

## **Terms of Reference**

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# **DEVELOPMENT OF COST RECOVERY SYSTEM OF DHM AERONAUTICAL METEOROLOGICAL SERVICES**

**(Contract ID No: PPCR/DHM/S/CQS-40)**

**Department of Hydrology and Meteorology,  
Building Resilience to Climate Related Hazards Project  
Kathmandu**

**June, 2016**



## **1. Background**

The unique topography, largely poor and resource dependent population and, weak institutional capacity to manage the climate challenges has made Nepal, the fourth most climate vulnerable country in the world. Floods, droughts, and landslides are deadly and endemic. Moreover, the effects of climate change are expected to intensify extreme weather events and other climate risks in the region.

Recognizing the high level of exposure to climate change risks, the Climate Investment Fund (CIF) selected Nepal as one of the nine pilot countries for the Pilot Program for Climate Resilience (PPCR) in 2009.<sup>1</sup> In Nepal, PPCR is administered by Asian Development Bank, The International Finance Corporation and The World Bank.

Government of Nepal has prepared a Strategic Program for Climate Resilience (SPCR) which was approved by Climate Investment Fund (CIF). The Building Resilience to Climate Related Hazards (BRCH) is one of the four projects funded through the Nepal Pilot program for Climate Resilience (PPCR) under the Strategic Climate Fund.

The main objective of the BRCH project is to enhance government capacity to mitigate climate related hazards by improving the accuracy and timeliness of weather and flood forecasts and warnings for climate-vulnerable communities, as well as developing agricultural management information system services to help farmers mitigate climate-related production risks.

The above mentioned objectives would be achieved by establishing multi-hazard information and early warning systems, upgrading the existing hydro-meteorological system and agricultural management information system, and enhancing capacity of the government organizations, specifically the Department of Hydrology and Meteorology (DHM). Activities funded through the project would help improve decision-making and planning in key climate vulnerable and water resources dependent sectors particularly agriculture, health, water and disaster management, and contribute to building climate resilience for communities at risk. The BRCH project became effective in June 2013 and is currently under implementation.

The BRCH project comprises of the following four Components:

- A) Institutional strengthening, capacity building and implementation support of Department of Hydrology and Meteorology (DHM);
- B) Modernization of observation networks and forecasting;
- C) Enhancement of the service delivery system of DHM; and
- D) Creation of an agriculture management information system (AMIS).

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<sup>1</sup> For more information on PPCR visit,

[https://www.climateinvestmentfunds.org/cif/Pilot\\_Program\\_for\\_Climate\\_Resilience](https://www.climateinvestmentfunds.org/cif/Pilot_Program_for_Climate_Resilience)

DHM is responsible for the implementation of Components A, B and C. Ministry of Agriculture Development (MoAD) is responsible for the implementation of Component D.

The first component A includes Institutional strengthening, Capacity building and Implementation Support of Department of Hydrology and Meteorology includes assessment of new business models and development of Cost Recovery Systems especially for Aeronautical Forecasting Services, for enhancement of DHM for performance as the main provider of weather, climate and hydrological information for the nation. Different options for cost recovery mechanisms are further elaborated in **Appendix I**.

As part of Component C the DHM services delivery systems will be enhanced. This component includes a design and implementation plan for further development of the aeronautical services for the next 3 years. For details of the rehabilitation of the DHM Aeronautical services, please consult **Appendix II**.

The estimation of capital and operating costs is essential for the decision between different kinds of cost recovery mechanisms which would fulfil the recommendations of International Civil Aviation Organization (ICAO). Following the international rules and best practices would ensure sustainability of high quality aeronautical meteorological services (see references a-j listed in chapter 14).

According to WMO principles the following cost recovery mechanism can be used in the member states of WMO and ICAO when covering the costs of aeronautical meteorological services:

- a) Financing of all or part of the service provision by tax payers through the general State budget;
- b) Financing of all or part of the service provision through specific taxes, part of which is directly allocated to the service provider; the decision to establish such taxes is a sovereign decision of the State and no justification is required;
- c) Financing of all or part of the service provision through user charges (enroute charges or landing fees); it is generally understood that the level of charges is directly related to the service delivered and that it should be justified; in such cases, the service provider is generally requested to justify in a transparent manner the use of the funds allocated from air charges and its costs are carefully watched by the national authorities (this is sometimes called “economic regulation”);
- d) Financing of all or part of the service purely under market conditions; this is particularly easy for direct services but may also raise safety issues;
- e) A combination of the above options.

It is a decision by the state which one of the above options to use and the option used will be based on national charging policy.

## **2. Rationale**

Department of Hydrology and Meteorology (DHM) is an organization under the Ministry of Population and Environment, established with an objective to collect, monitor, disseminate hydrological and meteorological information to the public, private and government organizations. DHM is a government information provider for sectoral planning and also supplier of regular reliable and consistent data inputs for the sectors like aviation, water resources, agriculture, energy, transport, tourism, health and local development among others. The BRCH project

The ICAO has recognized DHM as an authority to provide meteorological services for international flights.

These services can be for example but are not limited to:

- METAR bulletins for all airports with civil aviation
- TAF bulletins for all airports with civil aviation
- Complete SIGMET warnings to Nepalese airspace
- Low level forecast charts for civil aviation

The cost recovery from aeronautical meteorological services is one of the key issues for the long-term and sustainable international and domestic aviation weather services in Nepal. Thus it is very important to plan thoroughly how the cost recovery from aviation weather services is handled in Nepal for DHM.

## **3. Objective**

The main objective of this assignment is to (i) identify aeronautical meteorological services<sup>2</sup> that aviation sector users need from DHM, and prepare a draft agreements on products and cost recovery in coordination with aviation sector; (ii) assess users willingness to pay for different services and (iii) based on a review of Nepal policy and legal context and lessons from international experience, recommend the most suitable cost recovery mechanism for Nepalese aeronautical meteorological services which follows the policies and guidelines defined by ICAO and WMO (see list of references in Ch. 14 below.)

## **4. Scope of Work**

The consultant to be selected for the assignment will work with the System Integrator (SI), Project Management Unit (PMU) and DHM to develop policies and systems to improve

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<sup>2</sup> Services here refers to data, products and Information that the aviation sector users need from DHM.

DHM's ability to fully recover costs associated with aeronautical meteorological service delivery. The specific scope of services include, but is not limited to:

- Envision the standards, quality and level of service for aeronautical meteorological services in Nepal at the end of the BRCH project and in the future
- Identifying the main users of aeronautical meteorological services in Nepal
- Based on consultations with users of aeronautical meteorological services, listing facilities and services which will meet the aeronautical requirements in Nepal and which are exclusively intended to serve aeronautical requirements
- Determining additional services needed in consultation with the Civil Aviation Authority of Nepal (CAAN) (funding partner and regulator) and service users (airlines, airports, Air Traffic Management (ATM), pilots, military, general aviation)
- Defining and agreeing on the Core services provided by DHM in close consultation with users and CAAN which can serve both aeronautical and non-aeronautical users
- Estimate core and direct costs<sup>3</sup> of providing aeronautical meteorological services in Nepal at the end of the BRCH project and in the future in cooperation with DHM
- Develop a Cost recovery system that is accountable and transparent i.e. thus paying customers could specify their needs and requirements in detail.
- Propose a mechanism for regular consultation between DHM with users and CAAN so that fair, equitable cost recovery system is maintained and cost recovery can be agreed continuously.

Candidates should include in the proposal a detailed description of the review methodologies, as well as the methodology for issuing recommendations, prioritizing them and for trainings.

## 5. Tasks of the consultancy

The consultant selected for this assignment is tasked to:

### **Task 1      Analysis of user needs and level of Service for Nepal Aviation Meteorological services**

The Consultant should meet with service users to identify needs and document them in an easily readable table. The firm should also assess what the users are willing to pay for them, how often, through what modality etc.

#### **Task 1.1      Envision the standards, quality and level of service for aeronautical meteorological services in Nepal at the end of the BRCH project and in the future**

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<sup>3</sup> Capital and operating costs are in WMO/ICAO terminology known also as direct and core costs. Those are thoroughly defined in reference material f) and j) listed in chapter 14. Direct costs are e.g. salaries and O&M costs, while core costs are e.g. infrastructure, facility and capital costs.

- Task 1.2** Identify the main users of aeronautical meteorological services in Nepal
- Task 1.3** Based on consultations with users of aeronautical meteorological services, list data, products and services which will meet the aeronautical requirements in Nepal and which are exclusively intended to serve aeronautical requirement; **document services currently being provided by DHM to aviation sector**
- Task 1.4** Determine **gaps and additional services** needed in consultation with the Civil Aviation Authority of Nepal (CAAN) (funding partner and regulator) and service users (airlines, airports, Air Traffic Management (ATM), pilots, military, general aviation)
- Task 1.5** Define and agree on the Core services provided by DHM in close consultation with users and CAAN which can serve both aeronautical and non-aeronautical users
- Task 1.6** Develop initial agreements for products/services and the cost recovery in consultation with aviation industry.

## **Task 2Analysis of international best practices and Options for DHM**

Review of the future situation should be based on the design made by SI in the Phase I of the project. The design will be provided by the SI / PMU upon request.

- Task 2.1** Identify costs related to providing aeronautical meteorological services in Nepal to be classified as core costs ensuring that the operations and services meet the definitions of ICAO and WMO
- Task 2.2** Examine international best practices on full cost recovery of providing aeronautical meteorological services to ascertain DHM options for fully allocating overheads (e.g. surface observation network, weather radars, atmospheric sounding) to Aeronautical Meteorological Services keeping in mind the non-aeronautical community also (other surface transport, civil protection, agriculture, fishing, hydrology, air pollution control, retailing, sports and recreation, tourism, building and construction, the press and other media, and the general public). This share of costs covered by non-aeronautical community shall not be covered by the aeronautical community.
- Task 2.3** Estimate DHM's future finances related to aeronautical meteorological services to determine its actual spending on overhead, administration, and support services, direct spending (meteorological reports and observations, briefing and flight documentation, Meteorological Watch Office duties and core spending (surface and upper-air observation networks of the whole country, meteorological telecommunications systems for aviation sector, data-processing centers, supporting core research and training)

**Task 2.4** Analyze the overhead spending trends of other organizations for provision of aviation meteorological services and scope to DHM to determine a benchmark for what DHM should be spending on key overhead costs such as IT, human resources, finance, and administration to set targets for DHM spending on Aeronautical Meteorological Service

**Task 3 Recommendations for the optimum cost recovery model for DHM**

After analyzing the information collected the Consultant will:

**Task 3.1** Recommend how to best calculate the core (operational) costs resulting from operations that are difficult to allocate directly to Aeronautical Meteorological Services

**Task 3.2** Recommend how to calculate and allocate direct costs to Aeronautical Meteorological Services

**Task 4 Develop and document tools for cost recovery calculation of providing Aeronautical Meteorological Services**

The consultant shall work in collaboration with the DHM, PMU and SI to ensure proposed systems can produce information to the DHM financial system

**Task 4.1** Develop a regular (e.g. once per two years) re-evaluation cycle and methodology for the core cost recovery analysis

**Task 4.2** Determine and recommend the division of costs between en-route and terminal services

**Task 4.3** Determine and recommend the division of costs between general and commercial aviation

**Task 4.4** Determine and recommend the division of costs between domestic and international aviation

**Task 4.5** Determine and recommend the division of costs between VFR and IFR aviation

**Task 4.6** Calculate core costs in situation of BRCH phase-I plans upon completion

**Task 4.7** Provide DHM with a template with calculators to estimate direct and core costs to produce Aeronautical Meteorological services

**Task 5 Training**

Once the recommendations have been endorsed by DHM, the consultant will provide training to relevant staff:

**Task 5.1** Senior management and administration staff on the proposed cost recovery methodology including clear processes for including costs within Aeronautical Meteorological Services, and calculating costs during implementation and reporting.

- Task 5.2** DHM finance staff on the application of the cost recovery method, reporting costs and methods for reevaluating/adjusting the cost recovery method in the future

## **6. Consultant's Qualification and Experience**

This assignment can be completed by a Joint Venture formed by a group of individuals, or a Consulting Firm fulfilling the following requirements:

- At least 5 Years of experience in providing consulting services in cost recovery practices in meteorological services
- Strong experience with financial systems within governmental or organizations providing aeronautical meteorological services
- Demonstrated experience developing full cost recovery strategies for aeronautical meteorological services
- Demonstrated experience providing staff training on processes/systems
- Strong knowledge of ICAO / WMO guidelines and procedures and their application into practice (references a-j)

## **7. Staffing Requirements**

### **Key professionals:**

- a. International Team Leader / Cost Recovery expert (4 months)
- b. National Legal or Financial Expert (1.5 months)

## **8. Minimum and preferred Qualification & Experience**

### **a. International Team Leader / Cost Recovery expert (4 months)**

- Minimum of Master's Degree in Personnel Administration, Management and/or Business Administration. Additional degree on Environmental Law/ Water Law/Hydrology/Meteorology will be an advantage.
- Proven professional experience on conducting Cost Recovery Systems analysis or Business Models on Aeronautical Meteorological Services
- Excellent communication skills; and excellent knowledge of English language (both spoken and written).

### **b. National Legal or Financial Expert (1.5 months)**

- Minimum of Bachelor's Degree in law, accounting, management and/or related field.
- At least 5 years of professional experience
- Strong knowledge of the players and their roles in the Nepalese aviation sector
- Excellent knowledge in written and spoken English.

## 9. Deliverables

The consultant will be expected to produce the following deliverables in close consultation with DHM senior management:

### 9.1 Inception report

1. The inception report should contain the consultant's work plan, and a preliminary table of contents of the following reports. The report should also clearly specify all risks and issues, which may negatively affect an effective execution of work.

### 9.2 User needs assessment and Draft Agreements between DHM and Aviation sector users

2. Report focusing on analysis of User needs, products and services that need to be developed, draft agreements and cost recovery arrangements between DHM and Aviation Sector (corresponding to Task 1)

### 9.3 Analysis and Recommendations report

3. A comprehensive report addressing all the sub-tasks detailed in **Tasks 2 and 3:**
  - Analysis of the full cost of providing services i.e. identification of both operational and capital costs necessary to support services
  - Comparative analysis to benchmark key DHM institutional costs such as IT, HR and Finance against effective similar organizations
  - Proposed core pool costs and how these will be allocated against Aeronautical Meteorological Services;
  - Proposed calculation and allocation of direct costs to Aeronautical Meteorological Services

### 9.4 Cost recovery calculation tools

A calculation tool and documentation addressing the sub-tasks detailed in **Task 4:**

- Templates including calculators for developing Aeronautical Meteorological Services accounting tools for direct costs (the costs of staff, accommodation, furniture and equipment, communications, and so on)

### 9.5 Training

A training plan addressing the sub-tasks detailed in **Task 5:**

- Written training material explaining how to apply the proposed cost recovery method with accompanying tools
- Workshop for DHM executives explaining the rational and process.
- Training on the cost recovery method and how to apply it within DHM's finance systems (aimed at finance staff).

- These trainings will occur in DHM's central office.
- Trainings on the cost recovery method and how to develop Aeronautical Meteorological Services budgets which fully incorporate the cost recovery method. These trainings will occur in DHM's central office. Audience – DHM Customer Relations officers and staff responsible of selling the Aeronautical Meteorological Services.
- Report on the actual process of identifying services and the negotiating price for cost. The report will serve as a reminder of the process and will build capacity.

## **10. Client's Input to the Consultant**

At the request of the Consultant, the DHM shall provide the following:

- Project briefing.
- Description of current organizational structure and financial system of DHM, available legal and regulatory documents.,
- Project Appraisal Report (PAD), results of missions and other World Bank materials, assessment and design reports prepared by SI, related to preparation and implementation of the Project;
- Facilitate meetings with other relevant departments, and private sector relevant to DHM services.

## **11. Performance and Reporting Requirement**

The Consultant shall submit an

- a. **Inception report** within 1 month from the date of signing the contract
- b. **Final draftreport**incorporating the Analysis,all the Recommendations and Cost recovery calculation Toolswith documentation within 5 months from the date of signing the contract
- c. **Written training material and training completed in 6 months.**

## **12. Time-frame and payment modality:**

**Timeframe:** Total duration of the project is 6 months.

### **Payment Modality:**

- The consulting firm shall be paid 10% of the total amount against a bank guarantee after signing of the contract.
- 60% shall be paid after acceptance of the draft Final Report
- 30% shall be paid after training has been completed and upon acceptance of the training material.

The Consulting firm shall be responsible for all taxes and duties including income tax applicable as per the Rules of Government of Nepal.

## **13. Consultant's Selection Method**

The consultant shall be selected on the basis of CQS and consistent with the World Bank's Consultant Selection Guideline, 2011.

## **14. References**

- (a) Doc 7604—Directory of National Civil Aviation Administrations. Necessary to determine which entity is designated to ICAO by the government as the meteorological authority in each country;
- (b) Annex 3 to the Convention on International Civil Aviation—Meteorological Service for International Air Navigation;
- (c) Annex 11 to the Convention on International Civil Aviation—Air Traffic Services;
- (d) ICAO Doc 4444—Procedures for Air Navigation Services—Air Traffic Management (PANS-ATM); these documents detail the meteorological services that States agree are necessary for aviation.
- (e) The country's own Regional Air Navigation Plan (ANP) publication;
- (f) ICAO Doc 9082—ICAO's Policies on Charges for Airports and Air Navigation Services. The basic philosophy and principles expressed in this document, namely fairness and equity in the determination and sharing of air navigation costs, have remained unchanged over the years;
- (g) ICAO Doc 9562—Airport Economics Manual. Guidance material for those responsible for airport management including the setting and collection of charges on air traffic;
- (h) ICAO Doc 9161—Manual on Air Navigation Services Economics. The most important document in the context of cost recovery, this manual contains a number of appendices, including one which gives detailed guidance on determining and allocating aeronautical meteorological costs;
- (i) ICAO Doc 9377 —Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services. This document includes a description of the operational structure to provide air traffic and meteorological services, including coordination of actions between air traffic services (ATS) and meteorological offices. This information should be used for making an inventory of facilities and services needed to meet aviation user requirements.
- (j) WMO-No. 904 - Guide to Aeronautical Meteorological Services Cost Recovery, Principles and guidance.

## **15. Appendices**

Appendix I: Funding Opportunities through Cost Recovery at DHM

Appendix II: Capacity Building of Aviation Weather Services for DHM



## **Appendix I**

### **FUNDING OPPORTUNITIES THROUGH COST RECOVERY AT DHM**

## **1. Background**

The Department of Hydrology and Meteorology (DHM) is an organization under the Ministry of Science, Technology and Environment, established with an objective to monitor the hydrological and meteorological activities in Nepal. DHM is a government information provider for sectorial planning and also supplier of regular reliable and consistent data inputs for the sectors such as water resources, agriculture, energy, aviation, transport, tourism, health and local development among others. The department is also responsible for:

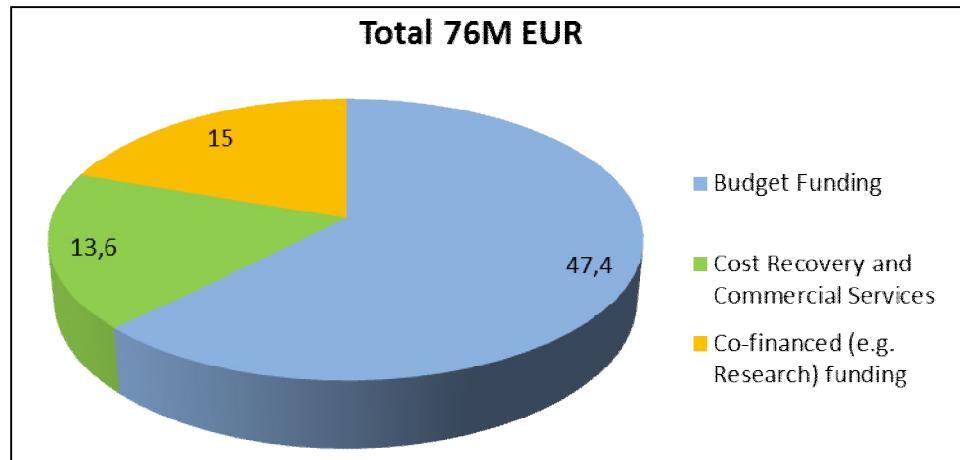
- Issuing early warnings in the field of hydrology and meteorology;
- Probabilistic forecasting and warnings;
- Information in support of pre- and post-disaster response and relief operations in climate related hazards.

Around the world, the National Hydro-Meteorological Services (NHMS's) have a variety of roles in terms of data- and/or service providers. The roles are typically governed by the laws of the particular country, and the ways to fund their activities are governed by the law, respectively. The role of NHMS may range from being only a data provider (while other private companies provide services for the public), to owning a "monopoly" on weather related data and services in the country. Most countries fall somewhere in between, i.e. having a governmental mandate to provide data and basic services based on governmental budget funding, while having to compete with private companies for commercial earnings related to extended service provision. In addition, the NHMS's may have a Research Unit, which actively seeks for its own funding. These are the cases in most European countries with developed NHMS's.

In light of these tasks, it was inspected how DHM could utilize cost recovery based – and commercial earnings within its future legal and regulatory framework in order to secure its operational budget for the modernized technology and services established in the BRCH project.

## **2. Funding options**

In principle, an NHMS may obtain funding in three main categories: 1) Governmental Budget Funding, 2) Cost Recovery- and Commercial Service Based Funding, and 3) Research Funding. As an example of the potential of these funding types, the budget of the Finnish Meteorological Institute is presented in Figure 1. It can be seen that about 62 % of the funding comes from the Governmental Budget Funding, and about 38 % from External Funding. It should be noted that over 50% of the FMI personnel works with Research, which explains the high share of Research Funding.



**Figure 1. FMI budget by Funding Source in 2013**

Typically, the funding scheme is based on the type of service provided, and as specified in the law governing the NHMS. Thus, there are no general rules as to what services should be under which funding type, as the rules differ from one country to another. With respect to Nepal, the country context and the development history of DHM services should be taken duly into account when planning to develop the future institutional and regulatory framework for DHM.

## **2.1 Governmental Budget Funding**

Governmental Budget Funding typically forms the core of any funding received by an NHMS, and it should secure the basic functions of the NHMS and the capacity to provide the quality of services required internationally. This basic funding should cover aspects such as maintenance and upkeep of the hydro-meteorological monitoring network, basic forecasting, issuing warnings and early warnings mandated to the NHMS, and supporting other authorities during natural disasters. Services offered to the public free of charge should also be covered from the budget funding, as this is financed by taxation.

## **2.2 Cost Recovery Based Funding**

The principle of Cost Recovery Based Funding is that an NHMS may charge an absorption (full) cost for providing services explicitly pointed to them in public law. The most typical example of Cost Recovery Based Funding is international civil aviation weather services. The main reasoning for collecting Cost Recovery Based Funding is that if services come within government funding only, the NHMS would be vulnerable to reductions or uncertainty in that funding, and services may be cut or not provided as required.

In Cost Recovery Based Funding it's considered appropriate to include both direct costs of providing services, and a share of indirect-, and infrastructure costs (see chapter 3.4). Examples of explicit services based on Cost Recovery Based Funding may include:

- Tailored services for the Armed Forces,
- Tailored services for the road- and railroad authorities,

- Specified reports for authorities responsible for e.g. civil-, air-, or water protection,
- International civil aviation weather services.

For international civil aviation, the legality and policy is already arising from the Chicago Convention on International Civil Aviation (Article 15); Annex 3 to Convention, which defines services provided or arranged for by Designated Meteorological Authority; ICAO Doc. 9802/4 "Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services"; ICAO Doc. 9161-AT/724 "Manual on Air Navigation Services Economics" (Appendix 6); and guidance from WMO-No. 904, "Guide on Aeronautical Meteorological Services Cost Recovery". As international legislation is already enabling this, it is recommended that a full cost recovery funding from international civil aviation weather services is proposed during the first steps of formulation the legal framework for DHM. It should also be noted, that although ICAO principles strictly apply to international aviation only, same approach may be adopted for domestic aviation as well.

### **2.3 Funding based on Commercial Services**

Providing commercial services is an additional way for an NHMS to get further funding for its activities. Pursuing the delivery of Commercial Services is not a task that should be taken lightly, as this requires a whole new (business oriented) mindset from the selected personnel, careful planning, and solid investments on product development and -delivery. The step is especially demanding if the former organization has been developed for authority purposes only. However, if Commercial Services are properly established with a well-functioning product delivery process, an NHMS can offer a plethora of services for different customers thus increasing its revenue, and provide sustainability in terms of funding.

Also the Commercial Services and how these services can be charged have to be defined in the legal framework of the NHMS. The law should define which general service types can be charged by net costs with a profit margin by the NHMS. In principle, the profit margin is defined by a market price – the customer can be charged as much as the customer accepts to pay. These services can be purchased from the private market as well, thus the NHMS has to compete in order to provide the services. Examples of Commercial Service types include:

- Weather-, climate- and hydrological services made by customer order or stored as a service available to customers,
- Expert reports or research produced by customer order,
- Use of premises owned/controlled by the NHMS,
- Copying and delivery of documents,
- Other tailored services ordered by a customer,
- Hydrological information published in newspapers and information boards,
- Mobile phone applications.

## 2.4 Research Funding

In NHMS's with a Research Unit / Section, an important way to fund these activities is by applying for research funding. There are several sources of research funding available, ranging from support to individual scientists attending conferences, to funding of large scale research programs with big international research consortiums. Funding sources include individual national and international Foundations, Academies of Sciences, Governments, International Research Organizations and Economic Unions.

Naturally, the target of research funding depends on the level of applicant and institution. It is advisable that a Research Unit of an NHMS applies for all levels of funding. Individual young scientists should be encouraged to apply for travel funds, developing scientists should be encouraged to apply for project funding, and mature scientists should be encouraged to be involved in research consortia and –programs. To this end, it is very important to network with other research organizations and try to get involved with experienced research consortia. From hydrology-, climate-, weather-, and air quality point of view, Nepal is a very interesting country, and thus being a local partner in different research projects and – programs is a very viable source of funding for DHM. In addition, a Research Unit and its individual scientists have a high potential to seek revenue by doing consulting work. This funding falls under Cost Recovery based and Commercial Funding.

It should be noted that Research Funding seldom offers full cost recovery. Thus, some amount of Budget Funding is always needed to finance Research at an NHMS. At FMI the self-financing from the government budget to research is on average 37 %.

## 3. Demands for providing cost recovery based- and commercial funding

### 3.1 Customers

The most fundamental goal in service and product development is to meet end user needs. This statement can be applied to any customer sector. One of the key issues is to make sure that customer needs are steering the production process throughout the organization. Much effort should be put into managing the customer relationships. This includes at least yearly organized meetings with different stakeholder groups; for defined strategic customers these types of meetings should be organized even more often. Besides meetings, communication with customers can be handled with phone, email, marketing events or for example by organizing customer training. It should also be ensured that customers always get high quality products in time and cost effectively. It is a good practice to regularly carry out a survey on the satisfaction of all customer groups including written feedback and indexed scores on satisfaction on different aspects of the services and products. When repeated systematically these surveys give useful information to orient the development of the tailored service into right direction.

### **3.2 Brand**

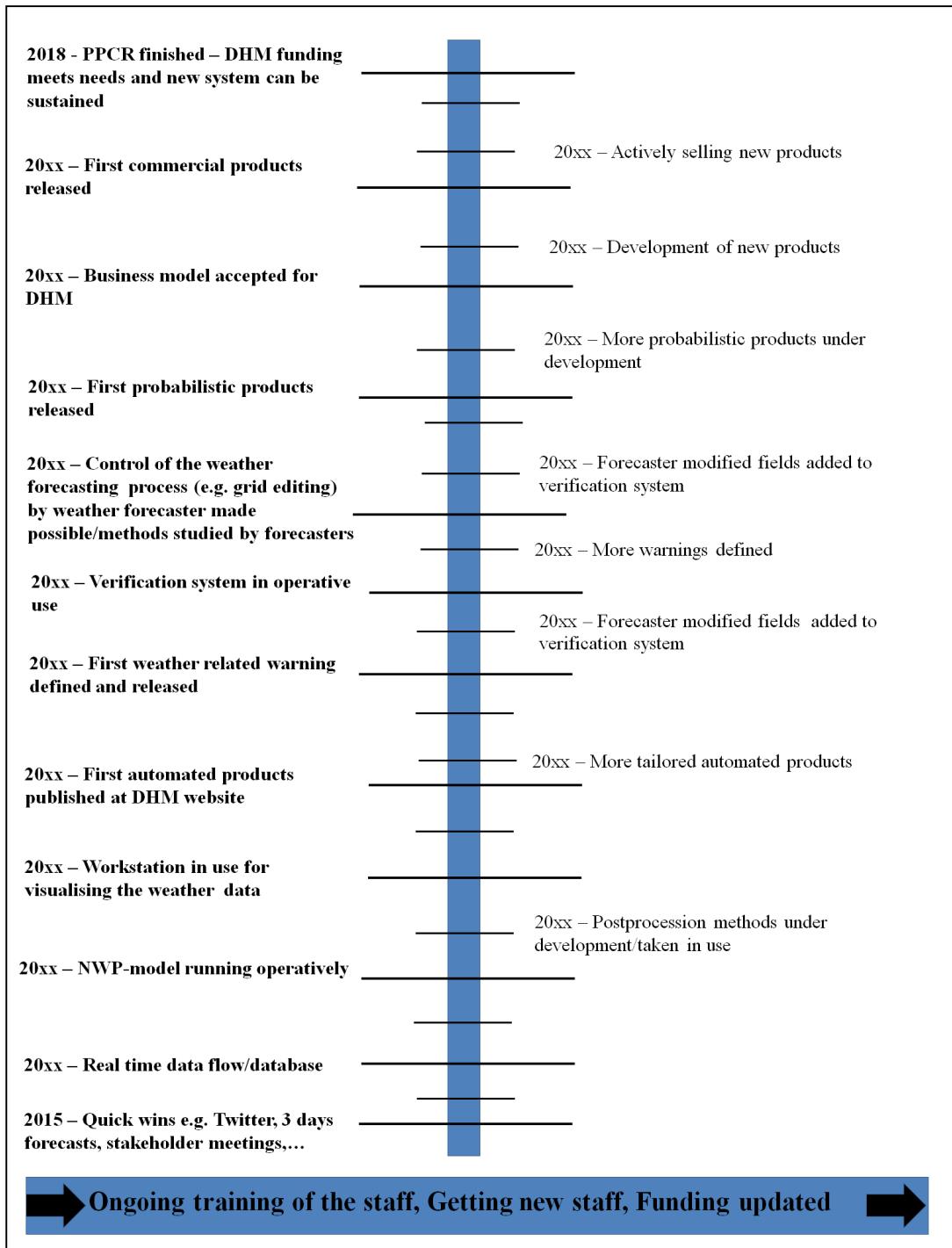
Creating a strong brand is one of the key issues for having successful Commercial Services. It is strongly recommended that a communication professional from outside DHM will design how the brand should be developed and maintained. Having attractive, consistent web pages with a single www- address should be the starting point when creating the brand, and the cohesive graphical look should propagate to all communication materials including reports, posters, presentations etc. Creating and maintaining the brand requires regular and frequent PR- work with the media and thus, also well trained communication specialists.



Another aspect helping to build a strong brand for an NHMS is that the customers know they can rely on the quality of the products provided by the NHMS. Therefore, product development, -verification and quality management are essential when wanting to provide Commercial Services. It is strongly recommended that Quality Management Standards (such as ISO 9001) for the different departments of DHM will be sought after. Having Certified for ISO 9001 (or similar) demonstrates that an organization continuously provides services that fulfill both customer needs and duties stated in the law. At the same time it aims at improving customer satisfaction. Having a certified Quality Management System is a pre-requisite also for managing cost recovery based actions such as civil aviation weather services.

### **3.3 Organizing Commercial Services**

Organizing Commercial Services is a long road, and as suggested by the BRCH System Integrator, the services in general should be planned as a road-map. This means that certain technical and organizational pre-requisites should be fulfilled before attempting to launch services at certain level. For public weather services this is illustrated in Figure 2.



**Figure 2. Milestones for modernizing DHM Public Weather Services**

Having a professional leader (or a Customer Liaison) with solid commercial experience is a backbone for organizing successful commercial services. S/he should have excellent customer relationship management skills and preferably knowledge of hydro-meteorological product development. One of the first tasks in the road map is to hire commercially oriented staff for customer services and product development; and based on identified needs, develop first tailored products. Automation of product generation is of utmost importance,

as this will lay grounds and free resources for further development work.

As progress is made in the roadmap, a clear business plan should be laid down (see Chapter 3.5.). Using input from customer events to create new products and services is topical, as well as making sure that customers are getting good quality products in time. This will help to build the DHM brand to get more customers, products and revenue.

### **3.4 Pricing and accounting for cost recovery and commercial funding**

Having a clear and transparent accounting system is needed if funding based on cost recovery and commercial funding is desired. This is related to pricing of the services and substantiating the costs correctly. It should be also noted that in Europe, public organizations' commercial branches can get absolutely no subvention from the tax funding so that there will be no distortion on the competitive market. To ensure this, the accounting and resource monitoring system of DHM should be redesigned so that all cost types such as investments, running costs and personnel work hours can be allocated to appropriate funding sources (budget based core activity, research project, commercial client, consulting task etc). Costs of indirect resources and assets such as working space, computing infrastructure and hydro meteorological data, for example, should be also included as an overhead to the unit costs for commercial or otherwise externally funded activity. The overhead may cover just the running infrastructure costs or include long term investment costs, depending on the type of the cost return model. Government departments or institutes are normally not allowed to earn profit or to invest on stock markets.

There are basically two types of overhead cost items in FMI:

1. Cost of support services (general IT-infrastructure services, observation services, general training, financial and personnel administration etc.);
2. Unit-level costs (general management, public relations and internal communications, premises, electricity & water, office supplies and other unit level costs).

#### **3.4.1 Pricing for Cost Recovery based funding**

As stated before, for cost recovery, full cost for providing services may be charged. The following points need to be taken into account for collecting the revenue:

- Charges should be based on costs of providing the service,
- An inventory of facilities and services to service the different user/customer communities is needed,
- Costs and human resources required to carry out the service is needed,
- A share of infrastructural costs may be charged,
- These should be distributed amongst users/customers based on proportional use of the infrastructure.
- Efficient mechanisms for collecting the revenues has to be implemented,
- All must be transparent and in consultation amongst stakeholders.

In addition, calculating the pricing may be divided in two parts; providing individual- or mass

products. If providing individual products or services, it is advisable to calculate the labor costs based on actual working time required to produce the service. These should include also indirect employee costs, such as possible social charges, overtime pay, or holiday payments. After this, the general costs, including infrastructural and other costs, should be added to the cost. Also consumable- type costs should be added, including e.g. material-, delivery-, and billing costs.

If providing mass products, the price of a single product should be defined, after which the cost is multiplied by the number of products delivered. If a price hasn't been defined, direct costs in providing the products should be calculated, after which the indirect and general costs should be added to them.

### **3.4.2 Pricing for Commercial Services**

For commercial pricing, the situation is quite similar as for cost recovery; however, in addition to the costs calculated for the full cost recovery, a profit margin should be determined. In principle, the profit margin is defined by a market price – the customer can be charged as much as the customer accepts to pay. Sometimes this may also lead to negative profit, e.g. in the case of research collaboration, prototype development, initial phase of a customer relationship, obtaining a market share, or for services with a strong societal value. In addition, the governing Ministry may set limits for the profit of the commercial services.

## **3.5 Business Plan**

As more commercial services are sought after, making a business plan becomes important. Some of the aspects in making a business plan include:

- Making a customer needs assessment,
  - Defining customer sectors and their needs
  - Defining revenue potential (how many customers, and how much a customer is willing to pay)
- Defining competition, i.e. who are the other service providers in the sector,
- Developing the product; reviewing the assets and resources,
  - What are the investment needs and can they be covered with the revenue potential?
- Developing marketing- / brand strategy,
- Making a detailed implementation plan,
- Reviewing the risks,
- Reviewing future scenarios, i.e. how will outside factors, e.g. politics affect the situation in the future.
- Preferably, the business plan should be made by an outside professional routinely conducting them, in consultation with DHM.

## **Appendix II**

### **Capacity building of Aviation Weather Services for DHM**

## 1. Weather services for aviation

### Overall goal

The envisioned system will have significant benefits for the aviation sector in Nepal. Advanced information on weather conditions will enhance aviation safety and maximize financial savings by e.g lowering fuel consuption and reducing the number of delays and amount of delay time which are the two biggest weather related costs for aircraft companies.

High frequency stability is needed for detection of large rainstorms, cyclones and strong convective precipitation, while detecting the weak dispersion signals from low level wind shear and dry downbursts in clear air-mode is also necessary for aviation purposes.

Aviation is particularly vulnerable to adverse weather conditions in Nepal. Flight diversions are frequent both for domestic and international airlines due to a lack of terminal area forecasts for fog and other high impact weather, and for sightseeing flights curtailed due to poor visibility in the high mountains. The International Civil Aviation Organization (ICAO) conducted an audit of aviation meteorology in Nepal in 2000 with the latest review in 2010 and has continuously recommended significant improvement in timely provision of significant weather information reports (SIGMETs, AIRMETs etc.), which are critical for aviation safety and efficient operations. The Aeronautical Meteorological Service Providerin Nepal DHM has been requested to take urgent actions to implement theenhancement procedures, but has been non-compliant since at least 2000 and has not filed a Corrective Action Plan (CAP) with ICAO.

As the designated Meteorological Service Providerfor Nepal within the ICAO framework, DHM has the responsibility and mandate to provide aviation weather services for the Civil Aviation Authority of Nepal and other aviation stakeholders. Supporting civil aviation safety through improved observations,forecasts and warnings and the introduction of a Quality Management System (QMS), which is a new regulatory requirement of International Civil Aviation.

### Production process

Production process, described in chapter **Error! Reference source not found.**, is hold up to aviation services with an exception that production of end products includes more manual handwork in general. Aviation services also have special requirement by ICAO, e.g dissemination of products to AFTN network. Additional product can be disseminated via DHM customer portal.

### Design of renewed services system for aviation

Upgrading of DHM aviation forecasting capability and aero-meteorological observing systems at Tribhuvan International Airporbis a high priority. By international agreement, it is

common practice in most countries for the recurrent costs of Aviation Weather Services to be supported on a full cost recovery basis through fees levied on civil aviation. Making these funds available to DHM should help ensure sustainability and ongoing upgrades required by ICAO to ensure flight safety. The introduction of a QMS, for example, is eligible for financial support through cost recovery.

High priorities are the automation of weather information for air traffic services at Tribhuvan International Airport in Kathmandu and at the proposed regional international airport. These upgrades and new capabilities should be consistent with the expected level of aviation meteorological services at an international airport, complying with current ICAO Annex III standards and practices, including the capability to provide:

- Aerodrome forecast (TAF and TREND)
- Aviation Weather Report (METAR/SPECI)
- Significant Weather Information (SIGMET, AIRMET)
- Weather Forecast for Local Aviation (SigWx, AIRMET)
- Flight Documentation consisting of weather forecasts for departure, destination and alternate aerodromes, forecast charts of significant weather en route, and forecast charts showing wind and temperature data appropriate for the cruising level of aircraft.
- Special Air Reports (ARS)
- Aerodrome warnings
- Wind shear and Turbulence alerts
- Special en-route forecast

It is also recommended that shared training is to be offered to CAAN and DHM personnel involved in the production and use of aviation meteorological services in air traffic services.

**Quickwin I**There is recommendation to hold regular meetings between MFD of DHM and CAAN staff and also between MFD of DHM and Tribhuvan airport. One of the major issues to decide between CAAN and DHM is how to organise the functions of Meteorological Authority (MET inspector) in Nepal. Thus a core team formed by key experts from DHM and CAAN is recommended to be activated.

**Quickwin II**The meteorological informationin METARs,disseminated by ATC, should be based on the same meteorological information. Thus discrepancies in visibility measurements should be minimized or the differences to be made clear to the customers.

High quality Automated Surface Observing Systems (ASOS) are designed to meet international civil aviation standards. These stations have the capability to provide information on current weather conditions including visibility and can be accessed directly from aircraft via air-band frequencies. There is also the capacity for limited prediction based

on extrapolation of current and immediately past conditions. The system can also be interrogated by telephone and other means. These systems automate the production of meteorological notifications for pilots and can provide direct input into air traffic services for onward dissemination to pilots, airline operators and for pre-flight briefing. They can also provide input to internet-based Aviation Meteorological Dissemination Systems enabling crew and airline operators to retrieve flight documents and other weather information from their own offices. Half-hourly to instantaneous broadcasts of weather information should be available to aircrafts in flight.

This can be achieved through the overall planned upgrade to the national meteorological observing network, improvements in short-range weather forecasting, and the installation of ICAO/WMO recommended meteorological observing capability at CAAN priority airports. Currently, there are 34 operational airports in Nepal and every effort should be made to provide a minimal level of automated observations and human observer support.

#### **Aviation En-route forecasts**

The extraordinary topography of Nepal puts extra demands for aviation weather service. The highest safety and economy will not be probably achieved with just regular ICAO products. Thus weather products that really add value to customer operations are needed. One such product type is en-route forecasts.

#### **The enhancement of SIGMET production**

Currently MFD only produces convective SIGMET forecasts. Convective SIGMETs are issued based on satellite data (FY2-D/E, 30 min time resolution) and thus currently SIGMETs are based on OBS only. Other types of SIGMETs could be issued when the relevant data and expertise is available. These SIGMET types are:

- The efficient usage of tropical cyclone advisories,
- Turbulence,
- Icing,
- Mountain wave,
- Dust storm,
- Sand storm,
- The efficient usage of volcanic ash advisories,
- Radio active material.

The baseline is to keep the production of the convective SIGMETs and to start solve the requirements to enhance convective SIGMET production and other SIGMETs.

#### **The enhancement of TAF and TREND production**

Currently MFD only produces TAF forecast for VNKT. The baseline is to keep the production of VNKT TAF and to start solve the requirements to enhance TAF production system (effective use of forecaster time, monitoring/amendment aid, supportive data) and enable producing multiple TAFs for other important Nepalese airports in ICAO compliant way.

### **The SigWx and AIRMET production**

To help the domestic civil aviation flying in en-route, low (from surface up to FL150-FL200) signification weather chart (SigWx) should be issued on regular basis (every 6 hours) and in case of high impact weather to expected en-route for low level flights the AIRMET warnings should start to issue.

### **Aviation weather service for helicopter operations and VFR pilots**

Currently helicopter operations usually rely on local people who submit weather information for the pilots. To serve such operations better telephone based pilot briefing systems could be developed. To realise such operations require high resolution numerical weather prediction data and preferably also information from high altitude weather stations.

### **TAF- and TREND-verification**

Some measures of meteorological quality of aeronautical meteorological products have to be developed in order to fulfil the basic requirements of QMS system. Traditionally comparing TAF forecast against METAR observations has been found to be useful in such needs.

### **Data Archivie for case studies, accident and incident investigations**

The capasity building of forecasters require that there is possibility to check weather situations afterwards. This requirement can be reached by customer feedback or the need for self-development. Accidents and incidents investigations every time require weather case analysis.

Thus, it is extremely important that basic aviation weather forecast products along with key weather materials are saved for future use. Some data sets should be saved by default (like radar, soundings, surface observations, selected NWP parameters, satellite imagery). Larger data sets should be saveable on demand, e.g. if there is known incident or accident occurred then forecaster can launch special archiving which saves all relevant data available (e.g. all NWP data,)

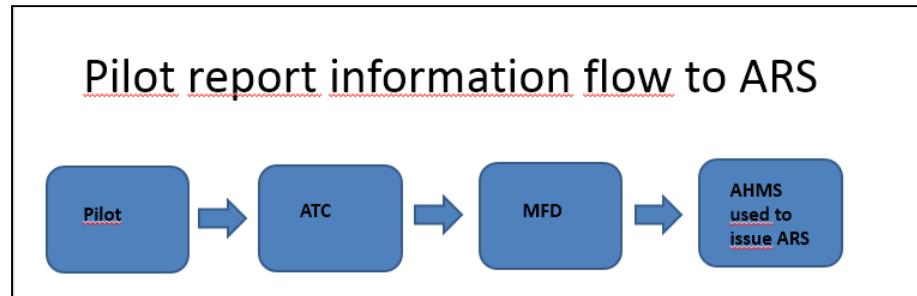
### **24-36 h Approach forecast for Tribhuvan airport**

The important and high impact weather parameters are to be defined according to customer needs. These can be different even within same airport depending on the customer needs. E.g. air traffic controller has to make decision on the runway in use and this decision is mainly dependent on wind speed and direction. On the other hand parameters like visibility, runway visual range, cloud base height and amount affect the activities of an aircraft operator depending on their ability to operate in different IFR conditions.

### **Special Air Reports (ARS)system**

In order to build better communication between forecasters, pilots, ATC and other aviation stakeholders a system to enable the collection of pilot reports of hazardous weather phenomena is recommended to be devised. These pilot reports should be disseminated by ICAO Annex III rules. Figure 6 below shows the information flow for the dissemination of pilot information to be published as official ARS message. The required stakeholders, in

addition to the pilot, are the ATC who initially receive the pilot observation by voice communication. ATC then transmits the information to the aeronautical meteorological forecaster. The forecaster then issues the official ARS message using AHMS system to be disseminated in AFTN network for the use of aeronautical community.



**Figure 8. Information from Pilot observation to official ARS message.**

#### **Satellite imagery zoomed closely on Nepal airspace**

Currently the satellite imagery provided in the DHM website is regarded by aviation as to cover too large domain leaving the details of weather elements in Nepal airspace indistinguishable from each other. The strong wish from user side is for satellite products that are zoomed over Nepal airspace, which give reasonable resolution for details and also give information on relevant weather parameters like cloud top height.

#### **Webportal dedicated for aeronautical users**

Webportal dedicated for aeronautical users would provide gate to aviation specific information. From aeronautical meteorological service point of view such portal could help to decrease the time a forecaster needs to spend on collecting flight folder data. Using webportal, aeronautical users could collect the information by themselves which is relevant to their operations. Aeronautical portal could also be used as dissemination channel for early warnings for aviation community and would help updating forecasts and observations in realtime.

#### **MFD and ATC weather information coordination**

Communication with the customer is recommended to be close. E.g. the customer feedback from September 2014 meetings suggested that customers have been confused from time to time on the discrepancies (especially visibility values) between weather information in METAR observations and information issued by ATC over voice communication. These differences may have natural reasons such as the METAR is issued every 30minutes and ATC can use instantaneous values. Thus the weather may have changed since last METAR.

The suggestion is that observer takes well into account the visibility value from AUTO-METAR. If the observer decides to issue a manual METAR whose values significantly differ from AUTO-METAR values then he/she contacts the ATC and gives his/her reasons to ATC why to ignore AUTO-METAR values.

**Cost recovery system - To be purchased from external provider (needs ToR):**

The calculation of direct and core cost of aeronautical meteorological services in post BRCH situation should be started right after Phase I. This is not possible earlier as the plans for the supporting infrastructure for aeronautical meteorological services is published in Phase I reports. The estimation of costs is essential for the proposal of different kinds of cost recovery mechanisms which would fulfil the recommendations of ICAO and would ensure the sustainability of high quality aeronautival meteorological services.

The best way to accomplish this task would be to hire an external consultant.

**Roadmap for renewed service system for aviation**

The production of high quality weather services is dependent on many aspects. These are:

1. Motivated and highly competent staff, who can use
2. Modern information systems, which can be used to view
3. Versatile information such as different kinds of weather observations, weather radar measurements, weather satellite data, numerical weather prediction data
4. And have thorough understanding on customers' needs, i.e. knowledge on the impact weather and climate on the comfort,economic consequences or safety of the customer

All these have to be in place for the service production to function efficiently. Furthermore, a whole set of continuous processes have to be in place to keep high quality service production sustainable.

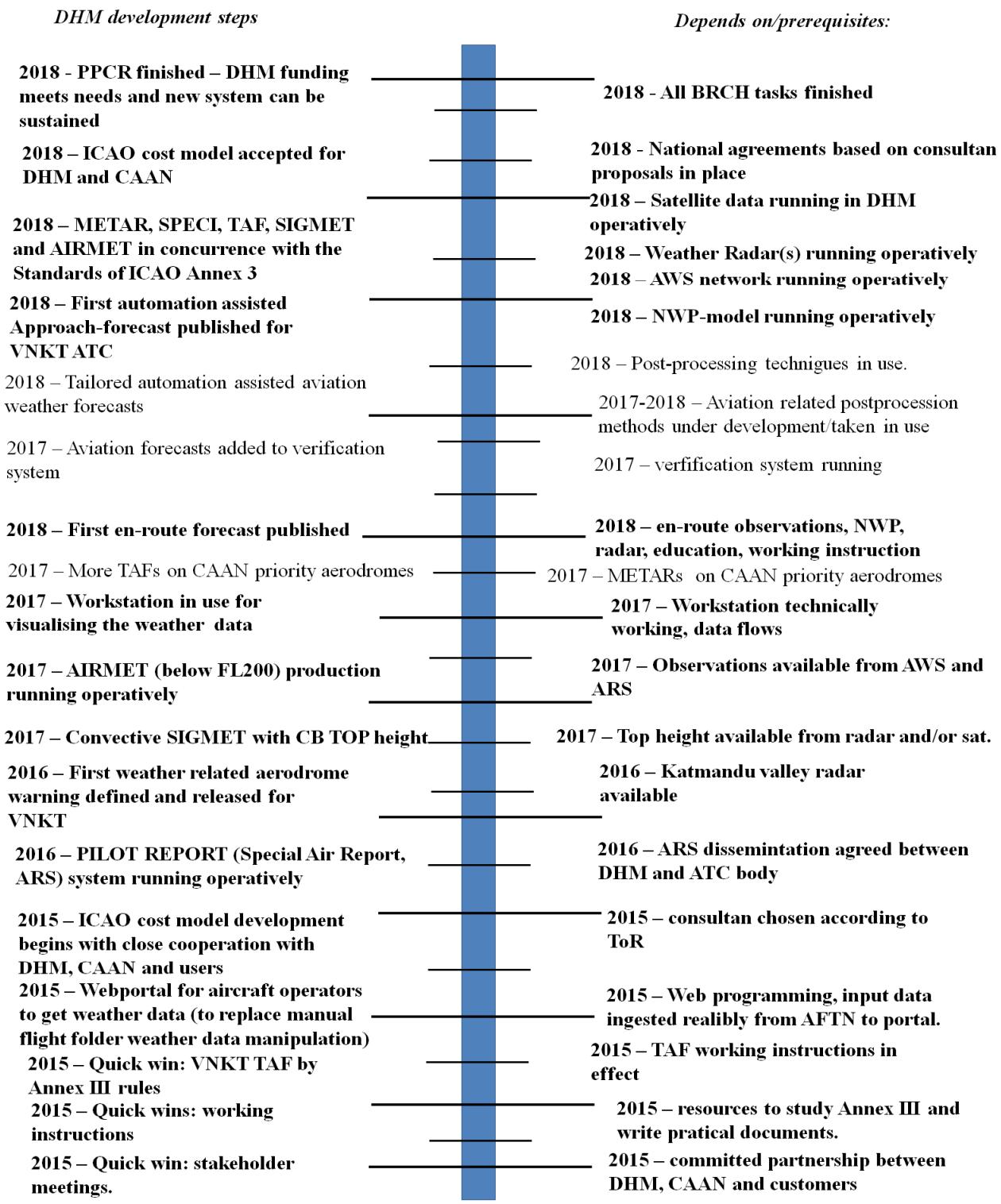
An example of the system capacity and competency prerequisites is demonstrated in the case of issuing a SIGMET warning for aviationbased on Cumulonimbus cloud (CB) top height: The CB height is a required parameter which needs to be assessed before issuing the warning:

1. The staff on duty will need to understand the principles of weather radar usage, measurement geometry principles and be competent on using relevant software to study CB characteristics
2. There should be software which can be used to study weather radar data
3. There should be a weather radar or weather radar networksufficiently covering Nepal airspace and the data is available for software analysis
4. The staff who should be aware of international rules of ICAO ANNEX III and understand the customer need for CB top height information for the decision between go around and go above.

These aspects are illustrated in detail in the Figure 9. On the left hand side of the development tree the development steps which DHM has to take while on the way towards a modern aviation weather service providerare listed. On the right hand side of the tree is a list of dependables or prerequisites on which certain development step is depending on.

The example shown above on CB top height analysis to enhance the quality of SIGMETs is estimated to take place on year 2017 in Fig 9. Similarly all of the other development steps envisioned can be found in chronological order in that figure.

## Milestones for modernising DHM Aviation Weather Services



→ Ongoing training of the staff, Getting new staff, Funding updated →

Figure 9. Milestones for modernising DHM Weather Services for aviation

## **Sustainability**

Assessment of sustainability of Public Weather Services is also valid for Aviation Services. The assessment is described in chapter 4.7. In addition, close attention is recommended to put on development of ICAO rules and developing services and products toward regulations including training of the personnel and QMS.