

3.3 The role of RAs

Regional associations will play essential role in the WIGOS implementation. Regional associations through their WIGOS regional task teams will coordinate planning and implementation of WIGOS on the regional level taking into account all WMO future priorities, such as GFCS and DDR. The regional task teams, in consultation with ICG-WIGOS, should also address regional aspects of standardization, observing system interoperability, data compatibility, data management, Quality Management System (QMS) procedures, performance monitoring, WMO regulatory material issues, and proposed improvements in observing networks/systems.

3.4 The role of TCs and ICG-WIGOS

Given the significance of active cooperation and enhanced coordination among the technical commissions, the ICG-WIGOS will ensure that technical aspects of WIGOS implementation is incorporated in the work programmes and implementation plans of all WMO commissions concerned.

3.5 The role of WMO Members

Cg-XVI stressed the important role of Members in the implementation of WIGOS. It also emphasized that the integration should be undertaken to accommodate the diversity among Members with respect to their capabilities and needs. Therefore, depending on levels of development of NMHSs, Members should collaborate actively in, and give all possible support to the following:

- Evolve their observing systems to become their national component of WIGOS,
- Provide adequate resources to the WMO Secretariat to support WIGOS implementation,
- Support regional and global WIGOS implementation activities,
- Keep the Secretary General informed about their WIGOS implementation activities,
- Share relevant experience and cooperate with one another in implementing WIGOS, including assistance to Members with specific WIGOS-implementation needs.

3.6 The role of Secretariat

Coordination through the WMO Secretariat and specifically its WIGOS project office is essential for successful WIGOS implementation. The Secretariat, under the institutional guidance of the WMO constituent bodies, will be in continual contact with Members, working bodies of regional associations and technical commissions, and relevant international organizations and programmes. The Secretariat in particular, will:

- Establish a WIGOS Project Office;
- Ensure management of, and support to, the WIGOS implementation process;
- Develop proposals for programmatic and governance structures in support of WIGOS taking into account WMO's strategic directions;
- Support WIGOS and WIS implementation;
- Ensure proper coordination with other observing systems contributing to the GFCS as it develops;

- Coordinate and collaborate with partner organizations and programmes in WIGOS activities;
- Support regional associations and technical commissions in developing their WIGOS implementation strategies and projects, including outreach and capacity-building activities;
- Work with Members and donors to provide adequate resources for WIGOS implementation.

3.7 The role of Partner Organizations

Improving coordination will be an ongoing activity at the policy, technical, and Secretariat levels. This will need to be supported by a high-level reconciliation mechanism defined in the WMO-UNESCO-IOC-UNEP-FAO-ICSU Memoranda of Understanding (MOU) in order to resolve possible problems in data policy, product delivery, and other governance issues. These interagency and inter-observing system coordination mechanisms will need to be complemented and supported through similar cooperation and coordination arrangements among NMHSs and through national implementation mechanisms for GCOS, GOOS, GTOS, and GEOSS.

4. PROJECT IMPLEMENTATION SCHEDULE

4.1 Project Phases

In accordance with the guidelines given by Cg-XVI, development and implementation of the WIGOS concept proceeded in the phases defined by the annual sessions of the Executive Council.

4.1.1 WIGOS Test of Concept (2007 - 2011)

Cg-XVI recognized that planning and implementation of the Test of Concept Phase (2007-2011) has been accomplished successfully, providing unique lessons learned and experiences gained in the implementation of WIGOS Pilot and Demonstration Projects initiated by technical commissions, Members and regional associations, respectively. The Test of Concept Phase also provided grounds for the development of the WIGOS guidance material became available to all Members and partner organizations.

4.1.2 WIGOS Implementation (2012 - 2015)

The Implementation, to be undertaken between 2012 and 2015, will focus on developing and implementing a framework for improved governance, management, integration and optimization of the multiple observing systems coordinated by WMO and its partner organizations. The current WIGOS Implementation Plan defines the essential steps to be undertaken over this period.

4.1.3 WIGOS Operational (2016 onward)

From 2016 onwards WIGOS observing components will continue to evolve to improve service delivery and support decision making in response to the evolving needs of users and technological opportunities. Although not limited in time, it is anticipated to include an initial period of rapid enhancement of observing capabilities between 2016 and 2019 in order to meet the highest priority needs.

4.2 Key Tasks, Activities and Milestones

Figure 2 shows the key milestones, including routine WIGOS related reports to EC and Congress, and timelines. Some tasks such as coordination with WIGOS component systems will be essential activities throughout and beyond the Implementation phase. The WIGOS project documentation will be a key deliverable early in the period, while Regulatory Documentation will be the focus in later phases. Capacity building will focus on the development of guidelines, training material and providing the technical and infrastructure assistance later in the project. Pilot and demonstration projects will continue to be an important activity in the later implementation stages, especially to assist developing countries including LDCs and SIDS to fully benefit from WIGOS.

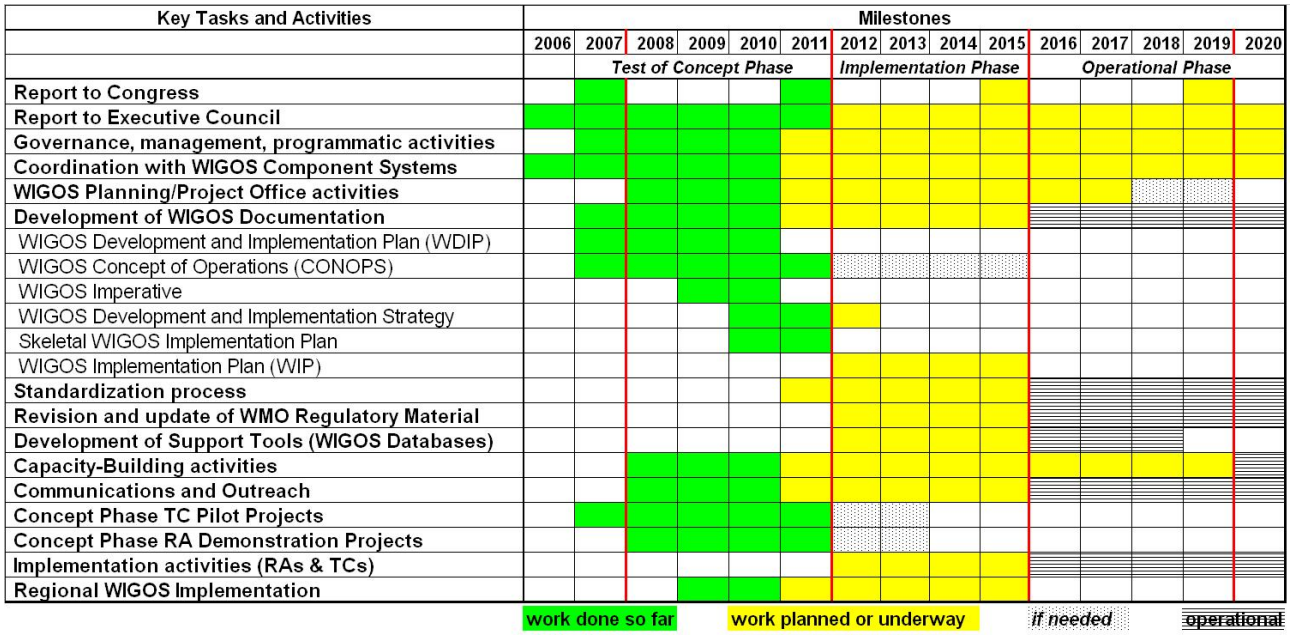


Figure 2: Key Tasks, Activities and Milestones

4.3 Tasks and Actions for WIGOS observing components

WIP should contain a list of tasks for all WIGOS observing components relevant to WIGOS key deliverables and milestones as specified by Sections 2.1 and 4.2. Priority of implementation tasks must be specified (i.e. criteria used to assign priority must be defined, taking into account WMO priorities and resources available).

Integration process should comprise a series of actions to be taken within the frame of individual observing system to ensure successful implementation of WIGOS. Based on positive experience gained by GCOS, the criteria were introduced to assign priorities to the implementation actions. Criteria for placing items within the current or near-future implementation time-line of this Plan include:

- Clearly significant and citable benefits towards meeting the requirements stemming from Resolution 11.3/1 (Cg-XVI) for enhancing integration between the WMO observing systems to improve Members capabilities to effectively provide the widening range of services and to better serve research programme requirements;
- Feasibility of an observation – determined by the current availability of an observation or by knowledge of how to make an observation with acceptable accuracy and resolution in both space and time;
- Ability to specify a tractable set of implementing actions (“Tractable” implies that the nature of the action can be clearly articulated, that the technology and systems exist to take the action, and that an Agent for Implementation, best positioned to either take the action or to ensure that it is taken, can be specified);
- Cost effectiveness – the proposed action is economically justified.

The table reproduced in the Appendix 1 provides an initial draft of areas where specific activities and actions should be accomplished within WMO and co-sponsored observing systems to support implementation of WIGOS6 in achieving corresponding deliverables. Existing Implementation/Strategic plans of WIGOS observing components will be taken into account when the WIP is further elaborated.

6 Implementation activities will be accomplished in close coordination with WMO Partners

4.4 Key tasks for Members

To achieve the WIGOS vision and deliver its promised benefits, Members will play a key role in implementing WIGOS at the national, regional and global levels. Specifically, national WIGOS implementation plans should identify all WIGOS implementation tasks including a risk management. The key WIGOS processes7 and tasks are summarized in Table 3.

Key WIGOS processes	Phase of completion	Tasks	Comments
1. Integrated Governance	IP	1.1 Develop National WIGOS Implementation Plan in coordination with all concerned	
	IP	1.2 Develop a resources strategy (expertise and funds) and provide resources to support the implementation of WIGOS.	
	IP/OP	1.3 Develop a risk management plan.	
2. Observing System Operation and Maintenance	IP/OP	2.1 Ensure the sustained operation of national observing systems and delivery/exchange of observations that are the building blocks of the GOS, GAW and other observing components of WIGOS.	
3. Quality Management, (including Performance monitoring, Evaluation, Feedback & and Remedial actions)	IP/OP	3.1 Specify procedures for an effective use of low quality data to fill the gaps in high quality data series. It requires good metadata practices and well documented procedures and data quality	
	IP/OP	3.2 Develop and implement QMS for its observing network(s)/system(s), including detailed specification of all processes, procedures and best practices for data acquisition and processing, QA/QC, monitoring, evaluation, feedback and remedial actions.	
4. Planning and Optimized Evolution of WIGOS Observing Components	IP/OP	4.1 Validate users requirements for weather, climate, water and related environmental observations using the RRR process (an integrated view of user requirements):	
	IP/OP	4.2 Assess capabilities of the NMHS observing network(s) to meet its own present and future requirements (Gap analysis of NMHS observing system capabilities);	
	IP/OP	4.3 Assess the national observing system against national needs and international requirements (sub regional/regional, WMO, partner organizations) (Gap analysis of NOS capabilities vs. national and international needs and requirements);	
	IP/OP	4.4 Summarize capabilities of Member's	

7 The key WIGOS processes to meet user requirements are specified in CONOPS Part: WIGOS Design and Functional Architecture, version 5.2.2

		observing systems/networks and user observational requirements; document user requirements in all details (horizontal and vertical resolutions, observing cycle, timeliness and accuracy) and identify gaps, shortcomings, deficiencies and incompatibilities of the current systems;	
	IP	4.5 Specify a data framework (data policies and processes).	
5. Standardization, System Interoperability and Data Compatibility	IP/OP	Enhance/initiate the NMHS standardization process through the following: 5.1 Examine current practices used by the NOS;	
	IP/OP	5.2 Determine, implement, maintain and document: • common standard processes; • procedures and best practices; procedures for the generation of observational data; • products and associated metadata from the NOS using standardized data and metadata representation in compliance with WIS information exchange requirements for all applications and users, including those for observing system interoperability; • traceability and consistency of observations (recommendations on instruments and methods of observation).	
	IP	5.3 Develop the standardization database (to document all implemented processes, standards, best practices, procedures).	
6. Data & Metadata Management, Delivery and DAR Services through WIS	IP/OP	6.1 Implement WIS requirements for data/metadata management and data/metadata representation.	
	IP	6.2 Develop the integrated national database system incl. metadata (WIGOS observational metadata, and WIS Discovery, Access and Retrieval (DAR) metadata).	
7. Data Archival and Retrieval	IP/OP	7.1	
		7.2	
8. Collaboration	IP/OP	8.1 Establish coordination mechanisms with partner organizations at national and sub regional levels.	
	IP/OP	8.2 Collaborate and coordinate with partners at the national and sub regional level to:	

		• overcome the gaps and shortcomings; • minimize duplications and shortcomings of the current systems.	
9. Capacity Building	IP/OP	9.1 Develop a national capacity building strategy.	Will be discussed at regional ICMs on WIGOS
10. Communications and Outreach	IP	10.1 Establish an effective communications and outreach strategy with national/sub regional partners with assistance of the WMO Secretariat.	
	IP/OP	10.2 Develop and manage a WIGOS portal providing relevant information on communications, outreach and capacity building.	

Table 3: Key WIGOS activities for Members

5. PROJECT MANAGEMENT

5.1 Project Framework

The WIGOS project framework consists of two parts. The first part is the organizational framework set up by the WMO Executive Council in order to monitor, guide and support the implementation of WIGOS in accordance with Congress decisions. The second part is the administrative structure within the WMO Secretariat.

Organizational Framework

For the WIGOS Test of Concept Phase (2007-2011), the organizational structure of the WIGOS project was set up by Resolution 3 (EC-LIX) in 2007 establishing an Executive Council Working Group on WIGOS and WIS (EC-WG/WIGOS-WIS) to steer and monitor WIGOS development and implementation activities and coordinate institutional arrangements for planning and overseeing WIGOS and WIS. The EC-WG/WIGOS-WIS established a Subgroup on WIGOS (SG-WIGOS) to provide overall technical guidance, assistance and support for the implementation of the WIGOS.

During the WIGOS Implementation Phase, it is highly desirable that an Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) be established. This group would replace the Subgroup on WIGOS and under the guidance of the EC it would be expected to:

- Coordinate, review, refine, and assess the development and implementation of WIGOS;
- Provide technical guidance and assistance for the WIGOS development, planning, and implementation activities, such as standardization and development of WIGOS databases;
- Advise regional associations on WIGOS implementation activities;
- Advise technical commissions on the standardization process and related activities;

Secretariat Structure

The Secretariat provides support to ICG-WIGOS. The WIGOS development and implementation has been coordinated by the WIGOS planning office that was established but is yet to be fully staffed. Taking into account the role, responsibilities and scope of the work required, establishing a fully staffed WIGOS Project Office will be essential for accomplishing the requested tasks.

5.2 Project monitoring and review

The project monitoring should be undertaken by the WIGOS Project Office. A regular reporting system will be developed to provide information on progress at the end of each year towards achieving results. Gaps will be identified, analyzed and corrective actions initiated, if needed.

5.3 Evaluation Methodology

The evaluation methodology should be designed with respect to the objectives and performance measures. It should include a schedule of monitoring and evaluation activities and related responsibilities. Where formal evaluation is taken, conflict of interest should be avoided. Mid-term evaluation, interim progress reports and post-implementation reviews should be considered as a means of providing early feedback on progress towards success, and as a means of meeting accountability and transparency requirements.

The methodology will be to compare numbers of activities committed to in the budget with the numbers achieved. Appropriate measures of success in the activities will include counting the numbers of activities completed, while the effectiveness of these activities for Members, user-institutions and partnering agencies will be assessed through surveys of participants at meetings and various training events, and of users of the publications, and through field missions to NMHSs for ground truth assessment of impacts, in particular for those outcomes linked to capacity-building. Such field missions would be carried out in collaboration with the WMO Secretariat DRA Department and the WMO regional offices.

5.4 Implementation/success indicators

The development of performance indicators to measure progress, both quantitative and qualitative, should be undertaken. Performance indicators should be developed for each activity as well as for the whole implementation phase. NMHSs should provide baseline information as requested. Performance indicators provide a basis for the Project evaluation activities.

In order to evaluate the WIGOS implementation, minimum Critical Success Indicators (CSI) should be defined for the individual steps of the integration process:

1) Implementation of the WIGOS organizational framework;

2) Integration of WMO systems:

2.1 Integration of the surface-based observing systems,

2.2 Integration of the space-based observing systems to more thoroughly address climate and other related terrestrial observations,

2.3 Integration of the space- and surface-based components of the GOS;

2.4 Integration of all WMO observing system components;

3) Integration process fully reflected in WMO Technical Regulations (upon the development and endorsement of the Manual on WIGOS by Cg-XVII);

5) Manual on WIGOS accepted by partner organizations.

5.5 Capacity-building

An effective capacity-building and training strategy is an essential component of the WIGOS. A coordinated capacity-building effort should assist developing and least developed countries to improve and sustain their contributions to WIGOS observing systems, including access to and effective utilization of observations, data and products, and related technologies. As a key factor in successful WIGOS implementation, capacity building activities at national and regional levels will be focused on:

- Institutional mandates and policies;
- Infrastructure establishment and/or strengthening;
- Human skills development and training;
- Technical assistance; and
- Technology transfer.

To take advantage of WIGOS benefits and to ensure that information and services are used to the maximum extent possible, transfer of technological innovations and development of decision support

tools will be essential. For this purpose, specialized education and training activities should be reflected in the Regional WIGOS implementation plans, especially for NMHSs of Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

5.6 Communications and Outreach

Development and implementation of relevant communications and outreach activities will be one of the key prerequisites to the success of WIGOS. These activities will comprise the following core areas:

- **Interaction of the WIGOS Project Office with the secretariats of WMO-co-sponsored observing systems and user programmes. The Project Office should also coordinate WIGOS activities with those related to WMO future priorities, as well as related activities of GCOS,GOOS, GTOS and GEOSS;**

- **Active involvement of regional associations and technical commissions through. Regional/inter-commission expert teams that will participate in the development and implementation of WIGOS at the regional/ technical commission levels;**

- **Establishment and management of a WIGOS portal. This portal will provide relevant information to stakeholders on WIGOS development, implementation, and standardization processes and on the communications and outreach strategy, and**

- **Proactive identification of new users as WIGOS evolves.**

6. RESOURCES

6.1 Funding of WIGOS

Most of resources needed for WIGOS implementation will be provided through existing WMO and national mechanisms, including voluntary contributions to special projects. It should be underlined that the timely completion of the WIGOS implementation in the sixteenth financial period 2012-2015 critically depends on adequate resources (budget and expertise).

The investment for fully implementing WIGOS should be given a high priority in Members' development and implementation plans. In addition, extra resources will need to be provided to the WMO Secretariat for both staff and non-staff costs for the implementation and coordination that are beyond the normal programmatic activities of the Secretariat. To ensure the funding needed for WIGOS implementation, the following resources should be considered:

- WMO Regular Budget for WIGOS implementation support activities;

- WIGOS Trust Funds to supplement WMO Regular Budget;

- In kind contributions;

- Staff secondments;

- Voluntary Cooperation Programme funds for WIGOS related technical cooperation and capacity-building activities;

- Regional fundraising activities to support WIGOS.

6.2 Cost definitions

6.2.1 Estimated total annual WIGOS implementation costs

Implementation of WIGOS key processes within existing observing networks will require additional

resources and investments. Table 2 below summarizes actions and estimated additional costs for key WIGOS processes (see section 4.4, Table 3 and Footnote).

Key WIGOS processes	***Number of actions***	***Estimated Annual cost***	***Number of uncosted actions***
1. Integrated Governance	11		
2. Observing System Operation and Maintenance	3		
3. Quality Management (including Performance monitoring, Evaluation, Feedback & Remedial actions)	4		
4. Planning and Optimized Evolution of WIGOS Observing Components	3		
5. Standardization, System Interoperability and Data Compatibility	XX		
6. Data & Metadata Management, Delivery and DAR Services through WIS	2		
7. Data Archival and Retrieval	2		
8. Collaboration	XX		
9. Capacity Building	4		
10. Communications and Outreach	2		
Total			

Table 2: Summary of actions in WIGOS process with estimated annual implementation costs

Cg-XVI considered the Compendium of Project Initiatives (Cg-XVI/Doc. 8.3(2)) proposed to be funded from voluntary contributions (2012-2015) in accordance with the five priorities as contained in the WMO Strategic Plan for 2012-2015 (*Priority 4: Implementation of WIGOS and WIS*). An amount of CHF 22.4 million will be allocated to address all the aspect of WIGOS and WIS in the sixteenth financial period. Due to the limited availability of regular resources, the voluntary resources are critical to implement these foundational programmes in a timely, effective and affordable manner. Members were invited to support these projects and project initiatives through their voluntary contribution processes, and to pledge such contributions.

6.2.2 WIGOS Secretariat activities

The WIGOS Project Office needs to be established within the Secretariat. It must be adequately staffed and resourced to meet the role, responsibilities and scope of the project. This will ensure a suitable project management function, improved coordination and cooperation with technical commissions, regional associations and partner organizations, capacity-building as well as communications and outreach activities that are essential for WIGOS implementation.

The detailed cost/resources estimation needed for WIGOS development and implementation at the Secretariat level is presented in Appendix 2, Tables 1 and 2.

6.2.3 Link to Deliverables and Risk Management Plan

The section should contain explanation and guidance on how estimated expenditures are related to all actions proposed in this Plan.

6.3 Fund rising activities

This section should specify activities to secure funds and resources needed for the implementation of WIGOS on national and international levels.

7. RISK ASSESMENT/ MANAGEMENT

The risk management process as shown in Figure 3, generally comprises four stages: identification, assessment, handling and monitoring.

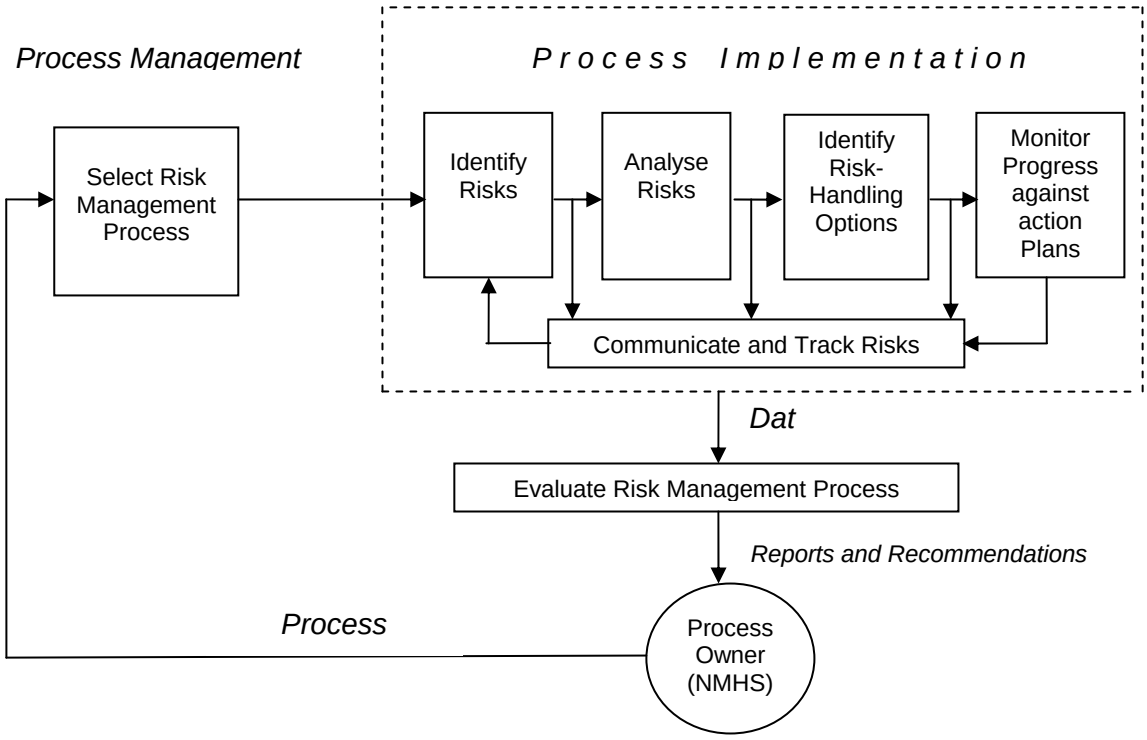


Figure 3: Risk Management Process

7.1 Risk identification and periodical revisions

An initial risk assessment (see WDIS, section 4.2) identifies the implementation of WIGOS as a high risk project because of its *Complexity, Basic infrastructure and Resources*. Therefore, risks will need to be clearly identified and managed at various points throughout the project, including the development of associated mitigation and contingency plans. The Secretariat will take a coordinating role in overall risk management by providing a focal point for these activities.

This section should contain Risk Management Plans (RMP) within the frame of each participating observing system (or make reference to the RMP, if it exists).

7.2 Risk mitigation activities

This section should specify Risk mitigation activities within the frame of each participating observing system (or make reference to the RMP, if it exists).

ANNEX I: Res. 11.3/1 (Cg-XVI) - IMPLEMENTATION OF THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

THE CONGRESS,

Noting:

(1) Article 2 of the Convention of the World Meteorological Organization,

(2) Resolution 30 (Cg-XV) – Towards enhanced integration between WMO observing systems,

(3) Resolution 14 (EC-LXII) – Implementation of the WMO Integrated Global Observing System (WIGOS),

(4) WMO Strategic Plan,

Considering:

(1) The greater vulnerability of society to extreme weather events and climate change and the need for more extensive and advanced information for WMO Members so that they can continue to improve service quality and to extend further service delivery,

(2) The benefits that can be realized through a more coordinated, collaborative and cost-effective approach to the planning and operation of an integrated global observing system,

(3) With satisfaction the progress achieved in the planning for the implementation of WIGOS (2007-2011),

(4) The importance of WIGOS to the development and implementation of the GFCS and the Global Cryosphere Watch (GCW),

Appreciating:

(1) The important contributions Members, international partner organizations and programmes make towards observing the Earth system,

(2) The relevant work undertaken by Members, the Executive Council, the regional associations, the technical commissions, the EC Working Group on the WMO Integrated Global Observing System and the WMO Information System and the Secretary-General on the development and implementation of the WIGOS initiative launched by the Fifteenth Congress,

Recognizing that:

(1) WIGOS and WIS are strategic priorities of the Organization to improve Members' capabilities to effectively provide in a timely fashion a wide range of high quality data, products and services,

(2) WIGOS will enable the evolution and integration of the observing system components of WMO and enhance collaboration with its partner organizations and programmes,

(3) WIGOS will improve WMO Members' ability to meet expanding national mandates and achieve higher visibility of NMHSs with other environment related agencies,

(4) WIGOS will provide a framework for improved collaboration and coordination between NMHSs and relevant national and regional organizations,

(5) WIGOS will enable WMO Members to better respond to natural hazards, improve environmental monitoring, and adapt to climate change and man-made environmental impacts, especially in developing and Least Developed Countries,

(6) WIGOS will lead to cost-effectiveness and enhancing observing capabilities of Members,

(7) WIGOS is a necessary prerequisite to allow WMO Members to realize the Organization's Strategic Thrusts,

Decides to implement the WMO Integrated Global Observing System (WIGOS);

Decides further that implementation activities will be undertaken during the next financial period as one of the major efforts of the Organization with the goal that WIGOS should become operational from 2016 onwards;

Requests:

(1) ***The Executive Council*** to:

(a) Monitor, guide and support the implementation of WIGOS;

(b) Establish an Inter-Commission Coordination Group on WIGOS (ICG-WIGOS);

(2) ***Regional associations*** to:

(a) Develop their regional WIGOS implementation plans;

(b) Coordinate WIGOS implementation activities with WIS in their operating plan and work programme;

(c) Promote capacity building and outreach activities to assist Members in the implementation of WIGOS;

(3) ***Technical commissions*** to:

(a) Guide the technical aspects of WIGOS implementation;

(b) Incorporate WIGOS implementation activities in their operating plan and work programme;

(c) Provide technical guidance and advice to Members and the regional associations on WIGOS;

(d) Develop guidance for the design and evolution of observing components of WIGOS,

(e) Develop standards to support WIGOS in collaboration with partner organizations and programmes;

(f) Update WMO Regulatory Material, including development of the Manual on WIGOS;

(g) Provide the technical lead for WIGOS through the Commission for Basic Systems (CBS) and the Commission for Instruments and Methods of Observation (CIMO);

(4) Urges ***Members*** to:

(a) Evolve their observing systems to become their national components of WIGOS;

(b) Coordinate their WIGOS and WIS implementation activities;

(c) Provide experts to participate in the WIGOS related work of technical commissions;

(d) Provide adequate resources to the WMO Secretariat to support WIGOS implementation;

(e) Support regional and global WIGOS implementation activities;

(f) Keep the Secretary-General informed about their WIGOS implementation activities;

(g) Share relevant experience and cooperate with one another in implementing WIGOS, including assistance to Members with specific WIGOS-implementation needs;

(5) Requests the ***Secretary-General*** to:

(a) Ensure management of, and within available resources provide support to the WIGOS implementation;

(b) Establish a WIGOS Project Office;

(c) Support the review and update of WMO Regulatory Material, including the development of the Manual on WIGOS;

(d) Coordinate and collaborate WIGOS activities with UN organizations and other relevant international organizations and programmes;

Invites partner organizations to collaborate with WMO on the implementation of WIGOS.

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Note: This resolution replaces Resolution 30 (Cg-XV), which is no longer in force.

ANNEX II: Res. 2/2 (EC-LXIII) - INTER-COMMISSION COORDINATION GROUP ON THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM (ICG-WIGOS)

THE EXECUTIVE COUNCIL,

Noting Resolution 11.3/1 (Cg-XVI) – Implementation of the WMO Integrated Global Observing System (WIGOS),

Considering the request expressed in Resolution 11.3/1 (Cg-XVI) for the Executive Council to:

(1) Monitor, guide and support the implementation of WIGOS,

(2) Establish an Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) with representatives of regional associations and international partner organizations during the implementation process,

Decides:

(1) To establish an Inter-Commission Coordination Group on the WMO Integrated Global Observing System (ICG-WIGOS) with terms of reference as follows:

   (a) To coordinate and prioritize WIGOS-related activities carried out by relevant technical commissions for all WMO domain areas, including deserts and drylands;

   (b) To provide technical guidance and assistance for the planning, implementation and further development of the Global Observing System, the Global Atmosphere Watch, the World Hydrological Cycle Observing System and the Global Cryosphere Watch (GCW) as core components of WIGOS, including interoperability of observing systems, their long-term sustainability, standardization of instruments and methods of observation, WMO Information System information exchange and discovery, and the quality management framework;

   (c) To advise the regional associations on the technical and capacity building aspects of WIGOS implementation activities in the respective Regions;

   (d) To improve guidance to Members on implementation of WIGOS at a national level;

   (e) To maintain close cooperation at a technical level with WMO partner organizations such as UNESCO and its Intergovernmental Oceanographic Commission, the United Nations Environment Programme, the Food and Agriculture Organization of the United Nations, and the International Council for Science, and ensure coordination between co-sponsors of the Global Climate Observing System, Global Ocean Observing System and Global Terrestrial Observing System;

   (f) To identify and communicate WIGOS benefits to relevant international partner organizations;

   (g) To address major issues identified by the Executive Council and provide technical advice on the further development and implementation of WIGOS;

   (h) To coordinate WIGOS and WIS related implementation activities;

   (i) To report to subsequent sessions of the Council on the progress in implementation of WIGOS;

(2) That a representative of each regional association, designated by its president, participates in relevant activities of ICG-WIGOS;

(3) That the chairperson may seek advice from, or invite experts, as necessary;

Further decides that the Executive Council focal points on WIGOS will be ex-officio members of ICG-WIGOS to ensure a close link with the Council;

Designates the president of the Commission for Basic System (CBS) as chairperson of ICG-WIGOS;

Requests:

(1) The presidents of technical commissions and regional associations to designate experts representing each technical commission and regional association respectively, to participate in the work of ICG-WIGOS;

(2) The presidents of the technical commissions and regional associations to review, at the annual PTC meeting, outcomes of the work of ICG-WIGOS;

(3) ICG-WIGOS to develop, review and submit the WIGOS Implementation Plan (WIP) for approval by EC-LXIV;

Authorizes ICG-WIGOS to establish Inter-Commission task teams as and when required with representatives of international partner organizations to address WIGOS standardization process, WMO regulatory material issues, and improvement of WIGOS observing components;

Requests the Secretary-General to provide the necessary assistance and Secretariat support for this group, within the available budgetary resources;

Invites the WMO/IOC/UNEP/ICSU Steering Committee for the Global Climate Observing System (GCOS), the WMO/ICSU/IOC Joint Scientific Committee for the World Climate Research Programme (WCRP), WMO/IOC/UNEP/ICSU Steering Committee for the Global Ocean Observing System (GOOS), and the WMO/FAO Joint Scientific Committee for the Global Terrestrial Observing System (GTOS) to participate in relevant activities of ICG-WIGOS and collaborate with WMO on implementation of WIGOS.

Note: This resolution replaces Resolution 3 (EC-LIX), which is no longer in force.

Appendix 1 – List of activities within WMO and co-sponsored observing systems to support implementation of WIGOS [8]

Key WIGOS Processes	Observing System						
	GOS[9]		***GAW***	***WHYCOS***	***GCOS***	***GOOS***	***GTOS***
	Surface	*Space*					
1. Integrated Governance			Membership in WG WIGOS-WIS and its subgroup	WHYCOS International Advisory Working Group (WIAG). Membership in WG WIGOS-WIS and its subgroup	Membership in ICG-WIGOS		
2. Observing System Operation and Maintenance							
3. Quality Management (including Performance Monitoring, Evaluation, Feedback and Remedial actions)			See Table 1 "Central Facilities" p. 18 in GAW SP (GAW Report 172)	Publication of guidelines and manuals in Hydrology	Rely on contributing networks' quality management Guideline for the generation of data sets and products meeting GCOS requirements (GCOS no. 143) Rely on contributing networks' quality management Guiding principles have been set up Guideline for the generation of data sets and products meeting GCOS requirements (GCOS no. 143)		
4. Planning and Optimized Evolution of WIGOS Observing Components			GAW global and regional networks support many purposes, the implementation of the IGACO strategy by GAW. GAW complies with GCOS strategy.	In accordance with WHYCOS guidelines and regional priorities	GCOS Implementation Plan (GCOS No. 138). Close collaboration with space agencies through CEOS and CGMS.		
5. Standardization,							

[8] **The initial draft**

[9] **It is recognized that other systems use satellite data and products**

	System Interoperability and Data Compatibility						
6.	Data and Metadata Management, Delivery and DAR Services through WIS			GAWSIS metadata pilot project for WIGOS Several WDCs in GAW will become WIS DCPCs	Global Runoff Data Centre (GRDC) for global hydrological data. Hydrological Information Systems through regional entities	Rely on data delivery done in contributing networks		
7.	Data Archival and Retrieval							
8.	Collaboration							
9.	Capacity Building			For all regions: GAWTEC Instrument intercomparisons Dedicated workshops	Production of SOPs, Training courses for the operating staff of WHYCOS projects	GCOS Regional Workshop Programme, resulting in ten regional action plans Programmatic guidance to "Climate for Development in Africa" Programme. 12/9/2011GCOS Cooperation Mechanism and System Improvement Programme		
10.	Communications and Outreach			Antarctic ozone bulletins, GHG bulletin, assessment contributions	Through the WhyCOS web page Regional outreach through regional implementation partners, i.e. river basin organisations	GCOS Newsletter Various brochures Web site National GCOS coordinator and focal points		
11.	WIGOS Regulatory material			GAW Technical manuals contribute to WIGOS regulations.	WHYCOS SOPs Data reporting increasingly compliant with WIS.	See no. 2, 4 and 6 under line 3, above		

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Appendix 2 – Secretariat cost/resources estimation

Table 1: WIGOS Secretariat activities and funds needed for 2012-2015 (CHF)

No	***Activities*** [1)]	***Required funds***
1	Governance, management, programmatic activities	500,000
2	Coordination with WIGOS Component Systems	100,000
3	Development of the WIGOS Implementation Plan	10,000
4	Standardization process	100,000
5	Develop, revise and update of WMO Regulatory Material (Manuals, Guides)	100,000
6	Development of WIGOS Databases	
	Operational DB	200,000
	Standardization DB	200,000
	User Requirements and Operational Capabilities DB	200,000
7	Capacity Building	200,000
8	Communications and Outreach	50,000
9	Translation and publication costs	20,000
	TOTAL:	**1,680,000**

[1)] ***Breakdown for each activity is given below*** (these costs are fully related to integration activities with respect to the WIGOS Implementation Phase)***:***

1. Resources amounting to CHF 500K cover: four meetings of the ICG-WIGOS (4x25K=100K); six regional WIGOS implementation-coordination meetings (6x40K=240K);
2. CHF 100K is allocated to convene two WIGOS coordination meetings of experts representing GOS, GAW, WHYCOS, GCOS, GOOS, GTOS (2x50K=100K);
3. CHF 10K is allocated for consultant services to assist the Secretariat in the preparation of the WIP;
4. CHF 100K covers expert services to assist countries to carry out Site classification (50K) and Maintenance classification (50K) for each WMO region;
5. CHF 100K covers consultant services to develop WIGOS-related amendments to the Manual on the GOS (10K), Guide on the GOS (10K), CIMO Guide (20K), WHYCOS Guidelines (10K), Guide to Marine Meteorological services (10K), GAW Guide (10K) and to develop the Manual on WIGOS (30K) (this does not include translation and publication costs);
6. Resources of CHF 200K for each of three WIGOS DBs cover: two expert meetings (2x25K=50K); development of the DB' technical specifications (40K); development of software (50K); development of the Operations Manual (10K); implementation of DBs, including data transfer and input (50K);
7. CHF 200K is allocated to convene one WIGOS training workshop in each WMO Region (6x30K=180K) and accomplish four expert fact-finding missions (4x5K=20K);
8. CHF 50K covers the development of the WIGOS Portal (10K); representation of WIGOS PO at the regional/inter-commission expert team meetings (20K) and at the relevant coordination meetings of partner' organizations (20K).

Table 2: WIGOS Project Office staff resources needed for a period 2012-2015

No	***Position***	***Activities[2)]/Duties***	***Staff cost for 2012-2015 (CHF)***
1	WIGOS Project Manager [3)]	1-8: To lead the WIGOS Project Office taking into consideration lessons learned from existing and future WIGOS projects. This person would also manage and review the implementation of WIGOS, undertake the necessary liaison within the Secretariat and stakeholders and to oversee all the projects within WIGOS.	900,000
2	WIGOS Support and Capacity building Manager	8: To accomplish general duties, such as outreach activities and capacity building. In particular, to assist with capacity building in Member countries and to work with Education and Training (ETR) and Development Cooperation and Regional Activities (DCR) to ensure Members, especially in least developed countries, reap the full benefits of WIGOS. An important role of this position will be to maintain the project register on activities in collaboration with other observing system staffs and task leaders including those not resident in the WMO Secretariat.	500,000
3	WIGOS Technical Documentation Manager	5: To review existing Technical Documentation and Regulations for observing systems in order to prepare appropriate updates as well as the Manual on WIGOS and related guidelines, and to support the expert teams in production of other guidance material such as those needed on the preparation and maintenance of metadata. This officer will also play a key role in the review of technical regulations in coordination with WIS.	500,000
		TOTAL:	**1,9 million**

2) Activities in accordance with Table 1

3) The WIGOS Project Manager post is established and financed from the WMO regular budget

REFERENCED DOCUMENTS

Reports of WMO Constituent bodies

1. Fifteenth World Meteorological Congress, Abridged final report with resolutions (WMO-No. 1026)
2. Sixteenth World Meteorological Congress, Abridged final report with resolutions (WMO-No. XXXX)
3. EC-LVIII, Abridged final report with resolutions (WMO-No. 1007)
4. EC-LIX, Abridged final report with resolutions (WMO-No. 1027)
5. EC-LX, Abridged final report with resolutions (WMO-No. 1032)
6. EC-LXI, Abridged final report with resolutions (WMO-No. 1042)
7. EC-LXII, Abridged final report with resolutions (WMO-No. 1059)
8. EC-LXIII, Abridged final report with resolutions (WMO-No. XXXX)
9. CBS-XIV, Abridged final report with resolutions and recommendations (WMO-No. 1040)
10. CBS-Ext.(2010), Abridged final report with resolutions and recommendations (WMO-No. 1070)
11. Final report of the 1st session of the EC WG on WIGOS-WIS (December, 2007)
12. Final report of the 2nd session of the EC WG on WIGOS-WIS (May, 2009)
13. Final report of the 3rd session of the EC WG on WIGOS-WIS (March, 2010)
14. Final report of the 4th session of the EC WG on WIGOS-WIS (February, 2011)
15. Final report of the 1st session of the Subgroup on WIGOS of the EC WG on WIGOS-WIS (November, 2008)
16. Final report of the 2nd session of the Subgroup on WIGOS of the EC WG on WIGOS-WIS (October, 2009)
17. Final report of the 3rd session of the Subgroup on WIGOS of the EC WG on WIGOS-WIS (October, 2010)

Other relevant documentation

18. Vision for the GOS in 2025 (CBS-XIV, 2009)
19. WIS Project and Implementation Plan (v. 1.2, February, 2010)
20. Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (GCOS-138, WMO/TD-No. 1523)
21. WMO Global Atmosphere Watch (GAW) Strategic Plan: 2008-2015 (WMO/TD No. 1384)
22. Implementation Plan for Evolution of Space-and Surface-based Subsystems of the Global Observing system (WMO/TD-No. 1267)
23. WCRP Implementation Plan 2010-2015 (WMO/TD-No. 1503
24. The first U.S. Integrated Ocean Observing System (IOOS) Development Plan, Washington, DC, January 2006
25. Global Earth Observation System of Systems GEOSS 10-Year Implementation Plan (GEO 1000, February 2005)
26. EUCOS programme management documentation
27. THORPEX International Research Implementation Plan (WMO/TD-No.1258)
28. JCOMM Observing System Implementation Goals for Building a Sustained Global Ocean Observing System in Support of the Global Earth Observation System of Systems (2009)
29. Overarching Implementation Plan for the Ocean Data Portal and WIGOS Pilot Projects for IODE and JCOMM (6 November 2008)

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DEFINITIONS

The section will be developed in due course.

LIST OF ACRONYMS

CONOPS	Concept of Operations
DAR	Discovery, Access and Retrieval
DB	Distributed Database
DCPC	WIS Data Collection or Production Centre
ET	Expert Team (of WMO Technical Commission)
FAO	Food and Agriculture Organization
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GISC	WIS Global Information System Centre
GFCS	Global Framework for Climate Services
GOOS	Global Ocean Observing System
GTOS	Global Terrestrial Observing System
PDCA	Plan-Do-Check-Act cycle
ICG-WIGOS	Inter-Commission Coordination Group on WIGOS
ICPC	Interagency Coordination and Planning Committee for Earth Observations
ICSU	International Council for Science
IOC	Intergovernmental Oceanographic Commission
ISO	International Standards Organization
LDCs	Least Developed Countries
MOU	Memorandum of Understanding
NMHS	National Meteorological and Hydrological Service
NOS	National Observing System
OSEs	Observing Systems Experiments
OSSEs	Observing System Simulation Experiments
QA	Quality Assurance
QC	Quality Control
QMF	Quality Management Framework
QMS	Quality Management System
RCC	Regional Climate Centre
RIC	Regional Instrument Centre
RMIC	Regional Marine Instrument Centre
RRR	Rolling Review of Requirements
SIDS	Small Island Developing States
SLA	Service Level Agreement
TC	Technical Commission
TOR	Terms of Reference
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WIGOS	WMO Integrated Global Observing System
WIP	WIGOS Implementation Plan
WIS	WMO Information System

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Appendix VII

WIGOS IMPLEMENTATION AT A NATIONAL LEVEL

(Initial Guideline on WIGOS activities to be implemented by Members)

(Draft Version 1.10, 15 April 2011)

PURPOSE OF DOCUMENT

The purpose of this Guideline is to assist WMO Members in developing their national WIGOS Development and Implementation Strategy ***(N-WDIS)*** and building a national WIGOS Implementation Plan ***(N-WIP)*** that supports the Strategy ***to implement their integrated national observing system (NOS) as a WIGOS national observing component***.

The Guideline aligns with the WIGOS conceptual and implementation documentation developed by the EC Working Group on WIGOS and WIS, in particular the WIGOS Concept of Operations (CONOPS) and WIGOS Development and Implementation Strategy (WDIS), specifying, *inter alia*, the role and responsibilities of Members in WIGOS planning and implementation. Both documents, in addition to this Guideline, are available on the WIGOS Web page at: www.wmo.int/wigos, under "Principal Documents".

The Guideline also builds on the experiences gained and lessons learned from the WIGOS Demonstration Projects, specifically from the one of the Australian Bureau of Meteorology" (more information available at: http://www.wmo.int/pages/prog/www/wigos/projects.html#demo).

WIGOS PHASES

The WIGOS implementation will start during the sixteenth financial period and will focus on an overall framework for improving and evolving the WMO observing systems into an integrated, comprehensive and coordinated observing system to satisfy, in an efficient, cost effective and sustained manner, the WMO Members' and Partners observing requirements10. The implementation will provide the groundwork for the operational WIGOS foreseen from 2016 onward, respecting diversity among Members, their needs, capabilities and resources available.

National Implementation Phase (2012 - 2015)

This phase will focus on developing and implementing a national framework for improved governance, management, integration and optimized evolution of the NOS coordinated by the NMHS and its partner organizations at the national and sub regional levels. It will focus on implementing WIGOS requirements through tasks and activities specified in the N-WIP.

National Operational Phase (2016 onward)

Once the framework is established, the NOS enters its Operational Phase, during which the NOS will continuously evolve over time to improve service delivery and support decision making in response to the user needs and available technological opportunities.

WIGOS KEY IMPLEMENTATION COMPONENTS

The key implementation components of the N-WDIS should include:

1. Planning and optimized evolution of a national observing system;
2. Integrated governance and management of a national observing system;
3. Technological infrastructure of a national observing system;
4. Quality management, including performance monitoring, evaluation, feedback and remedial actions;
5. Standardization and interoperability;

10 "Observing requirements" / "users' requirements" also include requirements of any application utilizing observational data and products.

6. Data delivery and information services through WIS, including data/metadata management;
7. Collaboration and coordination with partners;
8. Capacity building;
9. Communications and outreach;
10. System monitoring, evaluation and follow-up measures.

A brief description of the major implementation components is given in the following paragraphs.

1. Planning and optimized evolution of a national observing system

Planning is the first step of the Plan-Do-Check-Act (PDCA) Cycle to ensure that an integrated NOS will provide information for decision-makers in weather, climate and water sectors, for their use in real time, as well as information on climate change mitigation and adaptation, and disaster risk management; all in a coordinated, sustained and cost effective manner. Over time, this information will become more service-oriented.

To meet this WIGOS requirement in the planning process, it is important to implement and maintain an integrated and up-to-date view of user requirements and follow-up solutions through a coordinated strategic planning of the NOS based on outcomes of the Gap analysis and the Rolling Review of Requirements (RRR) process as an ongoing activity to guarantee continuous assessment of all user requirements, NOS capabilities and information provided, reflecting driving forces and priorities.

National RRR process

The development and implementation of a national RRR process will provide Member with a way to understand and assess user requirements, to inform the characteristics of the observations required and to design the system solutions that will deliver them; a tool for coordinated evolution of the NOS to tackle those requirements in an integrated way.

A comprehensive strategic and operational planning process will then allow the development of staged approaches to the design, development and implementation of new and/or improved systems, processes and networks, supported by the development of well-structured business cases and budget proposals. Failure with budget proposals may limit the achievability of the overall plans, but the information gained through the RRR process will still inform decisions on priority use of existing resources.

This includes close collaboration and coordination with all users to assess their requirements; a review of the existing components of the NOS; assessment of their adequacy in meeting current and future requirements; identifying future opportunities; prioritizing; and finally deciding on a strategy matched with resources available.

In addition to meeting requirements at a national level, the NMHS needs to address international commitments as a part of the design, development and implementation of the NOS. The Member is committed to implementing an integrated NOS that addresses the Vision for global observing systems in 2025; the GAW Strategic Plan (2008-2015); WHYCOS Guidelines as well as GCOS, GOOS and GTOS Implementation Plans.

Driving forces likely to impact on the design, operation and required deliverables of the NOS in the future include:

- Need for a holistic approach to planning and evolution of the NOS and enhanced integration of its components;
- More demanding service requirements in all respects, in a contrast to increasing pressure on resources;
- Greater emphasis on climate monitoring and services compared to weather service provision;
- Increased requirements for quality management, standardization and interoperability, efficiency and cost effectiveness;

- Available or emerging technological opportunities;

2. Integrated governance and management of a national observing system

To embrace the WIGOS concept more comprehensively at a national level requires an integrated approach to the design and operation of the full suite of national observing systems; in effect, operation of a national composite observing system (that is, a system of systems) that is optimised to address diverse user needs as efficiently and effectively as possible and with just enough redundancy and overlap to provide resilience and continuity.

Members will, in due course, receive regulatory and guidance material that will assist them in the integrated management and operation at a national level; also, technical guidance on how to design, develop and implement an integrated NOS to provide comprehensive observations in response to the needs of all WMO Members and Programmes will be available.

In implementing WIGOS at a national level, the current management, governance and support activities should be reviewed and aligned with WIGOS requirements. This alignment should enable collaboration and promote cooperation and coordination at the technical, operational and administrative levels.

The internal structure of the NMHS (departments/branches responsible for observations) should be organised in a manner that aligns with and facilitates the WIGOS concept at a national level. The integrated management should ensure an effective integration of observations from many sources inside the NMHS that includes as well an assessment tool of the value of each observation individually (see below Quality management); an integrated use of observations from various observing networks/systems; an integrated use of observations from different technologies with a range of characteristics. It should ensure that an integrated view of all component systems is at the forefront of planning and implementation activities.

A comprehensive data framework is needed to facilitate integration efforts: it is a framework of policies and processes that govern the end-to-end data landscape in the organization, including all aspects of data acquisition, management and usage, and linked to the international framework.

3. Technological infrastructure of a national observing system

Implementing WIGOS requirements at a national level requires an assessment and likely/possible modernization of data acquisition, processing, management and information systems. It includes a review of a status and capabilities of hardware, software and means of communication. Appropriate infrastructure should be set up / upgraded (if needed) during the implementation phase for a successful efficient and cost effective operation of the NOS.

With regard to the organization of an efficient data processing, as well as to guarantee rapid and flexible data/metadata access for all key applications, the idea of a central platform with an integrated and consistent data pool becomes pivotal. This approach should be put in a practice by setting up and operating a Data Warehouse (DW) system for data/metadata processing, management and information purposes. WIS Centres (National Centres / Data Collection or Production Centres) should be used for these purposes.

Integrated management of the NOS should be supported by a fully automatic multifunctional round-the-clock Management and Information System (MIS) built on the DW system that provides all information for both, a NOS management unit and decision-making.

4. Quality management, including performance monitoring, evaluation, feedback and remedial actions

The need for greater accountability in the operation of the NOS is recognized through recommendations for implementation of a Quality Management System (QMS), including more

systematic performance, evaluation and feedback with remedial actions. Consistent documentation about system performance, its operation, processes and procedures would assist not only in more effective whole-of-life planning, including operating, maintenance and replacement strategies, but also in assessing the value of observations.

NOS as an observing component of WIGOS should ensure that observations, records and reports on weather, climate and water, and other environmental resources, operational forecasts, warnings, related information and services are quality-assured, of identified and well documented quality, and in compliance with relevant WIGOS joint standards agreed upon with other international organizations.

To meet this WIGOS requirement, an integrated QMS that specifies all quality assurance (QA) and quality control (QC) standards/best practices for the NOS should be developed and implemented. It will ensure reliability, quality and timeliness of data streams with adequate quality control and relevant metadata. The N-WIP should specify all processes of QMS to be implemented, including performance monitoring, evaluation, feedback and remedial actions to fully meet WIGOS QMF requirements. Some basic principles of an effective QMS are as follows:

- All QMS processes and procedures must be well documented;
- Data/product quality must be known and documented at any stage of data processing.

Developing and implementing WIGOS successfully also requires a systematic and rigorous performance monitoring and evaluation (PM&E) of WIGOS capabilities in terms of both the flow of observational data/products to models and provision of products/information for decision-support tools and services in accordance with requirements specified by end users.

For more detailed technical guidance, reference could be made to following WMO technical documentation: Guide on the Quality Management System for the provision of meteorological Service for International Air Navigation (WMO-No. 1001), as well as the Guide on the Global Observing System (WMO-No. 488) and WMO Guide to Meteorological Instruments and Methods of Observation (CIMO Guide) (WMO-No. 8).

5. Standardization and interoperability

Taking into account the ongoing rapid progress in technology that will continue to provide a basis for further improvements in the capability, reliability, quality and cost-effectiveness of observations, WIGOS must utilize international standards and best practices set by WMO and partner organizations. A common standardization process is needed to facilitate interoperability of WIGOS national observing components as well as compatibility of their observational data and products.

A successful WIGOS standardization process will have to adequately address the differences and inconsistencies in current technical specifications, data acquisition, processing and quality management systems used by individual NMHSs and partner organizations before national and international observing systems can be regarded as truly integrated.

The NMHS needs to understand and address the evolving requirements for standardization and interoperability as embodied, in due course, in WMO Regulatory Material.

6. Data delivery and information services through WIS, including data/metadata management

WIGOS is crucially dependant upon effective WIS support and services. This includes the specialized data collection means as well as the generation, collection, management and handling of related metadata11) that is essential to ensuring that WIGOS data meet the stringent traceability requirements of special users such as climate scientists. The metadata also play an important role in the discovery

11) It is necessary to clearly distinguish between station/platform metadata ("WIGOS metadata") and WIS metadata needed for Data Discovery, Access and Retrieval (DAR) services that WIS must provide. Both are essential to WIGOS.

and access to observations and products. The needed metadata therefore includes both that which pertain to the observational information as well as that which describes the observational products and which is necessary to share the information.

7. Collaboration and coordination with partners

Close collaboration and cooperation among the NMHS and other relevant national agencies, establishment and implementation of appropriate mechanisms, defining partnerships and data policy principles, while respecting ownership, are needed to meet WIGOS requirements at national level. It specifically refers to enhanced cooperation among meteorological, hydrological and marine/oceanographic institutions/services where they are separated at the national level.

Interagency and inter-observing system coordination mechanisms at the international level will need to be complemented and supported through similar cooperation and coordination arrangements between the NMHS and its counterpart national implementation mechanisms for GCOS, GOOS, GTOS and GEOSS at a national level.

8. Capacity building

Specialized training activities should be reflected in the N-WIP, especially in case of LDCs, LLDCs and SIDS. Hence, capacity building is not to be limited to scientific and technological concerns, but also to strategic and management consideration including human resources development, and resource mobilization. To take advantage of WIGOS benefits, technological innovation will be essential.

From a WIGOS perspective, capacity building at a national level should be focused mainly on enhancing organizational capabilities through:

- Technological innovation, including decision-making tools to convert observational data and products into information for right and timely decision (implementing an integrated MIS for end users);
- Human skills development and training, including decision-support tools;
- Technical assistance for observing system/network managers;

9. Communications and outreach

Effective communications and sharing of experiences, lessons learned from the implementation process, reaped benefits, and documentation on standards / best practices between the NMHS and other national partner agencies, including the national counterparts of the cosponsors of GCOS, GOOS, GTOS and GEO is the first practical step towards implementing a more integrated approach to the operation of the NOS.

10. System monitoring, evaluation and follow-up measures

Periodic review and assessment of the integrated NOS, specification of follow-up measures and consequent modifications as necessary, all those are the inseparable parts of the PDCA cycle discussed under "1. Planning and optimized evolution of a national observing system" for a continuous improvement of an efficient, cost effective and sustained NOS and its performance.

IMPLEMENTATION TASKS

The N-WIP should identify all WIGOS implementation tasks at a national level, including a risk management plan. The key tasks could be as follows:

1. Validate users requirements for weather, climate, water and related environmental observations using the RRR process (an integrated view of user requirements):

1.1 Assess capabilities of the NMHS observing network(s) to meet its own present and future requirements (Gap analysis of NMHS observing system capabilities);

1.2 Assess the national observing system against national needs and international requirements (sub regional/regional, WMO, partner organizations) (Gap analysis of NOS capabilities vs. national and international needs and requirements);

1.3 Summarize capabilities of Member's observing systems/networks and user observational requirements; document user requirements in all details (horizontal and vertical resolutions, observing cycle, timeliness and accuracy) and identify gaps, shortcomings, deficiencies and incompatibilities of the current systems;

1.4 Collaborate and coordinate with partners at the national and sub regional level (if needed) to overcome the gaps and shortcomings, and minimize duplications and shortcomings of the current systems taking into account driving forces and priorities as well as available technological opportunity, through possible solutions, like integrated network and date management, adjusting observing programmes, sharing/integrating observing platforms/subsystems, etc;

1.5 Specify a data framework (data policies and processes).

2. Develop and implement QMS for its observing network(s)/system(s), including detailed specification of all processes, procedures and best practices for data acquisition and processing, QA/QC, monitoring, evaluation, feedback and remedial actions.

3. Enhance (or initiate if not in a practice) the NMHS standardization process:

3.1 Examine current practices used by the NOS;

3.2 Determine, implement, maintain and document common standard processes, procedures and best practices; procedures for the generation of observational data, products and associated metadata from the NOS using standardized data and metadata representation in compliance with WIS information exchange requirements for all applications and users, including those for observing system interoperability; traceability and consistency of observations (recommendations on instruments and methods of observation).

4. Develop the NOS basic tools as the parts of the DW system:

4.1 The integrated national database system incl. metadata (WIGOS observational metadata, and WIS Discovery, Access and Retrieval (DAR) metadata);

4.2 The standardization database (to document all implemented processes, standards, best practices, procedures); and

4.3 The NOS web portal providing relevant information on communications, outreach and capacity building.

5. Implement WIS requirements for data/metadata management and data/metadata representation.

6. Establish an effective communications and outreach strategy with national/sub regional partners with assistance of the WMO Secretariat.

7. Specify procedures for an effective use of low quality data to fill the gaps in high quality data series. It requires good metadata practices and well documented procedures and data quality (requirements covered by activities carried out under 2. and 3.).

8. Establish coordination mechanisms with partner organizations at national and sub regional levels.

9. Develop a national capacity building strategy.

10. Develop a resources strategy (expertise and funds).

11. Develop a risk management plan.

RESOURCES

WIGOS implementation at a national level will require initial investment. This investment should be a

significant component of the N-WIP.

The NMHS needs to recognize the principle that WIGOS activities are within the responsibility of WMO Members themselves and should be borne by national resources. It will require planning, priority setting and committed effort over a considerable number of years. It has been learned from the Australian demonstration project that substantial changes in the national observing system depend on substantial adjustments to resource commitments. Such adjustments are not easy without planning and priority setting with a long lead time.

The success of the WIGOS implementation will depend critically upon protecting adequate resources for both technical programme management and specific network needs. Data/metadata acquisition, processing and management systems that facilitate access, processing, monitoring, use, and interpretation of the data with a help of associated metadata have crucial importance.

Also, the NMHS should endeavour to assist efforts to secure adequate resources for the WMO Secretariat to support WIGOS implementation. Depending on the decision of Cg-XVI, a commitment to implement WIGOS will lead to a need for an expansion of resources in the WMO Secretariat. This support will be critical for successful completion of the WIGOS implementation. All Members will need to support it either through the regular budget, or secondment services and voluntary contributions to the WIGOS Trust Fund.

(Instead of) ***CONCLUSION***

Establishing a comprehensive 'system of systems' that meets the observational needs of multiple users and applications areas takes considerably more effort, and each Member will need to assess the size of that challenge and weigh up the costs and benefits. Through engagement of non-NMHS organisations in a national 'system of systems', the NMHS may use it as an opportunity to consolidate its own role as the national meteorological authority, especially in areas where they may be some challenge to that, for example in climate monitoring and delivery of climate services.

Integration does not mean that 'one size fits all'. Where opportunities do exist to serve multiple needs with a single solution, then real efficiencies can be delivered, but as a rule, integration is more about finding an optimum balance between needs and solutions.

As the integration process moves forward, gaps and shortcomings, incompatibilities, deficiencies in national observing system capabilities and duplications of efforts will be identified and addressed. This is the most cost effective and efficient way to make better use of existing infrastructure and improve the timeliness, quality and utilization of observational information for enhanced services and decision making.

ASSISTANCE PROVIDED BY THE WMO SECRETARIAT

Within the WMO Secretariat, the WIGOS Branch of the Observing and Information Systems Department (OBS) will provide the necessary support to Members when implementing WIGOS at a national level. Any WIGOS related inquiry and request for assistance should be sent to the Secretariat to the following address:

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Dr Wenjian ZHANG	***Dr Igor Zahumensky***
Director	***WIGOS Planning Office***
Tel: +41(0) 22 730 8567	Tel: +41(0) 22 730 8277
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E-mail: wzhang@wmo.int	E-mail: izahumensky@wmo.int
WMO, 7 *bis,* Avenue de la Paix, Case postale 2300	

CH 1211 Genève 2, SWITZERLAND

Annex

The Plan-Do-Check-Act (***PDCA) cycle***

The PDCA cycle is an efficient tool for continual improvement. The methodology applies to both high-level strategic processes and to simple operational activities. It consists of:

- ***P***-Plan: plan the improvement (based on the Gap analysis: what is required to be done; where, when and how to do it; who should do it);
- ***D***-Do: implement the plan;
- ***C***-Check: monitor and measure the results against the plan, requirements, policies and objectives;
- ***A***-Act: take actions and measures to improve the process / performance.

The PDCA cycle is the never ending cycle that can be applied within any individual process or across a group of processes within the organization. Further information can be found at: http://asq.org/learn-about-quality/project-planning-tools/overview/pdca-cycle.html, http://www.9001quality.com/continual-improvement.html.

Gap analysis

Gap analysis is a technique for determining the steps to be taken in moving from a current state to a desire future state. It is also called “need-gap analysis” or “needs analysis”.

Gap analysis allows the organisation to compare an 'as is' scenario with a desired 'future state'. Gap analysis generally follows 5 steps: (1) reviewing a current [as is] system; (2) determining requirements of the proposed [future state] system and (3) comparing these two states in order (4) to determine the implications and (5) requirements involved in getting from one state [as is], to the other [future state]. Further information can be found at: (http://toolboxes.flexiblelearning.net.au/demosites/series9/906/msd_respak/msd_e2/html/msd_e2_compads.htm)

Key gaps in observing capabilities identified will result in proposals for activities to fill these gaps reflecting priorities and taking into account resources available.

Rolling Review of Requirements (RRR) process

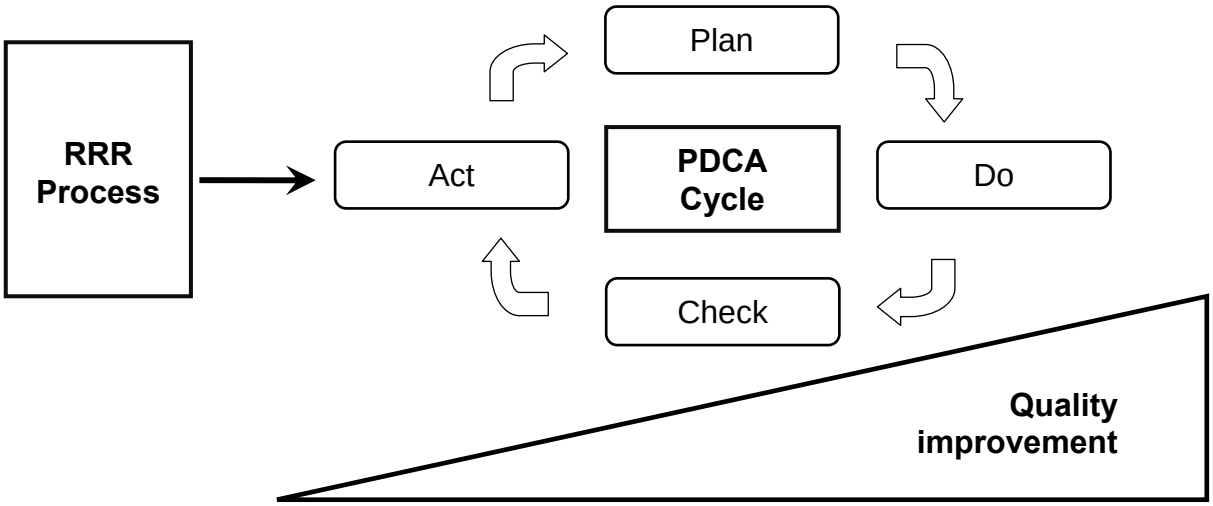
The RRR process described by the Guide on the Global Observing System (WMO-No. 488) (Part II, Observational Data Requirements, 2.3.1), is used to compare user observing requirements with the capabilities of present and planned observing systems to provide them.

The process consists of four stages:

1. A continuous review of user requirements for observations;
2. A continuous review of the observing capabilities of existing observing systems and available or emerging technological opportunities;
3. A Critical Review of the extent to which the capabilities (2) meet the requirements (1);
4. A Statement of Guidance based on (3).

The RRR process will “continuously” issue new Statements of Guidance to be implemented in the NOS management. It is a process directly linked to the Act step of the PDCA cycle.

The relationships between the RRR process and PDCA cycle is shown in Figure below.


RRR Process
Plan
Act
PDCA Cycle
Do
Check
Quality improvement

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Appendix VIII

FUTURE WORK PROGRAMME AND ACTION PLAN OF ICG-WIGOS

Table 1: Milestones and timetable for CONOPS-2 (WIGOS Functional Architecture)

Y-Q	*Milestone*	*Indicator* [1)]
2011		
4. Q	CONOPS-2, draft v.03 (by 25.XI.)	All comments of ICG-WIGOS-1 and its Participants provided by 31.X. incorporated in v.03; v.03 distributed to TC-FP & M-FP by 30.XI.
	TCs Focal Point (WIGOS-TCFP) nominated	Joint letter of Chair/ICG-WIGOS and D/OBS distributed to P-TCs by 30.X.; nominations received by 30.XI.;
	Selected Members FP (WIGOS-NFP) nominated	Letter of SG to PRs of those Members distributed by 30.X.; nominations received by 30.XI.;
	Comments from TC-FP & M-FP received by 31.XII.	
2012		
1. Q	CONOPS-2, draft v0.4 submitted to PTC	Comments from TC-FP & M-FP incorporated; distributed to P-TC and P-RA by two weeks before PTC-2012
	CONOPS-2, draft v0.5	Comments from PTC incorporated; draft distributed to TC-FP & M-FP by 31.III.
	P-TCs and P-RAs reports on incorporation WIGOS activities to their programmes and plans	PTC reported on the progress; guidance specified how to progress further
2. Q	CONOPS-2, draft v0.6	Comments from TC-FP & M-FP incorporated; draft presented at JCOMM-IV; draft submitted to EC-LXIV
	CONOPS-2, draft v0.7	Comments from EC-LXIV incorporated;
	CONOPS-2, draft v0.8	Structure of CONOPS-2 is fixed; distributed to P-TC and P-RA by 30.VI.
3. Q	CONOPS-2, draft v0.9	Comments from TC-FP & M-FP incorporated; distributed to ICG-WIGOS by one month before ICG-WIGOS-2 for comments to be discussed at ICG-WIGOS-2
4. Q	CONOPS-2, draft v0.10	Comments by ICG-WIGOS-2 incorporated; draft v0.10 presented at XV-RA-II, CBS-XV, CHy-XIV
2013 CONOPS-2 further elaborated based on the feedback/recommendations received; details be incorporated in due course		
1. Q		
2. Q		
3. Q		
4. Q		
2014 CONOPS-2 further elaborated based on the feedback/recommendations received; details be incorporated in due course		
1. Q		
2. Q		
3. Q		
4. Q		
2015 CONOPS-2 finalized based on the feedback/recommendations received; details be incorporated in due course		
1. Q		
2. Q	CONOPS-2	Approval by Cg-XVII
3. Q		
4. Q		

[1)] Each new draft distributed also to Chair, ICG-WIGOS; a new available version presented at all WMO Constituent bodies session (in 2012: JCOMM, RA II, CBS and CHy)

Table 2: Milestones and timetable for Metadata

Y-Q	*Milestone*	*Indicator*
2011		
4. Q	- ToRs for TT-WIGOS-MD defined - Members and chair identified	ToRs[13)] and membership/chair submitted to PTC after consultation with members ICG-WIGOS
2012		
1. Q	- PTC endorses membership - Secretariat invites first meeting	
2. Q	- First meeting of TT-WIGOS-MD	- work plan 2012-15 established
3. Q	- IPET-WIGOS-MD established	- IPET-WIGOS-MD established under CBS OPAG-IOS (at CBS-XV) - IPET-WIGOS-MD reports to ICG-WIGOS-2
4. Q	- Assessment report of existing metadata models - WIGOS MD design concept	
2013		
1. Q	- WIGOS-MD tree v0.1 available	- endorsement by PTC
2. Q	- WIGOS-MD tree v0.2 available - WIGOS-MD discoverable through WIS	- Demonstration to EC Agreed practice for linking from WIS metadata to WIGOS metadata in the WIS descriptions of datasets
3. Q		
4. Q	- at least one pre-operational demonstrator	
2014		
1. Q	- WIGOS-MD tree v1.0 [14)] available	Documentation of v1.0 released for general testing and feedback.
2. Q		
3. Q		
4. Q	- Pre-operational implementation by at least one NMHS in each RA	
2015		
1. Q		
2. Q	- WIGOS-MD core in place, demonstrations declared to be operational	- Demonstration to Cg-XVII
3. Q		
4. Q		

[13)] TOR to be in line with WIS planning
[14)] V1.0 will have defined the core as well as optional items

Table 3: Milestones and timetable for Manual on WIGOS

Y-Q	*Milestone*	*Indicator*
2011		
4. Q	MANUAL – draft v0.0.1 MANUAL – draft v0.0.2 Task Team (TT) on MANUAL established 1st meeting of TT MANUAL – draft v0.0.3	Considered by ICG-WIGOS-1; Recommendations of ICG-WIGOS-1 incorporated; Specified and approved: TORs, Membership, Work plan FR of the meeting TT propose structure for Manual and level of detail of initial Version 1.0; identify gaps to set work plan for Manual preparation Outcome of the meeting; Draft distributed for review by TCs/RAs
2012		
1. Q	MANUAL – draft v0.0.4	Draft considered by PTC; final inputs incorporated; Draft circulated to partner organisations and Constituent Body Management Groups.
2. Q	MANUAL – draft v0.0.5 MANUAL– draft v0.0.6 MANUAL – v0.0.7 MANUAL – v0.1.0	TT revises Manual Draft finalized and approved by Chair, ICG-WIGOS and D/OBS; Presented to JCOMM Draft considered by EC-LXIV; recommendations provided
3. Q	MANUAL – draft v0.1.2 MANUAL – draft v0.1.3	Updated by ICG-WIGOS-2; recommendations incorporated; Presented to CBS
4. Q	MANUAL – draft v0.1.4	Presented to CHy
2013		
1. Q	MANUAL – draft v0.1.5	considered by PTC; recommendations incorporated Formal TT meeting Draft circulated to partner organisations and Constituent Body Management Groups.
2. Q	MANUAL – v0.2.0	Update approved by EC-LXV; recommendations incorporated;
3. Q	MANUAL – v0.2.1	Presented to CAS
4. Q	MANUAL – draft v0.2.2	Updated by ICG-WIGOS-3; recommendations incorporated;
2014		
1. Q	MANUAL – draft v0.2.3 MANUAL – draft v0.2.4	considered by PTC; recommendations incorporated; Draft circulated to partner organisations and Constituent Body Management Groups. CAgM consider draft Possible TT meeting?
2. Q	MANUAL – v0.3.0 MANUAL – v0.3.1	Update approved by EC-LXVI; recommendations incorporated; CAeM consider draft
3. Q	MANUAL – v0.3.2	Updated by ICG-WIGOS-4; recommendations incorporated;
4. Q	MANUAL – v0.3.3	CIMO consider draft
2015		
1. Q	MANUAL – draft v0.3.4	considered by PTC; recommendation for approval; Draft circulated to partner organisations and Constituent Body Management Groups.
2. Q	MANUAL – v0.3.5 (To Cg) MANUAL – v1.0 (From Cg)	Approved by Cg-XVII; ongoing WIGOS governance approved; recommendations for future direction specified
3. Q	MANUAL – draft v1.1 et seq.	Continuing evolution mechanisms implemented
4. Q		

Notes:

- *Manual drafts presented to Commission Management Groups when they meet.*
- *Major drafts co-ordinated with CGMS*
- *Documents will be provided to Regional Association Meetings for comments and recommendations and these will be considered in further drafts.*
- *Drafts of the Manual provided to Partner Organisations for information (IOC [GOOS as well], ICAO, etc.*
- *NB Draft numbers are indicative - more or fewer drafts may be required.*
- *ICG-WIGOS, TT and other meetings associated with preparing Manual may be held electronically, and the standard way of working between meetings is an electronic.*

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Table 4: Milestones and timetable for Communications and Outreach & Capacity Development

Y-Q	*Milestone*	*Indicator*
2011		
4.Q	Nomination of national, regional and TC Focal Points (WIGOS-NFP, WIGOS-RAFP, WIGOS-TCFP)	Circular letter of SG to PRs and P-RAs with a request of nomination of the N-FP/R-FP/TC-FP, respectively (by 31.XII.) together with WIGOS "info" package (see below)
	Initial WIGOS "info" package developed	WIGOS "info" package distributed through the Circular letter of SG to PRs and Partners (in accordance with decisions of Cg-XVI; ref. is made to the *WIGOS related actions from Congress XVI* (ICG-WIGOS-1/Doc. 3.3-ADD1)) taking into account related guidance and recommendations by ICG-WIGOS-1
2012		
1. Q	WIGOS **PROJECT** Office established	One professional staff dealing specifically with Communications and Outreach & Capacity Building activities, supported fully by G staff for administration purpose
	Draft Communication and Outreach Strategy finalized	Draft considered by EC-LXIV; communications activities incorporated into the High-level WIP for consideration by EC-LXIV
2. Q	Further details for ***2012-2015*** will be added in due course, in accordance with the draft Communication and Outreach Strategy, draft WIP and recommendations by EC-LXIV	
3. Q		
4. Q		
2013		
1. Q		
2. Q		
3. Q		
4. Q		
2014		
1. Q		
2. Q		
3. Q		
4. Q		
2015		
1. Q		
2. Q		
3. Q		
4. Q		

Table 5: Milestones and timetable for a High-level WIGOS Implementation Plan

Y-Q	*Milestone*	*Indicator*
2011		
4. Q	WIP – draft v0.4 WIP – draft v0.5 Task Team (TT) on WIP established 1st meeting of TT WIP – draft v0.6	Considered by ICG-WIGOS-1; Recommendations of ICG-WIGOS-1 incorporated; Specified and approved: TORs, Membership, Work plan FR of the meeting Outcome of the meeting; Draft distributed for review by TCs/RAs
2012		
1. Q	WIP – draft v0.7	Draft considered by PTC; final inputs incorporated;
2. Q	WIP – draft v0.8 WIP– draft v0.9 WIP – v1.0	Draft finalized and approved by Chair, ICG-WIGOS and D/OBS; Draft considered by EC-LXIV; recommendations incorporated; Draft approved by EC-LXIV for implementation
3. Q	WIP – draft v1.1	Implementation started
4. Q	WIP – draft v1.x	Updated by ICG-WIGOS-2; recommendations incorporated;
2013		
1. Q	WIP – draft v1.x	considered by PTC; recommendations incorporated
2. Q	WIP – v2.0	Update approved by EC-LXV; recommendations incorporated;
3. Q		
4. Q	WIP – draft v2.x	Updated by ICG-WIGOS-3; recommendations incorporated;
2014		
1. Q	WIP – draft v2.x	considered by PTC; recommendations incorporated;
2. Q	WIP – v3.0	Update approved by EC-LXVI; recommendations incorporated;
3. Q		
4. Q	WIP – draft v3.x	Updated by ICG-WIGOS-4; recommendations incorporated;
2015		
1. Q	WIP – draft v3.x	considered by PTC; recommendations incorporated;
2. Q	WIP – v4.0 including post-implementation review	Progress (completion) confirmed by Cg-XVII; recommendations for future evolution specified. Management handed over to WIGOS governance structures. Plans for evolution of Component Systems
3. Q	WIGOS Improvement Plan – draft WIP v4.x	Start of continuous improvement phase
4. Q		

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