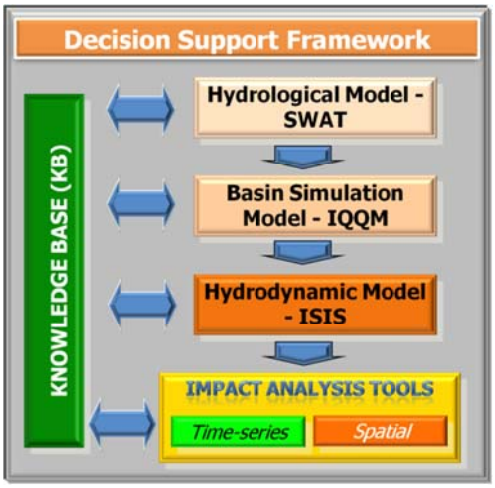
THE MRC DSF/Toolbox

The Toolbox is designed to facilitate access to and use of the data, information and decision support tools necessary to promote and co-ordinate sustainable development of water and related resources in the Mekong Basin.

Overview

The Mekong River Commission developed tools for Water Resource modelling in the four member countries since the initiation of the **Decision Support Framework (DSF)** in 2001 under the Water Utilization Programme (WUP-A) funded by the World Bank. The DSF system development aimed to have a transparent modelling system that could be used by each and any of the member countries to study and check proposals and strategies for water resource developments. The system has been developed and expanded under the Information and Knowledge Management Programme Phase 1 (IKMP 2005-2010). The first release of a new ***MRC Toolbox*** was developed and handed over to MRCS at the end of 2010.



The main purpose of the *DSF (Decision Support Framework)* is to assist planners to assess both the magnitude of changes brought about through natural and man-made interventions in the water resource system, as well as the impacts that these will have on the natural environment and upon people's livelihoods.

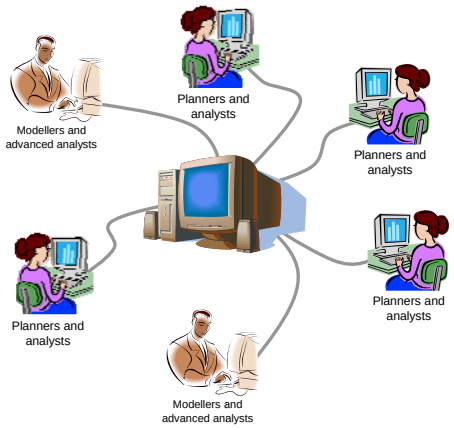
In the **MRC DSF Toolbox** the original models of the DSF have been supplemented by the more detailed models IWRM and 3D modelling developed under the WUP-FIN component and improved by Syke in IKMP Phase 1 as well as additional models (such as HEC ResSim) and tools for analysis of sediment and water quality to enable an approach based on Integrated Water Resource Management principles.

The MRC DSF/toolbox *comprises software and applications (tools) that are required by the MRC to enable the MRC, through its various Programmes and in-country activities, to undertake comprehensive and rigorous analyses and assessments as will be required to fulfil the MRC's commitments under its 1995 Agreement.*

The MRC toolbox, which will be intuitive to use, readily available for MRC and in-country staff and easily extended to include new analysis tools, will be recognised by other river basin management organisations as a clear example of best practice.

Purpose

In accordance with MRC's adopted strategy, the purpose of the MRC toolbox is to provide the necessary tools to support and promote planning and management of the basin's water and related resources throughout the LMB according to the principles of integrated water resources management (IWRM). The toolbox forms part of the MRC Information System and is designed to be used in conjunction with the MRC-IS Master Catalogue of quality assured basin-wide data.

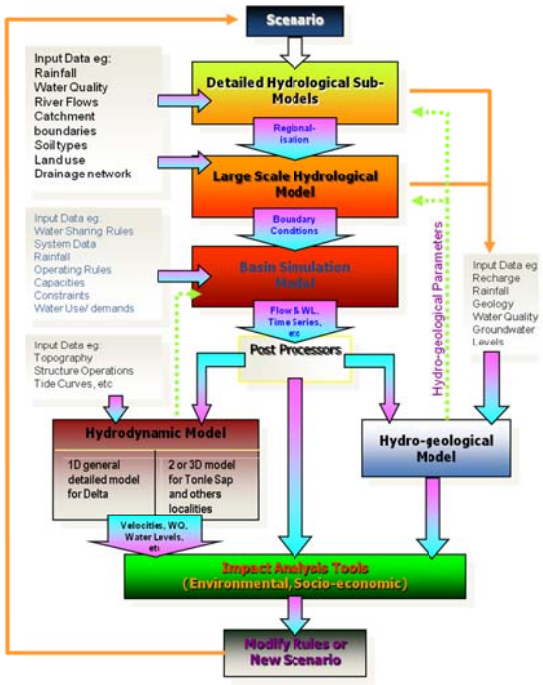


Target users

The target users of the toolbox are therefore all those **concerned with planning and management issues at basin-scale (regional), national level and sub-basin or tributary levels**. Thus the target user community embraces the MRC Programmes, the National Mekong Committees, relevant planning and line agencies within each Government and, where appropriate, academic and research organisations directly supporting relevant Government activities.

MRC TOOLBOX Welcome Screen

Conceptualization of Basin Modelling And Knowledge Base



MRC TOOLBOX User Interface

The structure of the Toolbox as shown in the Figure includes 4 main elements accessed through a single user interface.

1. Knowledge Base (KB)

A **knowledge base** contains the information on the historical records, model configuration set-up (prepared outside the MRC Toolbox and uploaded by modelling specialist), physical data, simulation model input data, modelling outputs, scenario description data and, when fully populated, socio-economic and environmental conditions, as well as predictions of how these may change in the future.

2. Data management tools

The basic data management tools are the foundation of the toolbox and comprise:

- A **Knowledge Base Manager** (KB Manager) that provide administration functions for the associated KB and also allow a user to add data to or remove or export data from their KB.
- A **Scenario and Model Manager** (SaMM) is an integrated tool that allows users to fully manage their scenarios and its associated data in a single workflow interface. The tool has been integrated with new features that allow users to create a scenario based on a parent scenario or from scratch; and its status and components are full editable for at any point in time.
- A **data transfer tool** (DTT) equipped with individual **adaptors** to facilitate linkage between the KB and each of the process models; where justified bespoke interfaces will be provided to run specific process models from the interface instead of the DTT.
- A **GIS-based knowledge base query tool** which enables the required data within the KB to be located and exported for either analysis (either using the toolbox's own data analysis tools or using proprietary software, eg MS Office, ArcGIS, etc).

3. Data analysis tools

The data analysis tools provide the capability to analyse the outputs from the process models and display the results in different reporting formats. The data analysis tools are applicable to both time series data and spatial (GIS) data and comprise:

- The current suite of **DSF impact analysis and reporting tools** built to assess changes in hydrological and salinity intrusion parameters and provide standard reports at key stations;

Environmental & socio-economic impact analysis tools

Main categories of tools	First Level	Second Level	Third Level	Accessed through
TIME-SERIES ANALYSIS TOOLS	Time-Series Plotting Tool	Time-Series Plots	101 Raw Data	
			102 Means of Raw Data	
			103 Moving Means of Raw Data	
	Flood Event Analysis Tool	Annual Flood Frequency Analysis	111 Ranked Flood Events	
			112 Mean Daily Flows (between years)	
			113 Fitted Frequency Distributions	
		Flood Threshold Analysis	121 Flood Start Date	
			122 Flood End Date	
			123 Flood Peak Date	
			124 Rate of Flood Rise	
			125 Rate of Flood Fall	
			126 Flood Duration	
			127 Flood Consistency by Event	
			128 Flood Consistency - Cumulative	
	Probability Exceedence Analysis Tool	Cummulative Probability all data at site	131 Daily or Monthly	DSF
		Cumulative Probability Distribution over Year	132 Daily or Monthly	
	Low Flow Analysis Tool	Low Flow Events	141 Start Date	
			142 End Date	
			143 Duration	
			144 Minimum Flow Value & Date	
		Low Flow Variability	151 Start Date	
			152 End Date	
			153 Duration	
		Tonle Sap Flow – Reversal Analysis	161 Start Date	
			162 Peak Date	
			163 End Date	
			163 Duration	
	Catchment Averaged Rainfall Generator (MQUAD)		170 Catchment averaged rainfall	
SPATIAL ANALYSIS TOOLS	SPATIAL DATA SETS in DSF Knowledge Base: GIS Layers (area, line & point features)	Planning Sub-Areas	201 Country & Province Boundaries	
			202 BDP Sub-areas	
		Environmental & Socio-Economic Features	211 Infrastructure - roads, crop types, etc	
			212 Villages & Associated Socio-Economic Data	DSF
			213 Environmental Habitats & Features	
	Miscellaneous Data Formats	Graphical and Image Data	221 Graphs & images	
		Vertically classified Cross-Sections	231 Vertically classified cross-sections	
	LINK TO SPATIAL SOFTWARE (ArcView GIS): Digital Overlay Analysis	Overlay Analysis	241 Multiple Theme Overlay Analysis	
			242 Analysis of Spatial Changes Over Time	
		Proximity Analysis	251 Proximity Analysis	ArcView provided with DSF
	Network Analysis	Network Analysis	261 River Network Analysis for Connectivity	
	Combined Spatial - Time Series Analysis	ISIS Model Output & DEM Analysis	271 Flood Extent & Duration	
	DSF Main View: GIS View		281 Scenario Views	
	ISIS Mapping: ISIS Flow		291 Flood depth maps	DSF
			292 Flood duration maps	
	ISIS Quality		293 Salinity intrusion maps	
			294 Salinity duration maps	
Links to FUNCTIONAL RELATIONSHIP TOOLS	Specialist Statistical Analysis & Visual Representations	User Defined analyses	301 User Defined functions & criteria	User own software

- **The key Indicator on Socio/ Economic and Tool for Indicator Assessment** will be added in the future (See list of Potential future categories of Tools in box overleaf).
- **Other bespoke data analysis**, visualisation and reporting tools to be developed and included in the toolbox as the need arises.

4. The Process Models/Software

The process models, which are built using different software, provide the capability to simulate different physical, environmental, social and economic processes of relevance to MRC within the basin and comprise:

- The suite of models currently adopted for simulating **basin-scale hydrological processes.** The DSF model that is a package of simulation models that enable the prediction of impacts of changes in conditions within the basin on the river system.

  - The SWAT developed by the United States Department of Agriculture has been set-up to generate subbasin runoff from rainfall and climate data. The Soil Water Assessment Tool or SWAT models provide inputs to a series of basin simulation models (IQQM)
  - The Integrated Quantity and Quality Model (IQQM) software originally developed for the Murray-Darling Basin in Australia. The simulation models route catchment flows through the river system, making allowance for control structures such as dams and irrigation abstractions.
  - A hydrodynamic model, based on iSIS software developed by HR Wallingford and Halcrow, is used to simulate the river system downstream part of the basin including Great Lake and Delta. The hydrodynamic model represents the complex interactions caused by tidal influences, flow reversal in the Tonle Sap River and over-bank flow in the flood season with the varying inflows from upstream.

- Various models provided by SYKE to simulate **detailed flow and water quality processes** at specific locations within the basin.

- HECResSim developed by The Hydrologic Engineering Center, US Army Crops of Engineers has been set-up to analyze reservoir especially hydropower system and operation performance.

- **Other models** to be developed and included in the toolbox as needs arise.

Potential future categories of tools

- **Agriculture** - main crops, production, balance, effects of nutrients
- **Geomorphology** - coastal erosion, geology, deep pools, riverbed
- **Carbon** - organic, FPOC, DOC, DIC, carbonate systems,CH4, carbon (natural) balance within basin
- **Impacts of human interventions** - hydropower dams, irrigation, groundwater use, dikes, fertilizer, wastewater, power plants (oil, coal, gas, nuclear, hydropower, solar, others), forest clearance / mono crops, reforestation, mining and energy balance (renewable verses non renewable)
- **Climate change** – changes to snow melt, glacier contribution, sea level
- **Nutrients** - nitrogen, phosphorous, potassium, plus any other found to be significant. assess nutrient balance, primary production and links to fisheries and agriculture production
- **Flow effects** - stream water / flooding, precipitation, groundwater, surface (floodplain) flow, drought, water balance
- **Sediments**- bed load, suspended load, erosion / deposition balance, effects on navigation
- **Water quality** - biota, balance
- **Fisheries** - migration, non-migration, spawning, catch, balance, effects of nutrients
- **Ecological indicators** –effects on particular flora / fauna species related to changes in flow regime and follow-on effects, e.g. water quality or sedimentation
- **Economic indicators** - related to changes in flow regime and follow-on effects, e.g. water quality or sedimentation and will require interaction with social and economic GIS datasets, e.g. population and industry data
- **Social indicators** - related to changes in flow regime and follow-on effects, e.g. water quality or sedimentation and will require interaction with social and economic GIS datasets
- **Others** - enhanced functionality in data management, visualisation and data analysis.

Using the toolbox

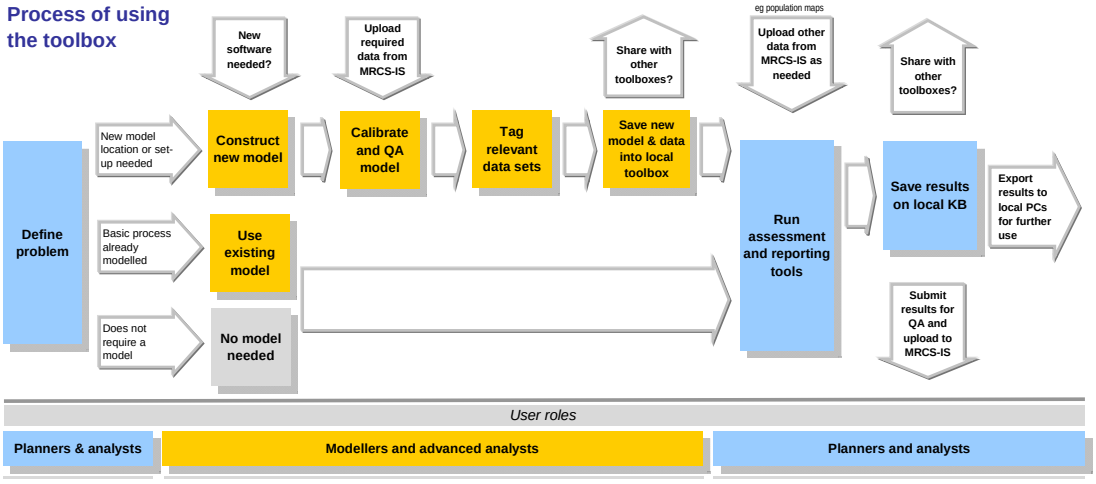
The toolbox provides a flexible approach to problem solving. The key first step, as illustrated below, is the clear definition of the problem and identification of the processes that have to be analysed.

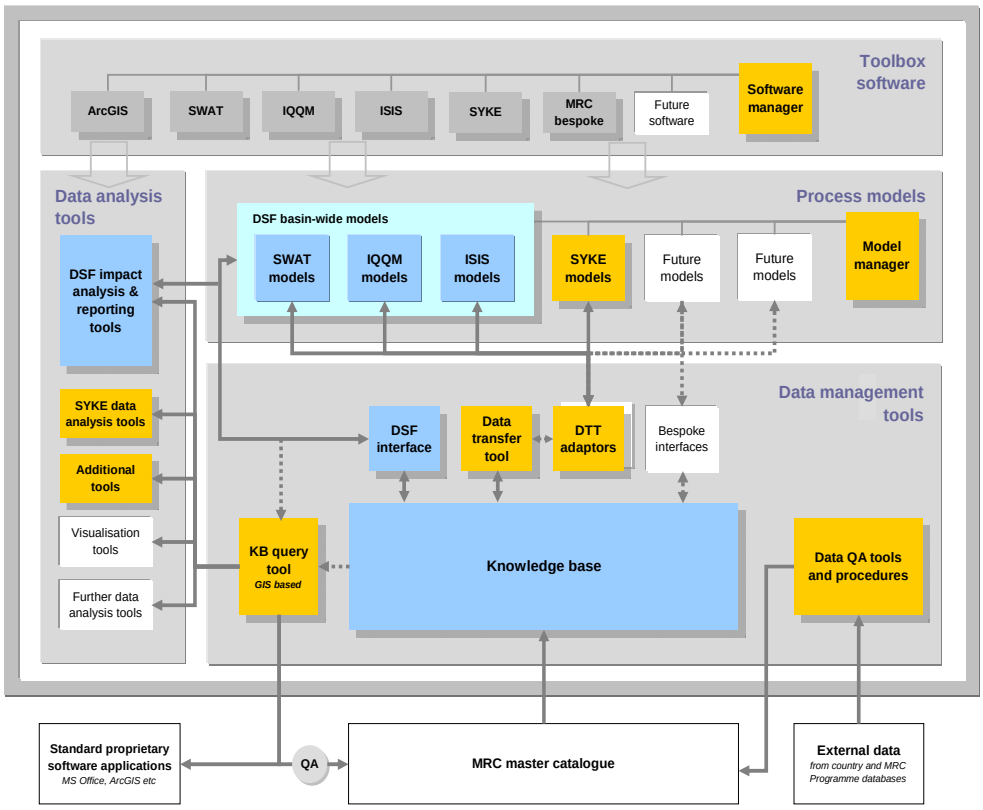
In some cases a process model will already exist that is capable of undertaking the required analyses, but in other cases either an existing model requires adaptation or a new model will need to be constructed, in some instances requiring new software to be added to the toolbox.

In other cases the problem may be soluble without recourse to further process modelling but instead through analysis involving use of different data sets held in the Knowledge Base (or imported from the Master Catalogue for this purpose), for example poverty analysis, trends in irrigation growth etc.

As new models are developed or different sets of processed results become available, where needed and once quality assured, these can then be shared with others in the user community at different locations in the basin.

Process of using the toolbox





MRC DSF/Toolbox Structure