NEEDS ASSESSMENT AND CONCEPTUAL DESIGN OF THE NILE BASIN DECISION SUPPORT SYSTEM CONSULTANCY

NILE BASIN DECISION SUPPORT SYSTEM

FINAL INCEPTION REPORT

ANNEX E: Methodology for Analysis and Synthesis Phase

Vienna/Austria, Addis Ababa/Ethiopia, 27 November 2007

NILE BASIN INITIATIVE
Initiative du Bassin du Nil

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consulting & knowledge development GmbH

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By

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1. Preamble

Based on the methodology chapter of our original proposal, we have updated the methodology based on experiences from the Inception Phase and as a result of discussions with the Client in Addis Ababa. Some methodological aspects are covered by other parts of the Draft Inception Report so that references to these Annexes are made in the respective chapters. We will intensively further develop the Methodology after the 1st Review Workshop in Addis Ababa (17/18 October 2007) especially during the first weeks of the Analysis Phase when Senior Water Resource Engineer Riddell and Water Resource Modeller Dreher will spend considerable time in Addis Ababa. Their presence will ensure that all comments during the Inception Report and the results of further discussions with the Client will be considered.

The consultations carried out during the Inception Phase have shown that more time should be allocated

- for preparation of the national consultations

This includes sufficient time for *thorough* preparation of standardized guidelines for the sub-regional teams, their local consultants, and the National DSS Specialists (e.g. standardized questionnaires, preparation of available information in light of consultation objectives etc.) for efficient consultations in order to maximize the outputs of the teams.

- for carrying out the missions

The consultations during the Inception Phase showed that the time schedule was very tight in light of the number of countries, stakeholders and necessary travelling; hence collation of information could not always be fully completed, hence, was subject to some compromises.

- for post-processing of collated information

The consultations during the Inception Phase showed that post-processing of such a wealth of data and information is time consuming. Moreover, *all* available information needs to be interpreted for the elaboration of required Deliverables to get the desired outputs.

2. Analysis Phase - Work Package 2 – Detailed Needs Assessment and System Requirements

Objective: To identify the key decisions, needs and requirements of the Nile Basin DSS focusing on the decision making policies, procedures and planning processes of the different water resources management, and to prepare a clear design for the future DSS.

After completion of the assessment of available data and information, this phase represents the start of the discussion on the main issues of the NB-DSS and the main decision-making process, after which the main concerns are usually the identification of suitable model(s) and the search of data required in the context of the specific decision. The collected information should be then ultimately expressed in the form of quantitative and/or qualitative indicators in tabular or geographical formats allocated to the decision making procedures and to finally formulate the problem and contribute to the objectives. This relates to the water technologies, but primarily to the model structure and therefore to the DSS Design.
Outputs of this WP:

- Training and Awareness Workshops
- Regional and National Stakeholder Consultation Workshops
- Identify key decision and information requirements
- Identify needs for DSS related data
- Identify long-term needs for data collection and monitoring
- Detailed needs assessment and system requirements
- Overall needs / requirements
- Functional capability of DSS

- Stakeholder participation
- River basin modelling system and multi-objective analysis tools
- Basin-wide communication and information/knowledge system
- Prepare DSS design specifications
- 2nd Review workshop

WP 2.1 – IWRM/DSS Training and Awareness and Consultation Workshops

Activity 2.1.1 – Planning and Implementation of IWRM/DSS Training and Awareness Workshops

Please also refer to Annex C of the Draft Inception Report.

Objectives:
The objective is to introduce the potential of DSS tools, illustrate the scope and benefits of possible applications, but also their limitations, data requirements, and infrastructure and institutional requirements, but in general get the participants interested in active involvement, including the exploratory application of the on-line tools for any specific problem or project.

Expected outputs:
Stakeholders are trained and aware of the DSS capabilities

Description of Activity
It is a recognised fact that user experience, user involvement, and user training are the most important user related variables with regard to DSS implementation. User **experience** involves engagement of the user in decision making processes prior to confront DSS. It refers also to user's work history. User **involvement** refers to the active engagement of the user in the DSS implementation process. User involvement implicitly deduces user participation, not only in the implementation of DSS, but in the design. **Training** in the context of DSS implementation, refers to provision of hardware and software expertise to the user.

At this stage, user experience (expertise) and his work history have been assessed accordingly, being an important part of the Inception Phase (Activity 1.1.6 and Activity 1.1.7). User involvement and DSS are two purposeful systems that are involved to the extent that activities of each facilitate the attainment of the ends of the other. In this context, involvement refers to user active participation in DSS project planning (design) and implementation. Training, in the context of DSS design and implementation, refers to the provision of sufficient hardware and software skills to the users.

According to the TOR, the Analysis Phase will begin with an awareness and consultation workshop, which is considered the most critical undertaken of the entire project. The consultant will take special care to following factors influencing user involvement in DSS design and implementation:

(1) Users perceive task complexity easily by means of simple and transparent concepts
(2) User's resistance to change is reduced through active participation by all affected users. Participation must be more than symbolic, i.e. it must be possible to influence issues that are particular to users so that they understand better and do not feel the system to be imposed. Implication of users must be understood and appreciated as positive opportunities.
(3) Training will motivate the users by focusing on skills improvement.
(4) The awareness workshop should win the heart and mind of the senior decision makers. This claims for good quality presentations and products.

These important issues will have special attention during the workshop in order to enhance needs assessment and DSS design approach.

As required from the TORs, training Workshops shall be accompanied with short trainings on key aspects relevant to water resources. Respecting those requirements, the workshop program is proposed to have the following two main parts:

Additionally, at the end of each thematic issues as well as after the second day's hands-on-training, the Consultant will initiate discussions with the riparian experts on their point of view about the used tools and graphical user interfaces, as an important part of needs assessment.

Sub-Regional and National Workshops

Awareness and Training Workshop (two days program)

1st day:

1. Baseline multiple-choice test – Definitions, DSS-Structure, DM Processes and Concepts, DPSIR concept, Decision theory, economic valuation methods, group decision making, game theory, uncertainty and risk management, etc (see Activity 1.1.9)

2nd day:

2. Presentation of the specific regional projects at SAP and SVP levels that will be the basis for the training sessions.
3. Training sessions according to Activity 1.1.9.: basics,

Examples and case studies from the NBI will be included in the training material. The proposed program of the Workshops will be discussed during the Inception Workshop. The regional workshops are to be held in Khartoum, Sudan for the Eastern Nile Countries and in Entebbe, Uganda for the Nile Equatorial Lakes Countries. Furthermore these work shops will be repeated in each of the NBI countries.
The work shops will be implemented by Mr. Fedra with appropriate local support.

Figure 2.1 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Fedra – Software Development Engineer	• See schedule Annex B • See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Training Workshop Minutes	

WP 2.2 – Identify Key Decisions and Information Requirements

Although selected projects and case studies at SAP and SVP level have been presented and discussed during the Inception Phase, being the base for the Awareness / training workshop, the consultant will conduct consultations with riparian experts in all countries, SVP project staff, and the two SAPs, as part of the needs assessment for the Nile Basin DSS. This Work Package focuses on *"the analysis of key decisions to be supported and identification of functionality and outputs of the DSS to support these decisions"*

It is understood that the main idea behind this WP is to address the existing water management projects and identify the interactions between the main components of the socio-economic and environmental systems within the framework of existing / planned water management infrastructures, natural environment, water supply and consumption, the institutional and socio-economic conditions.

The proposed approach is to follow a generalised concept, which is an easy-to-understand scheme used for analysing environmental management processes based on the well known DPSIR framework (Drivers – Pressures – State – Impacts – Responses), which was developed by the European Environmental Agency and Eurostat (EEA, 1999. Environmental Indicators: Typology and Overview. Technical Report No 52). Within this framework, the causal interrelationships for water, environmental, social, and economic stress conditions are explicitly presented. The environmental management process is defined as a kind of feedback loop controlling a cycle of five distinct elements describing the dynamics (cause-effect relationship) and the links between them:

(1) **Drivers**: can be defined as the primary causes exerting direct pressure on the environment. All kind of human demands for water, energy, transport, housing, as well as other development and economic activities lead to environmental pressures, only to mention some examples.
(2) **Pressures**: excessive exploitation of natural resources (exploitation of surface and

ground water, land, fuel, etc) caused by the Drivers (Driving Forces) leads to pressures on the environment, which in turn affect the

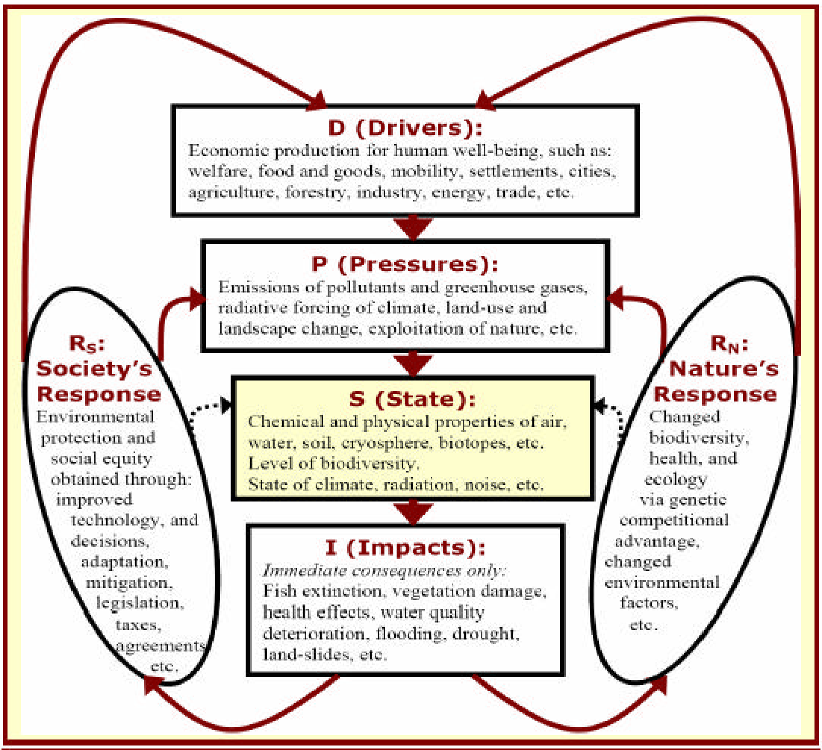
(3) **State** of the different elements of the environment, from the qualitative and quantitative point of view (CO2 content in the atmosphere, level of the groundwater table, water quality, soil contamination, etc.), the State mainly depends on the ability of these elements to cover the demands placed on them. If this is not the case, the

(4) **Impacts** will be measurable in the level of change on the State of the environmental elements. The Impacts may be expressed in terms of level of environmental harm, depending on the demonstrated efforts of the society to influence through decision making processes on the different levels of intervention, i.e. changing the Drivers, Pressures or State. These changes on one of the three elements or a combination of them are called the

(5) **Responses** to the changes on the environment. The level of the Responses mainly depends on the position of the decision maker, the carrying capacities and on the thresholds adopted for humans or eco-systems at risk. In general, the higher the level of decision and policy making the more important the influence on the Drivers and Pressures. The local decision maker in turn, will be able to make decisions towards changing the State.

Figure 2.2 shows the interdependencies between the causes and the related effects within the DPSIR framework that provide the means to analyse the decision making processes within the different concepts for the proposed regional projects. It shows the possible levels of intervention which can be chosen by decision makers in order to reduce the **Impacts** of the different **Responses** to **Driving Forces**, **Pressures**, and to **State** acting on the environment.

Figure 2.2 The DPSIR framework (adapted from "Strategies and Actions for Common Research" (SACRE) - Centre for Interdisciplinary Environmental and Social Research (CIENS),, Oslo)



The DPSIR butterfly: interdisciplinary research and sustainability

Central in the diagram is the state (**S**) of an environment system, which may change under influence from pressures (**P**) caused by drivers (**D**) to benefit human well-being. A perturbed state (**S**) leads to immediate impacts (**I**), which may provoke responses in nature ($\mathbf{R_N}$) or the human society ($\mathbf{R_S}$).

The society may adapt to impacts by reducing vulnerability, or mitigate impacts through new technology or through policy and decisions. This changes both drivers (**D**) and pressures (**P**). Nature's response ($\mathbf{R_N}$) is often an ecological adaptation which may influence the pressures (**P**) directly and the drivers (**D**) indirectly.

Activity 2.2.1 – Identification of key decisions and information requirement

Stakeholder maps, and identification of relevant institutions based on their levels of power/influence in managing water resources have been identified as part of Work Package 1 activities. Following the training workshops we will hold a series of National and Regional Stakeholder Consultations with riparian experts from each country. Whilst the DSS will be driven by technical information, we will ensure that a balanced approach to information feedback is taken, and will look at a wide range of riparian viewpoints, including both technical, legal and socio-economic perspectives. This will include NBI, SVP and SAP staff, and other project activities (for example the FAO project titled "Information Products for Nile Basin Water Resources Management").

One possible approach would be to identify current and future processes using a business process mapping approach. Organisations spend a lot of time each year developing strategic objectives, annual targets etc. Links are made between units/departments or programmes to deliver strategic objectives. In theory conflicts should not occur. All parts of the organisation should complement each other and support the overall objectives. However, in most cases the theory fails to work due to a number of reasons. Objectives may be developed in isolation, key 'trigger points' for making decisions can be miss-interpreted, communications can be unclear, and information can be missing or can be incorrect. The Nile Basin is a complex area of countries each with different economic and development goals, but with a communal wish to share equitable and use appropriately the resources of the Nile River Basin.

Using process mapping as a way to firstly identify key issues, current processes, and procedures which take place for making decisions allows a record of the processes to be developed. But it also identifies where problems occur. By linking this with the decision making processes in all the riparian states it is possible to identify where problems may occur in the future, the need for additional information, opportunities to streamline decisions, and opportunities to widen ownership and involvement in the decision making process.

Out of this element of Work Package 2 we aim to identify key issues, and the information/data required for decision-making remembering that too much information can often cloud the issue. In consultation with stakeholders key IWRM decisions will be identified based on Intersectoral uses of water. An inter-sectoral matrix will be prepared to ensure all uses of water are considered and stakeholders have equal representation in any discussions. It is anticipated that this will identify the 'process owners' – the key institutions and posts who determine the objectives, risks, key controls and measures of success surrounding the decisions they have to make. The future DSS will need to be tailored in such a way that these inter-sectoral decisions can be supported to ensure that appropriate, equitable, technically feasible, cost effective, and socio-economically appropriate and acceptable decisions are made in the future. This process will help the identification of data and information to support such decisions – which organisation is responsible for the data collection, and data quality monitoring (audit) etc.

Objectives:

- Examine current and (projected) future processes and procedures adopted for decisions making on planning and management of water resources at regional (SVP) as well as sub-regional levels (SAPs)
- Identify key overall decisions (policy/planning) that will be supported by the NB DSS.
- Identify specific decisions with to be supported respect to integrated water resources management of the Nile Basin water resources, focusing on the planning of sectoral projects, such as food production, energy production, navigation, watershed management, wetlands management, drought and flood management, etc. This exercise shall result in clear identification of what the outputs of the DSS shall be to support such investment planning, what data/information and tools the DSS need to provide to support the decisions, etc.
- Identify a set of core criteria and indicators that will be used as performance measures in evaluating alternative investment/development options and hence the DSS has to deliver to support investment decisions in water resources. The indicators will have direct relevance to and should be used to assess achievement of NBI goals, i.e. To achieve sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile Basin resources. Indicators would be identified with respect to:
    - Overall state of the system and performance in terms of water use conservation, efficiency, sustainability and loss management,

- o Sectoral benefits; Irrigation/Agriculture, Hydropower, flood and drought risk reduction, navigational uses related
- o Tradeoffs: inter-sectoral and inter-regional (country)
- o (Equitable) distribution of benefits from planned projects
- o Economic, social and environmental sustainability of the basin sub-systems
- o Impacts on Eco-systems
- o Social Impacts
- o Resilience to external factors, such as climate change

Expected outputs:

- Key issues (at sub-regional as well as at regional levels), are identified in connection with the existing and future decision making procedures and processes for water management and planning
- The overall and the specific decisions that will be supported by the Nile Basin DSS and the required tools and models.
- A list of core criteria and indicators that have been identified as a means for measuring the performance of future decisions made

Description of Activity

The DSS design, described later on this document, integrates hydrological and socio-economic models including a multi-criteria analysis tool (MCA) in order to assist the decision makers and water authorities in the management of the water resource adequately. The structuring of decision levels, from the highest, basin-wide institutional / political level, to the country-wide decision making point of view, and to the regional one, is the adequate way to cope with real problems and issues arising from varied and conflicting water uses and demands. With such an approach, the consultant focuses on the specific needs of the Nile Basin, where different decision making authorities will have to decide between formalised decision cases, as a set of alternative optional responses, which can be evaluated as unique solutions or in parallel, if so desired. The decisions will be then selected between various scenarios on the bases of a common list of criteria connected to the indicator values related to the Driving Forces, the Pressures, and the State (D-P-S). The models simulate the results showing the expected effects of the various options to be evaluated.

Immediately after the Awareness/Training Workshop, the Consultant will conduct a series of consultations in order to identify and foster the key decision making processes bearing in mind that every decision will be analysed in the future by means of DSS tools and that the stakeholders and the riparian experts in al countries are still not completely aware of how to use a SW tool in order to analyse their decision making processes. Moreover, most of them have certainly used a model to make simulations of certain environmental processes, but probably never used a Multi-Criteria-Analysis tool to evaluate several possible solutions using several scenarios. Due to short time spent for the workshops, at least two days at each Country, most of the learned issues on DSS during the training have vanished from memory. It will be therefore necessary to refresh the knowledge of the riparian experts on some important issues and needs of a DSS, in order to collect the right information that is needed for identifying the adequate decision making processes. After this, the Consultant will go through all relevant projects, in close cooperation with the riparian expert, to make a list of the intended and presently applied decision making processes and procedures, sorted by sub-regional, regional as well as local projects.

Before beginning with the consultations to all countries the consultant has prepared the training documentation and the consultation plan in detail that has been discussed during the Inception Workshop. The documents describing the Consultation Plan will include the objectives of the missions and explain in detail the purpose of the consultation meetings and visits.

The Consultant will carry out a comprehensive dialog with the riparian experts to:

(1) Find out the main issues and relevance of the problems to be supported by the Nile Basin DSS by means of a rapid assessment of the impacts caused by the short or long-term development plans, and current projects and their decision making processes.
(2) Define, together with the experts, in a participatory approach the different criteria they use to describe the system, its function, performance, problems, cost and benffits, and impacts (expressed by the corresponding indicators which may be important for the evaluation of the decision making processes). The impacts of different decision making processes on the society,

economy and on the environment, which are relevant and described by measurable criteria.

(3) The riparian experts should then find the most relevant indicators for monitoring and evaluating the performance of the decision making processes during implementation of the projected future projects.

(4) The last experience will be to make a proposal for ranking of the different issues and corresponding decision making procedures in close cooperation with the riparian experts and their incontestable local knowledge in order to consider the most relevant issues.

Figure 2.3 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Riddell – SWRE (Overall, selected countries – see below) Schuen – Socio-Economic Specialist (selected countries – see below) Hartveld - Socio-Economic Specialist (selected countries – see below) Nachtnebel – Water Resource Modeller (selected countries – see below) Dreher – Water Resource Modeller (selected countries – see below)	• See Annex B • See updated Work Plan and • Addendum to Work Plan “Agreed Work Schedule after Launching Meeting”
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report	

WP 2.3 – Identify needs for DSS related data

Activity 2.3.1 – Identify needs for DSS-related data

Objectives:
To assess the needs of the new Nile Basin DSS related to data requirements for the fulfilment of the DSS functionalities from the point of view of the identified relevant issues and main projects based on the data assessment carried out at the beginning of the Project (Activity 1.1.2).

Expected outputs:
- Inventory of supplementary data required for using in the new Nile Basin DSS with respect to relevance, accuracy, spatial and temporal resolution, and
- Strategy for the development of a Nile Basin-wide monitoring network designed to fit the needs of the DSS

Description of Activity
Based on the inventory carried out in the Activity 2.2.1, the Consultant will establish the data and monitoring needs related to the future development of the Nile Basin DSS and the concerned projects at SAP and SVP levels, as described above. According to the TOR, the Consultant shall assess the data needs for the operational use of the DSS taking special care that the proposed data acquisition system, monitoring network, database system, and the institutional set-up as well as the capacity building efforts are in line with the FAO Nile Basin Water Resources Management project.

The FAO Nile Basin Water Resources Management Project (http://www.fao.org/docrep/007/y5716b/y5716b01.htm) focused on four main areas:
- establishment of a transboundary hydrometeorological monitoring network;
- establishment of national georeferenced databases and spatial layers including hydrometeorological parameters, water use information, hydrographic features, land use, land cover, and soil types;
- development of a Nile decision-support tool (Nile DST) that models the entire Nile system and assesses the trade-offs and consequences of various development scenarios;
- improving capacity in setting out the needs of the institutional basis for cooperation and in promoting stakeholder involvement.

It is also proposed to closely cooperate with the experts of the SAP and SVP staffs and discuss the expanding of data monitoring and data storage systems, using their knowledge for design and planning of the new monitoring networks, in the extent it will be required.

Data needs assessment:

1. Step: Analysis of existing projects and their data needs based on the DSS functionality:
This issue will be assessed through the careful investigation of the regional projects and their regional area of operation, in form of a desk study in close cooperation with the riparian experts. Their knowledge is of utmost important for making decision on supplementary data acquisition. . Existing monitoring networks will be investigated first in order to evaluate the location of new data acquisition sites.
Eventually, and depending on the available information, it should be necessary to realize a project-related, regional socio-economic survey in order to assess the baseline data of the project area, which may be important for decision making processes.

2. Step: Data analysis:
The second step of this assessment will be to evaluate availability of historical data. If the data is not yet available, it should be recommended to prepared and stored them in a database for further evaluation. and verify the necessity of the new monitoring station.

3. Step: Data modelling
An accurate prediction of the hydrologic responses at ungauged locations can be a challenge due to limited number of reference gauging stations and a limited understanding of complex topology and vegetation interactions. A proposals will be made to improve the network if necessary

4. Step: Development of the strategies
Acquisition of the map material for new projects will be best discussed with experts and responsible staff of PMU and SVP projects. The establishment of hydrometeorological monitoring networks or water quality nets need to be more intensively discussed with the operational staff of the existing monitoring networks (FAO Project) in order to make an appraisal of the existing local monitoring units and the adaptability of the new network. What has to be carefully investigated by the local staff when establishing a new monitoring network, is the question of the security of the stations against vandalism. Monitoring stations should be always watched round-the-clock. Best location are the gardens of people living in near to possible locations. According to our experience in installing monitoring networks, mainly in Africa, remote locations have to be guarded.

5. Step: Long-term monitoring structures:
If not available, repetitive socio-economic surveys should be carried out in regular time periods. Such surveys are of utmost importance to monitor the socio-economic sustainability of the proposed measures.

Figure 2.4 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Dreher – Water Resource Modeller (and Software Development Engineer) Riddell - SWRE	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report	

WP 2.4 – Identify long term needs for data collection and monitoring

Activity 2.4.1 – Identify long term needs for data collection and monitoring

Objectives:
To enhance the data monitoring system in order to fill the identified data gaps

Expected outputs:
Recommendations on long term needs on data collection and monitoring systems

Description of Activity
Based on the outcomes of the underlying assessments on general data availability (WP 1.1), and the identification of needs for DSS-related data (Activity 2.3). the Consultant will compile these information and make consequently recommendations on the following topics:

1. Socio-economic surveys aiming at gathering and evaluating long-term parameter changes and performance indicators
2. Expanding of the hydrometeorological monitoring network in order to measure the main parameters of the hydrological cycle, allowing for determination of regional precipitation, evapotranspiration, water levels, etc.
3. Establishment of a water quality monitoring network for relevant parameters (in-situ measurements and real-time data acquisition), mainly for compliance monitoring and for transmitting the data of state and event parameters for the future DSS.
4. Meteorological forecasting centres: connection to the meteorological forecasting centres, which have the possibility to deliver the daily forecasts of the regional weather conditions should be established, if possible.
5. Planning of the training and capacity building program, and the institutional framework to enhance monitoring activities.

Figure 2.5 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Dreher – Water Resource Modeller (and Software Development Engineer) Riddell – SWRE AbuZeid – Team Leader	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report	

WP 2.5 – Detailed Needs Assessment and System Requirements

The vision, which will guide the development of the Nile Basin DSS, will be to provide to the decision makers a tool that can be used to easily assess the potential impacts of the various, Nile Basin-wide measures and scenarios on the society and on the environment. It will be a tool which the decision makers can understand and use with facility in order to estimate the extent of the decisions they have made and the associated socio-economic impacts for different scenarios. The intended users of the system must not be highly skilled hydraulic experts or modellers, but rather the technical staff, managers, stakeholders and decision-makers, who have enough background in water resources management and can interactively use the system and interpret its outputs.
In fact, the Nile Basin DSS is dedicated to the technical services of the decision makers for the analysing and planning of water resources management measures or planning of preventive measures to mitigate floods and droughts. It will place at their disposal, through a dedicated Internet interface (Web-based Information Management System) a tool for building, simulating, and comparing different water allocation scenarios. The DSS will be supported on the one hand by several rainfall-runoff, hydrological, hydraulic, water quality, and economic modelling and on the other hand by using the knowledge base which will be integrated in the application's database.

Activity 2.5.1 – Identify Overall needs / requirements

Objectives:
Based on the analyses of data / information collected during earlier activities and further conclusions with the riparian experts as appropriate, the Consultant shall determine the conceptual framework of the Nile Basin DSS and key functional and non-functional requirements for the Nile Basin,.

Expected outputs:
Description of the overall requirements of the Nile Basin DSS (deliverables: Requirement Analysis and DSS Design report)

Description of Activity
During the Consultations with the riparian experts, the common system architecture of a modern DSS will be comprehensively explained to the riparian experts and their comments considered, as far as all requirements may be fulfilled. The riparian experts will be informed about the impossibility to fulfil their different wishes and proposal, if those requests are not reasonable, from the technical point of view.

A commonly used configuration can be an **Integrated system:**
The complete system consists of different modules that are transparently integrated. The pre-processor, the models, the databases and the post processing tools are separate modules, but are integrated such that data flow is transparent to end users. Users have the capability to replace some components (models, impact assessment methodologies) or integrate new ones (internal or external models), by their own as long as the input and output formats are respected.

Web based interface;
The complete system has been developed following a distributed architecture and end-users can access the system through their web-browser. The models, which often require excessive computation time can reside on a distant server and can be also submitted for solution to a remote cluster. Each user has access to the common database and can get the information / simulations produced by the other users, provided he has permission rights for doing that.

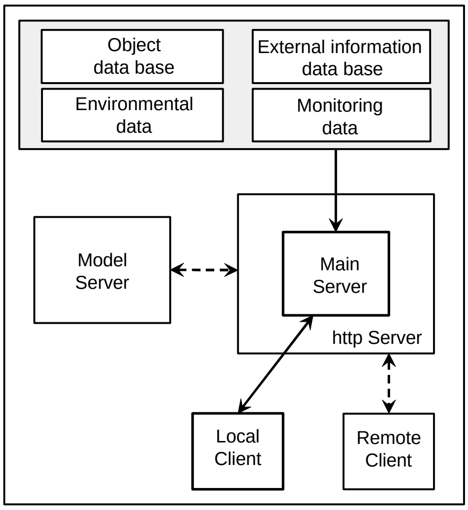
Extensive visualization capabilities;
All model results are translated to maps, diagrams and tables and extensive pre- and post-processing tools are provided in a GIS environment for further analysis.

Generic Model Building;
The system has been designed in a generic way and can be used for water allocation and crop simulation, flood simulation in a variety of rivers and situations. It integrates both 1-D and 2-D hydraulic models, it can be implemented in data rich and data poor environments and impact estimation methodologies can be adapted to the particular characteristics of the application area.

System Architecture:

Distributed Architecture
The DSS, in order to be a participatory tool, should be a web-based distributed system. Users with appropriate privileges can access the system through the web browser and perform simulations.
The integrated system available for user interaction includes the GIS databases, the models and the impact methodologies coupled with the appropriate user interfaces. Preparation of the various GIS coverages is performed outside of the integrated system through either remote sensing analysis, digitisation or data base manipulations. Once the various datasets have been prepared, they are stored as standard shape files in the system data repository (Object database) and may be normally used as background maps including all attributes as in the GIS.

Figure 2.6 DSS System Architecture

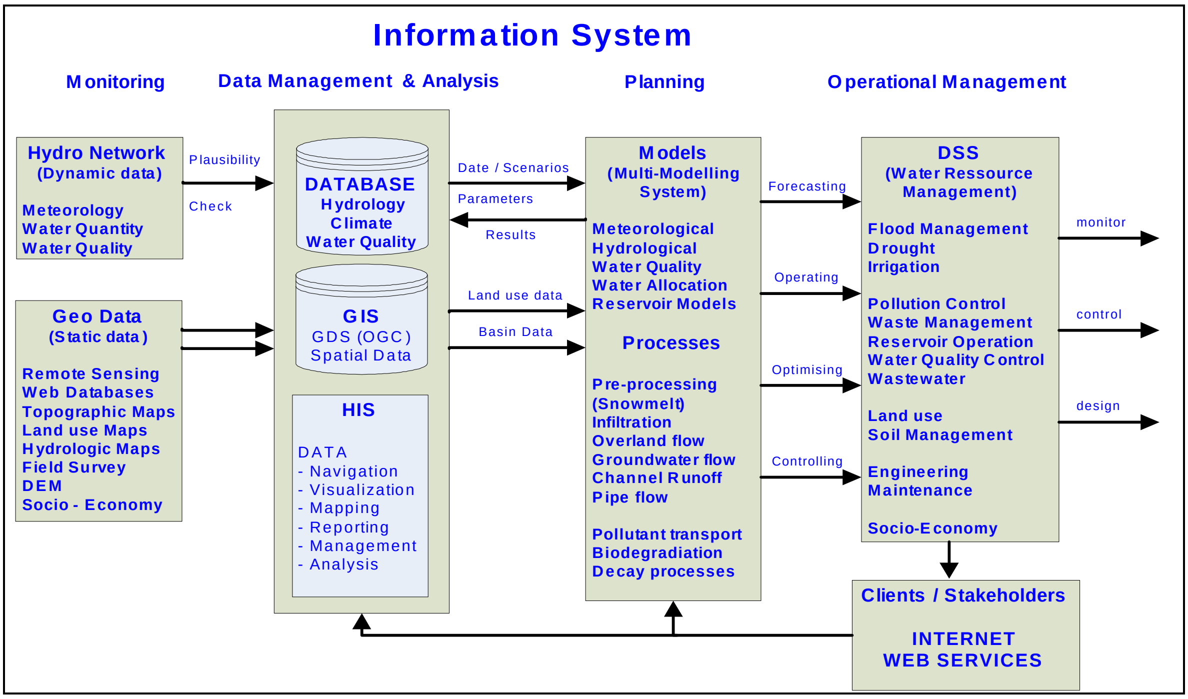


In order to fulfil the minimum requirements of today's systems, the key components of the system are the following:

- DSS Main Server: this is the core component of the complete system since it handles the interactions between the various servers, the user management, the graphical user interfaces, and the data management, etc.,
- GIS, Object Database Server : This is the component that handles all spatial (Object) databases of the system; it stores the data and extracts data as needed,
- Model server: This server integrates the various models into the DSS system; it applies the model on a defined data set through special interfaces for data input and output using XML protocols, it monitors the progress and the status of the processes (needed since complex models can sometimes run for several hours) and sends the results to the rest of the system. Depending on the processing level of the models, it should be decided whether a HPCN will be implemented or not.
- Client: may use the several data management, navigation tools, check lists interface if choosing weighting factor and other relevant result through the graphical user interface.

Figure 2.7 shows the general schematic configuration of the entire Information System and Decision Support System., including flow of data/information. Figure 6 doesn't include the decision making tools.

Figure 2.7 Configuration of the proposed Information System, Multi-Modelling System, and Decision Support System and the main data flow (It does not include the MCA)



Useful Hardware/Software Components:
State of the art hard and software, which will be preferably recommended are listed below:

Hardware:

- Server: Database Server (Oracle),
- Web-Application server (ContentManagementSystem CMS,
- GIS WebMapping System – including Metadata service
- Clients: DeskTop Profi Client (for data management, data check (QM),
- Loading into the Database server including Geodata server

Software:

- DB-Server: Oracle 10g, ESRI ArcServer 9.2 (former SDE)
- Web-APP-Server: ESRI ArcServer (Viewing or Editing Edition), IIS, .NET Framework Edition of ArcServer depending on the requirements, i fit should also use the Net.;
- eventually MicoSoft Sharepoint Server for the Content Management (CMS for Documents, etc....)
- Profi-Client: ArcGIS ArcEditor 9.2

- SAFE FME 2007 (Feature Manipulation Engine) for data check and conversion
- DeskTops as necessary (Analyse per ArcView 9.2 or others)
- WebClients: all connectionInternet Browser (IE 6 or 7, Mozilla, or others)

Figure 2.8 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Dreher – Software Development Engineer	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report (Requirements Assessment Document)	

Activity 2.5.2 – Functional Sectoral Capability of DSS

Objectives:
Identify the specific capabilities of the future Nile Basin DSS with respect to the integration of Projects from all sectors of activities.

Expected outputs:
DSS needs assessment as a Report (Deliverables: Requirements Assessment Report)

Description of Activity
Development of the Nile Basin DSS needs to be through a fully consultative process. Our understanding is that DSS technology is fairly new in many of the Nile riparian countries fostering effective participation is therefore fundamental to the sustainability of developing and then implementing in the short to medium term future.

Once stakeholders have been identified, there are a number of options which can be built upon. These include:

1. Development of DSS practice teams – individuals from different stakeholders within each country and regionally who will network of different issues relevant to the development of the DSS. For example a DSS practice team of hydrology, or dam investments helps in the process of sharing information between stakeholders and countries.
2. Outlining a structured decision making process (SDM) to go hand in hand with DSS technical development to guide it and benefit from it.

SDM is a process where problems are identified and resources focussed in the relevant areas, in an effort to reduce possible future problems. SDM development involves the production of assessment tools and possible associated service responses to identify critical decision making points to improve the structure and consistency of the decisions made and the services/actions provided as a result of the decision. SDM systems are based on the following principles:

- Decisions can be significantly improved when they are structured appropriately;
- Priorities and activities must correspond directly to the assessment process
- Expectations of key staff/decision makers must be clearly defined and practice standards must be measurable.

After having realized the Consultations with all riparian Experts and identifying all relevant Projects planned in the Nile River Basin, all kind of interventions, scenarios, and investigations using the future DSS will be analysed and discussed carefully with riparian experts. An inventory including all kind of these interventions will be established.

Figure 2.9 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Dreher – Software Development Engineer Riddell –SWRE AbuZeid – Team Leader	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report (Requirements Assessment Document)	

Activity 2.5.3 – River Basin Modelling and Multi-objective Analysis Tools

Objectives:
To assess modelling capabilities of the future DSS

Expected Outputs:
Survey lists of the projects analysed including the following information:
- Outputs of the models
- Description of the river systems
- Basin physical processes to be taken into consideration
- What kind of specific models are needed
- Multi criteria analysis tools

Description of Activity
Full basin-scale simulations can be carried out, such that the influences of land use, spatial variations of soil properties and spatial precipitation differences are taken into account. The ultimate aim of prediction of hydrological processes and water allocation using models must be to improve decision-making about a hydrological problem, whether that be in water resources planning and allocation, flood forecasting or flood protection, and mitigation of contamination, etc..

Rainfall-runoff modelling can be carried out within purely analytical framework based on observations of the inputs and outputs to a basin area. The basin is modelled as a "black box" without any reference of internal processes. Of course, many other models describe the hydrological processes with varying degree of complexity. This complexity is one reason why there is no commonly agreed modelling strategy for rainfall-runoff processes.

The DSS concept to be proposed should be based on the following facts:

1. Modelling Platform (Internal Models)

One possible and here proposed modelling approach for "Rainfall-runoff" includes a number of different models providing a variety of possible applications that can be implemented internally into the DSS model server for the simulation of rainfall-runoff and river routing processes. The methods can implemented as hard coded applications. The choice of the methods to be used is the first step for flood estimation. This choice is often made on a largely subjective and intuitive basis. While some subjectivity is mainly involved, the following considerations provide a sound basis for the usage of the right flood forecasting method:
- The structure of the used methods, their theoretical basis, and their relative accuracy,
- Whether the kind of precipitation event is considered
- Whether soil water storage plays a major role
- The type and importance of the invested work for which the estimate is required
- The capability of the method to be calibrated with data recorded at site
- The simulation time that can be spent in estimating the flood
- The available expertise to use the methods

The knowledge of the prevailing (regional and sub-regional) precipitation events, their spatial and temporal variability are of paramount importance for water resources management and also flood estimation. In most of the cases, the collected on site data only provide point measurements which should be improved with complementary information from Remote Sensing, GPM or Weather radar systems data for a more accurate runoff estimation.

The model builder or the model user should be able to choose the appropriate model elements depending on its “applicability”, by means of a generic GIS component, defined by the following main criteria:

- To meet user requirements under several constrains and with the purpose of producing good results to the particular situations (event based or continuous models,)
- To be able to adapt to the new flood or hydrological situations that have not been observed in the past (lumped or distributed models)
- To take into consideration model and data insufficiencies (filling data gaps, adaptive procedures, error correction)

Model Elements and Generic Model Building
The following model elements will be useful:

- Sub-Basin rainfall-runoff models
- Floodplain model
- River Channel model
- Reservoir model (incl. optimization capabilities
- Linkage (junctions)
- Diversions
- Water Allocation models
- Water quality models
- Sedimentation models
- Economic models
- Ecosystems (Wetlands, Lakes)
- Multi-Criteria-Analysis
- Integrated Modelling Assessment

All these model elements and optimization components are represented as special icons that are easily recognised on the PC screen and can be placed there to build a generic basin model.

Modelling Structure and Methods
There are many hydrological models and different ways of classifying them. A basic classification would consider the following choice:

Lumped or distributed modelling approach:
Lumped models treat the catchment as a single unit, with state variables that represent averages over the catchment area (average storage in the saturated soil, and other average soil characteristics). Distributed models use parameters that are distributed in space, with state variables that represent local averages of storage, flow depths or hydraulic potential, by making assumptions that the catchment is dicretized into a large number of elements (grid squares) and solving the equations for the state variables associated with every element of the grid.

Another type of distribution function model that attempts to define similarity more explicitly is that based on the idea of “hydrological response units” (HRUs). These models consider parcels of the landscape with the same characteristics as soil, slope, and vegetation type. The maps of these characteristics can be held on the databases of the GIS for easier classification.

Deterministic and Stochastic Models:
Deterministic models allow only one outcome from simulation with one set of parameters and input values. Stochastic models allow for a certain randomness and uncertainty is the possible outcomes due to uncertainty of the input variables, boundary conditions and model parameters. The models used are in their vast majority deterministic models. The proposed error correction modules consider nevertheless a stochastic approach.

Analysis of useful Models

Pre-Processor:
The pre-processor may probably be one of the key elements of the DSS Modelling System. It is conceived as to take into account grid data of meteorological forecasting systems available from Meteorological Centres as well as of available weather radar systems (within a radius of at least 200 km depending on the radar and on the polarisation). At the same time, the proposed pre-processor is responsible for the spatial interpolation and regionalization of precipitation data measured at the ground stations. Through a sophisticated methodology, the pre-processor is able to process the data in a very robust way, taking into account eventually missing station data.
NB: The difficult assessment of the evapotranspiration of Lake Victoria could be easily solved by the integration of the pre-processor in the DSS Modelling System

Rainfall-Runoff Models:
The concept is mainly based on the well known Soil Moisture Accounting Method developed for the HEC-HMS program of US-Army Corps of Engineering as well as on the HBV model concept from Sweden (Sing, 1995). The concept follows the approach of Semi-Distributed Models described above. Other models are based on more simple empirical approaches considering the snowfall and snow melt, the sub-basin losses, and base flow components. The direct runoff can be calculated from the excess precipitation using kinematic wave method, SCS Unit Hydrograph, or user specified Unit Hydrographs.

Surface Runoff and Channel Routing:
For surface runoff and channel routing, simple conceptual models as well as kinematic wave or hydrodynamic wave routing modules may be developed (hard coded). The user can choose both spatial and temporal resolution of the distributed model approaches as well as the more simpler lumped models based on the Muskingum method.

Floodplain Model:
Flood plains are represented by two dimensional flow components solved by the Saint Venant equation for two dimensional flow. The results can be displayed as a map layer on the GIS based on model grid squares. Some 2D models require direct intervention from the user in case of iteration problems. An automatic model processing is therefore with this kind of models not appropriate.

Reservoir Routing:
Reservoirs are always assumed to have a horizontal water surface throughout its length. Unsteady flow routing in reservoirs is approximated by a simple technique assuming the reservoir outflow to be a function of h(t). The following possibilities may be ineresting

- Reservoir outflow optimization using a linear programming (LP) approach: The flood storage zones of the reservoir and of the downstream canal are represented as areas with different priorities (penalty functions) of being filled during flood events.
- Reservoir operation according to the operation rules given as outflow targets depending on the reservoir water levels
- Reservoir operation at a given outflow time series.

Pre-flood drawdown of the reservoir water level can be fulfilled using inflow forecast (upstream sub-basin models)
The module proposed is also able to model reservoir cascades. This is fulfilled by the LP method for all reservoirs, in concern, implemented in the module.

Calibration Methods:
Different approaches are used for the parameterization of the built models. The calibration mainly depends on the observed data. A-priori parameter estimation based on remote sensing data or on-site measurements can also be used instead of the automatic calibration method offered.

Economic Model and Water Allocation Mode

Economic models should allow the following:

- Explain the **socio-economic and political processes** in watersheds

- Find out the **economic values** of different **water uses** (trade-offs between e.g. discharge and ecology)
- Find out the **economic net-benefits** of water for different **water users** (trade-offs between e.g. agriculture and hydro-power)
- Determine the most **efficient water management strategies** and **water policies** (e.g. water pricing)

Optimisation of the processes in watersheds:

- Water allocation among different water uses (abstraction, discharge, storage, shipping, natural habitats, recreation)
- Water allocation among different water users (households, agriculture, industry, power plants)
- Economically efficient measures in water management (water supply, water quality, aquatic ecosystems, flood control)
- Cost recovery and water pricing
- Water policies (regulations, water markets, subsidies)

2. External Models

Additionally, existing models can be integrated in DSS systems. Several rainfall runoff models and water allocation models are available in the market and can be easily integrated by means of an interface, as described under Activity 2.5.1.
Another alternative is to apply an open source Model Interface which is able to integrate all kind of models. Such an interface is now available under www.harmonit.org , and is known under "OpenMI". This system was developed by an European Consortium of several international well known companies, such as CEH, RIZA, DHI, WL Delft, WSL, Uni Do, JIRSA, and others, with the intension to use and integrate their models in existing DSS applications.

Regarding the external models, a survey will be carried out in order to make a choice of the best models that can be used for the DSS of the Nile Basin. Proposals have been already made in the available baseline studies of the different Countries (SVP, ENTRO, Flood Preparedness and Events Project). One of the findings of this Baseline Studies is that several Models have been used but not all of them are operational at the moment.

The Strategy proposed is to carry out a rapid appraisal of models listed in these Baseline Studies and discuss with the riparian experts during the consultations (Activity .2.1.2) on useful applicability of the models which are operational.

Multi Criteria Analysis:
The level of the decision making processes ("Responses" in the DPSIR framework) have to be related to the magnitude of the impacts. These different responses need different planning processes and different decision makers could be involved. The different planning levels could be policies, plans, programs and projects, from macro to micro level. A crucial aspect of implementing the proposed DPSIR approach in a methodology for implementing the principles of IWRM in decision making is the transformation of a static reporting scheme in a dynamic framework for integrated analysis and assessment.

Integrated Assessment Modelling:
Integrated Assessment Modelling (IAM) combined with a Multi-Criteria Analysis (MCA) method can provide methodological support for analysis and assessment procedures.
The implementation of IAM in the DPSIR framework is approached in the proposed methodology by focusing on the D-P-S (Drivers, Pressures, States) part of the conceptual framework. These three elements may be considered as explicit formalizations of driving variables, model parameters and outputs, respectively. In the case of water pollution models, for instance, D's represent the forcing variables ruling the behaviour of the simulated system (i.e. the catchment). P's may be represented by parameters that express the rate of pollution processes and S's are the output variables quantifying the dynamic evolution of the catchment system (State), as affected by the considered pollution sources and processes. Integration of models may occur at various levels and in different ways and thus relationships along the chains could be expressed by parallel one-to-one flows, or one-to-many (e.g. one activity affecting various environmental

compartments), or many-to-one (e.g. various sectors affecting the same environmental indicator), or even many-to-many, in the case of multi-sector integrated models. In the context of environmental decision making, IAM can support the identification of the correct Responses by providing sets of indicator values. These values are derived from subsequent simulation runs in which model(s) are parameterised to represent the expected consequences of a set of possible alternative responses. The development of a set of evaluation indices is a crucial step. It should be targeted to evaluate Impacts deriving from the State indicators provided by IAM.

Within this disciplinary context a preliminary phase of Problem Structuring is targeted to the identification of the criteria to be considered for choosing among previously defined options. These factors are expressed as indicators deriving from output variables of IAMs or monitoring activities. The step between the quantification of State variables and the identification of Impact evaluation indices can be conceptualised according to MCA theory as the conversion of the Analysis Matrix into an Evaluation Matrix (EM), which expresses the estimated impacts. Having identified the impacts as they vary under the effects of alternative response options, the decision maker has to apply a decision rule to aggregate the values stored in the EM to identify the preferred option, filling therefore the gap between I (Impact) and R (Responses). In the simplest case, the rule can be expressed by the weighted sum of values stored in the columns of the EM. Various iterations are possible and needed at this step to refine the weights, or apply alternative decision rules by considering the results of the sensitivity analysis to select a robust response. Parallel procedures are also possible in multi-stakeholders group decision making, by means of using the web capabilities of the DSS.

RECOMMENDATIONS:

A) ***Issues Related to Basin Management Modelling***

The current state of the art is to use simulation models with built-in linear programming (LP) solvers whenever possible. Some misconceptions persist in the industry, and those are mentioned below.

1) Some of the popular models that have been used such as the MODSIM or ARSP of Acres International rely on the network flow solvers to deliver flow solutions. Consequently, they are unable to resolve the non-linear constraints properly since they must resort to iterations. The negative impacts of using iterations have not yet been fully acknowledged in the industry. This is also the case for models that rely on full commercial LP solvers.
2) The existing models also resort to the use of iterations in an effort to optimize the hydro power generation, which introduces non-linear terms both in the objective function and in the constraints. A linearization of hydro power terms that does not involve iterative calls of the solver should be proposed.
3) Another common misconception is that the length of the time step is not as relevant to basin planning studies. This is not true both in terms of accurate modeling of the reservoir spills, as well as in terms of proper hydro power optimization.
4) There is currently no consensus among researchers and in the consulting industry regarding the best approach to determine cost or weight factors (penalty factors) that represent the priority of water use for each stakeholder.

B). Suggested technical specifications for a basin management model include the following:

a) Flexible time step (hourly, daily or weekly) such that the same model can be used either as a planning tool or as an operational tool if so desired;
b) Proper handling of non-linear flow constraints related to reservoir outflows and weir diversion flows;
c) Include channel routing into the solutions process (fast calculations and therefore user friendly)
d) Optimize allocation in the system for single or multiple time steps using either LP or non-linear solvers;
e) Equalize water use deficits among certain types of components if so desired;
f) Model storage change and net evaporation on reservoirs using the area vs elevation curves;
g) Enforce return flows as a function of consumptive use;
h) Model water license limits and apportionment agreements between bordering states by using multiple time step optimization to maximize benefits to all stakeholders (economic sustainability).

Figure 2.10 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Dreher – Water Resources Modeller and Software Development Engineer Riddle – SWRE AbuZeid – Team Leader	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report (Requirements Assessment Document)	

Activity 2.5.4 – Basin Wide Communication and Information/Knowledge System

Objectives:
Incorporation of comments on prototype and finalization of end product

Expected outputs:
Nile – IS with up-loaded documents, operational and running during the project life span

Please see Annex D of the Draft Inception Report.

Figure 2.11 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Blumauer/Koller – IT - Specialist	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Full Version of Web-based Information System	

Activity 2.5.6 – Training Needs Assessment

Objectives:
To assess training needs for the implementation of a DSS

Expected Outputs:
Trainings needs assessment document as an annex to the DSS requirements report

Description of activity:
The training needs assessment will focus on the issue of Identifying occupational and individual training needs. Once organisational training needs have been identified and prioritised, we would propose to assess occupational and individual training needs concurrently. The aim would be to determine the specific quality and quantity of training needs. We propose to use the following sources of information:

- **Existing documentation** – much factual information about training needs may be already available, for example within internal documents of the stakeholders.
- **Interviews** – we will undertake interviews with key personnel from each of the stakeholders.
- **Questionnaires** – we suggest an email survey with the key personnel of the stakeholders.
- **Required skills** – we have already an overview about the skills required to operate and use a DSS.

The skills gaps identified by this process will be the guidelines to arrive at an accurate and strategic assessment of training needs.

Figure 2.12 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Schuen – Socio-economic Development Specialists Hartveld – Socio-economic Development Specialists Riddel – SWRE	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report (Training Needs Assessment Document)	

WP 2.6 – Stakeholder Consultation

Please refer to Annex B for information on the Stakeholder Consultation Plan and the proposed program and schedule of individual Stakeholder Consultations.

It is unquestionable and of utmost importance that the process of developing the DSS should be in all Stakeholder levels using participatory, rapid appraisal techniques. In order to facilitate the organization of decision making procedures and a structured Stakeholder Interaction it is important to know if there are already organized Stakeholder clusters and groups involved in the decision making procedures in the NBI WRPM Project "technical components": (1) Water Policy Good Practice Guides and Support and (2) Project Planning and Management Good Practice Guides and Support; (3) as well as in other SAP Projects and SVP Programs (see also TOR, Chapter 5.5, Linkages and Synergy).
Before the Management groups, the involved Stakeholders and the facilitator start planning and outlining structured decision making processes, a common vision of the problem has to be developed in dedicated stakeholder consultations. We will implement the stakeholder consultation plan developed in the Inception phase.

Activity 2.6.1 – Stakeholder Consultation Missions

Objectives:
The objectives of the stakeholder consultations are (i) to identify the general and specific requirements of the stakeholders for the DSS (ii) to identify and rank key water management issues (iii) identify and rank key decisions (iv) appraise data availability and (ii) the facilitation of consensus building among the stakeholders.

Expected outputs:
DSS requirements assessment report as annex to the inception report.

Description of the Activity:
We have again divided the nine countries into three groups:
(1) Eastern Nile countries (Egypt, Sudan, Ethiopia)
(2) French Speaking Nile Equatorial Lake Countries (Rwanda, Burundi, Congo)
(3) English Speaking Nile Equatorial Lake Countries (Tanzania, Kenya, Uganda)

Each group of countries will be visited by a team of comprising expertise and specialists of (i) water resources engineering or water resource modelling and (ii) socio economic expertise. In each country appropriate local expertise will be provided. The institutional specialist and the hydrologist will have a determining support function. All the other experts will formulate a number of issues and questions to be analysed during the stakeholder consultation missions. Standardised reporting tools will be used in order facilitate reporting, analysis and comparison of data and information. A high degree of administrative efficiency will so be achieved. The missions will be carefully prepared and organised by our local support staff.

Annex B of the Draft Inception Report includes a proposed mission schedule which is based on the originally budgeted man-days. Considering the experiences from the missions during the Inception Phase (extremely tight time schedule) however, we suggest to budget additional time for the missions in order to get comprehensive information. The inclusion of South Sudan in the mission program was proposed by us but still needs to be discussed by the Client.

Emphasis will be put on assessment of the requirements of the DSS. The findings of Work packages 2.1 to 2.5 will be cross checked and rendered consistent by first hand information gathered from concerned stakeholders. A standardised requirements assessment document (Annex 1 to the DSS requirements report) will be elaborated for each country. Furthermore parts of the Trainings needs assessment for the DSS implementation will be carried out.

Logistical support and organisation will be provided from the project management staff at hydrophil office and the project office in Addis Ababa.

The compositions of the three teams are as follows:

(1) Eastern Nile Countries Team Members (Egypt, Sudan, Ethiopia)

Mr. Nachtnebel, Water Resources Modeller
Mr. Hartveld, Socio Economic Specialist
Local expertise will be provided from our consortium member CEDARE

(2) French Speaking Nile Equatorial Lake Countries Team Members (Rwanda, Burundi, Congo)

Mr. Dreher, Water Resources Modeller
Mr. Schuen, Socio Economic Specialist
Local expertise will be provided by by the consortium leader hydrophil.

(3) English Speaking Nile Equatorial Lake Countries Team Members (Tanzania, Kenya, Uganda)

Mr. Riddell – Senior Water Resources Engineer
Mr. Schuen, Socio Economic Specialist
Local expertise will be provided by the consortium leader hydrophil.

Responsible Staff:
The Senior Water Resources Engineer or Water Resources Modeller will be the respective team leaders.

Timing and Duration:
Please see Draft Inception Report, Annex B.

Figure 2.13 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
see above	• see schedule Annex B • See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report	

WP 2.7 – Prepare DSS Design Specifications

Activity 2.7.1 – Preparation of DSS Design Specifications

Objectives:
To design appropriate DSS specifications

Expected outputs:
Draft DSS design

Description of Activity
The following general structure will be proposed:

Components:
General structure
The following steps will be proposed for the design development of the Nile Basin DSS:

1. **State of the Art review** – review of all issues relevant for the design of the new Nile Basin DSS and formulate the State of the Art vision of the system, based on the needs assessment, review of existing systems, technical components, models.
2. **Requirements**: - Review of the system requirements according to the Activities of the Analysis Phase
3. **System Architecture**: - proposed system architecture following the results of the Consultations with the riparian experts.
4. **Detailed Design**: - In this phase the details of the DSS components will be extended and improved, and described in detail.
    a. **Guidelines:** - data models, data definitions, linkage mechanisms and interface definitions, and description of the DSS SW interfaces and environment.
    b. **Design of the main tools and components:** - Detailed description of tools, internal interfaces of components and the general framework with detailed functionality and design of tools.
    c. **Linkage mechanisms:** - to extent the architectural design, link new external models into a clear, well documented detailed specification document, covering the definitions,, and linkage mechanisms
5. **Dissemination of the concept:** - dissemination of the concept to gain the DSS Stakeholder's acceptance of the DSS tools and interfaces (Activity 2.7.1)
6. **Proof of Concept:** - acceptance of the design after workshop discussion and collection of comments of all participants.

Figure 2.14 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Dreher – Water Resources Modeller and Software Development Engineer Riddell – SWRE AbuZeid – Team Leader	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report	

WP 2.8 – Regional Review Work Shop

Activity 2.8.1 – Regional Review Workshop

Objectives:
Present the results of the work carried out so far
DSS requirements report, including the DSS requirement assessment, the stakeholder consultation plan, the training material and the full version of the Web based information system.

Expected Outputs:
Agreement concerning all components of the DSS requirements report and the web based information system is reached.

Description:
The Consultant will organise and hold a regional review workshop in order to present and discuss the findings and the proposals of the analysis phase with a large involvement of stakeholders. The results of the discussion will be documented; comments and feedback will be welcome in order to refine the results of the DSS requirements Report. This work shop will take place in Kigali, Rwanda and will have a duration of three days including travel time. From our side the Team Leader as well as the involved experts in the analysis phase will participate. During the work shop we will give presentations, hold discussions and build consensus concerning the Inception report, including the situation assessment, the stakeholder consultation plan, the training material and the full version of the Web based information system.

Consultants staff:

Mr. Abu Zeid, Team Leader
Mr. Riddell, key staff, Senior Water Resources Engineer
Mr. Dreher, key staff, Software Development Engineer
Mr. Yigezu

Timing and Duration:
The regional workshop is planned to be held at the beginning of the seventh month. This will allow for sufficient time to include all modifications resulting from the work shop proceedings and to submit the Final version of the DSS requirements Report in time. The work shop will have a duration of three days

Figure 2.15 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Abu-Zeid – TL Mr. Yigezu, DTL Riddell – SWRE Dreher – Software Development Engineer	• See updated Work Plan and • Addendum to Work Plan “Agreed Work Schedule after Launching Meeting”
CORRESPONDING DELIVERABLE	
Analysis and DSS Design Report and Web-based Information System	

3. Synthesis Phase - Work Package 3 – DSS Development Plan and Preparation of Implementation ToR

Objective: To synthesize the findings and finalize the DSS development plan and training plan.
Deliverables of this WP:

- DSS Development Plan
- Preparation of training plan
- Input to tender Documents for DSS Implementation Consultancy
- Final review Workshop

WP 3.1 – DSS Development Plan

Activity 3.1 – Preparation of DSS development plan

Objectives:
To elaborate a DSS development plan for future implementation of the DSS

Expected outputs:
DSS development plan

Description of Activity
Based on the findings and conclusions a DSS Development Plan will be elaborated according to the requests of the TOR..

Figure 3.1 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Dreher – Water Resources Modeller and Software Development Engineer Riddell - SWRE	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
DSS Development Plan	

WP 3.2 – Prepare Training Plan

Activity 3.2.1 – Preparation of Training Plan

Objectives:
Basic objective of the Training Plan is to enable the transfer of know how and specific DSS related competencies towards the employees and the management of the future users of the DSS.

Expected Outputs:
The output will be a structured, modularised DSS training plan. The plan will be part of the DSS Development Plan.

Description of the Activity:
In this paragraph we put the attention on some very important features when dealing with international transfer of know how and training. First of all the training activities shall not be regarded as stand alone interventions. They have to be seen in the wider context of the objectives of the partnership. The advice and assistance provided shall be both demand-driven and proactive, yet special attention will be given to intercultural communication. Any training programme must respond to the needs formulated and expressed by its partners, so that these needs are optimally and efficiently met and the intended results obtained. The implementing consultant should take a proactive role in assisting the beneficiaries to identify and understand their needs and to formulate their needs for capacity building and assistance.

In the whole co-ordination process for the different countries, the concerned staff and the different stakeholders, special emphasis should be placed on ensuring a harmonious team spirit and mutual support consistent with the objectives of the programmes. Changes in the framework conditions must be included through the steering and monitoring process. Adjustments are to be done on activity-level, and in strict conformity with the achievement of the objectives. It has also to be ensured that the trainings are conducted using the most efficient means; that ready access is available to expertise on all relevant matters. Most importantly, however, the approach must be flexible enough to respond to any need for further assistance that might arise during implementation.

The general approach must therefore be demand-oriented and pragmatic with regard to the country specific needs. Finally, the general approach is results-oriented. Capacity building needs to generate visible results.

The following three strategic aspects are crucial for sustainable success of the envisaged activities:

- **Building Long-Term Partnerships**
  Building long-term partnerships is a very important strategy in all components, not only to increase the effectiveness during implementation but also to make sure that activities like capacity building and knowledge transfer will continue also in the future.

- **Training**
  A special challenge of the implementation process will be to ensure an optimal format for necessary training at different levels and in all beneficiary countries. To use the best systems, this has to be discussed in detail with the counterparts in the partner countries.

  The target groups will mainly be staff of the various stakeholders in the NBI countries. In the long run, the activities shall ensure that all upgrading and training benefits remain within the organisations. Therefore, special emphasis will be given to “training of trainers” and sustainability, especially given the frequency of staff rotation and fluctuation. This is also to be taken into consideration in connection with study visits and exchanges. These should be targeted at operational staff and middle-level management, who have both a direct link to and control over operational activities. They should have responsibilities in and influence over management and policy decisions.

- **Disseminating Knowledge**
  Achieving a sustainable improvement in the use of a DSS requires strong political commitment, efficient co-ordination and distribution of responsibilities related organisations, as well as appropriate information and communication, specific expertise and of course financial resources. The core assumptions for success, therefore, are that the authorities in the partner countries remain committed to improving, and that they will do their utmost to overcome any political and procedural obstacles encountered. Therefore, capacity building in each of the partner countries is a crucial issue that determines the successful implementation of the partnerships. However, the institutions dealing with the implementation of the measures also have to build up the required competencies. Capacity building should not only focus on individual learning, but should also follow the concept of the learning organisation. Applying a learning cycle oriented approach allows shared learning processes benefiting teams, departments and whole organisations. This approach will also help to overcome a possible "brain drain" scenario affecting public sector institutions.

  Learning also raises the question of how to manage knowledge within the beneficiary organisations. Knowledge is embodied in routines enabling operations to be performed, in organisational structures and processes, and in embedded beliefs and behaviours. Knowledge management (within each organisation and between them) starts with the identification of the core knowledge processes required to achieve the objectives of expanding and improving services. After the available knowledge has been captured and located, it must be shared in a second step, and, finally, new knowledge needs to be created.

  Therefore, all trainings conducted within this programme must be hands-on to really attract and motivate the participants.

Planning should happen in detail in the analysis and especially in the synthesis phases of the project and be kept on updating for the following stages of the DSS development.

The DSS Training forms part of the activities within the implementation of the DSS. The training plan will be guided by three major principles:

- enhancement of the capacities already existing within the stakeholders
- elimination of the most urgent deficiencies in order to enable a higher degree of efficiency in the use of the DSS
- laying the basis for a sustainable form of capacity building

Therefore the contents of the training program will be determined by the results of the training needs assessment. The training will build up upon the existing capabilities of the concerned staff and is focused to be "hands-on", which means that a direct application and implementation of the acquired capacities and competencies is desired and actively supported. The contents of the modules might also be subject to change according to specific and time-related requirements. A considerable part of the training activities will be "on-the-job" and is so incorporated into the day-to-day operations of the stakeholders. To imply the standards necessary for a high quality and efficient usage of the DSS, the whole personnel must be able to work at a high degree of quality and liability. The personnel will be trained step by step in order to be able to assume all without tight supervision. This will be especially important for the period after the consultants direct involvement.

The Training Plan will divide the training process i into three phases:

- Evaluation of the present personnel, assessment of skills (elaboration of individual personal competence profiles through data sheets for each staff to be trained
- The implementation of the Training Plan
- Continuous and accompanying training activities

The competence profiles of the employees are elaborated through standardised written questionnaires covering two methods of evaluation:

- Auto Evaluation by the single staff/employee
- Evaluation of the employee by his direct chief

Initial point for a competence profile are the respective professional competencies, e.g. from the studied profession. Previous education will be documented. These personal competencies, together with the specific requirements deriving from the training needs assessment, will build the content of the training programme. The plan will be composed of several modules; each module corresponds to certain area of functions in working with a DSS. Central point hereby is always the practical challenge in the day-to-day work. The training programme in form of a modularised system is intended to be accompanying the work. It allows the employees to absolve a complete itinerary (basic courses, special courses and management know how) or just to absolve single elements, which are indispensable in their respective area of work. Each module transmits a package of competencies and is at the same time a separate unit of education. The modules themselves are composed by specific Training Units.

The Learning methods will be characterised by

- Transfer of ways to look at problems and action oriented competencies
  In the education programme there is pedagogical concept, which is committed to the principles of action oriented competencies. Each module transmits a certain package of competencies, which are closely related to real situation in the day-to-day procedures. The employees will be confronted with “typical” situations from their working environment.
- Sensitisation for specific applications of DSS procedures
- Train the Trainer system

The transfer of knowledge will happen in practice oriented seminars and workshops, through lectures, discussions, training-on-the-job-units and teamwork sessions. Also included will be case studies, and individual work. The majority of learning and demonstration units will be held at the respective locations. Some parts, especially for the management team might also be held by external institutions.

Figure 3.2 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Schuen – Socio-Economic Development Specialist Hartveld - Socio-Economic Development Specialist Dreher – Software Development Engineer Riddell – SWRE AbuZeid – Team Leader	• See updated Work Plan and • Addendum to Work Plan “Agreed Work Schedule after Launching Meeting”
CORRESPONDING DELIVERABLE	
Training Plan	

WP 3.3 – Inputs to Tender Documents for DSS Implementation Consultancy

Activity 3.3.1 – Elaboration of Inputs to Tender Documents

Objectives:
To enable the procurement for the future DSS.

Expected outputs:
Input to tender documents as part of the DSS development plan.

Description of Activity
On the basis of the previous activities we will be in the conditions to specify all major parameters of the future DSS for the Nile Basin. These parameters will be translated into tender documents

Figure 3.3 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Dreher – Water Resources Modeller and Software Development Engineer Schuen – Socio-Economic Specialist Riddell - SWRE	• See updated Work Plan and • Addendum to Work Plan “Agreed Work Schedule after Launching Meeting”
CORRESPONDING DELIVERABLE	
Implementation TOR	

WP 3.4 – Final Review Workshop

Activity 3.4.1 – Final Review Workshop

Objectives:
Discuss the proceedings and results of the project

Expected Outputs:
Agreement concerning all final documents to be delivered

Description:
The Consultant will organise and hold a final review meeting with the client in order to present and discuss the findings and the proposals of the project. The results of the discussion will be documented; comments and feedback will be welcome in order to refine the results of the DSS Development Report. This meeting will take place at the clients office in Addis Ababa and will have a duration of two days. From our side the Project Manager, the Team Leader, his Deputy as well as the Senior Water Resources Engineer and the Water Resources Modeller experts will participate.

Consultants staff:

Mr. Abu Zeid, Team Leader
Mr. Riddell, key staff, Senior Water Resources Engineer
Mr. Yigezu
Mr. Dreher, Water Resource Modeller
Mr. Edthofer/Eder, Project Manager/Project Director

Timing and Duration:

The regional workshop is planned to be held at the beginning of the eighth month. This will allow for sufficient time to include all modifications resulting from the work shop proceedings and to submit the Final version of the DSS requirements Report in time. The work shop will have a duration of two days

Figure 3.4 Responsible Key Staff, Time, Corresponding Deliverable

RESPONSIBLE KEY STAFF	TIME
Mr. Abu Zeid, Team Leader Mr. Riddell, key staff, Senior Water Resources Engineer Mr. Yigezu Mr. Dreher, Water Resource Modeller Mr. Edthofer/Eder, Project Manager/Project Director	• See updated Work Plan and • Addendum to Work Plan "Agreed Work Schedule after Launching Meeting"
CORRESPONDING DELIVERABLE	
DSS Development Plan Training Plan Implementation TORs Project Critique	