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

NILE BASIN DECISION SUPPORT SYSTEM

FINAL REQUIREMENT ANALYSIS AND DSS DESIGN REPORT

ANNEX D: Institutional Set-Up and Decision Making Process

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NILE BASIN INITIATIVE
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Acronyms

COM	Council of Ministers
CU	Coordinating Unit
DSS	Decision Support System
EN-COM	Eastern Nile Council of Ministers
ENSAP	Eastern Nile Subsidiary Action Programme
ENTRO	Eastern Nile Technical Regional Office
GIS	Geographic Information System
IWRM	Integrated Water Resource Management
MCA	Multi-Criteria Analysis
NBI	Nile Basin Initiative
NEL-COM	Nile Equatorial Lakes Council of Ministers
NELSAP	Nile Equatorial Lakes Subsidiary Action Programme
NGO	Non Governmental Organization
Nile-COM	Nile Council of Ministers
Nile-SEC	Nile Secretariat
PMU	Project Management Unit
QC	Quality Control
RBO	River Basin Organization
SSM	Soft System Method
SVP	Shared Vision Program
TAC	Technical Advisory Committee
WRM	Water Resource Management

1 NB-DSS Stakeholder Categories and Institutions

1.1 Introduction

The NB-DSS is there fundamentally to support the decision makers and stakeholders in the region. The human, organisational and communication dimensions are thus of paramount importance. It is proposed to build on the remarkable and significant progress that has been made over the first 10 years of the NBI in particular to build on the 'transitional' institutional structures comprising ministerial councils, senior officials forums, and secretariats that have been formed along with the two-part Strategic Action Plan containing a Shared Vision Program and two sub-basin Subsidiary Action Programs.

Thus the NB-DSS should include a consistent institutional concept that is needed for transboundary collaboration. The proposed framework given below is built upon previously prepared proposals within the NBI but is also informed by the results of the stakeholders consultations carried out at country and sub-regional levels within the DSS design phase. These consultations showed that the stakeholders have significant expectations and ideas about the linkages and collaborations between the planning and water management organizations at regional, sub-regional, national and sub-national level in the Nile river basin.

1.2 Current Set-up

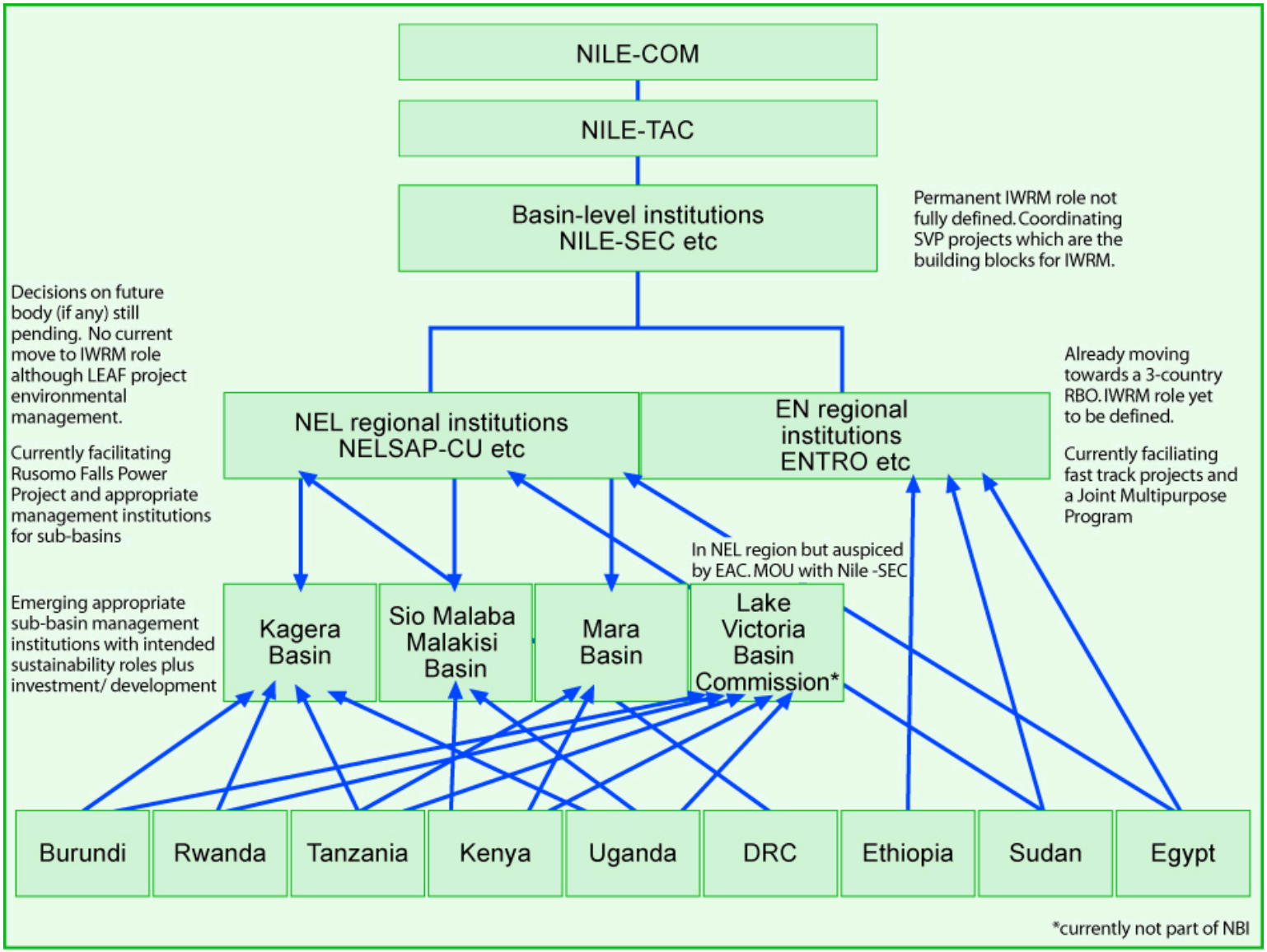
The Nile Basin Initiative is governed by a transitional institutional set-up that comprise a Council of Ministers (Nile-COM), a Technical Advisory Committee (Nile-TAC) and a NBI Secretariat (Nile-SEC)[1]. The institutional arrangements at sub-regional level vary according to the sub-region:

- The Eastern Nile and Nile Equatorial Lakes sub-regions have Council of Ministers (EN-COM and NEL-COM).
- The Nile Equatorial Lakes Subsidiary Action Program has a Coordinating Unit (NELSAP-CU) as executive unit and still has the status of project under the NBI Secretariat.
- The Nile-SEC has established legal collaboration arrangements with existing trans-national collaboration arrangements at hydrological sub-basin level (e.g. Kagera and Lake Victoria sub-basins).
- The Eastern Nile sub-region has the Eastern Nile Technical Regional Office (ENTRO) as the executive unit, which shares its office with the NBI-WRPMP in Addis Ababa (Ethiopia).

Figure 1.1 shows the complexity of the current institutional arrangements of the NBI. The Institutional Strengthening Project 2007-2010 is to consider strengthening options from the foundational legal arrangements into more permanent arrangements. This is a large institutional challenge having to deal with both the management functions at Nile basin level as well as the diversity in geography, hydrology, culture, politics and institutional and legal arrangements.

[1] Further description of the present roles and functions of the institutions can be found at http://www.nilebasin.org/

Figure 1.1 Current institutional Arrangements



The following organizational structure is according to Annex 1 – "Overview of the Nile Basin Decision Support System" of the Terms of References "Needs Assessment and Conceptual Design of the Nile Basin Decision Support System Consultancy" (The Nile Basin Initiative, Water Resources Planning and Management Project, 11 June 2007):

***Regional DSS Center**: A regional DSS center is being established at the PMU to serve as the hub of the DSS work. The regional DSS center will be instrumental in developing DSS tools and applying them at the regional level, as well as ensuring effective liaison and coordination with national DSS units (described below). To ensure that the DSS remains firmly anchored in the basin, regional staff from the PMU and from national DSS teams, along with consultant teams, will make up a DSS core team, which will be responsible for the development and implementation of the DSS*. [Remark: already been established]

In the longer term, it is envisioned that the regional DSS center will evolve into a center of excellence serving regional needs and with advanced capabilities in DSS-related activities, such as information management, GIS, web technology, and water resources modeling. This center could play a crucial role in supporting the large-scale investment programs expected to emerge over time from the subsidiary action programs.

***Basinwide working groups**: working groups may be formed on an ad hoc basis to address technical issues, such as those related to data guidelines and information exchange. In addition, an advisory panel of international experts will be available to provide advice and guidance on DSS development efforts.*

***Regional DSS Network**: composed of representatives from SVP projects and the subsidiary action programs, and other stakeholders as appropriate, is being established to ensure that the DSS appropriately supports NBI programs.* [Remark: already been established]

***National focal point institution**: At the country level, a national focal point institution for the Water Resources project has been designated in each NBI country within the Ministry responsible for water affairs. Within the national focal point institution, each country will initially appoint a staff member to serve on the policy task force (as described above), as well as DSS counterpart staff to serve as members of a national DSS team.*

***DSS counterpart staff**: DSS counterpart staff will be appointed by the government and will serve as member(s) of a national DSS team and participate in DSS development, training, and application. DSS counterpart staff will include at least one expert in water resources engineering/modeling and one IT/database technician. Some NBI countries have decided to designate a multidisciplinary team to participate in DSS activities. DSS counterpart staff responsibilities will be carried out on a part-time basis.*

***National DSS unit**: To strengthen capacity at the national level, a national DSS unit will be established in each country. The government will provide office facilities in the ministry responsible for water affairs, while the project will hire, on a nationally competitive basis, a full-time*

national DSS specialist, an IT/database expert, and other support staff as feasible. At the regional level, the national DSS specialist will participate in development of the DSS as a member of the DSS core team. At the national level, the national DSS specialist will serve as the head of the national DSS unit and be responsible for guiding DSS-related work in-country and for ensuring that a strong national DSS team is developed with the government counterpart staff. S/he will also liaise with the Nile-TAC members in the country on component-related matters, the National NBI office, and other SVP projects to ensure synergy between component- and national-level NBI activities.

***National DSS network**: to build capacity and broad support for the DSS, a national DSS network will also be established. It will be composed of major stakeholders, water resources specialists, and other sector experts (e.g., meteorology, power, GIS/mapping, environment, agriculture, professors). The network is expected to function as a forum for exchanging knowledge, expertise, and data. A cooperative working relationship will yield mutual benefits for the DSS unit and network nodes.*

1.3 Institutional Design Principles

The institutional set-up for the operation of the DSS should be established before the implementation of the DSS (or at least at the onset of the implementation phase) in order to ensure ownership and sustainability. The initial and further development as well as the operation of the NB-DSS should be based on principles of sound water related institutional set-up under transboundary context which are as follows:

Allow Participation and Demand Driven Approach:
- Response to identified needs for the NB-DSS at all levels of use considering all relevant current and previous documents (e.g. Institutional Strengthening Project 2007-2010; relevant Documents of the Needs Assessment and Conceptual Design of the Nile Basin DSS consultancy)
- Participation of Stakeholders on the DSS Design at regional and national level (facilitated by the Regional NB-DSS Centres)
- Participation of the Stakeholders on the overall DSS development throughout the process
- Development of a modular, open-end system to adapt for further user needs

Clear Organization and Administration:
- Clear organisation and administration through management of DSS by Regional NB-DSS Centres
- Avoidance to the extent possible of redundant institutional structures and conform with current set-up and evolving thoughts with respect to NBI and its institutions

Ensure Transparent Processes:
- Reliable data, information and estimates based on best available knowledge (all assumptions, methodologies and technical descriptions need to be agreed upon and be readily accessible)
- Implementation of transparent processes using history logfile capabilities
- Provision of full access to DSS knowledgebase to all citizens, stakeholders and private sector (e.g. via Web services)

Financial Sustainability:
- Due collaboration at all levels
- Service-oriented organization
- Agreed legal mandate and an institutional set-up
- Assurance of financial mechanisms through collaboration with ADB, The World Bank, and through identification of income generation activities
- Financial plan geared towards financial sustainability through the provision of demand-based services
- Intensive training and capacity building programmes at all levels and areas
- Continuous maintenance of Nile Basin databases
- Collaboration and networking with other institutions and universities

Phased Implementation of DSS:
- Gradual participatory development of the DSS
- Follow-up awareness and training sessions within a dedicated capacity building programme to enhance usefulness of the DSS
- Commitment with governments

Process and Results Orientation Development:
- Necessary participation and involvement from riparian stakeholders requires a flexible implementation plan that properly balances process and result orientations.

1.4 DSS proposed Set-up

For an efficient, informed and effective NB-DSS there will need to be a consistent institutional concept that can facilitate transboundary collaboration at **basin/regional** as well as at **sub-regional** and **national** levels.
There are essentially two types of coordination platforms which apply at each of these levels:

- Technical, environmental and economic considerations
- Political and administrative considerations

The interconnection of these is given in Figure 1.3 Note that there is also the important public/stakeholder consultation platform, which has been included in the figure, but crosses over both platforms. The figure is set out as a matrix indicating both the type of platform (on the vertical axis) and the geographical level, regional/national level (on the horizontal axis).

It will be difficult to keep a balance on the relevance of the committees and centres, against the cost and practicality of setting up 'too many committees/centres'. The proposed framework allows for multi-tasking of activities/roles to take place where possible.

Institutional Set-up and Roles (as related to the DSS)

Consultation at national and sub-regional level during the first phases of the DSS project has formed the basis for the following section, which sets out the requirements from a DSS perspective.

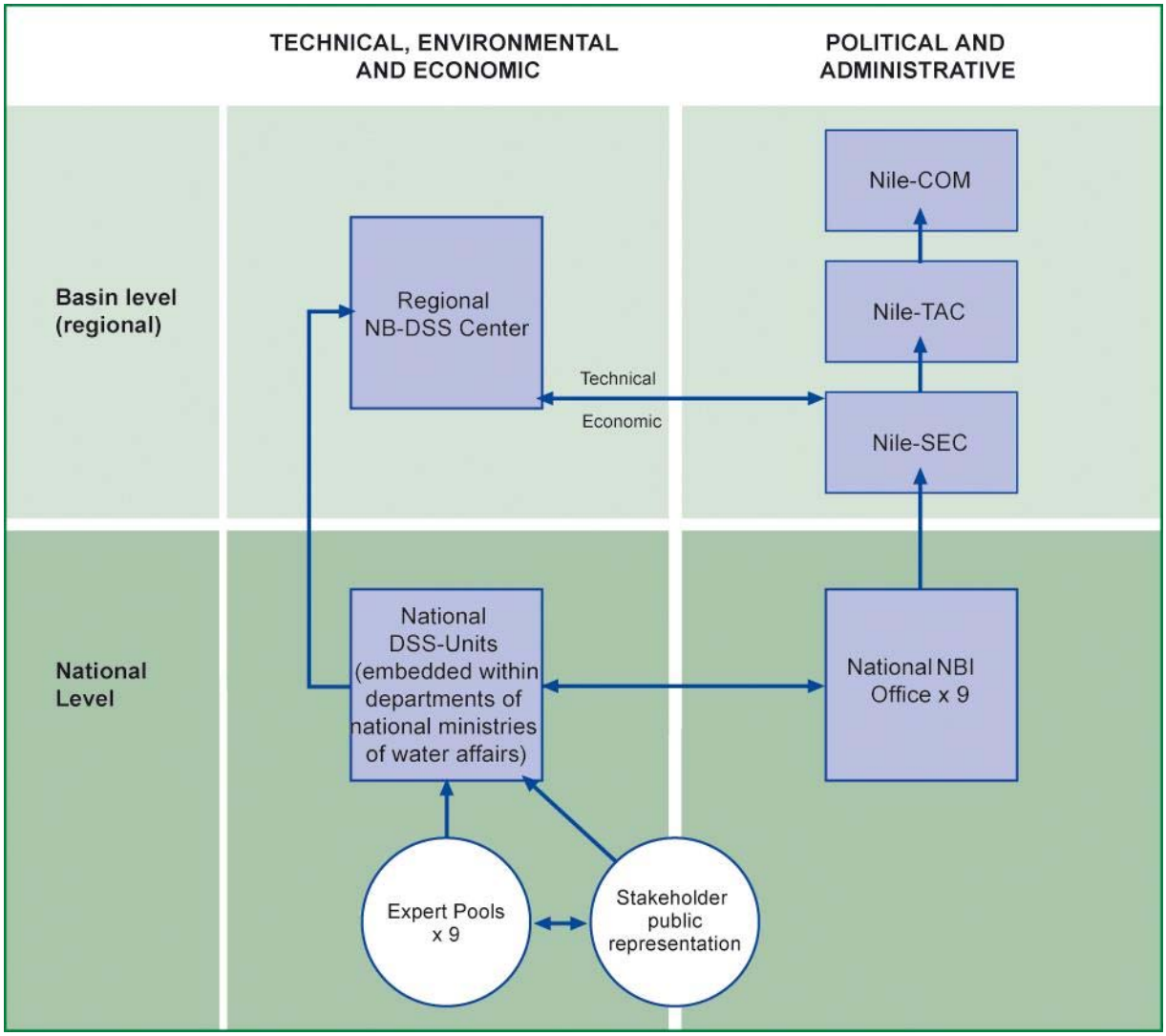
Within a proposed cooperation platform, the functional requirements of the DSS depend on institutional interaction at different levels, namely the:

- Regional level
- Sub-regional level
- National level

The complete establishment and roles of the institutional framework will evolve as the agreement on data and information sharing is prepared and the '*proposed institutional strengthening project*' takes place (between now and 2010). It is important that roles and functions are clearly defined so that overlap is avoided in accordance with each organization's mandate.

Please do consider that Figure 1.2 presents the institutional framework in a rather general form. More links could be made with the consequence of difficulties in the interpretation of different levels and arrows signalizing different forms of institutional links.

Figure 1.2 Proposed Institutional Framework for the NB-DSS



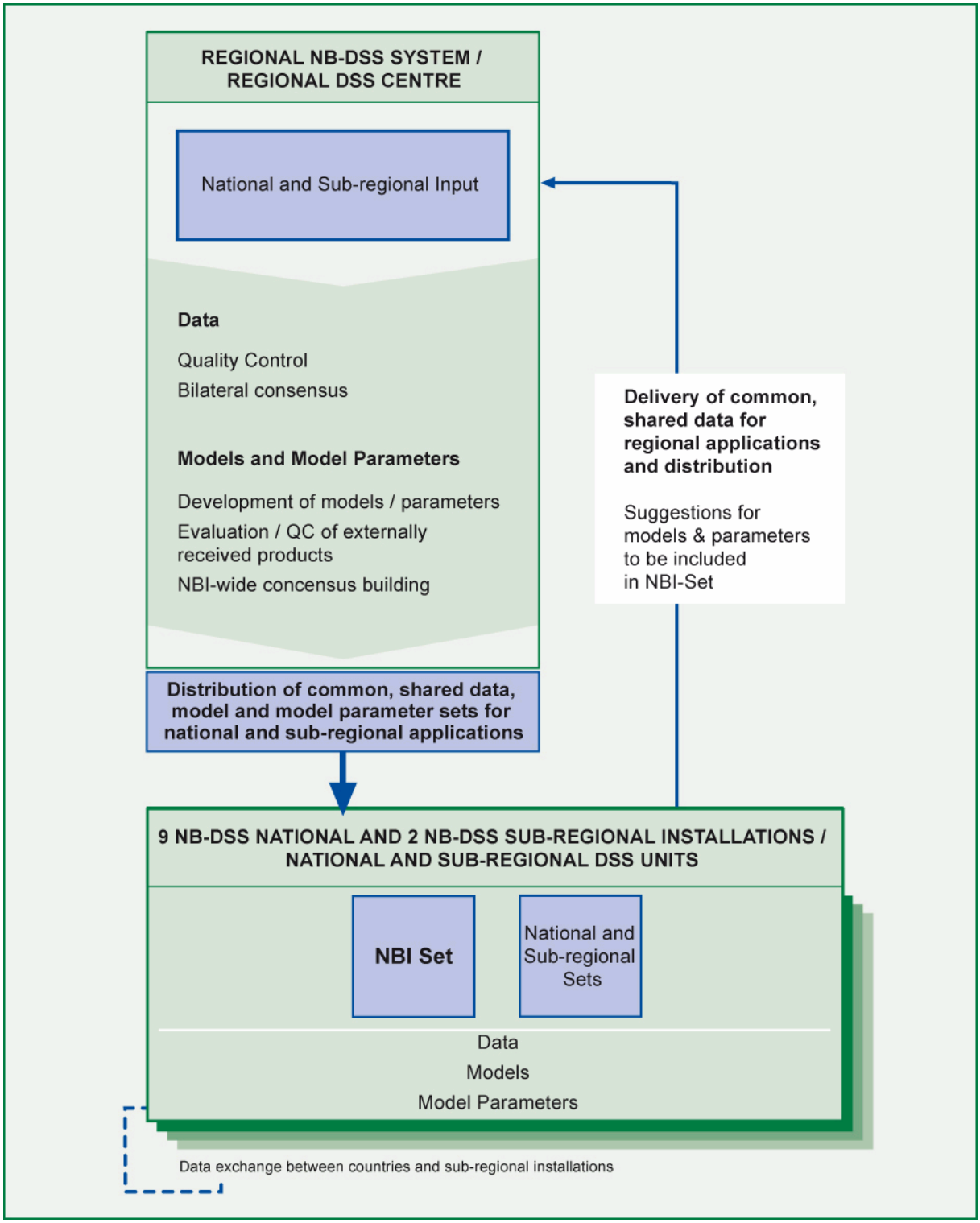
National DSS-Specialists and DSS Counterpart Staff are already operational in all riparian counties. The offices of the DSS Counterpart Staff are in general part of the line Ministry for Water Resources Management.

Similar as on the regional and national levels, on the sub-regional level Sub-regional DSS-Units should be established.

Once the DSS has been developed, the current organizational setup (regional, sub-regional) can be reviewed to decide on any required changes, such as physical locations of the centers/units and staffing arrangements. Such decisions are expected to be made by the appropriate decision makers (Nile-COM/Nile-TAC, ENCOM/ENSAPT, and NELCOM/NELTAC).

Where as Figure 1.2 focuses on the institutional set-up Figure 1.3 sheds light on the more operational DSS collaboration between the regional level on one side and the national and sub-regional levels on the other side. Figure 1.3 especially visualizes the exchange of common, shared data, models and model parameter sets.

Figure 1.3 Collaboration Path



The Nile Basin countries are currently developing agreement on data and information sharing. The agreement shall, among others, lay down the roles/responsibilities of relevant NBI institutions and riparian countries with respect to provision of data and maintenance of databases. However, the proposed lines of collaboration in terms of sharing and distribution of common shared data, models and model parameter sets (Figure 1.3) should be followed.

Technically and institutionally it should be possible that regional institutions provide date for regional DSS use. The Consultant recommends that such provisions should be considered independently from currently available agreements that allow, foster or prevent such data exchange.

Nile Basin Council of Ministers for Water Affairs

The Council of Ministers to provide policy guidance and operates for the whole of the Nile Basin; it is supported by Nile-TAC and Nile-SEC at the political and strategic level and provides decision making authority.

Regional Nile Basin-DSS Centre

As laid out in the initial thought of the Nile Basin countries, the Regional NB-DSS Centre shall assume the responsibility for providing the technical core team and modelling tools to support transboundary water management. The centre shall be accountable to the Nile-SEC/Nile-TAC/Nile-COM through the arrangements in a permanent RBO:

- Support policy interventions through provision of information and required analysis.
- Facilitate the decision making process by providing the means and expertise in the process of defining and structuring the decision problems in participatory processes with all stakeholders.
- Support the development of scenarios for the simulation of alternative water resources development plans and evaluates their impacts on the society, environment and on the economy, and on the regional collaboration by means of defined criteria, and assess the trade-offs and investment planning.
- Establishes the contacts to leading universities and national knowledge centres to provide the required data management and modelling services when necessary.
- Develops capacity building programmes and hire the national and international experts for collaboration at all levels.
- Develops the data monitoring and baseline surveys programmes, and provide the means for data analysis in order to feed the knowledge base and the EIS with newest information and evaluation of data.
- Serve as the custodian of the Nile Basin DSS and associated knowledgebase.
- Provide technical backstopping to Sub-regional and National DSS-Units, as per demand.
- Maintain the DSS; coordinate the upgrade of the system in respond to emerging needs. In order to enhance ownership National DSS-Units with support from expert pools and the Regional DSS-Centre could be entitled to develop new model tools which then (after basin-wide quality approval) become regionally accessible and integrated in the standard NB-DSS.
- Together with the DSS Core team be responsible for quality control, validation and testing of common, shared data, models and model parameter sets as well as its regular distribution. Development of technical guidelines, e.g. data quality control guidelines.

The country representation in the staff developing and operating the DSS is a sensitive issue, which was mentioned frequently in the various consultations and workshops during the Analysis Phase of this assignment. A greater role for the National DSS Units in the DSS development process as well as in the operational use stage is envisaged to build trust. With respect to the operational stage, the issue of country representation should be taken care of by relevant decision makers for the operational stage.

Quasi-Steering Committee Function

Existing NBI institutions such as

- Nile-COM, Nile-TAC and Nile-SEC at the regional level;
- EN-COM and NEL-COM at the sub-regional level;
- and National DSS-Offices at the national level

will serve as Steering Committees and

- will set the priorities for operation and will formulate the specific operation instructions for the Regional NB-DSS Centres, Sub-regional and National DSS-Units, respectively;
- will review the outputs of the studies implemented by the Regional NB-DSS Centres, Sub-regional and National DSS-Units, respectively;
- will guide the level of transparency that will be given to the various categories of stakeholders at national and international level.

National DSS Offices steer the operation of the National DSS-Units. Decisions regarding investment oriented projects at subsidiary level shall be made via the EN- and NEL-COM. NEL-COM and EN-COM will steer the operation of the Sub-regional DSS-Units. The Nile-COM is the overall decision making body and, as such, its roles and responsibilities will focus on policy guidance.

See Figure 1.3 for flows/responsibilities of DSS data and analysis.

Sub-regional DSS Units

It is anticipated that the principle of subsidiarity shall be maintained through which the sub-regional arrangements (EN- and NELSAP) shall continue to identify, prepare and implement investment projects. Sub-regional DSS units could be established. The physical locations of such units can be decided by the Nile-TAC and other relevant decision makers.

Therefore, the Nile Basin DSS shall be embedded within these two institutions without the need to create new sub-regional set-up. They are accountable to sub-regional NBI bodies via the sub-basin organizations.

Primary roles of these two units shall be to support development of cooperative projects at subsidiary level, i.e. provide necessary technical support for planning of cooperative projects. Further, they provide technical capacity building (in coordination with the regional centre). The Regional DSS Centre, having a basin-wide focus, shall be instrumental in integrating data and models to support investment decisions at subsidiary level.

Similar as with the Regional DSS-Centre, the country representation in the formation of Sub-regional DSS Units is a sensitive issue, which need special attention. With respect to the operational stage, the location and staffing of the Regional DSS-Centre and Sub-regional DSS-Units shall be decided by the Nile-TAC and other relevant decision makers.

National DSS-Units

There should be a National DSS-Units in each of the NB countries which is embedded within appropriate departments of national ministries of water affairs. Those are responsible for the

development and operational use of the DSS for planning and management of cooperative projects, but also for collating and analysing technical, environmental and economic information/data, see Figure 1.2 National DSS-Units facilitate the use of the DSS in the planning and management of cooperative projects. National DSS-Units are the core units in Nile Basin countries and shall serve as repository of the DSS at country level. They are accountable to the ministries within which they are established. It should be noted that arrangements may differ by country. During the development of the DSS, the National DSS staff shall contribute as appropriate to activities, such as selection of consultants, review of development progress, training and selection of case studies.

National DSS-Units are provided with technical advice by National DSS Offices and will in turn provide political and administrative advice to the sub-regional and regional levels.

Expert pools, support the National DSS Units with advisory or backstopping activities. It will include relevant experts from various ministries and academic/research institutions. It shall form a technical forum to ensure continued use of the DSS for practical IWRM. It can also support research on further development of the DSS. The quality of the DSS depends significantly on the quality of data that is put in. The expert pools will be of varying capability initially but should be encouraged and developed. Their function will depend on the support at national level but activities should include assistance in the development of new DSS sub-models and feeding of the database and knowledgebase.

Stakeholder Forum(s)

There will be a communications role for the National DSS-Units which has the function of providing information to, and collecting from, all stakeholders and public representatives (see stakeholder public representation shown in Figure 1.2). In future the National and Regional DSS Networks will become part of the stakeholder public representation.

The application of the Nile Basin DSS is meant to assist in important processes and consequently impact on the socio-economic and environmental development of the entire Nile basin. It supports long-term development of the regions which will go hand in hand with political processes; national and regional ones. The involvement of a wider stakeholder group is important for the legitimization of such decision making processes. The exclusion of stakeholder groups, which benefit and/or bear the negative affects from decisions, will in the long run result in negative drawbacks, which should be avoided.

At all levels of operation, from local to basin-wide, it is important for the DSS to be open and transparent and continuously work with stakeholders. This can be achieved through a number of additional supporting means, such as regular multi-stakeholder forums as well as through partnerships with civil society or NGOs on particular activities.

2 Decision Making Processes and Procedures

2.1 IWRM: an Introduction

Water resource management and the affiliated decision making processes are complex, challenging and difficult tasks since they involve various, even contradicting stakeholder interests, environmental interdependencies and uncertainties over time and area and fundamental contradiction between use and protection of water sources. Most decisions also require taking account of often conflicting criteria such as long-term and short-term benefits as well as costs and risks. More over preferences have to be defined and communicated to achieve a transparent decision process; impacts of the planned interventions have to be assessed including accumulation processes and feed back loops. Hence IWRM has led to the promotion of river basin as the logical geographical unit for its practical realisation which offers advantages for strategic planning and decision making particularly at higher level of governments.

Nevertheless the scale of decision making is important to WRM and has to be differentiated generally into macro-, meso-, and micro level (regional (basin), sub-regional (sub-basin), national, and even local) to assure efficient decisions for all stakeholders and relevant issues. Accordingly a DSS and its tools have to be adapted to these levels and integrate the decisions on all levels corresponding to the impact in the socio-economic and natural system. The lowest level is frequently the domain of local authorities which exercise local watershed management through local action planning. The national and international level is best known as basin management in large scale activities. The challenge is to assemble capabilities and tools on the one hand and to develop and apply coordination mechanism between these levels of management and decision making processes in the river basin. The current institutional set up in the Nile Basin as described in Figure 1.1 shows the structure from national to bilateral, sub-regional and regional (basin) level with a high number of relationships on the bilateral country and sub-regional levels.

During the development and more specifically for the decision making processes necessary for the future application of the NB-DSS the following common principles should apply:

- Consider the Nile Basin as a planning and management unit taking into account the hierarchical structure and information needs on different levels;
- Promote an Integrated Water Resources Management approach considering all 3 dimensions socio-economic, hydrological and ecological including quantitative and qualitative aspects;
- Understand the magnitude of the changes brought about through natural events (externalities) as well as man-made changes (political, economic, and social pressures);
- Compensate the impact of those changes on the water resource regime and consequently on the environment, on the economy and on the society through mitigation measures and different interventions;
- Take special consideration of the regional and international collaboration within the Nile Basin as a whole.

2.2 The Decision-Making Process

Prior to introducing the proposed NB-DSS requirements and design specifications in subsequent chapters of Annex B, the decision-making process applied to solve complex decision problem is discussed at this stage.

Decision-making is a challenging and difficult task and even more difficult when applying formal techniques that are normally called decision and evaluation models, i.e. a set of explicit and well-defined rules to collect, assess and process information in order to be able to make recommendations in decision or evaluation processes. The methods are so wide spread that careful analysis of their performance and weaknesses and how things can go wrong are of utmost importance. According to the evaluation made, a perfect or even the best formal model does not exist. Even so, it is proposed in this report to provide a kind of guide to help the analyst to choose a methodological approach, model concept and eventually a model and to use it consistently.

The methodological approach consists on the following three distinct phases usually proposed for the decision-making process:

1. **Conceptual Phase**: Definition of the problem and general objectives, issues to be explored (cause-effect relationship) in connection with the major Concerns discovered during the stakeholder consultation, collection of data and information;
2. **Design Phase**: Specification of objectives, criteria and alternative actions (alternatives) and constraints, impact assessment (linking decisions with outcomes), identification of societal preferences, selection of a decision making technology;
3. **Decision Phase:** Ranking of alternatives, sensitivity analysis; review of the process and outcomes**.**

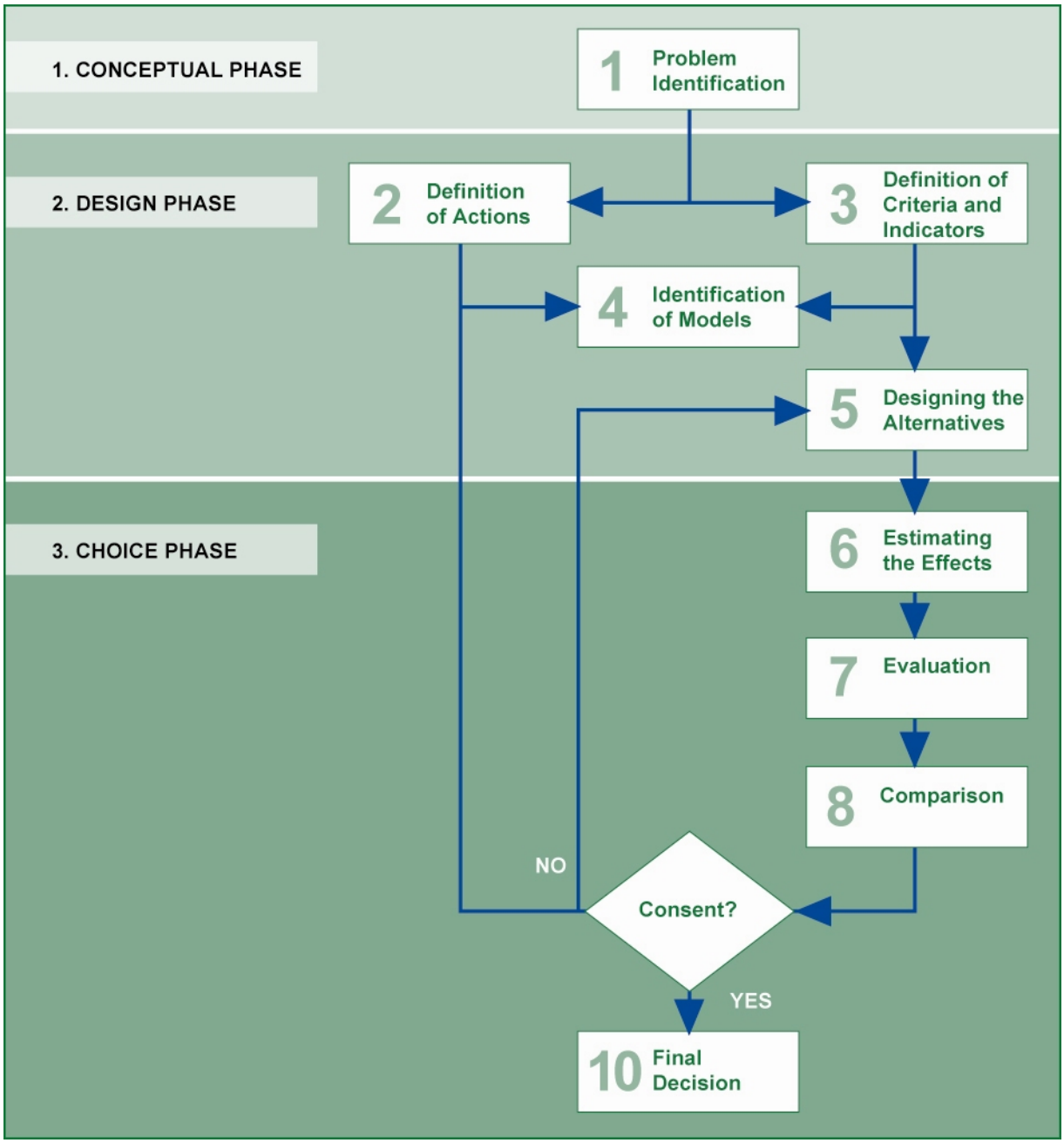
The Conceptual and Design Phase has already been supported by this consultancy project. The National and Sub-regional Consultations in the Inception and Analysis Phases are a first step in the facilitation of the decision-making processes. In the National and Sub-regional Trainings the basic theoretical knowledge on how to structure the decision-making processes was given and practical case studies analyzed.

A proposal for the procedure to be used by the stakeholders and decision-makers on how to make decisions systematically and in a participatory atmosphere is presented hereafter.

The methodology for description of the process of decision-making in general, but also specifically within the frame of a DSS is shown in the flow diagram in Figure 2.1. It is based on the Participatory and Integrated Planning Procedure (PIP, developed by Soncini-Sessa et al., 2007) and using the approach of he PROACT scheme (Problem, Objectives, Alternatives, Consequences, and Tradeoffs) developed by J. Hammond et al., 1999. The directives are the following

- Work on the right decision problems – examine current and future procedures for decision-making,
- Specify the goals, overall goals and specific goals,
- Identify alternatives and main performance indicators,
- Understand the consequences, tradeoffs, uncertainties, and risk tolerance.

Figure 2.1 Phases of the decision-making procedure (adapted from Soncini-Sessa et al., 2007)



According to that methodology Figure 2.1, the following phases of the planning and decision-making process can be explained:

2.2.1 Conceptual Phase

1. Problem Identification:

The first step of a planning process is the knowledge and formulation of the problem to be tackled. The decision-maker has access to all kind of existing and relevant information through the DSS knowledge bases in order to know the details on the current situation. The next activities within this phase concentrate on the definition of the objectives of the planning process, the

spatial and temporal scales, the normative and planning context in which the process will operate the data available and information that needs to be collected in addition. In order to respect the expectations and the interests of the stakeholders, it is necessary to involve the right persons and to build groups that are as heterogeneous as necessary to consider all the needs and perceptions of each participant. At a first step, it is important to identify the stakeholders before beginning with that procedure. Instead of simply defining the goal of the project it is some times advisable to translate and visualize the goal into interventions or planning strategies in terms of pictures or sketches. This enables the human visual capacity to translate the real problems into rational solutions.

2.2.2 Design Phase

2. Defining the Actions (Alternatives):

In this second step, the different Alternatives that are proposed to achieve the goals of the project have to be identified. The interests of the stakeholders involved in the process have to be considered. Since this seams to be one of the most difficult tasks because of discordant opinions of each stakeholder, it is advisable that the analyst (facilitator) be present to support and to advise how to choose alternatives and therefore avoiding the group getting into a dead end. The methodological approach is to organize workshops where the stakeholders participate in order to structure their problems in a common understanding even if they have different ideas and paradigms, may have their own vocabulary, means and expressions, hidden agendas, different values and competing interests.

At this stage, “Cognitive Mapping” and “Dialogue Mapping” (see Chapter on Cognitive Mapping further down in this Annex) seem extremely useful when the decision-makers consist of a group of people involved in decision processes in which the emergence of consensus on different issues is extremely difficult and remains subject to power manipulations. This should be supported by means of software products, such as SODA, IBIS, etc and more recently developed software called WISDOM, just to cite as an example.

3. Defining Criteria and Indicators

The evaluation criteria have to be defined in this phase in order to express and make measurable all the positive and negative effects that are expected by the different stakeholders. The Criteria are based on standards, rules or tests on which judgements of the different Alternatives defined/expressed by the stakeholders can be built on. The indicators set the targets or threshold values to express to which extend goals are achieved. Possible constraints should be evaluated. It has been proposed that the Criteria, respectively the Indicators follow the sustainability principles mainly emphasizing the economic, social, environmental and regional collaboration issues.

4. Identifying the Models and Data requirements

Most of the criteria and indicators are expressed by values that quantify the effects of the different alternatives on the status of the systems underlying the Criteria. In order to transform those values into efficiency, the specific model has to be provided for description of the cause-effect relationship within the system. The Model has to be chosen depending on the necessary accuracy and on the degree of detail required for describing the system. In parallel with the selection of the adequate model, the availability of the required data should be checked. If the data does not correspond to the requirements of the Model, simpler Models or simplified conditions have to be applied or additional data have to be collected.

5. Designing the Alternatives

In order to consider all feasible solutions for the possible “Alternatives” it is appropriate and necessary to expand the focus of the problem. Only those alternatives that are generally accepted by all the stakeholders should be adopted and analyzed together in the context of the decision-making procedure. The so-designed Alternatives will then be discussed and analyzed

with respect to the previously defined Criteria and Indicators. Even the baseline should be considered as an alternative (zero alternatives).

6. Estimating the Effects

In this phase the effects of each Alternative on the system have to be computed by the Models in order to translate the effects of the specific Alternatives into efficiency according achievement of goals. The outcome of this phase is the so-called Analysis Matrix, representing the values corresponding to each Criterion as rows and the Alternatives (Options) as columns of the matrix. Several approaches have been applied e.g. DPSIR (Driving forces, Pressures, States, Impacts and Responses) or State Space approach.

2.2.3 Decision Phase

7. Evaluation

As soon as the Analysis Matrix shows a complete set of Indicator values, a Multi-Criteria Analysis (MCA) will be performed. The values of the Analysis Matrix being of different categories and different dimensions have to be transformed in dimensionless figures to be comparable for the evaluation. The result is the Evaluation Matrix. For this procedure several methods are available discussed in the chapter decision-making tools.

8. Comparison:

If there is more than one stakeholder or decision-maker participating to the decision-making procedure, the ranking of the Alternatives is obtained by the so-called group-decision-making. The methods used are based on an evaluation of weights that have been attributed to each Criterion by the stakeholder or decision-maker according to their “preferences”. If there is no agreement possible in this phase, the stakeholders are requested to proceed with step Nr. 5 (see Figure 2.1).

9. Final Decision

If an agreement can be achieved, a final decision can be made. The Alternative chosen is then accepted by all the parties and decision-makers. If there is no agreement the process swings back to the design phase where new alternatives are formulated. If this iterative process leads to no agreement at all the process eventually has to be discarded.

2.3 Procedural Decision Support Methods

The facilitation of the decision making process should be supported by means of a software product which is extremely useful when the decision-makers consist of a group of people/nations involved in decision processes in which the emergence of consensus on different issues is extremely difficult and remains subject to power manipulations.

2.4 Formulation and Structuring of Problems

In case of formulating the problems the role of the analyst will be to translate the reality or the way of thinking of the decision-maker into decision support language. That means that the decision-maker’s concerns will be formulated as a formal problem. Hajkowicz & Higgins, 2006, conclude that “the selection of MCA techniques will practically be of less importance than the initial structuring of the decision problem which includes: (a) selection of criteria, (b) selection of decision options, (c) weighting the criteria, and (d) obtaining performance measures to populate the evaluation matrix”. In other words, the decision-maker and the analyst are the two bodies called “cognitive agents” who will share information and knowledge with the perspective to produce a set of methodologies (cognitive artefacts) to answer the questions like “who has a problem?” or “why is this a problem?” or “who decides on this problem?” etc.

A high number of Problem Structuring Methods (PSM) or “Procedural Decision Support” (Mackenzie et al., 2004) is proposed in the existing literature on how to structure a problem (see D. Bouyssou et al., 2006, for an overview):

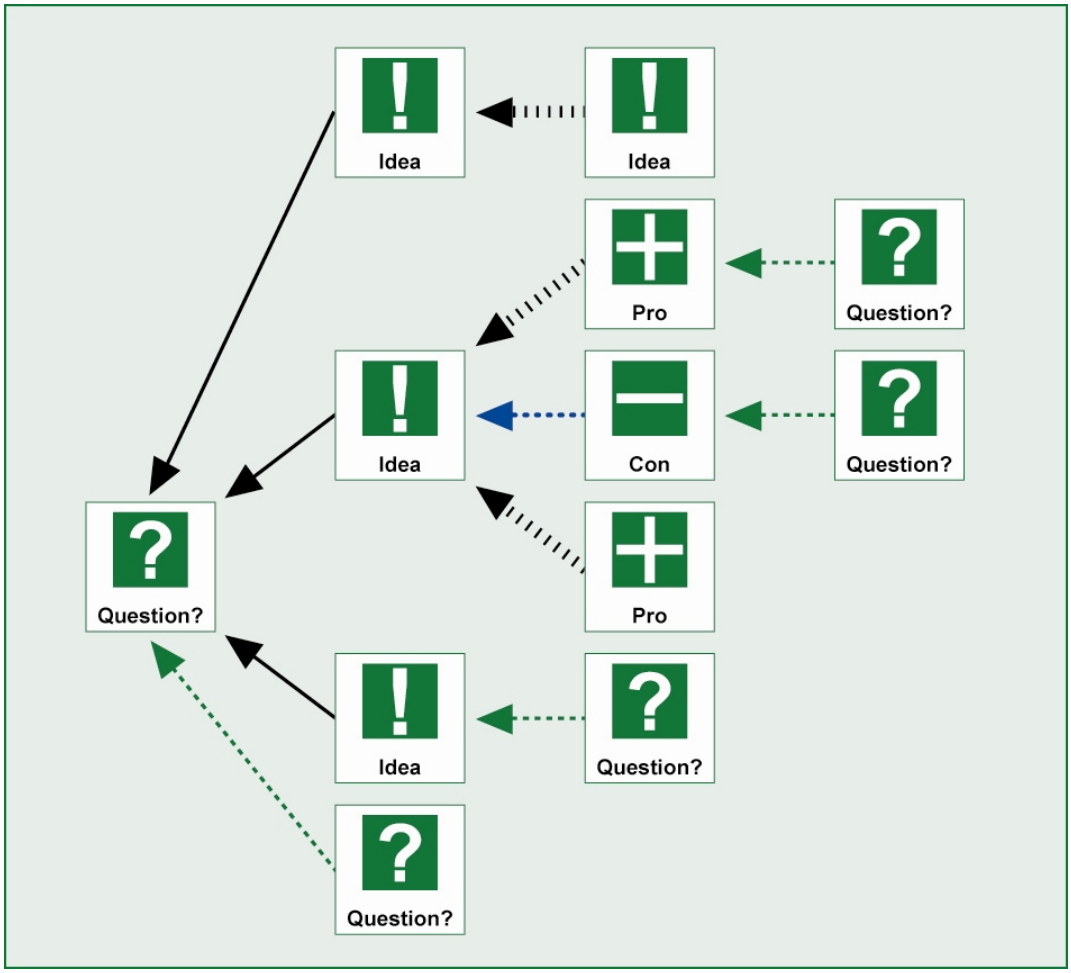
2.4.1 Cognitive Mapping

Cognitive mapping is a tool that aims to give a presentation of how the decision-makers think about a set of issues, i.e. a network in which the nodes represent the issues concerning the decision-makers and arrows representing the way in which one issue may lead to or have an implication on another (Figure 2.2 is an example of Cognitive Mapping or Dialogue Mapping). Issues are represented by sentences calling for actions or problem definitions. Various software products are available; some of them are highlighted in the following exemplarily. Examples do not express any preference.

SODA I and SODA II are described by Eden et al., 1998, and IBIS and WISDOM by Mackenzie et al., 2006. Figure 2.2 shows the simple notation of IBIS that can be used as cognitive map based around questions, each made in its own node. The questions should begin very directly, such as:

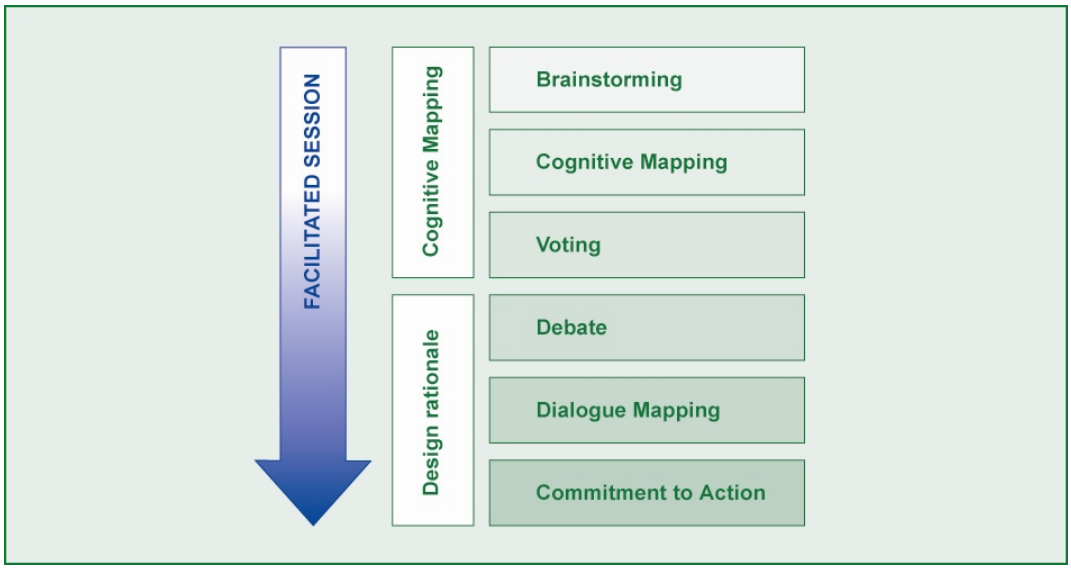
- What do we need to do?
- How should it be done?
- How much would it cost?

Figure 2.2 IBIS Notation's Standard Nodes and legal Links



IBIS allows for processing the whole history of the questions-answers in a very transparent manner. This is what makes it different from SODA, where the cognitive map does not follow the debate through time. WISDOM was developed with the purpose to combine the advantages of SODA and IBIS together (Mackenzie et al., 2006). The process is shown in the following figure:

Figure 2.3: The Wisdom Process (Mackenzie et al., 2006)



2.4.2 Strategic Choice Approach

Strategic Choice Approach is a method intended to manage three main sources of uncertainties, i.e. about guiding values, about working environment, and about choices and related agendas. The method distinguishes four modes of decision-making: (1) shaping mode (structure of the problem), (2) designing mode (where feasible actions are discussed), (3) comparing mode (where the decision-makers look for different dimensions to compare the solutions), (4) choosing mode (the decision-makers look for arguments and commitment to continue with the proposed actions over time).

2.4.3 Soft System Methodology (SSM)

SSM was developed as a learning system between the real and the abstract world. It considers the thinking process on the real world: (1) enter the situation considered as the problem; (2) express the problem situation, (3) formulate root definitions of related systems of purposeful activity (this is the abstract world); (4) build the conceptual models of the systems used in the root definitions (abstract world); (5) compare models with the real world actions; (6) define possible changes which are both feasible and desirable (real world); and (7) take an action to improve the problem situation. The SSM can be considered as a methodology and not as a method.

2.4.4 Valued Focused Thinking

Valued Focused Thinking is more an objective focused method encompassing following questions that focus on the structuring of the “fundamental objectives”: (1) is it essential, (2) controllable (3) complete, (4) measurable, (5) operational, (6) decomposable, (7) non redundant, (8) concise, and (9) understandable. The idea is to decompose the fundamental objective in sub-objective through attributes and organize the insight into the problem such that the attention is driven towards high value alternatives, expanding the decision context.

2.4.5 Integrating Approaches

Belton and Stewart, 2002, pled for the integration of different approaches of multiple criteria analysis, distinguishing following stages: (1) indication of the problem issue, (2) problem structuring, (3) model building (4) using the model to inform and challenge thinking, and (5) development of an action plan. It is then suggested to use a checklist of issues in order to be able to establish a model: (1) criteria, (2) alternatives, (3) uncertainties, (4) stakeholders, and (5) environmental facts and contributions.

All these methods/approaches are basically prescriptive in nature. Models in Problem Structuring Methods are used to graphically represent inter alias relationships between concepts, activities or stakeholders, relationships of similarity of influence, and relationships between options. Especially significant is the identification of cause and effect relationships clarifying the different elements which create the problem situation.

3 References

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