SIXTH FRAMEWORK PROGRAMME
PRIORITY 1.1.6.3

Global Change and Ecosystems

Contract for:

INTEGRATED PROJECT

Annex I - "Description of Work"

Project acronym: ***SPICOSA***
Project full title: *Science and Policy Integration for Coastal Systems Assessment*
Proposal/Contract no.: 036992
Related to other Contract no.:

Date of preparation of Annex I: November-December, 2006

Start date of contract: *1st February 2007*

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1. Project Summary

The overall objective of SPICOSA is to develop a self-evolving, holistic research approach for integrated assessment of Coastal Systems so that the best available scientific knowledge can be mobilized to support deliberative and decision-making processes aimed at improving the sustainability of Coastal Systems by implementing Integrated Coastal Zone Management (ICZM) policies. Based on a system approach, a multidisciplinary assessment framework will be developed with a balanced consideration of the Ecological, Social and Economic sectors (ESE) of Coastal Systems. This System Approach Framework (SAF) will be used to explore the dynamics of Coastal-Zone Systems and potential consequences of alternative policy scenarios. Achieving this objective will require a restructuring of the science needed to understand the interactions between complex natural and social systems at different spatial and temporal scales including the overall economic evaluation of alternative policies. Furthermore, SPICOSA will contribute to a more integrated science-policy interface, i.e. specifically by developing and testing deliberation support tools for the transfer scientific products to policy decision-makers, stakeholders, and end-users. The SAF and its tools will be implemented in eighteen coastal Study Site Applications, which range from Norway to Portugal to Turkey and to Romania, A SAF Portfolio consisting of generic assessment methodologies, specific tools, models, and new knowledge useful for ICZM, will be produced in a manner that is user-friendly and updateable for future CZ researchers and professionals. In addition, SPICOSA will generate new curricula, training modules, and training opportunities for academics and professionals involved in Sustainability Science and ICZM implementation.

SPICOSA has a duration of four years from February 2007 under a full cost budget of 14,300 KEuro with a EC contribution of 10,000 KEuro As an IP, the Project focuses on integrating new knowledge and methods throughout its 54 partner institutes from 22 countries and a critical mass of researchers, stakeholders, policy operatives involved in improving ICZM throughout the European region. The Project's organization is strongly focussed on its central objective, that of developing the SAF through a practical combination of experience and theory, and is designed such that its supporting objectives will provide an assisting synergism to this SAF development, application and dissemination. The implementation design is based on an iterative, accumulative manner such that all of its products will be well validated and that the community of researchers will grow along with the evolution of the SAF methodology for future use towards Sustainable Development in coastal zones.

2. Project objectives

The overall objective of *SPICOSA* is to develop a self-evolving, holistic research approach and support tools for the assessment of policy options for sustainable management, through a balanced consideration of the ecological, social and economic sectors of Coastal Zone (CZ) Systems. Achieving this objective will require a restructuring of the science and methodology needed to understand and to quantify the response of the coastal ecosystems, together with their consequences to their social and economic services, when these ecosystems are subjected to changing environmental and anthropogenic conditions from local to global. It will also demand integration through disciplinary and through geographic, political, and social scales. These efforts translate into six major objectives.

2.1 Create an operational **Systems Approach Framework (SAF)** for assessments of policy alternatives in Coastal Zone Systems. The SAF must emerge from existing knowledge and evolve with new knowledge.

2.2 Overcome two critical challenges facing multidisciplinary science, that of creating a working **science-policy interface** and that of qualifying and quantifying **complex systems**, in order that the SAF is scientifically credible and operationally functional.

2.3 Implement and test the SAF over eighteen diverse **Study Site Applications** throughout the European region, such that its operational use is not limited to any specific policy issue, socio-economic condition, or Coastal Zone type.

2.4 Generate **SAF Portfolio** consisting of generic assessment-methodologies, decision-support tools, models, and new knowledge useful for ICZM, in a manner that is user-friendly and updateable.

2.5 Improve the **Communication and Integration** among the main actors and infrastructures of CZ Systems that promote Sustainable Development in a manner that is self-perpetuating.

2.6 Generate new opportunities for **academic and professional Training** in ICZM.

The project has only one central focus, that of demonstrating the practicality of systems thinking into the research and management of Coastal Zones. Given that this experience will be a learning curve for all involved, it is expected that the level of achievement would not be maximal. On the other hand, requiring that several hundred researchers collectively experience and contribute to the first objective (creating the SAF protocol) will certainly stimulate the evolutionary process required to develop appropriate strategies in support of Sustainable Development. All of the other objectives are closely linked with creating this SAF protocol, and in turn will produce a much greater involvement from academic to commercial and to public endusers. In sum, these objectives are about creating, implementing, and testing the SAF through experiential activities that combine, in a concerted manner, the methodologies from the three sectors Ecological, Social, and Economic and that engage society in the transition to Sustainable Development in the Coastal Zones.

3. Participant List

Table 1 : SPICOSA PARTICIPANTS

Role	N°	Name	Short Name	Country	Enter project	Exit project
CO	1	French Institute for Exploitation of the Sea (IFREMER)	IFREMER	FR	1	48
CR	2	Consejo Superior de Investigaciones Cientificas, CSIC	CSIC	ES	1	48
CR	3	CNR Institute for the Coastal Marine Environment(IAMC)	IAMC-CNR	IT	1	48
CR	4	University of Saint-Quentin en Yvelines - C3ED	UVSQ	FR	1	48
CR	5	Consortium Coordination of Research Venice Lagoon (CORILA)	CORILA	IT	1	48
CR	6	Flemish Institute for Technological Research (VITO)	VITO	BE	1	48
CR	7	EUCC Med Centre	EUCC Med Centre	ES	1	48
CR	8	University College of Bodø	BUC	NO	1	48
CR	9	Agricultural and environmental engineering research	CEMAGREF	FR	1	48
CR	10	TUBITAK Marmara Research Center (MRC)	TUBITAK-MRC	TR	1	48
CR	11	University of Algarve – CIMA	UALG	PT	1	48
CR	12	University of Western Brittany – IUEM	UBO	FR	1	48
CR	13	University College Cork (UCC)	NUIC	IE	1	48
CR	14	University of East Anglia – CSERGE	UEA	UK	1	48
CR	15	University of Cardiff	CU	UK	1	48
CR	16	University of Plymouth	UoP	UK	1	48
CR	17	Napier University, Edinburgh	NUE	UK	1	48
CR	18	University of Stockholm	SU	SE	1	48
CR	19	Université Libre de Bruxelles – CEESE	ULB	BE	1	48
CR	20	Hellenic Center for Marine Research (HCMR)	HCMR	GR	1	48
CR	21	Maritime Institute in Gdansk	MIG	PL	1	48
CR	22	Scottish Association for Marine Science (SAMS)	SAMS	UK	1	48
CR	23	DISY Information systeme GmbH (data basis management)	DISY	DE	1	48
CR	24	KMG Kolleg for Management and Formation of Sustainable Development	KMGNE	DE	1	48
CR	25	SOGREAH	SOGREAH	FR	1	48
CR	26	Free University of Amsterdam	IVM	NL	1	48
CR	27	Institute of Oceanography, University of Gdansk	DEEMO - UoG	PL	1	48
CR	28	Institute of Marine Research (IMR) - Dept. CZ	IMR	NO	1	48
CR	29	Baltic Sea Research Institute Warnemünde (IOW)	IOW	DE	1	48
CR	30	Technical University of Denmark - Danish Institute for Fisheries Research (DTU-DIFRES)	DTU-DIFRES	DK	1	48
CR	31	University of Tartu - Estonian Marine Institute	UT	EE	1	48
CR	32	Middlesex - Flood Hazard Research Center	MU-FHRC	UK	1	48
CR	33	Aarhus University - National Environment Research Institute	NERI-AU	DK	1	48
CR	34	Institute for Ecological Economy Research	IOeW	DE	1	48
CR	35	University of Bremen, MARUM	Uni-HB	DE	1	48
CR	36	Bulgarian Academy of Sciences - Institute of Oceanology - BAS	IO-BAS	BG	1	48
CR	37	Delft Hydraulics	Delft Hydraulics	NL	1	48
CR	38	Institute of Aquatic Ecology - University of Latvia	LHEI	LV	1	48
CR	39	University of Tromso, Norwegian College of Fishery Science	NFH	NO	1	48
CR	40	Danube Delta National Institute	INCDDD	RO	1	48
CR	41	JRC Institute for Environment and Sustainability (IES)	EC-DG-JRC	EU	1	48
CR	42	University of Haifa	HU	IL	1	48
CR	43	Envision	ENVISION	UK	1	48
CR	44	University of the Aegean - Lab. Of Applied EnV. Economics.	EREOPE	GR	1	48
CR	45	PC Raster	PCRASTER	NL	1	48
CR	46	University of Sevilla	USE	ES	1	48

CR	47	University of Aristotle of Thessaloniki	AUTH	GR	1	48
CR	48	Enveco (Environmental Economics Consultancy)	ENVECO	SE	1	48
CR	49	Institute for Coastal and Marine Management (RIKZ)	RIKZ	NL	1	48
CR	50	Sagremarisco - Viveiros de Marisco Lda	SGM	PT	1	48
CR	51	Stazione Zoologica di Napoli	SZN	IT	1	48
CR	52	Marine Hydrophysical Institute	MHI	UA	1	48
CR	53	University of Southern Denmark (Marine Ecology / Economics)	SDU	DK	1	48
CR	54	Association GEYSER	GEYSER	FR	1	48

4. Relevance to the Objectives of the Global Change and Ecosystems Priority

4.1 Strategy for Sustainable Development

SPICOSA is directly focused on generating research methodology to support policy and for the transition to sustainability.

Sustainable Development is a major cross-cutting dimension of EU policies. Major elements, in relation to ICZM are Bird and Habitat directives, Agenda 21, Lisbon and Göteborg Strategies, Water Framework Directive, Sustainable Impact Directive, ICZM recommendations and forthcoming Maritime Strategy and new ICZM directive. This interacts with most other thematic or sectorial strategies (rural or urban development, resources management,…). SPICOSA aims at supporting the implementation of SD framework in the area of Coastal Zone Management by considering the need for a better integration of scientific knowledge into policies at the most appropriate level (subsidiarity). In the area of ICZM it is widely accepted that the key processes leading to sustainability take place at the local and regional levels and that higher levels (national, international) should focus at developing enabling, capacity building and monitoring frameworks. SPICOSA will contribute to this process by considering the following strategic perspective. This will be convened in the research activities of the project as well as dissemination and participation by SPICOSA members in policy forums as experts.

4.1.1 Sustainability versus Vulnerability. The historic evidence for the vulnerability of a society to the depletion of its resources is overwhelming (cf. Diamond, 2005). The present global society is unquestionably no exception to this trend (e.g. Imhoff et al., 2004; Vistousek et al., 1998) except that our modern society has a far greater capacity to understand and document the process of resource degradation. Unfortunately, this capacity is not yet sufficiently inserted into governance to reverse these trends, many of which are irreversible on human time-scales. The vast differences in political, cultural, economic, and educational characteristics of the present global population contribute to the non-resolution of this dilemma, which, on a global scale, condenses, to a choice between default self-destruction and active reorganization. If reorganization is to occur, it will proceed incrementally on different scales. Reorganizing towards sustainability in the coastal zone represents a challenge in its extent and complexity, but it also presents a strong advantage in that experimentation and cooperation can be realized at much more feasible political scales. Badly needed are some examples of success where the union of science with policy has made a difference. *SPICOSA* aspires to constructing a framework for this union that can be adapted to specific applications and that can evolve with advancing knowledge and changing issues.

4.1.2 Needed Transition. The stability of our present global society is increasingly threatened by the persistent degradation of natural systems, which support it with goods and services, caused by human interventions (over-extraction, destruction, and disposal) in excess of these systems' aggregate carrying capacity. Consequently, on a global scale, the ratio of resource-wealth per person is decreasing exponentially with a half-life decay of two decades. The global disparity in this ratio creates inequalities in economic and social conditions that, in turn, generate political pressures. Recognition of these pressures and our apparent inability to halt or reverse these trends is forcing a transition to environmental and social sustainability. Because of its population, the coastal zone (CZ) is the most important global area of human habitat exposed to this threat. Specifying this wealth ratio for any specific CZ requires integrating the over all available resources (numerator) and all their users (denominator). It is further complicated because both numerator and denominator change with time and space and, in addition, the users change as a function of the resource availability and social preferences. The question of scale is another compounding factor. Both these resources and their users can each be changed by influences external to a particular CZ system, e.g. climate change, tourism, migrating predators, etc. The resident CZ ecosystems have evolved resilience to their pre-existing envelope of input variability. Human interventions have significantly changed this variability, in amplitude and quality, beyond the resilience of these ecosystems and have thereby increased the probability of irreversible or costly changes in their ability to support human societies.

Essential to a transition towards sustainability is the quantification of the linkages between natural-system degradation, decreased economic efficiency, increased social inequalities and conflict generation; likewise, essential is the return linkage between policy change, more social equity, better economic efficiency and more resilient, rich resource-support systems. Quantification of these linkages will require a body of new knowledge, technology, and methodologies and it will require collaboration between all sectors of society to design and implement adequate policies. Since there is no map for the transition to sustainability, SPICOSA is investing that we know how to begin this transition and what set of ecological-social-economic knowledge and what level of collaboration are needed.

4.1.3 Strategy. Systems Theory would argue for a transition strategy that combines both the human system and natural systems into a greater complex system in order that their interactions can self-organize towards a sustainable configuration of mutual benefit. Simply stated, achieving sustainability requires both intelligent information and feedback concerning the responses of natural systems and of human development. *SPICOSA* argues that, without sound prognostic information, decision-makers cannot make a soft-landing on sustainability within an adequate time scale. It also argues that science and technology have reached a sufficient level of competence to provide this feedback to policy, but the disciplinary structure of science and the inability to translate its knowledge to the social sector have so far blocked this feedback. All three of *SPICOSA*' s primary outputs directly support the EU strategy for Sustainable Development: an operational research framework for improving this policy feedback, a practical suite of ecological-socio-economic assessment tools for management, and an increased comprehension of sustainability and its practical implementation among a critical mass of the CZ community.
The *SPICOSA* products will enhance the capacity of Europe in the transition to sustainability, in which human societies co-exist harmoniously and fruitfully with thriving natural ecosystems.

4.2. Sustainable Development and ICZM

Sustainable Development in the coastal zone requires an ability to optimize a balance between the social and economic benefits derived by Human Activities (HAs) with the productivity and the long-term capacity of the ecosystems to support these HAs. We perceive this goal of optimization, which is implicit in the FP6 Work Programme, as a formidable challenge for the CZ research community. We therefore interpret the ICZM topic description as indicative, rather than inclusive, of the set of objectives and approach needed for measurable success. In this section, we address the specific items included in the topic and we reference the broader aspects inherent in the SAF.

4.2.1 Decision-Making Tools. The decision-making or decision-support tools encompass a wide range of information-packaging and communication tools that may apply to channelling scientific knowledge but also other source of knowledge towards end-users in the decision-making processes. Prominently included in these end-users are, of course, those politicians making final decisions, but also those experts advising the decision-makers; or bodies in charge of policy preparation, implementation, or monitoring; or stakeholders influencing the process; and etc. The System Approach Framework pertains to this category of tools that will be referred in *SPICOSA* as Decision Support Systems (DSS). *SPICOSA* will also work at developing tools dedicated to helping the public debate that is much needed to increase public support and stakeholders' commitment towards sustainability. They will be referred as Deliberation Support Tools (DST). Communication tools for stakeholder-policy mapping and the SAF Output as a science-policy interface are two major components of DST development in *SPICOSA*. Relevance and utility of these tools is fortified by the position that stakeholders and decision-makers play in the SAF process: they specify the type of decision they need at the beginning and receive a tailored, interactive Information portfolio at the end of the process. Furthermore, these tools are not a one-time, user dependent set. The SAF is structured such it can:

- be user friendly and be delivered with instructions and an adequate information base,
- evolve with new techniques and with increased societal awareness,
- be applied to any type of CZ issue throughout Europe and beyond, and
- produce communicable results to the entire set of endusers.

The methodologies employed to generate these tools is explained in B.4.2, and the activities for generating them are explained in B.4.3 (cf. Nodes 1, 2 and 3).

4.2.2 Describing Human Activities (HAs). Often HAs within the watershed generate impacts that are communicated to the coast through water or air transports, which then combine with those HAs directly impacting the lower coastal terrestrial and aquatic ecosystems. Tracing and evaluating these impacts back to their causal HA becomes an essential part of the EU Sustainable Development Strategy and requires coherent and compatible exchange between EU projects involved in quantifying land-use practices, pollutant discharges, and overexploitation of resources in coastal watersheds. *SPICOSA* focuses on cause-and-effect relationships and on producing scenarios such that changes in HAs can be simulated relative to the impacts in coastal ecosystems and in coastal societies. This focus emphasizes the important strategy of providing prognostic tools to decision-makers in order that policy can convert from retroactive regulations to proactive planning and negotiation. In addition, *SPICOSA* will have a wide public exposure and thereby will contribute to the necessary strategy of increasing public awareness to the methods and concepts involved in transitions to greater sustainability. The HA description is a fundamental part of the SAF in the sense of identifying the cause of impacts elsewhere in the CZ System. A range of activities is dedicated to methodological development in this area (Nodes 1&2) to be tested while implemented in the 18 Study Site Application (Node 3).

4.2.3 Land Use. Land Use is considered as a subset of Human Activities (HAs), which form an essential component of the CZ Feedback Loop – as in Fig. 1. Changes in Policy ultimately affect change in HAs, even if the policy is directed at institutional change. In the vast majority of cases, impacts in the natural systems (land or freshwater or marine) are the result of land-use practices. For example, this statement would even include atmospheric deposition, because land-use practices alter its distribution and its pathways through a watershed.

Because Land Use constitutes an essential component in the reaction between Policy decisions and their Impacts to natural systems, the type and distribution of land-use practices will be a consideration in nearly all of our scenario calculations. It may enter into all of the appraisals of all the SD dimensions. The fact that the IP partnership has a dominant number of organizations dealing with coastal marine issues rather than coastal terrestrial issues is a reflection of their actual distribution. To compensate for this asymmetry, the Consortium has a number of strong partners specializing in Land Use (e.g. CEMAGREF, FHRC, PCRaster, VITO, INCDDD). In addition, it has added the WP 11.2 specifically to ensure good exchange with EU projects involved in the Land Use Perspective (e.g. SEEMLESS, SENSOR, PLUREL). In this sense, we hope that SPICOSA will eliminate some of this thematic imbalance among institutes and among their researchers dealing with ICZM by stimulating avenues of research that are less focussed on disciplinary lines and more focused on systematic problems.

The methodology of SPICOSA has no bias regarding issues relating to land or sea use or land use. The importance of a no-bias approach is essential to the effectiveness of the methodology. This logic stems from the strong interaction between land and aquatic systems. This interaction is two-way in nearly all cases, albeit asymmetrical, in the sense that it is often more direct in the case of land impacting sea and more indirect in the case of sea impacting land/society. An extremely simple example would be a situation where land runoff impacts directly the sea and the impacted sea indirectly changes the human use of the sea. In the context of developing an integrated methodology it would be irresponsible to neglect this two-way interaction. In fact, by considering this interaction we demonstrate the necessity of integrating quantifications along the three main SD dimensions in order to be of comprehensive and practical tool for ICZM.

4.2.4 Assessing CZ Degradation. The basic rationale of the SAF is to trace the causes of environmental degradation (impacts) back to some source cause, usually related to HAs, and the policies, practices, and laws that control these causes. This sleuthing process cannot be done without a good understanding of the impacts, the processes of degradation, and the system function. This understanding cannot be neglected in the *SPICOSA* exercise. However, much more research has been focussed on describing these impacts than on their causal links. By completing and simulating the causal linkages we will increase the current knowledge and provide a more effective mechanism to monitor the changes in the rates of degradation as a result of changes in CZ management. The environmental description of the CZ enters in the system design, where an information inventory is made concerning the specific impact involved in the chosen Policy Issue.

4.2.5 Thresholds of Sustainability. Our knowledge of system function has not yet allowed us to well predict phase shifts (sudden degradation) in natural systems. This has become more obvious with the recent increased frequency of environmental collapses. While in hindsight many of these have been diagnosed as a convergence of several stress thresholds, which in combination had caused the system to degrade to a lower level of function (Hughes, 1994). The EU emphasis on this problem is exemplified by the THRESHOLDS and other projects. This is exactly the kind of dynamic that should be of interest to decision makers, because of the costs implied in these shifts and because of the unknown costs of recovery. *SPICOSA* places a very high priority on a better understanding of the nonlinearities of the phase shifts and on how to monitor the thresholds of sustainability in a system, which would give early warning signals to researchers and management. An increased understanding will result from two activities within the project:

- from the non-linear simulations of the systems interactions and the various cause-&-effect chains studied, and
- from WP 6 System Output of the SAF protocol, where a concerted focus is on prescribing dynamic indicators that portray more accurately the system sensibility to these thresholds.

4.2.6 Data Management Systems. In aggregate the SSAs require the use of very large, distributed, heterogeneous sets of CZ data (i.e. hydrological, biogeochemical, geophysical, ecological, eco-toxicological, economic, institutional and social data). The *SPICOSA* research will not acquire much data. However, it will mobilize a large quantity of pre-existing data and produce new information as an output. WP 9 deals specifically with data management for the project. It will rely on international protocols and standards for information storage and delivery adapted to the needs of the Project and compatible with GEOSS. Remotely sensed data represent a valuable mechanism for monitoring and interpreting spatial distributions and change. *SPCOSA* will generate new uses for remotely sensed data in terms of monitoring and interpreting system function. These will result from WP 10.3 and in the individual SSAs of WP 7. Consequently, we expect a mutual dialogue between *SPICOSA* researchers and the GEOSS initiative, both in the areas of utilizing data and in the development of new uses and models for GEOSS datasets and environmental decision-making tools. A strong link with the GMES is expected with the WP 10.3 “Intelligent Monitoring” which targets new ways to monitor coastal systems in order that simulation models can be run in quasi-real time. In a similar way, available social and economic information is rarely used in the area of coastal zone management. Protocols and standard used in other policy areas will be applied to mobilize these data.

4.2.7 Broader Statement. By improving our understanding how the CZ System functions and how its components interact, *SPICOSA* is designed to assist policy with decision-making choices and scenarios for ICZM through quantitative and qualitative assessments, which are more useful, more accurate, and more amenable to the forecasting of consequences. In doing this it will quantify the cause-&-effect linkages to identify how impacts are connected to multiple HAs in each of the above areas of Human influence at the most appropriate scale of integration. It will objectively study the social and economic impacts of change. It will indicate how and which alternatives are available to make each of these areas of Human influence less damaging taking into consideration the perception of stakeholders as well as the institutional capacities in relation to regulatory frameworks and governance structures.

5. Potential Impact

5.1 Strategic Impact.

SPICOSA will modify the quality and manner of integrating the results of research into the governance of our societies, will broaden the applied-research opportunities for commercial enterprises, and will stimulate research and academic opportunities for sustainability science.

<u>5.1.1 EU Added Value</u>. The 'systems thinking' inherent in the SAF, and its practical application, will have a positive influence towards understanding the sustainability transition, with the research, academic, economic, public and management CZ communities. Opportunity for the evolution of methodology and experimentation are hard-wired into the design of the SAF. The broad distribution of SSAs and their connections with ongoing projects will guarantee a wide exposure and dissemination of information on all operative levels. It will support the implementation of existing EU Directives and ICZM good practices. It will also contribute to improved management, the reversal of coastal degradation, and the more efficient and sustainable use of CZ Systems. It will produce tools, methods and models that can be included into GEOSS. Finally, it will contribute to the understanding of social interactions within the CZ System and how these impact the environment and future policies. In sum, the design and approach of *SPICOSA* specifically contributes toward added value for Europe through its activities, which will:

1) Assess the causes of environmental degradation and their economic and social impacts in the CZ at regional and global scales.

2) Contribute to achieving a 'knowledge-driven society' by responding directly to societal needs and by enhancing the availability of scientific knowledge to decision-makers, industry and the public.

3) Restructure research by involving a critical mass of European organizations in a common, broad set of objectives.

4) Stimulate new research efforts supportive of the EU requirements on Sustainability.

5) Strengthen the European Research Area through innovation in multi-disciplinary science, integration and cooperation between research organizations, SMEs, and decision-making infrastructures on national and regional levels.

6) Advance Europe's role as a leader in the methodology and technology required implementing Sustainable Development.

<u>5.1.2 Research Innovation</u>. *SPICOSA* will be the first European-wide effort dedicated to creating a multi-disciplinary framework for delivering best assessments for policy options in Coastal Zones. The 'systems thinking' inherent in the SAF, and its practical application, will have a positive influence towards understanding the sustainability transition, within the research, academic, economic, public, and management CZ communities.

The innovation of *SPICOSA* project is in its design, its scope, and its focus. This is reflected by its creation of a synergistic dovetailing between social, economic, and natural sciences as well as between public and private R & D, for example, by:

1) Explicitly addressing Coastal Zone systems at a representative range of scales, types, and exposure to human activities and policies.

2) Improving the direct links between scientific analysis and the decision-makers, ICZM practitioners, and the public.

3) Focusing on stakeholder interests and on pragmatic outcomes.

4) Seeking to offer transparent multi-criteria indicators, alternative future development scenarios, and applicable options for a sustainable coastal zone management.

5) Prescribing more intelligent monitoring schemes to provide quasi real-time inputs for continued simulations of the key functions of the CZ system.

<u>5.1.3 Effectiveness as an Integrated Project</u>. *SPICOSA* strongly supports the goals of the IP instrument by integrating and strengthening the European Research Area. The research methodology proposed is strongly multidisciplinary and will be implemented through the research institutions, private enterprises and end-users networks of 20 countries, plus the

Joint Research Centre of the European Commission. The IP will effect change in research and academic infrastructure, engage a critical mass of CZ actors from the User and Public sectors, and accommodate evolving technologies and changing public perceptions.

The durability of these changes rests on the operational practicality of *SPICOSA* approach and on its integration into the CZ community. We will demonstrate this practicality by our ability to deliver the *SPICOSA* products and to demonstrate their validity, effectiveness, and applicability on a time scale closer to that of Policy than that of research. *SPICOSA* considers that the success of its approach depends equally on the quality of its science and on the practicality of its applicability. By offering a common goal and a coherent approach over a considerable portion of the EU coastal zones, *SPICOSA* will stimulate change in European coastal research and strengthen Member-States' participation regarding EU directives/ policies for the CZ including the Global Monitoring for Environment and Security (GMES) and Global Earth Observation System of Systems (GEOSS) initiatives.

5.1.4 Commercial Exploitation. An important tenet of *SPICOSA* is that commercial exploitation of its research outputs is essential, as an entrée into the socio-economic fabric of society, to the transition towards sustainability. We have several work areas, which potentially will spawn commercial opportunities and which will enhance dissemination of *SPICOSA* and related material. The coupling of simulation software (WP 8) with large public databases (WP 9) is an incipient area of model application with great potential. The SAF protocol (WP3 to 6) can be adapted easily to commercial applications. Our review, use, and recommendations of technical alternatives for sustainable practices and observations (WP10) constitute another area for commercial exploitation. The participation of 10 commercial organisations in the consortium is also an incentive for such development.

5.1.5 Science-Policy and Stakeholder-Policy Interfaces. By developing and validating the Systems Approach Framework (SAF) and its Deliberation Support Tools, *SPICOSA* will have a strategic impact on shaping the interaction between new scientific knowledge and policy, on one hand, and on the efficiency of communication between stakeholders and policy, on the other hand.

5.1.6 Ecological Advances. *SPICOSA* will contribute to securing better ecological status for future generation by reducing the risk of irreversible losses in ecosystem biodiversity and function, increasing the ecosystem health and productivity; supporting more environmental friendly practices and remediation/mitigation strategies; and by raising the awareness of the environment as our support system.

5.1.7 Societal Improvements. Preserving and enhancing the potential for environmental benefits for present and future generations will improve social conditions. The implementation of more equitable environmental regulations, and possibly a reduced need for such regulations, will result because of the *SPICOSA* effort to stimulate greater public awareness about sustainability, improved participation of stakeholders in policy-making, better institutional design, and improved tools for resolving user-conflicts.

5.1.8 Europe's coastal zones' economic competitiveness. A third of the European population lives today within 50 km from the coastline and about half at less than 100 km. Still coastal areas experience a positive net balance of their demographic trend. The economic competitiveness of European Coastal Zone is critical. *SPICOSA* will contribute to the CZ's economic enhancement by improving sustainability of the flow of market and non-market net benefits derived from coastal ecosystems; supporting economic efficiency of uses by reducing externalities and their associated social costs arising from damaging HAs and inefficient management; and market stimulation for sustainable technologies.

5.1.9 Information Dissemination. A whole range of activities (WP11) is dedicated to constructing a strong Dissemination and Media Plan for promulgating project-related information to the research community and to various end-users, policy/management, stakeholders, and public. The Study Site Activities will also provide many opportunities for direct interaction with the policy-making process and stakeholders at local and regional levels and they will address issues of governance in the context of ICZM typically with the Area "End Users" defined in the GEOSS architecture as health, water, ecosystem, agriculture, fisheries and biodiversity. Likewise, a planned close collaboration with the Coordinated Action ENCORA through thematic links will enhance the community exposure to *SPICOSA* activities.

5.1.10 Training in Sustainability Science. Work packages 11 and 12 will focus on the transfer of knowledge to academic and coastal professional communities through the development and delivery of *SPICOSA* training courses across the SSAs. The partners involved in this work package will draw from existing training experiences (e.g. Erasmus Mundus, Marie-Curie Programmes, CoastLearn & Corepoint projects) to deliver an effective response to training needs in Member States, taking issues such as local specificity and language into consideration. Dedicated training activities will help to build capacity in ICZM among coastal professionals and young researchers. In particular, participants will obtain an enhanced understanding of the inter-relationships that impact on the sustainable development of the coastline, including the physical, social and economic aspects of sustainability science, inherent in the Systems Approach Framework. The training of trainers will be an important component of Node 5 to ensure effective transferability of capacity building skills across the region.

5.1.11. Links with other Research Activities. By design, *SPICOSA* requires the insertion of the best available knowledge and methodologies into the SAF and thereby necessarily requires close connections to relevant ongoing projects. In addition, many of the Participants are involved in the suite of relevant international projects, listed in Table 2. These interactions are facilitated and coordinated in a WP11.2, which will be responsible to build and maintain close interactions with those projects most relevant to *SPICOSA* objectives. Coordinators of main on-going IPs related to land and resources use will be invited to join or to be represented in the External Scientific Review Panel as well as to interact directly with SPICOSA community by participating in SPICOSA forums as well as electronic group discussions.

Table 2 : Main ongoing or recently terminated projects linked to *SPICOSA*

	Description	Objectives	Funding	Duration	More info	Contact
SEAMLESS System for Environmental and Agricultural Modelling. Linking European Science and Society	Research and policy project that aims at the generation of an integrated framework with computer models and approaches for ex-ante assessment of alternative agricultural and environmental policy options for sustainable development in Europe.	To develop an integrated and operational framework called SEAMLESS-IF	EU FP6 Integrated Project	2005-2008	http://www.seamless-ip.org	Martin van Ittersum (Wageningen University) seamless.office@wur.nl
SENSOR Sustainability Impact Assessment: Tools for Environmental, Social and Economic Effects of Multifunctional Land Use in European Regions	Involving 33 organisations from across Europe, it takes an interdisciplinary approach covering biological, social and economic subjects.	Development of Sustainability Impact Assessment Tools (SIAT), which decision makers can use to assess how new policies may affect land use and as a result impact upon broader sustainability issues.	EU FP6 Integrated Project	2004-2008	http://www.sensor-ip.org/	Dr. Katharina Helming (Leibniz-Centre for Agricultural Landscape Research) sensor@zalf.de
EFORWOOD Sustainability Impact Assessment of the Forestry-Wood Chain	Four-year integrated project that provides methodologies and tools that will integrate Sustainability Impact Assessment of the whole European Forestry-Wood Chain (FWC)	Development of a quantitative decision support tool for Sustainability Impact Assessment of the European Forestry-Wood Chain (FWC) and subsets thereof (e.g. regional), covering forestry, industrial manufacturing, consumption and recycling.	EU FP6 Integrated Project	2005-2009	http://www.thresholds-eu.org	Prof. Kaj Rosen (The Forestry Research Institute of Sweden) kaj.rosen@skogforsk.se
THRESHOLDS Thresholds of Environmental Sustainability	THRESHOLDS carries out innovative crosscutting research to develop, improve and integrate research tools and methods supporting the formation of sustainable strategies.	The THRESHOLDS IP will develop an innovative target-setting procedure, encompassing both the environmental and the socio-economic dimensions required to formulate robust policies ensuring sustainable development	EU FP6 Integrated Project	2005-2009	http://www.thresholds-eu.org	Prof. Carlos M. Duarte (IMEDEA - Instituto Mediterraneo de Estudios Avanzados) cduarte@uib.es
NATURNET-REDIME	New education and decision support model for active behaviour in sustainable development based on innovative web services and qualitative reasoning.	The improvement of knowledge and the provision of education concerning all aspects of Sustainable Development.	EU FP6 Integrated Project	2005-2007	www.naturnet.org	Karel Charvat charvat@ccss.cz

	Description	Objectives	Funding	Duration	More info	Contact
MarBEF Marine Biodiversity and Ecosystem Functioning	A network of excellence funded by the European Union and consisting of 82 European marine institutes, is a platform to integrate and disseminate knowledge and expertise on marine biodiversity, with links to researchers, industry, stakeholders and the general public.	To bring together the presently dispersed units of scientific excellence in Europe and will create a virtual European centre of excellence in marine biodiversity and ecosystem functioning.	EU FP6 Integrated Project	2004-2009	www.marbef.org	Prof. Dr. Carlo Heip (Netherlands Institute of Ecology; Centre for Estuarine and Marine Ecology) marbef@nioo.knaw.nl
ELME European Lifestyles and Marine Ecosystems	ELME brings together a necessarily large consortium, covering all relevant disciplines and regions.	To provide the best available scientific information for predicting the likely impacts of major economic, social and institutional changes within Europe on marine ecosystems.	EU FP6 Integrated Project	2003-2007	www.elme-eu.org	Laurence Mee (University of Plymouth)
DITTY	Development of an Information Technology Tool for the Management of European Southern Lagoons under the influence of river-basin runoff	To develop the scientific and operational bases for a sustained and rational utilisation of the available resources in Southern European Lagoons, taking into account all relevant impacts from agriculture, urban and economic activities that affect the aquatic environment.	EU FP 5	2003-2006	www.dittyproject.org	Dr. Michel Retourna (Organisation Biologique et Fonctionnement)
ENCORA	European network project build on national and thematic networks dealing with coastal management	European platform for sharing knowledge and experience in coastal science, policy, and practice	EU FP6 Network project	2006-2009	www.encora.org	Job Dronkers (RIKZ)
PLUREL	Study of Rural Urban Regions (RUR) based on the concept of Functional Urban Region as an urban core and its surroundign commuting ring, including areas of recreational use, food supply and nature reserve functions in rural areas	To develop new strategies and innovative planning and forecasting tools for developing sustainable rural-urban land use relationships	EU-FP6 Integrated Project	2007-2011		Prof Kjel Nilsson, Danish Center for Forest Landscape and Planning

5.2 Contributions to standards

The setting of standards is a major component of public policies. In the course of the review of natural and social processes at work in the coastal systems, both to elaborate methodological frameworks and for application purposes, standards related to water quality in watersheds and coastal waters is expected to be the major area where the evaluation of standards adequacy will take place. In addition, *SPICOSA* will analyze the motivations and implications of setting standards.

5.3 Contribution to policy developments

SPICOSA will address all major aspects related to sustainable development of coastal zones in an ICZM perspective. Therefore, *SPICOSA* will deal with issues directly connected with the preparation and implementation of EU policies and policy initiatives including, e.g., ICZM Strategy and Recommendations, the Regional Policies, Water Framework Directive, Nitrate Directive, Common Agricultural Policy, Bathing Water Directive, Soil Thematic Strategy, Sustainable Impact Assessment Directive, EIA/SEA legislation, Rural Development Policy, Habitats and Birds Directives, the Convention for Biological Diversity and forthcoming Maritime Strategy and new ICZM recommandation. Specifically, it will contribute strongly to tools and methods for defining sustainable practices for land and resources use. The involvement of large European networks will strengthen *SPICOSA*'s interaction with policies. For example, the Coastal Union – EUCC Med as a participant will maintain information and activity links with ongoing pan-European or regional EU projects, with CZM practitioners and decision-makers. *SPICOSA* will actively participate in the ongoing debate for the definition of a maritime strategy for the EU and of an ICZM agenda following the demonstration programme and the 2002 recommendation for ICZM. The Study Site Activities will also provide opportunities for direct interaction with policy-making process at local and regional levels.

The process of translating the ICZM objectives arising from a political or scientific reflection into regulatory frameworks is very slow and goes in many different directions across European countries. The same thing is observed all over the world. The ICZM demonstration programme initiated by three DGs of the European Commission was set to pave to way for regulatory initiatives at the European level. The review of the work conducted in the sites of the demonstration programme has concluded that there was little scope for EU regulations in the field of ICZM and that the diversity of issues and contexts would rather call for a progressive move through local and national initiatives. Regarding this situation, the European institutions have limited their action to producing recommendations as a first step. The second step, presently under political and technical review, would be to produce a EU directive on Coastal Zone Management. Within the context of the breadth of local and national pieces of regulation, the European initiative should become the focal point of the policy debate. By emphasizing the juridical dimension of institutional frameworks for ICZM in the ESE Assessments, *SPICOSA* will largely contribute to this debate. Furthermore, under its activities to develop science and policy interfacing, *SPICOSA* will construct a deliberative tool for multi-scale interaction between its study sites and the policy at the European level.

The IP will work in close relation with local stakeholders and policy-makers within the SSAs. As such it will develop an empirical knowledge about successes and difficulties in implementing EU strategies at the field level. Because most researchers involved in the IP also intervene as experts at different level of EU policy framing and evaluation, this expertise will be made available in various contexts of policy formulation. This expertise could also be called upon on an ad-hoc basis to participate in consultation or other expert forums in relation with the on-going processes of monitoring the implementation of 2002 ICZM recommendation, monitoring the integration of coastal waters in the implementation of the WFD, monitoring and expanding the field of implementation of Natura 2000, elaboration the Maritime Strategy of the EU, preparation of a new ICZM recommendation (eventually to become the grounds of an ICZM directive). By publishing special issues of SPICOSA newsletter in the format of policy briefs and by actively contributing to networking and dissemination activities of the CA ENCORA, the IP will also directly participate in the policy process.

5.4 Risk assessment and related communication strategy

No risks are associated to the development of the *SPICOSA* IP.

6. Outline implementation plan for the full duration of the project

6.A - Activities

This section gives an overview of the scientific and technical approach by summarizing its uniqueness of design and the innovation of key components, by outlining how its activities interact to achieve its objectives, by outlining the function of its activities, and by explaining its contingency plan for success. Certain terms are used in this document that are context-dependent and therefore require definition to avoid confusion.

We define the term '*coastal zone*', following the definition of LOICZ as a geographic region consisting of the "long narrow boundary between land and ocean that is a dynamic area of natural change and of increasing human use". In the context of LOICZ and of SPICOSA, the width of this boundary varies not only geographically in terms of size of watershed and continental shelf, but as importantly by a natural continuum between terrestrial and marine ecosystems and by the extent to which HAs, regardless of physical boundaries, interact with this continuum.

The term *'system'* implies a more functional definition that a spatial one, although the two may overlap. Since, the universe contains a continuum of interactions on all scales and all functions, functional clusters of these interactions are often not well described by a specific scale as one uses to describe a physical quantity. As a result the word is used to convey a specific functionality, which may or may not have a clear spatial extent, e.g. gravitational system. A corollary is that any system fits into a larger system and itself contains smaller systems.

Relative to the above definition of a Coastal Zone, the geographic sense is most commonly used, as in statements like "high population centres are frequently located in the coastal zones". However, the non-geographic use of the CZ suggests boundaries defined by human activities or by strong interactions, even interior to the coast as dam construction in the headwaters of a river. For SPICOSA, this emphasis on human-use function enters strongly into our definition, and consequently we use the term CZ System to refer to a specific CZ that is defined by the relative strength of these interactions. In this case, a number of different spatial scales may be implied for its primary components (sub-systems). Furthermore, within the application of the SAF, any given CZ System is redefined for the purpose of focussing on a particular functionality specific to a question about this System (e.g. Policy Issue). In other words, the SAF begins with the full CZ System and then reduces the functionality to provide specific answers.

The term *'scale'* is also used both generically (e.g. the degree or size of a problem) and specifically to refer to a dimension, as in length scale. In the SAF, it is used in both senses. For example, reducing the scale of the problem would mean reducing its size or complexity and, simply, downscaling the problem; or when used for a simulation conducted at a shorter time scale, it would mean making calculations at shorter time intervals.

The term *"model"* is also frequently used in a generic sense to something, or some system, physically, mathematically, or conceptually. These different model forms are usually understood by the context or by modifying adjectives. In each case however, the purpose of the model may vary in the way in which it represents a system, i.e. statically (as a function of space, or components) dynamically (as a function of time, or time &space), Dynamic models can be run in hindcast or forecast mode for simulating past response or future response. Modern dynamic models are almost exclusively mathematical in representation. In Spicosa we will describe a CZ system using conceptual models for planning and presenting the structure of our quantifications. For the downscaled quantifications, will use a dynamic, non-linear, simulation model with time as the primary independent variable, in which space is represented virtually (spatially integrated quantities) but with inputs from dynamic geophysical models. With more advanced applications, we plan to use spatially coupled simulation models.

In the context of this project, the phrase "*SD dimensions*" refers to the three major sectors (natural, social, and economic) of Sustainable Development (see Sect. 6.1.1 c for further discussion). They are referred to as dimensions to emphasize the complicated dependence of SD on these sectors, i.e. SD is functionally dependent on each and all of these dimensions and on their interactions. The term "*multifunctionality*" is used to refer to these interactions, again, to emphasize that in order to be effective any SD policy initiative must consider these interactions in order to obtain a sustainable balance between the services and use of each of these sectors. For example, natural systems provide multiple services and uses to human society and its economy, and reciprocally human society and its economy provide multiple damage or protection to natural systems. SPICOSA is contributing to the quantification of these balances in order that more stable, productive relationships can evolve for CZ systems.

6.1 Research, technological development and innovation activities

Our research approach is based on an innovative adaptation of the Systems Approach, which incorporates the ecological, social and economic dimensions of the Coastal Zones together with emerging concepts on system complexity. For the sake of clarity regarding the SD dimensions, we use the adjective 'ecological' to refer to the portion of the CZ system relating to the non-human components, the adjective 'social' to the institutional, policy and cultural components, and the adjective "economic" to the monetary components of the CZ system. These three adjective will be referred to as ESE. The main purpose of our adaptation is to develop a holistic, pragmatic framework for guiding policy decision making, which we refer to as Systems Approach Framework (SAF). It includes interactive/participatory procedures for stakeholder mapping and policy scenario elicitation as well as deliberation over SAF output.

6.1.1 Design Concepts of the SAF

a) System Concepts

The Systems Theory (Bertalanffy, 1968), states that complex, non-linear systems function differently in vivo than a separate scrutiny of their component parts might indicate. The goal of the Systems Approach is to devise strategies to extract information on the functioning of complex systems that could not have been garnered from a sequence of subsystem-scale studies.

Fundamentally, this requires the best-possible understanding of the processes and dynamics of a system. The theory of Biocomplexity (Kauffman, 1995) suggests that self-organization is a function of the diversity and interaction of its components, i.e. many diverse components constructively interacting can evolve to a more complex organization that better optimizes its available resources. This suggests that systems issues concerning resilience and recovery need to devise system indicators of the strength and number of interactions (Patrizio, 2004). Furthermore, according to Gödel's Theorem, we cannot understand how a system functions unless we also know what are its external influences and controls. This means we must be able to well prescribe the external interactions of whatever system we define.

An essential characteristic of quasi-stable systems is their capacity to self-regulate to external inputs through internal interactions. These external inputs often exceed, in substance or intensity, those occurring naturally. Because natural systems re-organize slowly to large changes in energy or mass inputs, but can degrade quickly because of these inputs, major human interventions inevitably lead to a spiral of degradation. This is largely because the time scale of degradation is generally quicker than that of recovery and because many of the HAs develop independently of trends in the state of the natural system. If a human society is to co-exist with their supporting natural systems without degrading them, it is imperative that it learns to anticipate changes and correct its activities. As mentioned, the system that we want to study must be extended such that these previously considered external inputs, become internal, reactive components of the system. We also must require the best possible information on the function of the ecosystem and on its internal interactions in order that we can simulate its combined response to projected external influences, including policy choices. Finally, to make these responses useful, we must convert them into scenarios adaptable to economic valuations and to social assessments. Because these are complex systems, we must be able to distinguish, in our interpretations, between the level of uncertainty introduced due to our methodologies and that due to our lack of knowledge.

The parallel can be made between natural systems and social systems. An important difference, which must be considered, is that while natural systems operate with available energy as the controlling variable, whereas economic systems use money, and social systems use acceptance as controlling variables. Institutional change, as the major outcome of policies, often translates into changes in social concerns and preferences that are somewhat analogous to all the systemic characteristics mentioned above. An important difference is that the modelling of social processes is much less easily translated from literary expression to numerical computation. Economic relations within the social system have a particular status regarding quantitative measure because a large part of economic phenomena can be measured in commensurable units, i.e. monetary terms. *SPICOSA* is dedicated to demonstrating these concepts in the context of the CZ and to work at a better integration of interacting ecological, social and economic components. Practically speaking, the better we can understand the CZ System, and the more we can improve the quality of the interactions between its components, the greater chance we have of self-correcting to a more sustainable configuration for our CZ Systems.

In sum, the most prominent concepts that govern our approach towards meeting our objectives are:

1) One cannot reliably extrapolate to the functioning of a complex system from studies of its components because of potential changes in system function occurring due to synergistic interactions between these components. This requires the systems approach.

2) The definition of the system studied must include all components that have strong, external interactions (as fisheries, tourism); but the definition exclude non-interactive or weakly interactive components and treat them as inputs (as atmospheric deposition, navigation).

3) This manner of definition requires the inclusion of the social and economic drivers into the studied system, because they constitute strong internal interactive drivers; and it requires the inclusion of policy change as a major control mechanism for achieving CZ system stability.

4) Representations of the system studied must allow for changes in its dynamics as a result of internal changes (by e.g. loss of components, resilience thresholds, etc.) and its response must be continuously validated and monitored. This underlines the need for successful hindcasting models and a concerted research effort to understand the internal interactions.

5) Systems issues concerning resilience, degradation, and recovery require sophisticated system-indicators, e.g. providing information on internal interactions (strength and number) between components, in addition to those available regarding the status (composition and distribution) of components. This sets a higher priority for dynamic indicators that can anticipate non-linear changes, for designing intelligent monitoring of a system's response and health, and for translating scientific information for decision makers.

6) In considering the sustainability requirements for a combined system containing the Ecological, Social, Economic components a common language must be found to describe the interactions between these components and a common variable for making value estimates; e.g. a conceptual qualitative capacity to understand system function and a common monetary base for evaluating costs and benefits of decision scenarios.

b) Coastal Zone Feedback Loop (CZFBL).

Historically, the default correction loop involves that human society waits until the damage is obvious before reacting to adapt, mitigate, or correct the situation (external loop line in Fig. 1). Most commonly, society reacts by adapting to the change in the goods and services provided by natural resources. In times of accelerated degradation, where economic and social risks are more obvious, society commonly reacts through regulatory controls. Arguably, exercising the precautionary principle would be more prudent, as well as cheaper in the long run, to anticipate changes and implement solutions before damage occurs. This is the goal of *SPICOSA*, i.e., to provide new knowledge and technologies directed at strengthening a shorter, internal information feedback loop, which begins and ends with the policy decisions, and thereby facilitates more preventive, proactive decision-making. By employing the integrated Ecological, Social, and Economic (ESE) Assessment box, *SPICOSA* will increase the potential for quick evaluation of policy changes. While it is designed primarily to pass information directly to Policy, the *SPICOSA* loop (internal loop line in Fig. 1) will also enhance the default, outer loop through simultaneous dissemination of information and knowledge to stakeholders, users, and the public.

The implication of a research framework based on this accelerated CZFBL requires disciplinary integration of science in its broadest definition, particularly in considering strongly-forced, open systems in the sense that the conditions on energy and information are continually changing making improbable any steady-state solution in favour of a "continuum of reorganization" of the dynamics and structu3re of the system. Much of the change that occurs is stimulated by non-linear internal reactions to trends in external forcing. These changes may arise in mass storage in food web structure or pressure over water resources, and can be irreversible. Thus, in order to understand the degradation of our natural ecosystems, we must include the larger CZ System composed of the public policies, economic, and societal components that influence and control these ecosystems, as illustrated in Fig. 1.

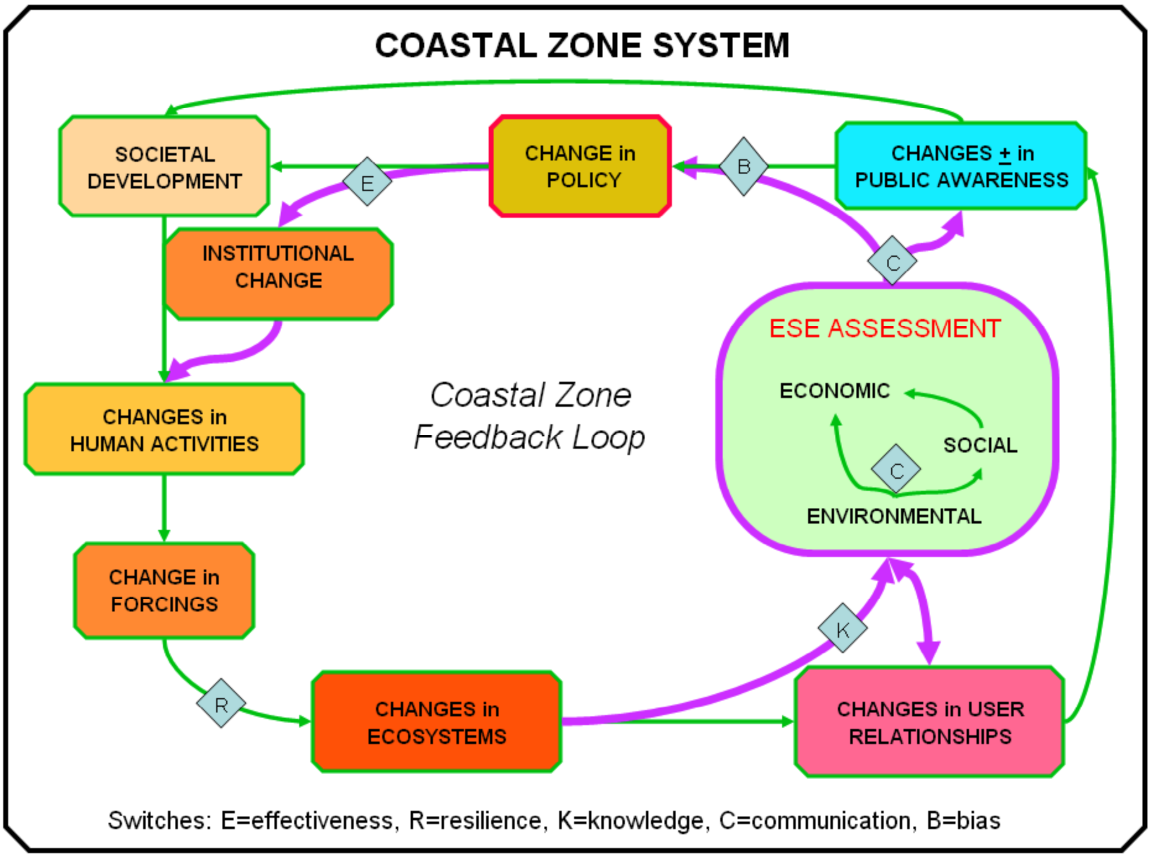


Fig. 1: Coastal Zone System Information Feedback Loops (CZFBL) The default loop is shown as a thin external line, and the *SPICOSA* loop as a thick internal line. The default loop is slow in forcing policy to be reactive to problems, many of which become irreversible; while the *SPICOSA* loop is prognostic and allows policy to be precautionary regarding serious losses. The Ecological-Social-Economic (ESE) Assessment box represents the central activity of *SPICOSA*. The small diamond boxes represent critical threshold constraints on the interactions between components of the system, which need to be properly represented for successful forecasting of policy scenarios.

c) Ecological-Social-Economic (ESE) Assessment

The key link in the *SPICOSA* science-policy feedback loop is the integrated ESE Assessment component of the CZFBL. While the need for somehow joining these disciplinary components has been expressed in various forms, here we consider it as a fundamental dynamic to the goal of Sustainable Development. Our deliberate emphasis on theoretical and practical aspects of the ESE concept is reflected in the structure and function of *SPICOSA*.

Concurrent and combined assessments involving all three of ESE components are essential to providing realistic portrayals of policy choices. Each of these components has been well studied in the sense of each representing a complex system with its own function, structure, and composition. The institutional, governance, and cultural dimension (Social) and the economic dimension (Economic) are commonly considered as separate dimensions from each other but have been rarely successfully integrated with each other nor with the Ecological dimension in the form of operational tools in the field of ICZM. Policy evaluation generally suffers the lack of economic evaluation that would provide information on the sensitivity of variables such as costs and benefits (market and non-market) or employment towards resource management or environmental protection alternatives. Relatively less recognition is given to the challenges to policy evaluation posed by institutional arrangements, i.e. the design and implementation of property-rights structure or forms of governance. Preferences and social norms also play a significant role that needs to be recognized. We will provide an improved balance and integration of the dynamics of these social and economic components in relation with anthropogenic pressures on natural systems. Significantly lacking also is a better identification of the interactions between these social and natural components within the context of the larger system. These interactions are essential to the *SPICOSA* design.

To achieve this SPICOSA will focus on evaluating the sensitivity of economic variables to variations in properties of natural resources and conditions of access and on mapping the controls, constraints, and multi-functionalities posed by the socio-economic sectors, e.g., public acceptance, legal constrains, probabilities of efficient enforcement, etc. These will be inserted into the simulations in the form of multivariate functions, thresholds, switches, options, etc. The overall ESE assessment would involve both qualitative and quantitative descriptors of the system plus interpretative information from component level to the highest possible level of integration. In addition, it will ensure comparability of alternative scenarios, discriminate their short and long-term implications, conduct stochastic and sensitivity analysis of the results, provide measurable criteria, and will be presented in an easily communicable format to stakeholders and policy-makers.g

6.1.2 Key Methodology Components of the SAF

The underling goal of Sustainability is to optimize political and economic strategies for preserving equitable social benefits without damaging the productive potential of its resource base. Because most urbanized CZ Systems are strongly open (large mass and energy inputs), the local natural systems provide only a portion of their total inputs needed to sustain the resident society. Therefore, inefficient wasting by the urbanized component impose an abnormal burden on the surrounding natural systems of absorbing much greater mass and energy fluxes compared to their carrying capacity. This situation places a greater requirement on minimizing the degradation of natural systems and, equally important, on optimizing its productive potential. Simply put, our exercise is to anticipate the response of the supporting natural systems to changes in the way in which they are used directly or indirectly by the local society. For this reason we focus our project towards improving our ability to understand and simulate changes in the CZ System caused by changes in the four general use areas (Habitat Modification, Waste Products, Pollution, and Harvesting), policy areas (as with regulatory controls, planning, development, changes in governance. etc.), and social areas (as institutional constraints, public acceptance, resource use, etc.).

In the *SPICOSA* application of the SAF, Policy has a role as a type of control mechanism, which can influence change through out the CZ system in response to information from its constituent components. Thus, the goal is for science to provide better quality information through its deliberations with Policy. For this reason, we make the interaction with policy the starting and ending point of our SAF. However, this goal is not limited to the direct science-policy interface because it necessarily must also tailor its output to the other sectors (formed by local stakeholders, institutional structures, and public end-users) that play a strongly determinant role in policymaking. Simply put, the information from research must objectively be presented to all sectors involved. This requirement, in turn, emphasizes the necessity that the SAF methodological be tested in a significant number of socially diverse CZ Systems in Europe.

An important requirement of the SAF is that it must be indifferent to the type of CZ system being analyzed and therefore can serve as a common medium for investigation and exchange between the scientific, economic and political sectors involved in implementing sustainable management of coastal zone systems. Since all three of these sectors are interdependent, in which a mal-function in one affects the others, an approach that enhances the information exchange between these components would have high validity. This is the basis of the CZFBL explained in Fig. 1. The objective is to generate diagnostic and prognostic information that would tend to dampen damaging, and reinforce constructive, perturbations in the system. Our goal can be described as an attempt to short circuit the default information loop, which functions on a geologic or genetic time scale but does not function quickly enough to prevent irreversible or costly change brought about by modern development.

The SAF is the umbrella methodology for facilitating the *SPICOSA* loop in the CZFBL and for achieving its overall objectives. Incorporating the above concepts into the SAF involves five major methodologies, all of which are based on existing methodologies, and each of which are adapted explicitly for the *SPICOSA* application. *We would underline one important caveat: that the goal of SPICOSA is* not just to propose the SAF protocol, but to *test, and iterate* the integration of *these methodologies* within *the Study Site Applications (SSAs) in order that our SAF,* its *products,* and its procedures *can* be more explicit and more *useful to the researcher, policy, and stakeholder communities.* We use this section to provide an overview of these major components, while the SAF implementation are elaborated in terms of specific tasks in the Node Activities (6.1.5)

a) Systems Approach adapted for the SAF

For developing the SAF, we will expand the conventional application of the Systems Approach to the larger CZ System of Fig. 1. In general, the term Systems Approach refers to efforts to extract information on the functioning of complex systems. The term Systems Analysis is also used, but more in the sense of explicit mathematical treatments of complex systems. In addition to application in the area of natural sciences, the Systems Approach has also been applied in a wide range of areas involving complex systems (e.g. in management, Blake and Mouton (1964; in education, Greer, (19); in environmental management, Jorgensen (19); and in applied mathematics, Murota (). We will adapt the general sequential strategy described by Jeffers (1978), which is well suited for our purpose because it has the following attributes:

1. It is indifferent to the type of system being analyzed and therefore has value as a common medium for different types of systems investigations.
2. It is holistic and hierarchical, in that it considers the entire relevant system (including all major interactions) but initially only focuses on the first-order functioning of the system relative to the studied question, and then if greater resolution of the studied is needed, it can incorporate the effects of higher-order functioning.
3. It requires a phase of iteration and rescaling in order to insure a balance between effort, accuracy, and resolution.
4. It is by definition completely multidisciplinary, rendering very useful and complementary to redress knowledge gaps created by over-specific disciplinary or process studies.
5. It places a high focus for information flow (in addition to mass and energy) through a system, and thus facilitates the inclusion the controls and constraints imposed by human society.
6. It is well adaptable to systems simulation modelling and producing prognostic diagnoses.

For our CZ application, the systems approach would require a system's model that follows the pathways of mass, energy, money, employment and other information through the large feedback loop of Fig. 1 such that feedback of policy changes can be tracked through the CZ System. In Fig. 2, we synthesize the sequential approach as follows into four steps. It is important to note that the research design is conducted in reverse order to the linking cause & effect pathways, i.e. from the effect to the cause. One starts by defining what is the problem in the system that needs attention and then works backward from that problem in order to design what information would best constitute a cause-&-effect chain.

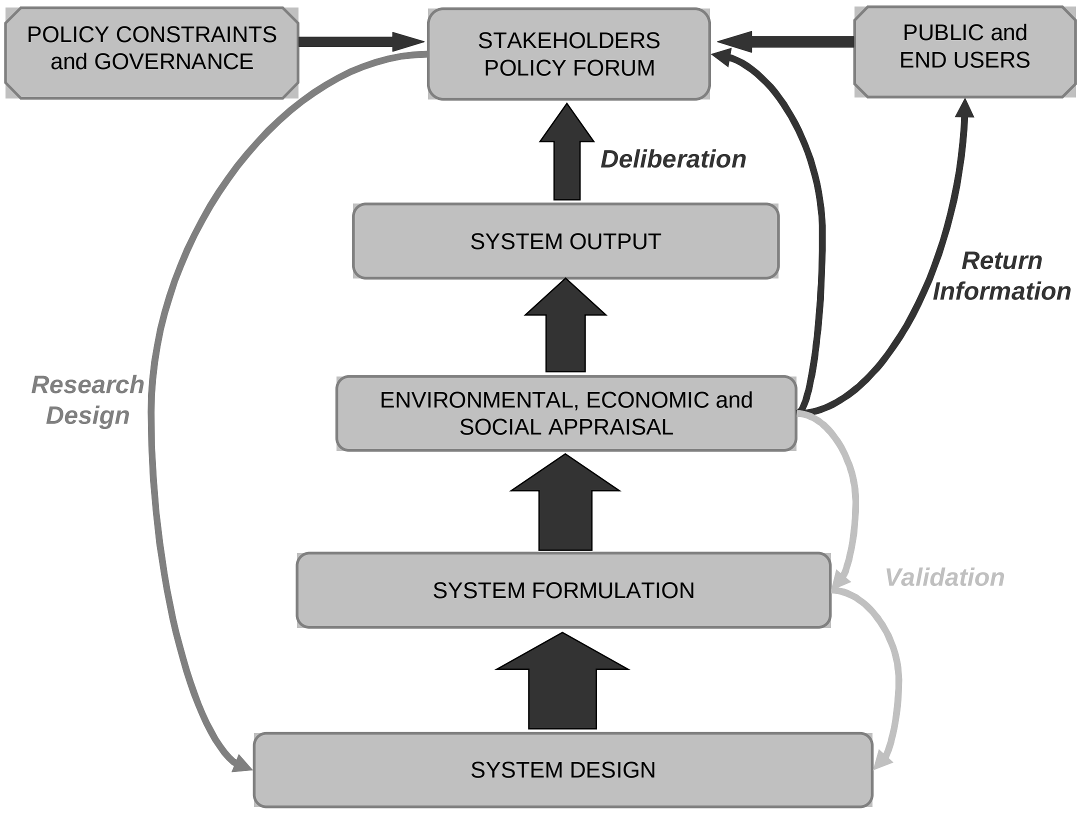


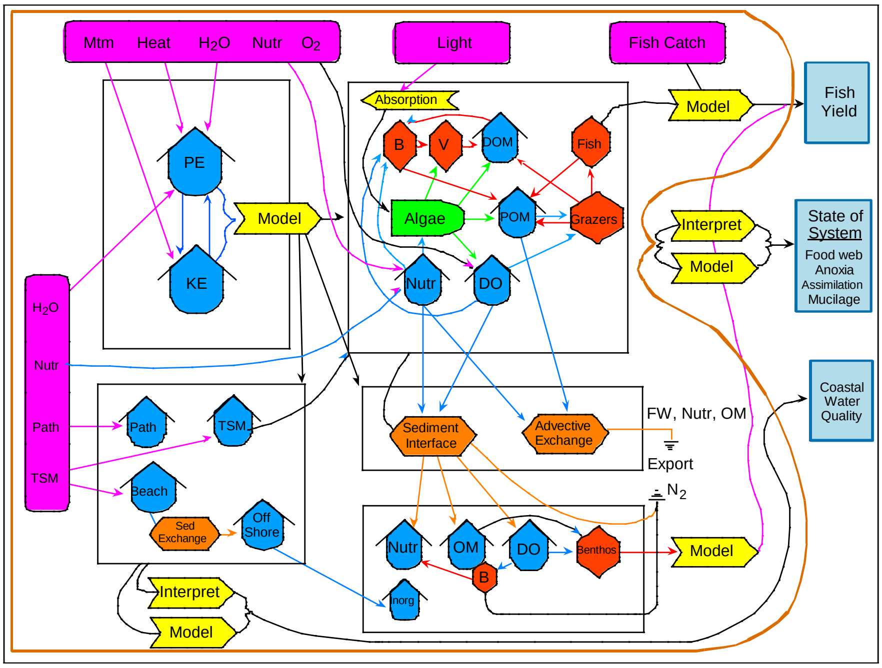
Fig. 2: Schematic of System Approach components for an ICZM Policy Issue.

1) Design. The CZ System Design identifies the structure, function, and dynamics that should be studied, to resolve a system, along with the methods and information needed to do so. Questions can be of any nature about the system, but usually are about some dysfunction, impact, change in the system that is causing economic, social or resource problems. In SPICOSA these questions are referred to as Policy Issues. Thus this Design Step first establishes the Policy Issue(s) for which prognostic decision-making is requested. It then determines how this Policy Issue is related to impacts within the natural system, by tracing backwards from the impact along the primary causal links to the cause(s) (Human Activities) and thence to the policy affecting these Activities. It constructs conceptual models to represent the problem, including its socio-economic interactions, in a schematic way, and a master plan for the scenarios and outputs. Then, it designs a downscaled configuration of the system to represent only those first-order inputs, interactions, and processes that govern the flows of information (mass, energy, money, employment) relevant to the cause & effect chain. Hence, a series of primary tasks are required in this phase, which can be listed in the sequence in which they be conducted: the issue resolution, the system definition, the elaboration of conceptual models, the design of information base, and the scale of the problem. Portions of these tasks are inter-connected with each other but each one constitutes a separate section of the SAF protocol. Examples are given in the following outline.

Issue Resolution. The Issue Resolution aims to:
• Establish the links by engaging policy-makers, industry, and stakeholders and determining their main policy concerns and constraints.
• Define expected output in terms of format, scope, with the clientele with whom the output will be delivered and with whom any modifications might be discussed.
• Specify the types and scope of scenarios required for the output.

System Definition. The System Definition defines the ecosystem to be studied by
• Converting the policy issue(s) into primary cause-&-effect relationships.
• Ascertaining that all primary functionality is within its boundaries, i.e. leaving in the system all major interactions.
• Specifying the necessary boundary conditions, i.e. identifying information/data needed for prescribing the external boundary conditions, anthropogenic drivers.
• Specifying the relevant internal inputs, controls, constraints, and social demands relative to the proposed Policy Issue(s).

Conceptual Models. The design and elaboration of Conceptual Models require the following:
• Construct a master plan of the ecosystem response through the use of a conceptual model that allows visualization of the external boundary conditions, major compartments, and the internal processes that control the flow of mass, energy and information through the ecosystem.
• Indicate the large-scale interactions of the system with its multiple stresses, the key forcings, variables, and processes constituting the identified cause-&-effect relationships.
• Indicate the social and economic interactions, controls, processes, and components and their interactions relative to the cause & effect chain.
• Display/describe storages, thresholds, choke points, dynamic switches, and internal feedback loops,
• Define sub-system components of the cause & effect chain and construct higher resolution blow-up models.
• Provide a sample format for these conceptual models by adapting various in-use methodologies (e.g. Odum, Forrester, EXTEND, other), which permit visualization of the important interactions. An example for a natural system is given in Fig. 3.
• Specify the system outputs for both qualitative and quantitative analyses.



Hopkins et al., 1999

Fig. 3 Odum Diagram of the Northern Adriatic. Example of a conceptual model of the Northern Adriatic depicting its major internal processes and external connections used for impact assessment only. Diagram drawn as an Odum diagram (Odum, 1983)

Methods and Information Required. The Information Base needed is partially a function of the methodologies available and relevant to the resolution of the chosen Policy Issue(s):

- Based on the master plan of the Conceptual Model, identify the methods suitable for resolving the various quantifications and qualitative interpretations needed. Supply also options in order to allow the users to achieve a balance between effort and resolution.
- Prescribe the type and scope of data needed by these methods, making sure to cover the three dimensions of CZ system (natural, economic, and social) and to cover essential time and space requirements.
- Prescribe the type and format of the data required including procedures for acquiring it, i.e. the input data needed for boundary conditions and internal sources, and validation data for key processes.
- Acquire available data and provide and simulation schemes for adapting data not available from other CZs, literature, etc.
- Format for storing the CZ relevant data will be specified in conjunction with the different tasks of the Ecological, Social, and Economic (ESE) assessment.

Problem Scaling. An important but difficult task with implementing the systems approach is that of extracting from the multi-scale multi-dimensional CZ System the appropriate dynamics to quantify the required cause-&effect chain. Some of the more important tasks needed to address this issue are listed as follows:

• Construct hierarchical plan for the quantification of the conceptual models by identify the first-order dynamical links in the cause-&-effect chain and the processes and variables necessary to trace mass, energy, or information transfers and conversion along this chain.
• Identify the second order links and internal interactions that might needed to evaluate other scenarios.
• Anticipate characteristics of potential risks that should be evaluated and define additional indicators required for system stability.
• Conduct a reality check on scope of effort, i.e. balance resolution and accuracy to meet allotted resources, schedule, and minimum output configuration.
• Conduct changes/updates in these definitions, if required after the validation and simulation phases.
• Describe the methodologies and interpretations needed for the social and economic assessments.

2) Formulation. The CZ System Formulation aims at represent the functioning of the system in both quantitative and qualitative terms. This requires that all the processes and interactions, including the controls and constraints of the socio-economic components, be formulated into functional modelling blocks that are individually validated. These quantifications are included in broader qualitative analyses that describe all processes and their interactions, such that the exercise can be scientifically critiqued. The formulation step involves four key tasks: Inputs, Internal Processes, Functional Components, and Documentation. These are outlined as follows:

Inputs
• Express quantitatively all boundary conditions of the defined system, and all transformations of mass, energy, and information that occur in the linkage between causal forcings and their inputs (both external and internal) to the system.
• Describe and explain each formulation, including dimensional checks on all formulations.
• Describe the degree that the input functions are independent of internal and external dependencies not included with the input data or that switched through an information feedback loop from inside the system or external to the system.
• Evaluate the relevance, for all possible inputs, regardless if they are not listed in the first and second order cause-&-effect relationships.
• Commence acquiring data for social and economic appraisals.

Internal Processes
• Explain how each process will be formulated, e.g. deterministically, empirically, statistically, etc.
• Evaluate approximations in the dynamics, e.g. range of validity, and the origin of these formulations.
• Illustrate the formulation with an adequate process model with full documentation and validation data.
• Provide a supplementary information from interpretive analyses (e.g. role of process in component or system, etc.)
• Simulate the dynamics of the economic and social processes (to be replaced with real results later)

Functional Components. Processes can usually be collectively grouped to form a major function with in the system, e.g. bacterial regeneration, or light transmission, etc. This grouping facilitates calibration and representation of the system.
• Consult the conceptual model and the selected first and second order processes, assemble them in to functional components, and define the interactions with other components in the cause-&-effect chain.
• Specify any thresholds, tolerance levels, and functional limits affecting the function of the component relative to its expected use (Study Sites Activities).
• Define and evaluate all external controls that are not included in the already defined key variables.
• Construct process models for simulating the behaviour of these components with respect to variability in the inputs and external control variables.
• Setup the social and economic analyses and define the variables needed for interaction with the natural system.
• Conduct sensitivity tests and validate the formulations with known results, and if possible, provide criteria for validating their accuracy.

Documentation
• Validate each of these functional components using available data (and iterate as necessary. Acquire available data useful for hindcast validations and calibrations of process, components, and systems models.
• Provide a scientific critique of these components including error estimates, sensitivity to inputs, quantitative indicators that might be useful in the output, and qualitative assessments for output.
• Include a revised conceptual model with respect to the initial model of the system design step.
• Provide description of the social and economic assessments and rationale.

3) Appraisal. The set-up preparations and output from System Formulation initiate the System Appraisal step. Thus, the ESE quantitative assessments will derive from different component models. These component models are coupled to construct the system simulation model. This assemblage involves several different types of linkages. The most straightforward of which is the coupling of functional component models of the same structure as the systems model. Even in these cases, the assemblage into a cause-effect chain must be accompanied by careful scrutiny as these interactions may involve loss or conversion of mass, energy, or information. For this reason, modelled variables are then compared with historical data at 'choke points' in the system. In case of non-validity, iterative improvements will be made in the formulations and/or the sequence will be scaled-up to include secondary interactions, until a threshold level of accuracy or a limit of resource is met. In this step, the entire process is critiqued relative to its planned output. Deviations are addressed either by re-running parts of the simulation or by evaluating their absence in sense of the validity/error in the output.

The hierarchical nature of our simulation needs can be accommodated by allowing for both series and parallel connections to outputs of other models, which will require other types of coupling. These support models are usually spatial models or differently resolved in time, e.g. connecting to a watershed model for simulation of non-point sources or expanding to an hourly computed benthic-pelagic component for simulation shallow-water applications, respectively. A simple file transfer could be used for the case in which no significant feedback occurs; however, if feedback does occur, then a higher-level of inter-process communication would be required to resolve these situations.

For linkages between outputs of the ecosystem response model and the social and economic special parameter, interfaces will have been specified for each SSA, in the Formulation Step. Similarly if they are time independent then they enter merely as constraints or controls (e.g. switches or thresholds) on the simulation. If their outputs are dynamic (e.g. cost versus level of pollution), the simulation model must communicate back to these support models either dynamically or by means of look-up tables. These interfaces between the various assessments of the ESE Appraisal are regarded as an area where SPICOSA will make an important contribution. One clear objective of SPICOSA is to succeed in addressing system complexity in an integrative way to offer decision tools that can better assist the decision making process by taking these discrepancies into account (Engelen et al., 2004).

If the appraisal models are to have scientific credibility, there operation and results need to be validated and calibrated, respectfully, dependent on the type of modelling appraisal made. If the model is used to simulate management questions, model outputs and significance must be translated into a format readily understandable by non-scientific. This implies that while the models are being run, the entire set of relevant interpretive material must be processed to help with the synthesis of the model results and to provide descriptive, quantitative information for the next step. This is where much of the output is converted to indexes, simplified plots, and tables, deliberation and presentation material, training modules, etc. Any conversion of output that involves a loss of information should be accompanied by an explanation of error and any predictions by probability envelopes of error.

The tasks conducted in the Appraisal step will depend on the system being analyzed and on the scope of the simulation problem. In general, they will follow the following guidelines:

Assemble information

- Link together all component models of the cause & effect chain.
- Review results of the social and economic assessments.
- Outline the desired output and plan the scope of its presentation.
- Check and validate all interfaces (model connections) and component linkages.
- Assemble qualitative information in support of the simulations and interpretive descriptions.

Run Simulations

- Test and validate all model linkages
- Run cause & effect simulation with fixed socio-economic parameters
- Review all social and economic appraisals and insert the quantitative results into the system simulation model
- Conduct validation tests and hindcast simulations
- Control prognostic data inputs for forecast simulations
- Control prognostic simulations of the Policy issues using socio-economic controls

Alternatives

• Review and assemble the alternatives relevant to the SSA policy issue, as provided for by Node 4.

• Prepare some further analyses for options to present in the Output Step.

4) Output. The CZ System Output step involves the organization of the information for policy deliberations, scientific publication, and for dissemination the non-science end-user community. The deliverables at the end of each SSA will be in various formats such as: interpretation (qualitative descriptions, dynamic indicators, error and effectiveness critique, recommendations), forecast scenarios with multiple policy options, economic analyses of scenarios, and interactive deliberations conducted with the policy end-users, with stakeholders and with the public. These fall into three general categories as listed below:

Forecast scenarios. Run Simulations of 'what-if' scenarios based on priorities provided in the discussions with Policy makers and established in the Design Step. All scenarios would use uncertainty envelopes to visualize the prognostic error and they would be accompanied by interpretive text. Some of these would be converted to interactive displays for dissemination and deliberations (below).

Science Critique.

• Scientific interpretation of results for critiques of all deliverables.

• Identification of knowledge-gaps and uncertainties that critically impair the reliability of the above outputs.

• Assessment and presentation of alternatives, with additional (optional) simulations

• Recommendations for monitoring and for conducting ‘quasi’ real-time assessments for end-users.

Deliberations. Output of simulation, set in easily communicable format, will be communicated to stakeholders and policy-makers in the forum where initial problem mapping has been discussed. Any further needs will be taken into account by reformatting the output or by running other simulations.

Dissemination. Output will be made accessible to the general public, to CZ management practitioner’s community and to researcher communities through the dissemination channel of SPICOSA (WP 11) and by making it visible from other sources.

b) System Simulation

This section briefly describes some of the major aspects concerning the simulation modelling that accompanies the SAF.

1) Simulation Models. For the systems approach, we need most a ‘model’ that can represent the ‘function’ of a system including its important nonlinearities and changes in dynamics. This requirement places primary importance on the dimension of time, i.e. how does the system behaviour or productivity change in time, i.e. to evaluate the changes in a system subject to time-dependent controlling, or forcing, conditions. Both natural and anthropogenic systems are strongly time dependent, inherently so, because their inputs (e.g. sunlight, social needs, life-cycles) are all strongly time dependent and often importantly spatial. For decision-making processes, the first order questions will have to do with changes in cost or public disapproval as a function of time and important between second order questions will be the distributions of these cost over the policy domain. There are several obvious complications to depicting a complicated system, such as the coastal zone or any part of it, as simply time dependent:

- that the spectrum of time dependency is full (from global sea-level change microbial activity),
- that both the function and composition have a spatial variability (from aquatic to urban productivity), and
- that the interactions between components change with time and space.

These and other characteristics present obstacles to representing a system's function in a simple manner. This, in fact, is exactly the scope of the Systems Approach, which considers the characteristics of complex systems, is the knowledge that they self-organize under the influence of external constraints, i.e. they tend to minimize energy expenditures and conform to cultural constraints, etc. The simplifying tricks of the Systems Approach concern:

- designing simulations with the best possible knowledge of the system, its inputs, and constraints,
- initiating with first-order processes such that their results can be calibrated,
- iterating to higher-order processes, specifying the degree of resolution required.
- specifying how the spatial dimension will be represented, e.g. as in virtual space or more detailed as with a spatial numerical grid,
- unknown inputs and functions can be simulated (by statistical, empirical, etc.) and later replaced with more accurate data

These tricks will serve us to the degree that we want an integrated response and that we can accept some degree of error. These concessions are offset by the possibility that we can continue refine the exercise to the limit of our understanding and information base. With modern advances in commercially available software, we are much less limited by computation than were the researchers of the sixties when system simulations were first attempted. Likewise, the availability today of large supportive data sets and greater knowledge allows us to tackle problems that would have been impossible a generation ago.

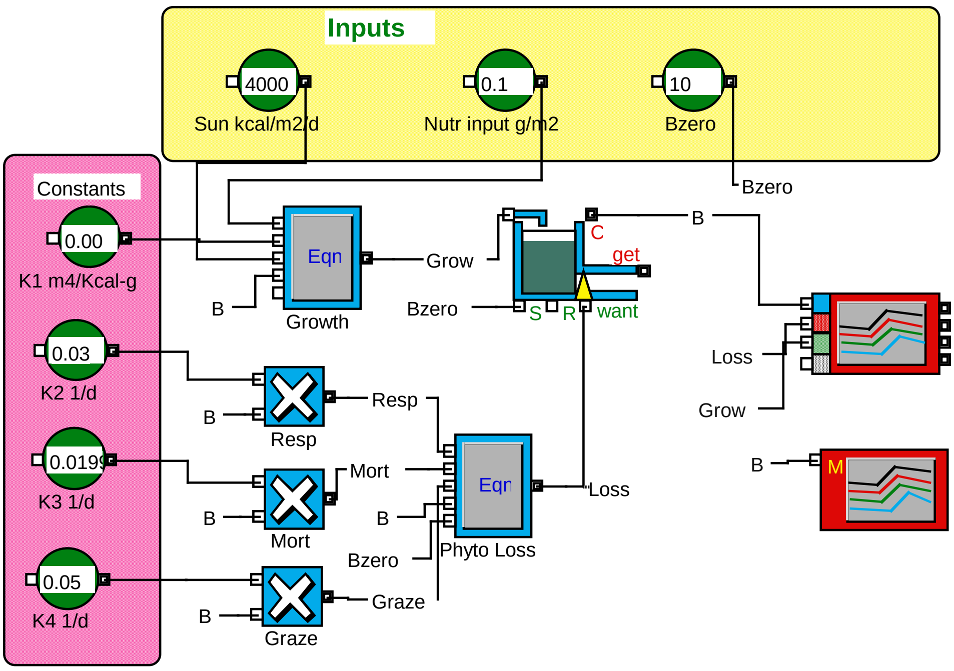
2) Simulation Software. Because of our resource and time constraints and because we want to emphasize an operational time scale, we have preselected EXTEND™ for the simulation software because it best matches our needs. We plan to have training courses for researchers within the Project's 6-mo start-up period. A part from being inexpensive the simulation software has a number of characteristics critical to our needs, a few are listed here (see description at http://www.gtpcc.org/gtpcc/extend6.htm) :

User interface. Extend models are very user friendly, portable and can be cloned, which allows researchers with relatively no modelling experience to read, write, and operate Extend models. This is essential to our objectives that researchers, not software experts, construct the basic model components.

Hierarchical. Very simple representations can be easily expanded or coupled. This allows researchers to email components to each other for use or critic and facilitates the use of a

shared model library. In addition, the user support web site provides access to additional model blocks.
Programmable. The Extend modeller (familiar with ”C” language) can access the built-in, compiled language, “ModL”, to modify or change any operating block. All models and modifications belong to the user.
Tools. The basic software comes with a set of tools for graphics, database system for input and output, data analysis, built-in optimization schemes, animation routines, an internal notebook text and cloned model blocks, hierarchical blocks (specialized clusters of smaller blocks), and connectivity such that inter application communication is a drag and drop operation.

Examples. The following three figures illustrate simple applications of the Extend software to resolve environmental processes or responses.



<u>Fig. 4. Phytoplankton Growth</u>. A very simple process model is illustrated, in which the exponential growth of phytoplankton must crash or come to some longer stability with the processes of death and grazing. Most of the calculation is done in the ‘Equation’ block. This tutorial model is used to demonstrate the sensitivity feature of Extend, in which one parameter is varied (e.g. growth rate) until a stable solution is found relative to the rest of the model.

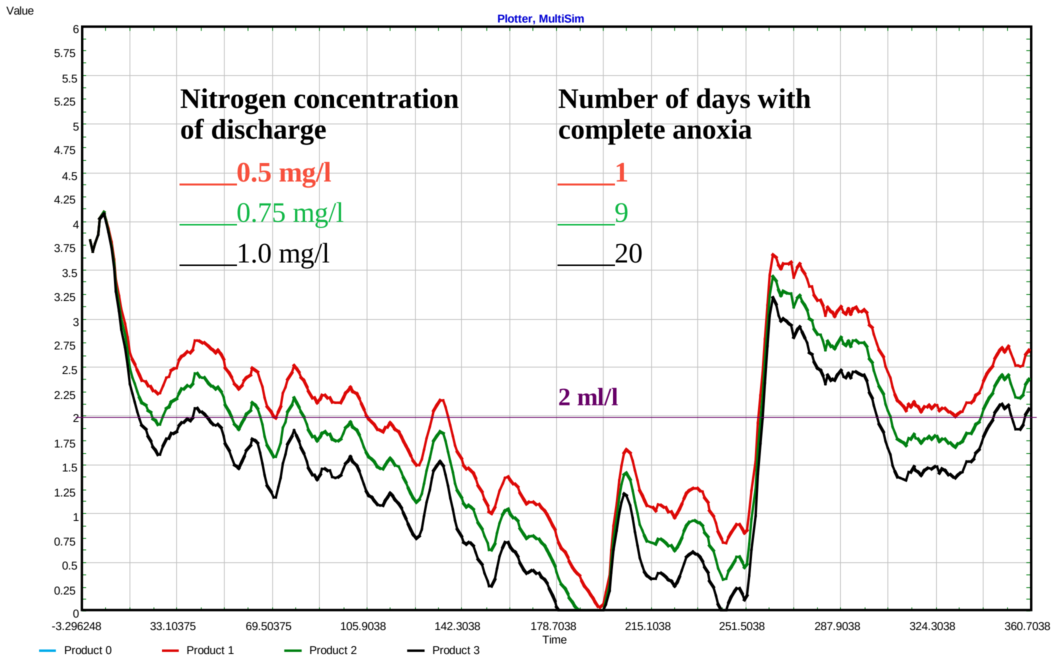


Fig. 5. Estuary Hypoxia. Simulated change in oxygen values in the bottom layer of the Neuse Estuary with reductions in Nitrogen input into the Neuse River for 1996. This plot illustrates the hypoxic sensitivity of the bottom layer of an estuary to changes in the river input of nitrogen. The purpose is to demonstrate that linear reductions in nutrient do not have a linear affect on the impact. This nonlinearity would be more evident with the inclusion of second order processes, like, real bottom topography, variable N, better sedimentation trajectories, etc. were included.

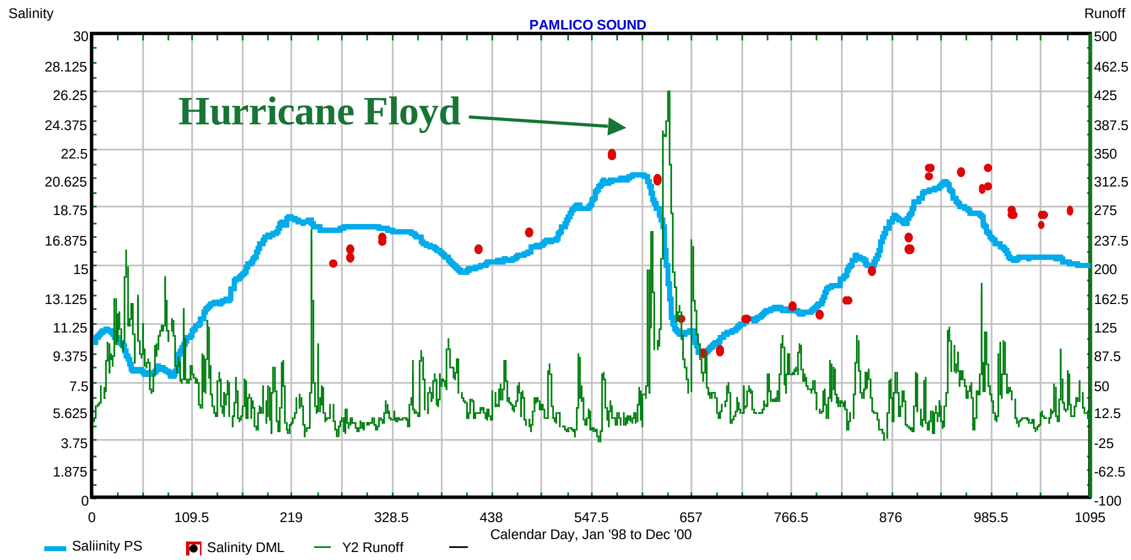


Fig. 6. Lagoon Salinity. A simulation of the salinity in the Pamlico Sound was run for the years 1998 through 2000 with the only input being the observed Atlantic salinities, and the local meteorology. The series was run without adjustments after its initial calibration for mixing and

friction in the inlet. Blue line is the simulated salinity values, the red dots are observed salinities, and he green line the observed runoff. The large runoff peak was due to the flooding caused by Hurricane Floyd. This model is constructed using the non-linear thermohaline method for estuarine exchange (Hopkins, 2001).

c) Spatial Interface.

In its streamlined hierarchical design, the SAF must develop strategies for gradually increasing the dimensional complexity. Initially, the SAF places a higher priority on the capacity for time-dependent simulations, but retains essential that it initiate the development of spatial resolution in the simulations. In practice, decision-makers require information on future-response scenarios for planning, cost-benefit analyses of policy options and etc. In order to supply these scenarios, researchers must be able to estimate change in the system and to identify its trajectory through the system and often its location within the system. Thus, a combination of spatial and temporal dimensions is needed. The SAF strategy is to simulate interactions between functional components of the system while retaining a reference to their spatial extent and location.

In order to specify clearly the work tasks and to expedite the initiation of the Project, we pre-selected the software to be employed for the SAF. This does not mean that future users of the SAF would be bound to the software, because a condition in the selection was that the software be an extendible and user-friendly and not be specific to a particular user or CZ situation. The two softwares selected are 'Extend' for the time-simulation of the Policy Issue and the 'PCRaster' for adding a capacity to compute and visualize on systems variables on spatial grid at a GIS scale. Both of these have several characteristics essential to the SAF:

- They are user friendly and allow a non-modeller to design a model solution for their specific problem
- They are flexible and capable of handling and including large amounts of data in differing formats and/or of embedding data into the source software.
- They both have script language amenable to coupling with other computational software,

While this complementariness will enrich our capacity to provide valuable output, we could greatly increase this value and utility to the SAF by constructing an interface between them that would allow them to be run simultaneously. Applications of the use of this capacity would be, for example: the need to introduce spatial variability in the meteorological input, as atmospheric deposition: the need to track spatial integrations of a systems variable, as the extent of bottom pollutants; the need to visualize different land-use scenarios, as comparisons of surface runoff distributions or urban expansions; or the effects of habitat destruction or damage, as with flooding.

6.1.3 The social and economic and the science-policy interface for ICZM

The integration of social and economic dimensions into Coastal System assessment calls for some elements of definition. Different views of system are proposed. An "extended" view of ecosystems claims that human is part of nature as any other species and should thus be looked at as a component in natural interdependencies building up on energy and information exchange. The social dimension of human societies would be of similar interest to the social organisation of bees or aunts. At the opposite and "extended" view of socio-systems argues that nature is not much more than a set of "social constructs" and nature is to be understood as the outcome of built-up cultural preferences and economic opportunities. The standpoint in SPICOSA is that research on sustainability is about co-evolution of human societies with their bio-physical environment, humans having a unique position in terms of capacity to influence this co-evolution but controllability of this influence being both challenged by increasing complexity of interactions and subject of societal choice.

Though the frontier between bio-physical and social sub-systems may seem relatively easily to grasp, the boundary set between social and economic dimensions may need some clarification. The division is partly arbitrary, because of the obviously intricate nature of the two dimensions, but can be defined by considering how operational is the outcome (i.e. how it serves the objectives of integrated assessment) and from the state of the art in social science research (research objects and present state of integration between different areas of research). The following provides a reference framework to define the main entries to investigate the social dimension (a) and the economic dimension (b). But research on ICZM is not only investigating the structures and dynamics of coastal systems, it is also questioning the place of scientific knowledge and scientific actors into the process of promoting and implementing ICZM processes. Therefore it is important that the nature of deliberation in the social arenas of public debate (consultation) or decision-making be also debated so that the objective of interfacing science and policy can be better implemented. Major conceptual items are presented in section (c).

a) Social Dimension in System Assessments

The "social dimension" of sustainability-performance assessment is a matter of some methodological diversity. "Fairness" or "justice" in the distribution of opportunities, benefits, costs and risks between stakeholder communities and within each community of interest is an important feature of the social domain. We can also "isolate" the social dimension of an integrated evaluation problem by the application of an "ethical appropriateness" test. The character of this test is epitomised by expressions such as *"save the whales"* or *"you don't sell your own grandmother"* — examples highlighting that there is something other than a purely economic/utilitarian motive for systems integrity, whether in the environmental or the social domain. Based on such "tests", evaluation of the biophysical environment may attempt to quantify opportunity costs (in the ECONOMIC SPHERE) with due consideration of the limits of what is acceptable in terms of social preferences or values (in the SOCIAL SPHERE). In the case of complex natural capital, such monetary evaluation often takes the format of a cost-effectiveness analysis rather than a monetary cost-benefit evaluation. It provides estimates in monetary terms of changes (costs or benefits) in the economic sphere, set against changes specified in non-monetary terms relative to system maintenance criteria (e.g. thresholds) relevant for the social and environmental spheres.

The notion of an "ethical appropriateness" test as an entry point into the social dimension of assessment highlights the importance of three key fields of analysis for this aspect of SPICOSA's programme: the ***perceptions*** among the public and the stakeholders, the ***juridical framework*** applying to the policy issue, and the ***governance structure*** for policy design and implementation.

Attention to perceptions is of critical importance in order to understand reasons for stakeholders' stances for or against options and, particularly, what determines the limits of "acceptability" in a policy field. On a more 'objective' plane, the juridical framework and the governance structure are widely noted as the key dimensions of institutional analysis for social impact assessments (Ostrom, 2003; Ostrom, 2005).

Therefore, a variety of sociological, political sciences, anthropological, and legal perspectives will be applied to produce a cross-view of these three dimensions in relation to the CZM policies. The time changes in the perceptions and the evolution of the institutional framework must be given much importance to place these assessments in a dynamic perspective (cf. North, 1990). The output of these assessments will be comprised of quantitative data sets, such as survey statistical analysis, and qualitative information. Methodological frameworks for social and institutional assessment developed under international initiatives such as the work on ICM indicators by the Intergovernmental Oceanographic Commission of UNESCO (IOC Manuals and Guides n°45), the EU state of the coast initiative run by the European Topic Centre for Terrestrial Environment (http://terrestrial.eionet.eu.int) or, in other areas like water or forestry (International Forestry Resources and Institutions - http://www.indiana.edu/~ifri) will be used as benchmarking references for further methodological development and empirical applications. More sources that are general, like the publications of the Directorate for public governance and territorial development (http://www.oecd.org), will also be reviewed.

The three facets of social assessment are briefly described in the following subsections. In addition, gender issues will be addressed as a transversal issue.

1) Public and Stakeholders Perceptions. SPICOSA will conduct scoping studies that employ discourse and institutional analyses to assess the awareness and attitudes of people towards specified policy issue(s) as well as the progress of policy in resolving the problems concerning natural resource degradation. We illustrate this, for example, with two questions that have arisen from the EUROSION study. *How aware are people of certain problems and of their possible solutions*? The study showed that people in many places do not oppose hard engineering solutions, are not aware of more sustainable alternative solutions, and have a very low awareness that coastal erosion is a problem at all or that it is induced by human activities. The same applies to many coastal policy makers. Similarly, *how do people perceive the interests of various groups, their attitudes as well as the progress of the policy process?* The responses to these questions should provide a better understanding of social roots for the support of or opposition to new policies. Beach users of a Catalan beach are opposed to the replacement of breakwaters and groins by softer erosion control techniques because the present structure divides the beach into smaller separated beaches that are used by distinct groups of society, i.e., people don't want to give up this separation although from an esthetical point of view the beach would be more beautiful without these structures. The analysis of perceptions will also include the appraisal of conflict resolution strategies, public information strategies, public participation procedures, and procedures/structures to promote collaboration of scientific institutions and public administration. Both qualitative and quantitative data fields will be investigated.

2) Juridical Framework. The regulation of access to coastal resources, space, and ecosystems may relate to any and every area of law. In a few cases, such as for land planning or environment, specific laws have been developed for the coastal zone management. The “littoral law” in France is one example. In other cases, the coastal zone is mentioned as one area of application of the law (i.e. Water Framework Directive). However, for many aspects, laws that are more general apply. The practice of coastal zone management always raises many juridical aspects. One major challenge of ICZM is the compatibility or incompatibility of different regulations when addressing multiple resources or multi-uses situations. Another major challenge is in the evolution of the law to incorporate the guiding principals and constraints arising from the “precautionary” or “ecosystem” approaches. Both of these are integrated into the SAF, and as such, they serve to insure that future trends in ecosystem damage are an integral part of SAF Portfolio. This essential aspect promotes long-term conservation of the CZ ecosystem health and guarantees a more complete accounting of the ecosystem functional and dynamic complexity. Additionally important in these considerations are the number of important social and juridical implications that necessarily arise concurrently with damage to the ecosystem function. For example, one implication might be a greatly extended jurisdictional impact associated with the environmental damage and thus a change in the range of actors standing to take legal action in relation to such damage. The application of the ‘ecosystems approach’ has had profound significance at the interface between the pollution of watercourses and that of marine waters, over 80 per cent of which is attributable to land-based sources through watercourses. It may mean, for example, that a party responsible for pollution of a river would also be responsible for the ensuing coastal and marine pollution. The water framework directive, as well as many other pieces of regulation in the EU, tends to extend to scope of responsibility. This evolution of juridical principles and their translation into the regulation has major implications for the future of CZM policies. Therefore, the assessment of the juridical framework should not only aim at assessing the regulations associated with existing policy issues within coastal zones but should also consider the origins and consequences of the main trends for change in the juridical framework.

This evolutionary approach to the law should also consider the question of juridical sourcing. The number of entities that are entitled to produce regulations or that are responsible for their enforcement or monitoring tend to increase. Different models of authority transfer, i.e. State from EU level, devolution or decentralization are tested in Europe either specific to policies or to countries. Beyond the constitutional law produced by the States, the “soft law” produced under the umbrella of international organizations, there is also a source of operational regulation under the responsibility of trade organizations or user-group forums. This complexity of juridical sourcing should be explored, and the diversity of models found in Europe assessed, in relation with the analysis of the governance structure. This part of the work will define the structure for such assessment based on the following:

1. Ascertain the juridical competences of the coastal state as well as the extent of transfer to supra-national authorities (EU) or devolution to lower levels. The coastal zone is not an entity defined by the law. From the international law point of view, depending of the distance from the coast, the coastal waters may be under different regimes.
2. Determine the juridical conditions of the elements (land, water, fish, etc.) contained in the coastal space under sovereignty. This will determine the status of each element (private property, public property, res nullius, res communis) and the generic regulation mode applicable.
3. Assess in detail the set of regulations derived from these standards and translating the policies applied in the coastal zones. This assessment will consider the major elements of

evolution in the juridical basis of regulation and their determinants.

3) Governance Structure. This part of the social assessment will study the features of the institutional components of the social stage of ICZM. These will include the different property-rights arrangements, the "access rules in use", the organisations and functional structure of the decision-making process and the various monitoring and sanction systems for use of the coastal resources. It will aim at assessing the institutional effectiveness of these in the light of different policy alternatives.

Social institutions strongly influence the governance of coastal systems in two major ways: Institutions effectively determine the public awareness about, and influence the policy alternatives enacted, regarding coastal systems. The other is that institutions form the base for future collective choices regarding the type of "goods" and "bads" produced by the coastal systems (Agrawal, 2005). The following questions illustrate some of these choices:

- Can coastal systems provide public goods that are openly accessible and that, due to their character, are unlikely to be overused?
- Can coastal systems provide common goods, the use of which is not easy to restrict from the public, and which due to their character are in danger of being overused?
- Can coastal systems be closed (privatized) and therefore unlikely to be overused, but which, due to their exclusion, will have its social consequences.

From an integrated assessment perspective, i.e. considering a coastal system as a complex social-ecological-economic co-evolution) existing institutions are often identifiable as primary causes of environmental degradation (cf. Luhman, 1989). Perceived, or anticipated changes, can initiate the process of institutional change, whether it involves stakeholders or governmental organizations. However, attempts to change existing institutions often provoke entrenched interests in the coastal zone, by those who formed organisations that benefit from the existing institutions. The 'ecosystem' facet of the social-ecological-economic system may then fall victim to the inability of the social actors to undertake necessary governance changes in time to prevent continued degradation. Institutional rigidity is therefore a prime cause for ecosystem vulnerability to degradation in the coastal zone; while an institutional flexibility, which is responsive to ecosystem damage, tends to promote healthier and more robust coastal systems (cf. Fig. 1).

Institutional analysis will evaluate the positioning of major organisations relative to ecosystem processes in the coastal systems, and hence their role in controlling the implementation (or not) of alternative policies. The understanding of the drivers for institutional change over a relevant period of time will also be studied.

4) Gender Analysis. Gender analysis will be conducted as a transversal issue linked to the three dimensions of the social assessment. Adopted strategies for ICZM have been imbedded by the lack of equity for certain segments of the population, including categories of women or even 'women' as a category. Management practitioners have sometimes looked the communities as simple "black boxes" with homogenous people without made difference between men and women, young and old, etc. The use of a "gender lens" can provide coastal managers better information about how men and women access and use the resources differently, who has the power and makes decisions, whose priorities are being addressed and who is impacted by, or benefiting from different policies concerning coastal management. This type of gender lens can be generalised to highlight the spectrum of different memberships, communities and stakeholders that needs to be brought into play in multi-stakeholder deliberation processes.

b) Economic Dimension of CZ Sustainability

In line with our SAF, ICZM should be viewed as a continuous and adaptive process, which consists of a set of tasks, typically carried out by several or many public and private entities. The tasks together produce a mix of products, services and livelihoods from the available coastal resources. ICZM involves a continuous interaction between and among social and ecological sub-systems, as they "coevolved" over time. The management process must therefore be dynamic and adaptive in order to cope with the changing circumstances, changing social tastes, increased knowledge of the behaviour of coastal processes and of human behaviour and "value" of coastal ecosystems. Other economically relevant components of the "environmental change" process will include changing income and wealth distributions and their impacts, changing technology, changing factor prices, and changing governmental policies.

Because the resources of a coastal zone can generate a range of different products and services, not all of which are naturally compatible and most are scarce, conflicts are likely and trade-offs are necessary. This situation is exacerbated by the variety of different stakeholders that are usually present in any given coastal zone. For example, the creation of a Marine Protected Area may be motivated by ecosystem preservation, fisheries management or the development of recreational activities (Polunin *et al.* 2000; Boncoeur *et al.* 2001). Equally, interest groups involved with resource extraction may oppose this zoning policy. Adding to the complexity are the policies, like water quality improvement, coastal defence and stabilisation, or biodiversity conservation/enhancement that will not only impinge on multiple stakeholders but can themselves be enabled through a whole range to technical and institutional options with different impact profiles. Moreover, the coastal resource base is now under severe pressure from the sheer "scale" of the resource demands to which it is exposed. CZ ecosystems have become increasingly "vulnerable" to the stresses imposed by economic/socio-cultural changes (e.g. urbanisation, tourism, and waste disposal, etc.) and in addition to changes wrought by climate, other geophysical factors, and population growth. These stress accumulations can result in changes in the "entropic state" of the coastal environment and, thus, require corrective action, for which the human response options are evaluated in a consistent and systematic fashion (EUROCAT project final report).

The objective of ICZM is to produce over a time a "socially desirable" mix of CZ products, services etc. This mix is likely to change over time with changing demands, knowledge and pressures. Fulfilment of this objective will require, among other things, an economic assessment of the policies involved, focused on the effective, efficient and equitable provision of the social mix of coastal outcomes (Squires and van der Tak, 1985). From an economic perspective, analysis should be based on the economic efficiency criterion and cost-benefit evaluation method. The primary objective would be to assess the global, net additional wealth occurring to society. However, the basic economic method can be tempered by any relevant equity considerations, i.e., how will the gains (benefits) and losses (costs) be shared across social groups, and what type of compensatory measures might be instituted to mitigate loss impacts. It can also be tempered by other precautionary environmental (e.g., ambient quality) standards and regional economic constraints.

In the standard Cost Benefit Analysis (CBA), the traditional criterion is to maximise the net economic (efficiency) benefits (Pearce and Turner, 1990; Hanley and Spash, 1993). Simplifying, the method has four basic stages:

1. Mapping of all relevant stakeholders (i.e. individuals, groups and agencies affected directly or indirectly);
2. For each stakeholder, valuing (in monetary terms) the market and non market costs and benefits related to the project/policy and computing the resulting balance;
3. Aggregating these balances over a specified time horizon in order to calculate the so-called net present value of the global surplus of the project, policy etc. Accounting for the effect of the passage of time on costs and benefits ("discounting") is a hotly debated issue and one which will be subjected to sensitivity analysis;
4. Analysing the results of sensitivity analysis for changing scenarios (with reference to a status quo baseline scenario), which includes multiple discount rates and other parameter variations.

The maximum net economic benefits criterion is often too narrow in situations where not all resource values can be translated into monetary terms and when criteria other than economic efficiency are deemed important by the relevant decision-makers. Operational trade-off relationships can nevertheless be developed by imposing constraints (e.g., ambient environmental quality, regional employment/income targets, conservation of designated nature reserves, etc.) on net benefit estimation (Bower and Turner, 1998).

In many coastal areas, maintenance or expansion of a regional economy is a major objective. Adverse effects on coastal economies (e.g. losses of tax revenues, tourist expenditures, employment) can occur because of degraded water and/or beach quality or loss of or damage to unique features. Thus, beach replenishment programmes are typically justified based on the need to maintain local economies dependent on tourism. In the context of regional or area economic development, the objective of ICZM can be expressed as follows:

Maximize the present value of:

$GRP - C_p - C_{cm} – D + B - C_a$

where

GRP = gross regional product

C_p = normal production costs

C_{cm} = net coastal management costs

D = remaining damages

B = benefits from improved environmental quality; and

C_a = administration costs of ICZM.

A number of problems may arise when implementing CBA within ICZM. An initial management problem involves making choices between the possible sets of outputs of goods and services that can be produced, e.g., marine transport, waste disposal, fisheries yield, recreation, amenity, preservation of unique coastal ecosystems, etc. Secondly, because of the dynamic and "open-system" nature of coastal zones, analysis must consider at least three areas (multiple foci for

ICZM) for which the boundaries rarely coincide. These are: the politically designated management area; the ecological areas, ecosystems or catchment areas; and the demand areas. The latter are those areas from which demands are exerted on the resources of the designated coastal area. There may be demands from within and outside the designated management area; demands from outside the catchment area and internationally determined demands, e.g., recreation visits to unique marine/coastal areas, global shipment of oil and gas, etc. In analysis, explicit consideration must be given to cross-boundary flows in and out, upwind and downwind. Techniques such as regional input-output models, chain analysis and economic multiplier models can serve a useful role in this context but data requirements are formidable (Gaudement and Walliser, 1983; Chervel and Le Gall, 1981; Bénard, 1985). A third generic problem is the meaningful translation of all costs and benefits into monetary “market” values, that has been addressed above in the social assessment perspective and will be address further in a later section.
Given multiple problems and limited resources ICZM has to establish priorities, based on the following criteria (not an exhaustive list):

1. benefits in relation to costs, i.e., cost-effectiveness,
2. distribution of benefits and costs, i.e., who gains who pays,
3. political/cultural concern for some segment of the population, e.g., artesian fishers or cultural assets base,
4. physical, chemical, biological effects on “critical” ecosystem functions,
5. effects on institutional/administrative structure,
6. feasibility of financing,
7. time to first returns, and
8. accuracy of cost-benefit estimates, i.e. how likely are they to be achieved.

The significance of these criteria and their relative importance vary from area to area and over time. The time dimension is crucial to economic valuation. The costs and benefits that the project generates at various time periods can be compared in present value terms through the discounting technique. The choice of a discount rate, i.e., how much less weight is put on longer-term costs and benefits compared to the current position is a controversial but significant issue. The conventional approach of a fixed constant discount rate (related to capital and government bond markets, “opportunity cost of capital”) has been challenged by arguments in favour of lower rates (e.g. social time preference rate) and time declining rates (hyperbolic discounting and other variants) sensitivity analysis will be used to test the results of different discounting producers and project/policy time horizons (cf. ELOISE project final report and website).

The benefits of ICZM can be most readily discerned if they are related to baseline conditions in the coastal zone i.e. coastal area A at time T_0. The condition of the coastal resources at T_0 reflects the effect of various human activities and of natural events over past time to T_0. ICZM benefits are achieved by: reducing damages from storms, sedimentation, pollution and over-exploitation of fish species and wetland restoration etc. (mitigation benefits); enhancing coastal zone outputs, including resource conflict resolution (enhancement benefits); and preserving unique ecosystems (preservation benefits). Two types of benefits are involved:

- use values, which refer to the utility from direct consumption of the good,
- non-use values that are generally classified into existence, option, and bequest.

In particular, existence is due to the utility an individual derives from the awareness that a good exists, even though the individual does not use it and will not do so in the future. Option-value derives from the possibility to use the good in the future, as individuals cannot forecast their future preferences. Finally, bequest value is about the utility from preserving the good for future generations (Freeman, 2003). All together, they form the so-called Total Economic Value (TEV) of environmental assets (Pearce and Turner, 1990). In some cases, e.g. where the productivity natural system has be degraded, the costs of system restoration are included in the TEV. Environmental economists employ different valuation techniques to estimate the monetary values of non-market components of the TEV. The more prominent methods are summarized in the following paragraphs.

1) Contingent Valuation (CV). The CV method is a well-established technique used to assign a monetary value to non-market goods and services, such as environmental resources (Mitchell and Carson, 1989). CV is a survey-based technique, in that it asks individuals to report their willingness to pay (WTP) for a specified improvement in environmental quality. WTP is defined as the amount of money that can be taken away from a person's income at the higher level of environmental quality to keep his utility constant. It is, therefore, the theoretically correct measure of the welfare change – and hence the benefits – associated with the change in environmental quality.

2) Choice Experiments (CE). This second method is based on the stated preferences technique widely used to assign monetary values to environmental goods and services. In a choice experiment-based survey, respondents are asked to choose between hypothetical public programmes or commodities described by a set of attributes (see Hanley et al., 2001). Respondents trade off the attributes of the programmes or goods, one of which is usually its cost to the respondent, allowing researchers to infer the willingness to pay for public goods or programmes and implicit marginal value of each attribute.

3) Travel Cost Model (TCM). This is a survey-based technique used to study the demand for the services of a recreational site. The essence of the model stems from the need to travel to a site to enjoy its services. The travel cost to reach a recreational site gives an estimate of users' WTP for the access to the recreational site. The model assesses the value of recreational activities and measures the benefits of pollution control and other public programme in policies that influence the quality of sites.

4) Hedonic Price (HP*)*. This method uses equations, and it is used widely used in the context of atmospheric pollution. The method looks at how environmental variables, such as clean air, affect residential property values. The model assumes that, other things being equal, a positive relationship exists between the prices that people are willing to pay for housing and the quality of the environment. Therefore, the analysis of residential property prices enables researchers to impute a value for a change in environmental characteristics of interest to researchers.

5) Value Transfer (VT). This method can be used when the four above described techniques cannot. That is, when data are often scarce about economic values of non-market goods, it necessary to generalise results from earlier valuation studies and thus conduct a "value transfer". A hot topic is to find out robust procedures for doing such value transfers that might be important to consider in coastal zone cases. Benefit transfer is defined as the adaptation and use of existing economic information derived to specific site under certain resource and policy conditions to new contexts or sites with similar resources and conditions. Brower (1998, 2000) defines as a technique where the results of monetary (environmental or health) valuation studies, estimated through market based or non-market based economic valuation techniques, are applied to a new policy context. When the relevant economic values and the required resources are not available, for developing new environmental valuation studies, then economic measures estimated in similar contexts and sites can provide a proxy for the estimates necessary for the decision-making (Navrud, 2004).

Another category of benefits, indirect economic benefits, is comprised of benefits stemming from "second round" effects of measures applied to produce benefits in the first two categories (mitigation and enhancement) and in the "use" category of preservation benefits. The context for the analysis and estimation is the regional economy (and/or the national economy), as the direct economic benefits result in additional economic activities in the region/nation.

SPICOSA-IP will review the methodologies to assess cost and benefits of market activities as well as to represent the interconnection through market chains. It will review the alternatives for economic data collection. Collecting economic information on market activities is generally done from secondary sources such as European, national or local statistical office. A common limitation is the inadequacy of existing data with the economic or geographical boundaries of the policy scenarios. In this case, complementary primary data collection may be needed as well as information reorganisation to take into account differences in boundaries of economic and ecological systems.

Methodological development is awaited in major areas such as economic measurement of tourist activities, which presently represents an important bottleneck in the study of coastal economies. Another one is the exploration of the complexity of interrelation among economic activities when water-quality issues are considered at the watershed scale, including coastal waters. High demand for recreational services both of ecological and cultural nature is typical of coastal zones leading to problems like congestion, overuse of resources, and degradation of ecosystems. Dealing with environmental issues in areas under strong anthropogenic pressure, makes the economic assessment of non-market goods and services a major challenge for a complete social accounting of public policies.

To progressively integrate all these dimensions of economic analysis the input-output (I-O) matrix approach is retained as the starting point. With the perspective of being policy relevant and problem oriented, the methodology proposed to integrate the economic dimension into SAF modelling is based on building ad-hoc input-ouput matrix at the scale of the economic and ecological interactions to be considered. The purpose of such matrix is to provide a tool to explore downstream effects of changes in ecosystems or in rules of access to ecosystems through linkages between physical and monetary dimensions. The input-ouput approach is an old concept in economy. There are few challenges in applying it for the specific purpose of ICZM. They are :

- the need to produce an input-ouput framework different for almost each problem that involves a specific set of activities (market based and non market based), components of the ecosystem and

rules or policies. Applying the SAF implies that an ad-hoc simple input-output matrix is first build to explore first order interactions. Then, following the opportunity of integrating different problems or different scales, more complex structure can be built.
- data from economic statistical offices are generally available according to administrative boundaries that do not necessarily match with ecological boundaries. The geo-referencing of economic data at the lowest possible scale will provide the flexibility requested to work on different policy issues.
- a common problem to input-output approach is the pertinence of static technical coefficients to measure the linkages across sectors. Technical options to introduce change over time in these coefficients or thresholds will be given particular attention.
- typical economic information include data on turnover, added-value distribution and employment for market sectors. The relevance of different ways to infer such data in place where they are not directly available will be given particular attention.
- the introduction of the non-market uses into input-output matrix is also a major challenge in the area of environmental economics. The possibility to introduce monetary evaluations of non-market values will be explored. It is expected that such type of information is very scarce in SPICOSA SSAs. As the production of new primary data is not within the scope of the IP, this will take the form of guidelines and frameworks for implementation in other contexts. The road of physical satellite accounting, as a way towards “green accounting”, will also be explored. This approach fits well with the objective of coupling economic and ecological modelling.
- the interpretation of simulations based on input-output matrix can easily be misleading. Therefore particular attention will be payed to define the core information that should be awaited from this tool for the purpose of scenario based participatory forecasting.

c) Governance and Deliberation with Scientific Knowledge

Recent years have been marked by calls for “science-based policy”. There are also increased calls for the better integration of “stakeholder perspectives” in public policy, and in the performance obligations placed on the business community. In the face of complexity and requirements for collective action, a pragmatic evaluation approach would be to frame the problem of ‘social choice’ as a multi-stakeholder deliberation about the merits and demerits of policy alternatives that present themselves to the society. We propose that a participatory approach for mapping and evaluation of policy options are developed and that a set of dedicated multi-media, deliberation tools be developed based on existing methodology applicable to ICZM. This sub-section identifies some of the key, and innovative features of the SPICOSA approach to development of integrative evaluation procedures and tools to interface science and policy. The first specifies conventions to make distinctions between the “economic” and “social” spheres and between the “economic” and “environmental” spheres for the purpose of analysing tensions for achieving desirable outcomes across all three spheres.

1) The Monetisation Frontier. O’Connor and Steurer (1999) have introduced the concept of a ***Monetisation Frontier*** which signals thresholds or limits beyond which assessing choices, or the consequences of choices, in terms of financial trade-offs is *either* scientifically very difficult (uncertainties, complexities, nonlinearities, etc., relating to the environmental sphere), *or* morally inappropriate (relating to the social sphere, or to the non-human living sphere, *or both).* This gives as a demarcation line separating phenomena attributed to the economic sphere from phenomena that attributed to the environmental and social spheres (Fig. 7). Physical system complexity and ethical appropriateness are taken as the main component to illustrate the relative position of the three spheres: nonlinearities, etc., relating to the environmental sphere), *or* morally inappropriate (relating to the social sphere, or to the non-human living sphere, *or both).* This gives as a demarcation line separating phenomena attributed to the economic sphere from phenomena that attributed to the environmental and social spheres (Fig. 7). Physical system complexity and ethical appropriateness are taken as the main component to illustrate the relative position of the three spheres.

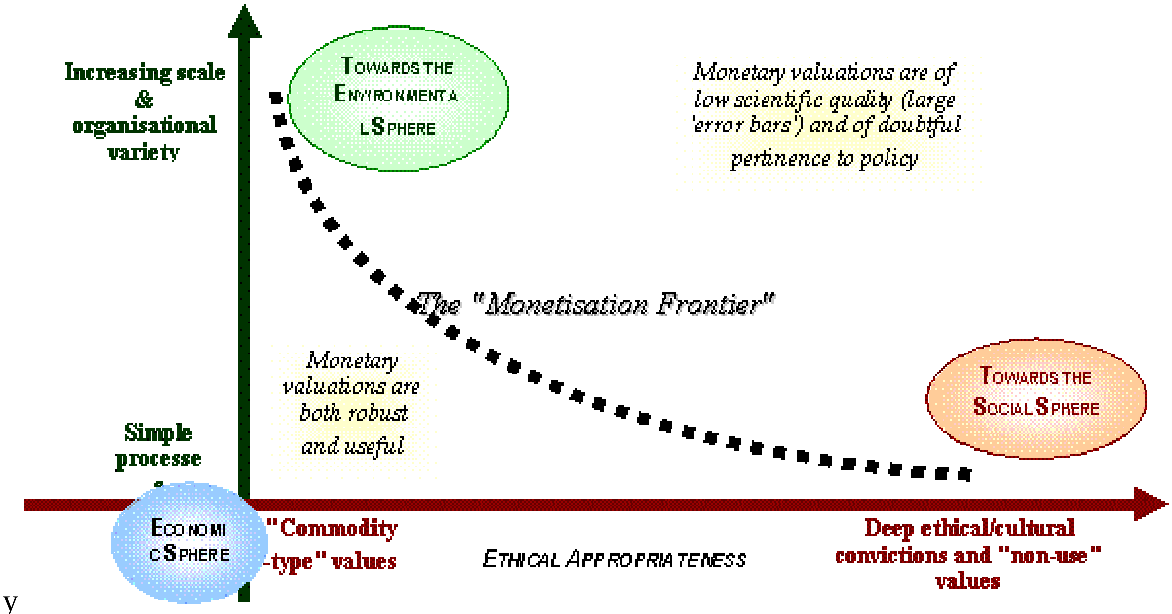


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Fig. 7 "The Monetisation Frontier and the three spheres"

Since there is no meaningful way of aggregating the grand diversity of natural resources, environmental services and ecosystems (see Victor, 1991, Victor, et al. 1997), an operational approach to sustainability is obtained through the identification of categories of 'critical natural capital' whose stocks ought to be maintained at or above identified minimum levels. This builds on several decades of work on environmental standards and on the maintenance of environmental functions (cf. Ciriacy-Wantrup 1952, Bishop 1978, Hueting 1980, Brouwer et al. 1999). Once targets are set, the cost-effectiveness methodology expounded by Baumol and Oates (1971) or at macroeconomic scales in the GREENSTAMP project (Brouwer et al., 1997, 1999) can be applied.

This highlights an ***Iterative Process,*** where environmental policy is formulated by, on the one hand, scientific and political work to determine environmental standards or norms (for example, for pollution emissions or natural resource consumption; and, on the other hand, analyses of the least-economic–cost way of achieving the defined norm. This gives an operational meaning to the notion of *"economic costs for respecting the integrity of the environment"* on the interface of the Economic and Environmental spheres (Brouwer et al. 1997, 1998). In effect, the analysis "at the frontier" organises systematically the relation between evaluation of costs and benefits with reference to the economic sphere (monetary evaluation) and the "social demand" for sustainability expressed as principles of respect for environmental and social/cultural values. Analysis identifies, on one side of the Monetisation Frontier, resources and assets that are valued within the conventional logic of the ECONOMIC SPHERE, that is, from the point of view of their potential conversion into commercially priced goods and services (trees into wood products, for example); and, on the other side, assets that are valued from the point of view of their permanent roles in the BIO/NATURAL SPHERE as *in-situ* services as sites, scenery, scientific interest and ecological life-support in complement to economic sphere activity.

2) Sustainability and the Social Dimension. Social and environmental dimensions of evaluation analysis and policy are always interlinked, because there are always asymmetries of need and of access to environmental benefits (and of exposure to harms or risks) between different classes of stakeholders. This is certainly the case for all significant ICZM challenges. The specifically "SOCIAL" dimension of analysis is developed, as already mentioned, by applying ethical appropriateness considerations (as signalled along the horizontal axis in Fig. 7).

Sustainability-related social assessments must address considerations of justice and equity at two levels. The primary level is the articulation of the obligations of respect for the stakeholders or collective identities or communities given standing in the ethical-governance framework adopted in the society, in other words, the identification of the classes of community meriting respect and the specification of the forms or norms for expression of that respect. The second level concerns the distribution of access to costs and benefits (viz., fairness or unfairness in the distribution of opportunities and risks, etc.) within each broad class.

There are three main classes of community: i.e., the present generations, the future generations (of human society) and the communities (present and future) of the non-human world, which when taken together, are the fundamental stakeholders in sustainability. The two most fundamental frontiers of community are thus signified as 'human society', 'the rest of nature', and the 'present and future generations'. Within each major stakeholder class and at chosen spatial scales of analysis, there can be an indefinite variety of sub-categories, according to circumstance, some of which will be poorer, or more vulnerable than others categories.

This is why a stakeholder mapping (obtained via institutional and discourse analysis methods that include participatory processes and Information and Communication Technology based support tools) is a necessary reference point for any ICZM analysis. Thereafter, qualitative considerations such as non-violence and poverty alleviation can provide benchmarks for respect of specific classes of community or sectors within any given community. Indicators may be selected that signal when a community (human or non human) is in danger and the directions to move away from danger (viz., reduce the community's vulnerability).

3) Society's Reasons and Choices: A Deliberative Approach. The underlying policy problem for sustainable development is thus, "*sustainability of what and for whom?"* It has become commonplace to seek out indicators for judging societal progress relative to specified goals. In this general framing, technologies, investments and policies should be evaluated against sustainability criteria. As shown in a broad spectrum of empirical and conceptual analyses, aggregate index such as total income, total energy flow or monetary valuation of total environmental benefits, abstracts away from the various dilemmas associated with a reconciliation between the various interests and forms of life that are currently in conflict with each other or at risk. The process of imposing 'monetary or energetic commensurability' can result, unless care is taken, in a loss of transparency and loss of information about the properties of the systems and the full spectrum of relevant societal concerns. In the face of complexity and requirements for collective action, a pragmatic evaluation approach would be to frame the problem of 'social choice' as a multi-stakeholder deliberation about the merits and demerits of policy alternatives that present themselves to the society (Habermas, 1984; O'Connor, 2002).

For SPICOSA, we propose that comparison of policy options can be developed both as a direct interactive/iterative process between scientist and other stakeholders but also as a deliberation process assisted by multi-media technologies. This is the backdrop to our proposed approach to scenario development for ICZM policy preparation in the context of the EU-wide Sustainable Development strategy. The objective is the development of methodologies and application of tools for sustainability scenario building and appraisal. Scenarios are interfaces between 'system science' and 'social significance' as illustrated by Fig. 8. This places the work in the integrated environmental analysis and "social foresight" perspective (Faucheux et al., 2002). Typically, such tools are wanted for forecasting *("What will be the future state the environmental assuming certain environmental, social or economic trend?"),* or for simulation *("In which direction and with which magnitude will this outcome differ from the business as usual outcome assuming certain shifts in policy?"),* and for hindcasting ("*What do we need to do to achieve a certain vision?"*). In the European context, it is required that the approach should be robust and scientifically sound and that it should go beyond classical bio-economic or ecological-economic modelling. In addition, it should combine quantitative and qualitative elements and multidisciplinary analysis using results and methods from economics, social and natural sciences (O'Connor et al., 2006).

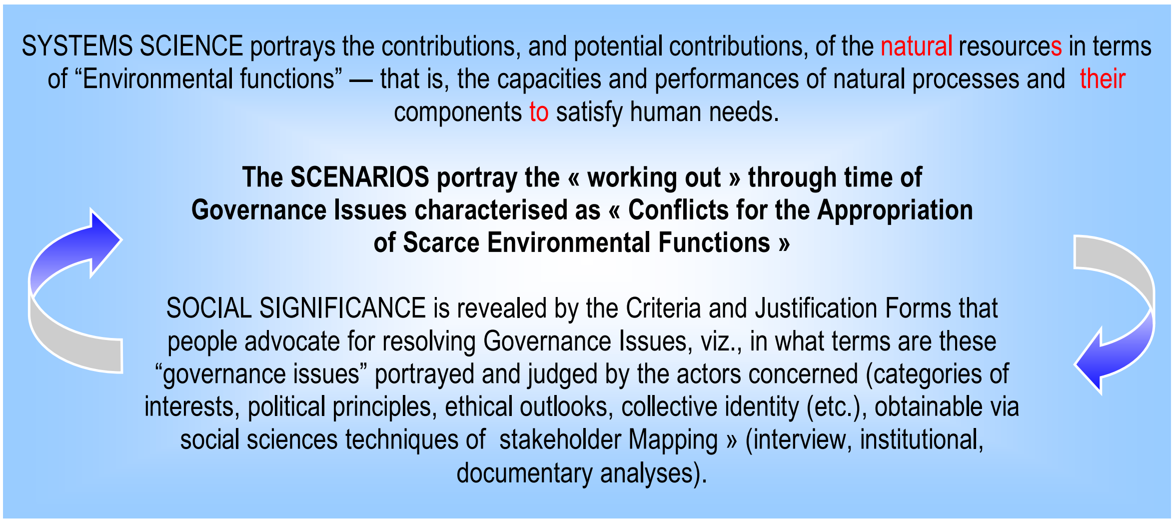

Fig. 8 "Scenarios as 'Interface' representations"

Our focus in SPICOSA thus is on tools and procedures (Node 1) that can enhance the effectiveness of scientific work as supports for participatory resource governance processes. In most cases, communication between sciences and policy is made through direct communication. There are few major models by which communicative *mediation* role between scientific knowledge and other sources of knowledge in the policy arena is ensured. A very common one is the expert consultation. Another one uses the services of professionals dedicated to environmental knowledge mediation. However, it often happens that the scientist themselves are placed in the position not only to voice as experts but also to act as mediators. This is an experience shared by many scientists working on coastal issues. In more and more cases, multi-media interface tools are being developed to assist the deliberation process among the stakeholders. With the increase of IT capacity, this has become an efficient way, when properly designed, to give access to knowledge to many people, to make it more accessible by visualisation but also to operate virtual deliberative arena in conjunction with face-to-face exchanges. The outcome of all these procedures may be more or less satisfactory, but the general view is that, particularly for CZM, there is still a lot to do to improve their efficiency by testing new approaches and by sharing experiences.

4) Indicators for the ICZM Process. The choice of indicators, also called descriptors, is a key input to this assessment of scenarios and to the quality of their evaluation in a participatory or deliberative context (O'Connor, 2004). Relative to the spectrum of decision criteria or governance issues, a range of potential indicators must be identified as suitable to be used as an element for evaluation judgments. However, in response to this need for information, there will exist extremely diverse claims of and sources of knowledge and information. Information categories put forward by decision makers, administrators or other stakeholders as 'candidates' for planning and evaluation purposes, will not always be tightly' linked to the formal categories engaged in the scientific description of scenarios. This information diversity is inevitable given the complexity of the economic, social and ecological phenomena existing in the many different activities and uses. In a context of participatory governance, where robustness and acceptance of decisions depends partly on communication quality and on legitimacy accorded to expert advice, such diversity can be counterproductive, especially, when institutional, cultural, and 'local' socio-economic dimensions bear weight on the governance process. An inclusive or participatory procedure would therefore seek to have these two different qualities of performance observations (the 'formalised' and the 'informal') accepted and maintained as somehow complementary within the deliberation process. Therefore, both the "face to face" participatory exercises and the multi-media based deliberation when inserted into the SAF methodology will give a prime importance to the quality of the information it processes and to the balance in considering the ecological, social and economic dimensions.

6.1.4. RTD Activity Structure

This section describes how the *SPICOSA*'*s* research effort is constructed to achieve its objectives in an efficient manner. The hierarchy structure of activity components, from Node to Work Package (WP) and to Work Task (WT), is designed to focus the project's resources around its central objective of improving the science-policy for ICZM. Described here are the interactions among the Activity Nodes, the content of the work packages and their tasks, and the partners that will lead the various efforts.

The primary activity unit is that of a Work Package. These are clustered into functional Nodes. Each of the Project's five nodes is differentiated by functional distinctions based on differences in objectives, deliverables, and scheduling that facilitate their coordination and management. A deliberate overlap between the Nodes is sequential in function and in composition to improve to the productive efficiency and to ensure coherency in the information flow through the implementation of the 4-yr project. Nodes are placed under the responsibility of coordinators who participate in the Executive Coordination Board. The connections between Nodes are shown schematically in Figure 9.

Each Node has two or more WPs, which are further broken down into WTs that are responsible for completing the programmed tasks and products in an integrated and collaborative manner among the participating partners. Thus WPs leaders have the overall responsibility for their coordination and performance of their WTs, and they participate in the Scientific Steering Committee. Table 2 lists the name of node coordinators and WP leaders, their country, and their organisation. The Table also indicates the lead organisation in Study Site Applications. The distribution of the leadership among the participating countries is such that nearly all have significant roles.

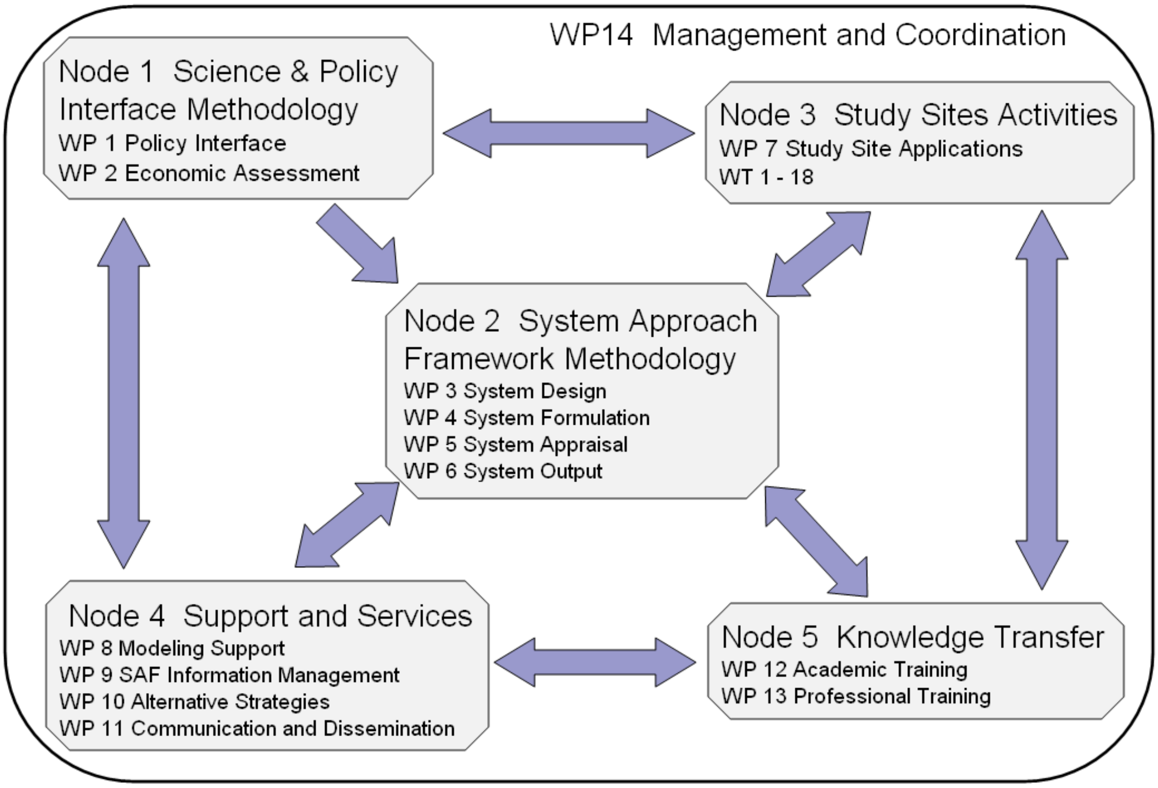

Fig. 9 Content and Interactions between SPICOSA Activity Nodes.

Nodes 1 & 2 assemble the methodologies to create the Systems Approach Framework (SAF) and to develop science-policy interface methodologies. Node 1 establishes generic methodologies for economic assessment (WP2), stakeholder, and policy scenario scoping through participatory approach, and deliberative methods for transferring the output information to decision-makers, institutional components, and stakeholders (WP1). Node 2 combines the information from Node 1 with existing methodologies into the systems-approach format that involves a sequence of four major steps structured as separate WPs: Design, Formulation, Appraisal, and Output. Each step will first provide the start-up SAF Protocol to Node 3 (Study Site Applications), then it will iterate on it during its execution through feedback from the SSAs, and then it will finalize the Protocol after SSA's completion.

Node 3 tests and validates the SAF in 18 Study Site Applications (SSAs) following the protocol of Node 2. Each of which will have similarities and differences with the others, therefore, some diversity and flexibility in the application is expected to allow that researchers adapt according to their own experience. However, adherence to the scheduled sequence of its application and to the delivery of its products will be compulsory. This requirement evokes a real-world time frame and develops the necessary practical skill of re-scaling a problem to obtain the best assessment within the constraints of time and existing resources. Each SSA will be managed as a Work Task of one WP (WP7).

Node 4 provides the services and support relevant to the SAF that are needed by all of the SSAs but which would cause costly delays and redundancy if they were included in every SSA. Node 4 advises Nodes 1 and 2 in the areas of model development (WP8) and alternative strategies (WP10) that should be considered in the SAF protocol. It also provides internal and external communication services that will improve the functioning of the Project through knowledge management (WP9) and information dissemination (WP11).

Node 5 transfers the methodology and knowledge, generated in the Project, through the forums of higher education (WP12) and professional training (WP13). The WPs of this Node are strongly integrated into the rest of the project (Fig. 9) through the participation of students and professionals in SSAs and by the requirement that the academic courses and training modules are all based on the SPICOSA experience and its results.

Table 3: List of Node and Work Package Leading participant

Node	WP/WT	Title	Leading participant, country
1		**Science and Policy Interface Methodology**	**8, Norway**
	1	Stakeholder-Policy Mapping	4, France
	2	Economic Assessment	14, United Kingdom
2		**System Approach Framework Methodology**	**16, United Kingdom**
	3	System Design	17, United Kingdom
	4	System Formulation	1, France
	5	System Appraisal	2, Spain
	6	System Output	24, Germany
3	**7**	**Study Site Activities**	**30, Denmark** 22, United Kingdom 2, Spain
	7.1	SAF in Riga Gulf	31, Estonia
	7.2	SAF in Gulf of Gdansk	21, Poland
	7.3	SAF in Oder Estuary	29, Germany
	7.4	SAF in Himmerfjarden	18, Sweden
	7.5	SAF in Limfjorden	30, Denmark
	7.6	SAF in Sonderled Fjord	28, Norway
	7.7	SAF in Clyde Sea	22, United Kingdom
	7.8	SAF in Cork Harbour	13, Ireland
	7.9	SAF in Scheldt Delta Estuary	37, Netherlands
	7.10	SAF in Pertuis Charentais	9, France
	7.11	SAF in Guardiana Estuary	11, Portugal
	7.12	SAF in Barcelona Coast	2, Spain
	7.13	SAF in Thau Lagoon	1, France
	7.14	SAF in Taranto Mare Piccolo	3, Italy
	7.15	SAF in Venice Lagoon	5, Italy
	7.16	SAF in Thermaikos Gulf	20, Greece
	7.17	SAF in Izmit Bay	10, Turkey
	7.18	SAF in Danube Delta Coast	41, EC-DG-JRC
4		**Support & Services**	**6, Belgium**
	8	Model support	6, Belgium
	9	SAF information management	35, Germany
	10	Alternative strategies	3, Italy
	11	Communication and dissemination	7, Netherlands
5		**Knowledge Transfer**	**13, Ireland**
	12	Academic training	11, Portugal
	13	Professional training	15, United Kingdom
n.a.	14	**Management Activities**	**1, France**

6.1.5 RTD Activity Schedule

A schematic diagram of the IP activities in Fig. 10 and a more detailed presentation is found below in Fig. 15 for the 18-mo plan in Sect. 8.2. The Project is planned over the four-year duration in a manner to require a continuous interaction among the Node activities. All nodes will start from the first month except for Node 3. The SSAs will officially start after a 6-mo start-up period, during which the SSA Host institute must form his team and program the initial workshop with policy-makers and stakeholders. The first 6 months will be dedicated to the launch of the programme and the preparation (Nodes 1,2,4) of the start-up information for the SSAs. Thereafter, these WPs will have a 4-mo lead on the SSAs in which feedback from the SSAs will contribute to revisions in the SAF protocol. In the same interactive way, technical support and services (Node 4) will enrich and benefit from interaction with methodological groups and with SSAs. As part of this node, the communication Work Package will provide means for internal and external communication. The last year of the project will be spent in comparison, evaluation, composing the SAF Portfolio, dissemination to endusers.

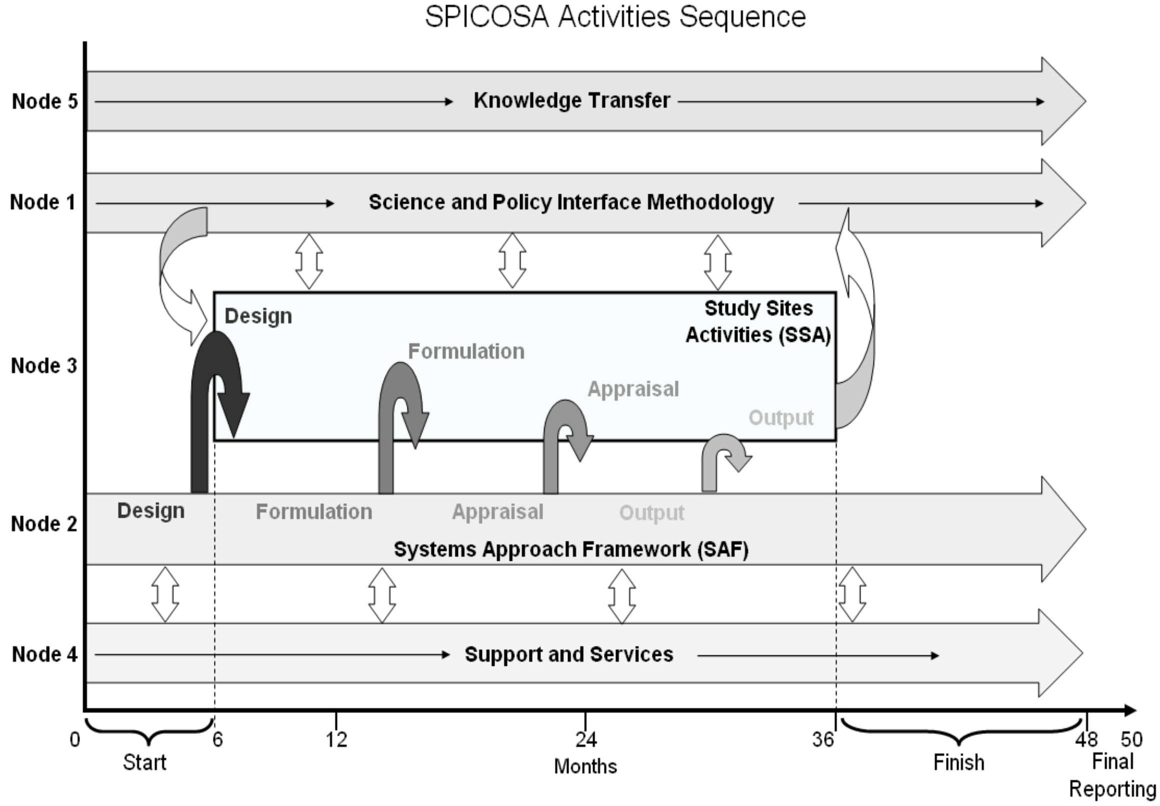

Fig. 10 Sequence of Node Activities. Most of the project activities last for the entire period, but many have shorter periods of more intense work. This is due to the iterative-accumulative nature of the Project's central objective, the SAF.

6.1.6 RTD Activities description

The Node, Work Packages and Work Tasks activities are described in this section. Fig. 11 shows the complete structure of WPs and WTs with their linkages.

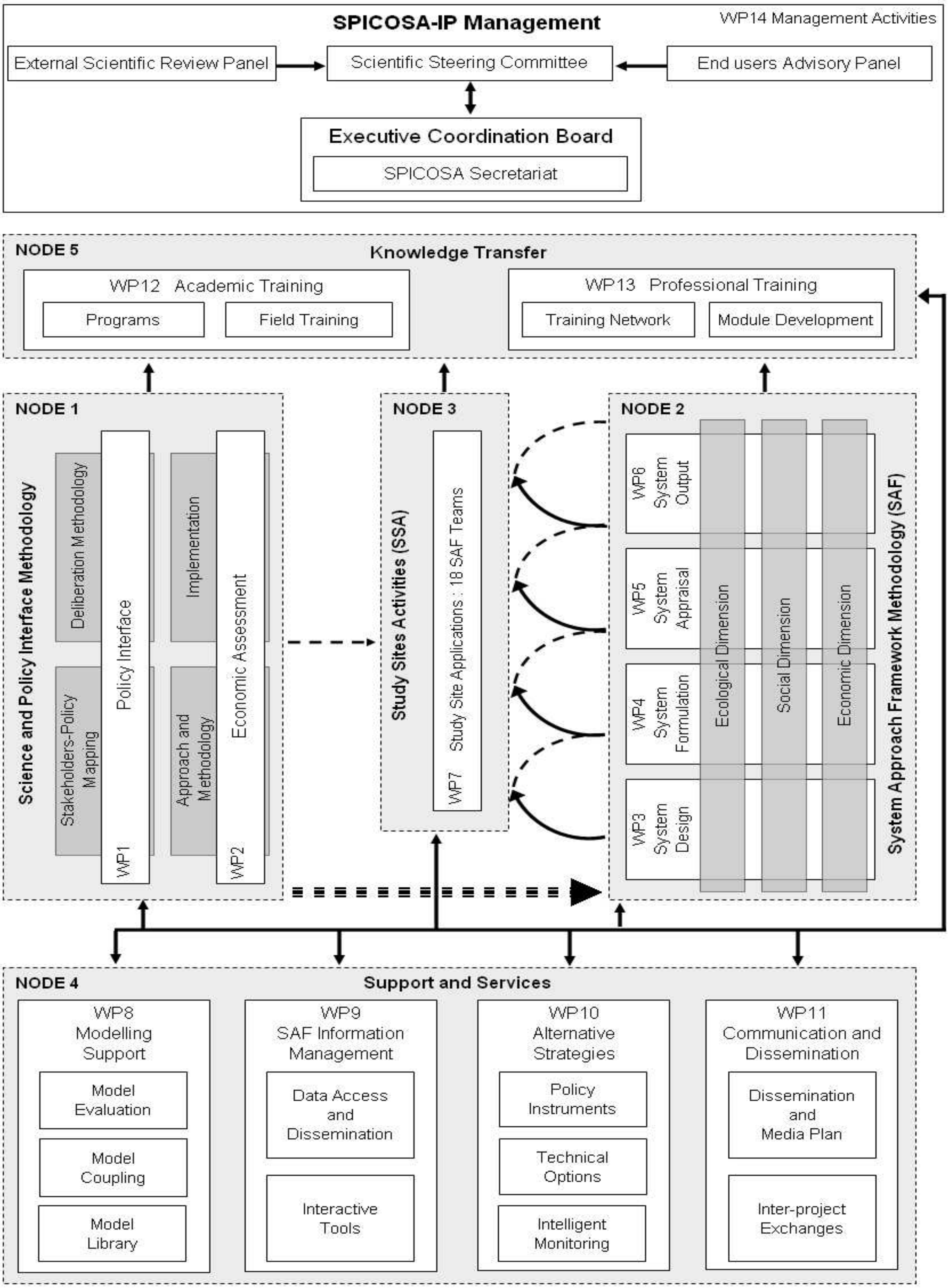

Fig 11: Pert diagram of SPICOSA activities

<u>NODE 1, Science and Policy Interface Methodology</u>

Coordination: P.8, University College Bodoe, Norway

This node will develop analytical tools for insertion into the Systems Approach Framework (SAF). Thus it will aid the development of a more policy-relevant SAF-protocol, so that the interaction between scientific knowledge and other knowledge areas in the policy-making process are improved.

In keeping within the goals of the EU Lisbon Strategy calling for a knowledge-based society, the objective of Node 1 is to develop and implement methodologies to improve the interface between scientific knowledge and policy-making processes. Especially in the very complex area of Coastal Governance, the multitude of stakeholders and ongoing policy-making processes makes this a demanding task. In total, Coastal Policies on the ground is the compound result of Individual Choices, Common Social Choices, and Public Choices in specific action situations and Policy making processes that impose constraints and open possibilities for the three first categories of choices. In addition, nature itself, i.e. the coastal ecosystems, has its own dynamics, which can react to, support or undermine any policies made by human decision makers. A knowledge-based society must therefore open the “black box” of Ecosystem Science to Policy makers, Stakeholders and the Public at the same time as it has to open the “black box” of Policy Making to Ecosystem Scientists. By thus utilizing both natural science knowledge and social science knowledge across earlier sharp disciplinary dividing lines, both Institutional Analysis and Design as well as Adaptive Ecosystem Management can become more readily applicable tools to Integrated Coastal Zone Management (Governance) (ICZM) in the Greater European Area.

Policymaking is both a bottom up and a top down process, and neither group of stakeholders know exactly what are the policy needs and the knowledge gaps are. In principle it is “hard to know what we don’t know”. But beyond the traditional consultation meetings and political bargaining forums where the strength of interests are tested, there are new participatory methods developed, e.g. focus groups, citizen jury, internet polls, etc. These have been tested in the context of environmental policy negotiations during the last decades, but in relation to Coastal Zone management in Europe, the experience of the formally organized dialogue between policy makers and stakeholders is not conclusive. And little has been done at the European level to systematize the numerous experiences and to transfer the information to potential end-users. It has been acknowledged in numerous reference documents about ICZM that a major drawback in these participatory processes is the fact that very little of the existing scientific knowledge is readily accessible to the stakeholders. Thus factual knowledge plays a smaller role in the processes towards formulating policy choices than it potentially could, and this is seen as a critical aspect for the future development of a knowledge based Europe.

Node 1 addresses this problem in two ways: a first set of “Policy Interface” work in WP1 will prepare a methodological framework to facilitate the System Analysis Framework Methodology (Node 2) and the Study Site Applications (Node 3). This will partly be done by developing interactive procedures for stakeholder-Policy Mapping (WT 1.1) to identify hypothetical scenarios for system and institutional design and to provide a yardstick for interpreting SAF output. Partly it will be done by developing a more appropriate set of economic assessment methods (WP2) and techniques that can be inserted into the SAF (WT 2.1 & WT 2.2) in such a way as to integrate ecological dimensions, social dimensions and economic dimensions. The interactions between the two WPs and with other activities are illustrated in Fig. 12.

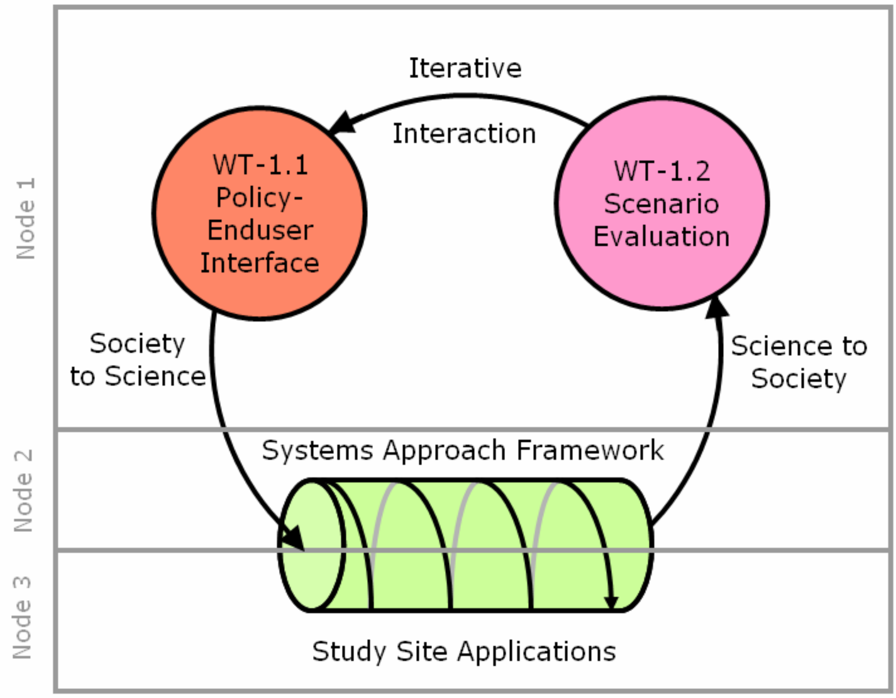

Fig. 12 Schematic of interaction between work tasks of WP 1 and other activities.

WP 1 Policy Interface. Lead P.4, UVSQ

This WP will provide the methodology for social and economic mapping of policy stakes and the protocol for interactions between science and other stakeholders. The overall objective of this work package is to provide a methodological framework to 'set the stage' for the initial and final acts of the SPICOSA approach by ensuring a Science-Policy dialogue before and after the scientific assessments are made. The interactions between environmental sciences and environmental policy are made different by a number of often-sited factors, including that they have different perspective on what is the environment, how it functions, what are its services to the public, and how it might serve human society in a sustainable configuration. Our working hypothesis is that researchers must be more proactive in establishing a dialogue with Policy rather than to just do 'good research' and publish the results hoping, perhaps, that they will help guide decision-makers. Consequently, SPICOSA-IP will initiate a dialogue before starting to conduct assessments and later return to discuss in participatory forums the results with other stakeholders. This defines two levels of dialogue: initial policy-issue mapping to define it in the most appropriate way regarding the "social scene" (WT1.1) and final scenario evaluation based on the output of scientific assessments (WT1.2).

This interaction between scientific knowledge and other sources of knowledge for scenario identification and scenario evaluation is deemed to enrich the pertinence of the scenarios to be elaborated, of the descriptors (components, processes, objectives, performances, etc.) to be used, and overall, of the contribution of science to public-policy choice. If well operated, this should be a permanent interactive/iterative dialogue between the policy social scene and the scientists. Evaluation of scenario outputs should lead to the formulation of new hypothetical scenarios.

This work package will develop dedicated Deliberation Support Tools as referenced in section B.4.2.1 based on the experience gained from other programmes by the leading institution. It will interact with Node 2 working groups by proposing reference typologies for issues and scenario identification and by helping to the design of SAF output to improve its adequacy with the needs of the public dialogue. Second, it will assist Study Site Application teams. The Work Tasks of WP1 will be managed according to the format of methodological group. A “core group” will prepare drafts of reference material and work with a “review group” of other participants at preliminary and later stages. An iterative approach will allow for progressive refinement of support documentation and generic toolkit.

WT 1.1 Policy-Stakeholder Mapping – Leader, P.4, CE3D-UVSQ
This WT is a social science based work that will show how to carry out a multidimensional mapping of policy issues and human activities for SAF. It will establish the terms in which progress of policy in resolving problems may be perceived and judged. To do this, it will utilize desk analysis, documentary analysis, and a series of stakeholder dialogues, to specify the guidelines needed for carrying out the necessary scoping studies that will allow a “mapping” of the perceived “Policy Issues” and of the awareness and attitudes of people towards the these Policy Issues.

1) Collection of documents of all sorts (physical and electronic, published and ‘grey literature’) as the basis of a literature review;
2) Small group discussions (so-called “focus groups”, in-depth discussions) and interviews with selected individuals;
3) Workshops bringing together stakeholders in selected configurations (e.g., the dynamics of a gathering of stakeholders at one site, is likely to be very different from a gathering of stakeholders from across Europe as “representatives” of national CZM interests or activities...)
4) Analysis and reporting of results of the stakeholder dialogue and documentary analyses.

The **Stakeholder Workshops** will take place during the first months of the SSAs. Interactive ICT techniques will be used as an aid for structuring the discussions and for producing “conceptual maps”, e.g., ‘*Open Space Technology*’ and the *Mind Manager©* software. Note that assessments of these and other relevant software tools will be made in the first months of the project, to ensure satisfaction of multi-language requirements and functionality of the selected system.

Overall, WT 1.1 will produce a methodological guide for the identification of key issues, institutional features, stakeholder categories, precepts of public acceptability, data needs review documents identifying the logic of discourses and attitudes toward the key ICZM policy issue(s) and deliver this guide to WP3 for insertion in the SAF Protocol, The use of the various procedures will be illustrated through examples of effective ways to generate the appropriate "raw material" for the social assessment and to produce results.

WT 1.2 Deliberation Methodology –Leader, P.4, UVSQ
This WT will develop methodology and tools for deliberations over the contribution of science to ICZM policy debate. The chosen strategy is development of the "SPICOSA" multimedia Deliberation Support Toolkit (DST) that responds, with the aid of the new generation of interactive communication tools, to the needs of multiple stakeholders, at different sites and scales of observation, for structured access to a diversity of scientific knowledge bearing on the governance challenges of ICZM in Europe. Three main outcomes are expected from WT 1.2.

1) First, design specifications must be given for effective and appropriate procedures for ensuring the policy impact of SPICOSA science results in each of the Study Sites.
2) Second, and related, there needs to be a "multi-scale" interfacing, so as to establish a "forum" centred on governance issues, policy targets, and associated indicators and on the exchange of perspectives between Study Sites and the emerging European frameworks for ICZM policy.
3) Third, the basis must be laid for the translation, in due course (much later in the project) of the SSA experiences, into recommended procedures and tools for working ordinarily on the science-society interface in ICZM.

Three main sub-tasks will be conducted:

1) To design work (from concepts to operational specifications) and prototype development, in close collaboration with other SPICOSA consortium partners, for the "SPICOSA DST".
2) To apply more detailed tuning and validation of the DST in selected SSAs.
3) To develop in close collaboration with other SPICOSA consortium partners, of the "multi-scale" interfacing, so as to establish a "forum" centred on governance issues, policy targets and associated indicators for the exchange of perspectives between SSAs and the emerging European frameworks for ICZM policy.

WP 2 – Economic Assessment. Leader, P.14, CSERGE-UEA
The primary aim of this WP is to provide a set of economic assessment methods and techniques that can be implemented into the SAF. These methods should emphasize the integration of the economic dimension into the ecological and social dimensions (including scenario analysis) and cover macro-micro scales as well as short and long-term considerations. Emphasis is placed on providing regional input-output models (I-O) based on a uniform approach within the SSAs and insuring potential linkages to a wider monetary valuation of the costs and benefits of ICZM (encompassing mitigation, replacement and preservation strategies).

The economic assessment is undertaken in the context of continuous integrated management. This means that the analysis is done at some "point" in time, or over some finite time period. This in turn implies that the analysis must be based on some "baseline conditions" and linked to the natural science models and data. Thus, an important problem in estimating the costs and benefits of ICZM is that of defining what would happen in the absence of ICZM i.e. what is the "baseline scenario" or a "business-as-usual" trend projection. One way to demonstrate the ICZM benefits is to use the "without ICZM" versus "with ICZM" comparison. The net benefits i.e. benefits minus costs associated with (attributable to) ICZM are represented by the difference between these two states in a given coastal area. This with vs. without comparison is combined with the application of scenarios of conditions extended to whatever points in the future are considered to be of interest. A scenario comprises some combination of values of three sets of linked variables:

1) Economic and demographic conditions over the time horizon of interest;
2) Environmental conditions; and
3) Governmental policies, institutions, social norms and perceptions, technological changes and factor prices etc.

Operationally, the following basic steps are involved in the ICZM-benefits assessment:

1) Define the problems/issues in quantitative and qualitative terms (combination of natural science models, social assessment and economic evaluation).
2) Select and construct a scenario and tabulate the related spatial pattern and levels of population and economic activities, social consequences for the time horizon specified in the scenario.
3) Estimate the outcomes of trend-projections in management strategy, based on the social and economic relationships identified in the previous tasks,
4) Define an ICZM strategy and apply to the same scenario as selected for the "trend" management strategy, to identify cost, benefits and net benefits.
5) Test other possible alternative-future scenarios

WT 2.1 Economic Assessment Methodology – Leader, P.14, CSERGE-UEA

This WT will specify the types of economic analyses needed and feasible to evaluate economic tradeoffs involved in alternative scenarios taking into account market and non-market values, and local and larger processes. The following sub-tasks will be conducted in sequence.

1) Liaison with social assessment to highlight in particular stakeholder mapping distributional issues and time horizons/scenario analysis.
2) Basic formulation of the overall structure of the economic model
3) Construction of generic regional I-O framework.
4) Formulation of generic economic cost-benefit model and valuation approach for ICZM.
5) Survey of I-O monetary valuation studies and benefits transfer possibilities.
6) Integration of I-O components with other economic components.
7) Liaison with core study partners to implement I-O and valuation analysis.
8) Production of guidance documentation.

WT 2.2 Implementation of Economic Assessment – Leader, P.19, CEESE-ULB

This WT will provide versions of these methods compatible to their prescription in the SAF protocol and provide further assistance in selected SSAs to demonstrate higher-level assessment methods.

The implementation will be accomplished in following areas:

1) To act as an interface between WP2 and the economic assessment portions of the SAF protocol in Node 2. This will be facilitated by duplicate participation and close coordination with economic researchers in Node 2.
2) Independently critiquing the recommendations of WT2.1 from the point of view of facilitating application. This will be done by reviewing success of application in other projects and in the literature.

3) In selected cases, work directly with a few selected SSAs that have already conducted economic assessments in order to foresee problem areas in implementation to pass on to Node 2.

NODE 2, Systems Approach Framework
Coordination: P.16 UoP and P.3 IAMC

This Node acts as the driving engine for the project's objectives; it develops the SAF protocol in a sequential, iterative manner from inputs from Nodes 1 and 4, iterative interaction with Node 3, and collaborative exchange with Node 5.

It is the responsibility of this Node to adapt the systems approach applied to the larger Coastal Zone system and to provide detailed guidance as to its application. This adaptation will be done in the context of a CZ System Feedback Loop as in Fig. 1, and it includes the innovative concepts described in Sect. 6.1.1 and the methodologies in Sect. 6.1.2. Thus, the four Work Packages of this Node have the responsibility of writing the descriptions, methodological procedures, and guidelines for the SAF Protocol, which is then applied and tested in the Study Site Activities (SSA) of Node 3. The SAF is organized into the four major Steps, which constitute the four major chapters of the SAF and the four WPs of this Node: Design, Formulation, Appraisal, and Output. The content and purpose of each Step is explained in Sect. 6.1.2. The writing of the SAF is sequentially precedes implementation in Node3, see Sect. 6.1.4, such that the draft version starts the sequence, its implementation follows in the SSAs, after which the SSAs return their critiques to Node 2, which then writes the final version. The initial draft versions of the SAF must provide sufficient guidance, reference, and examples of the required tasks that they can initiate the SAF with little additional assistance. To help in this regard, a SAF workshop at the third month will help familiarize all partners with the concepts, tools and the procedure.

Evolving Quality. Recognizing that the scope of this experiment has no precedent, particularly in the areas of geographic and disciplinary extent, we have designed an iterative procedure for the content of the SAF. In order to accommodate both the revision iterations and an operational time schedule, we have designed a strong start and imposed a strict time frame for completion. Therefore, the rationale for drafting the SAF protocol separately and prior to beginning of the SSAs is both to start with the best possible guess for the SAF and to avoid loss of time on the part of the SSAs in deliberating over their approach. However to preserve the opportunity for the SAF quality to evolve, the SSAs will not be constrained to follow exactly the draft version of the SAF protocol. From the onset of the SSAs, if a SSA would like to propose major exceptions to the SAF, they would need the consent of the coordination of Nodes 2 & 3. By allowing a certain degree of freedom, we permit each SSA to make some variations of the basic protocol in order to adapt to their particular situation and to encourage experimentation on the basic methodology, providing that the schedule and objectives are not jeopardized.

When the result of each Step is completed in the SSAs, their output becomes an iterative input for the each of the WPs of Node 2. Each Node-2 WP will first review these outputs for satisfactory performance relative to the following conditions set in the draft version. In the post-

SSA period, the WPs of Node 2 are then responsible (with SSA representatives) for the summary evaluation, the final SAF protocol, and the comparative analysis of the SSA results.

WP Organization. Each Work Package of this Node will be structured into Work Tasks in relation to the tasks required to produce the SAF Protocol chapters for each of its four Steps. The approach and composition of the WTs will follow the guidelines of Sect. 6.1.2. Each work task will be addressed first by a small 'Core Group', who will write the first draft of the protocol that will be subsequently critiqued by a larger 'Review Group. Both these groups consist of experts not directly involved with an SSA, with a few exceptions. After the draft product is completed it will be presented and discussed in a larger workshop in which there will be Node 2 representatives from each SSA. For each of the core groups of this Node, there will be an assigned WP leader and 5 members of which there will be at least one representative from each of the ESE components. These assignments will initially be designated, and later selected to adapt to availability and expertise. This lead committee will organize themselves as needed to meet its work assignments and schedules.

Each WP will begin with a plenary meeting of both groups to familiarize themselves with the WP objectives. Subsequently, the Core Groups will define the specifications for each WT and assign responsibilities. The Core Group will again meet to draft the WP Chapter. Next, both the Core and Review groups will meet together to critique and edit the WP Chapter. All the WTs for each WP will be drafted and reviewed in a manner independent of disciplinary considerations; however, the person chosen to lead each of the WTs must have an expertise best suited for the task. If this expertise does not exist in the Core Group then it will be brought in from elsewhere in the project.

Disciplinary Integration. Critically important to the coordination of this Node is that the process of constructing and applying the SAF will encourage disciplinary integration. The assemblage of methodologies and procedures recommended in this Node must reflect the continuum of components, processes and interactions occurring throughout the ESE System rather than reflecting a fragmented set of disciplinary-based methodologies belonging to the team of researchers that applies them. For example, this requires that the methodologies be selected that require a wider researcher participation than that implied by the set of methodologies by practiced by the team of researchers assembled to conduct a SSA.

WP 3 CZ System Design – Leader, P.17, NUE

This WP authors the CZ System Design Step for the SAF Protocol through an iterative process of initially following the SAF methodological rationale (Sects. 6.1.1-3) and subsequently modified based on feedback from the SSAs. The purpose of Design Chapter is to explain how to establish the 'Policy Issue', which the SAF will address, and how to plan its satisfactory resolution within specified time and resource constraints. It will provide procedures for engaging policy/stakeholders to determine a Policy Issue and decision-support information based on a negotiated agreement, between the SSA team and the participant group of policy/stakeholders. In each case, the negotiated trade-off will be between policy priority and expected scientific resolution; that is, the selection process will result in a Policy Issue for which decision-makers would like to have interactive information (indicators, forecast scenarios, options, etc.) and for which the research team has sufficient data and expertise to address.

The Chapter contents will clearly describe the procedure for identifying of the primary and secondary interactions involved in the cause-&-effect relationships through the CZ system, i.e. from policy change to natural system change thoroughly considering the three ESE dimensions. The chapter must include a clear explanation of how to select the interactions and processes of this chain and how to portray them in the context of conceptual models. Also, it will include the criteria for defining the best scenarios in order that they will provide interactive assistance to decision makers. The Chapter must provide criteria for selecting the dimensional (time and space) extent of scenario resolution required for satisfactory resolution of the Policy Issue(s); i.e. the temporal extent of historical data available for hindcasting and the extent of requested prognostic scenarios; whether and what spatial information is needed for qualitative presentations, data integrations, and/or for 3-D modelling of scenarios. The Chapter will provide instruction on determining the accuracy of the prognostic scenarios, and how the scenario simulations can be validated, such that the initial design can be iterated until an acceptable 'error envelop' can be achieved for scenario predictions. Thus, the design process is iteratively linked to the succeeding steps in the SAF and the final version must wait the conclusion of the final results of the SSAs.

The Chapter will also suggest mechanisms to facilitate a significant level of participation throughout the SAF process by the Policy-Stakeholder Participant Group, which forms a part of the SSA research team (WP7). The Chapter will provide guidance on the planning and organization of the SSA team necessary to conduct e its assessment. In anticipation of this, WP3 will be assisted externally by information passed from WPs 1, 2, 8, & 10 and internally by a dedicated review group and by representatives from each SSA.

The Design Chapter will be organized with separate sections dealing with each of the major tasks outlined below. Major revisions or additions would require consent by the Node coordination. The importance of conducting theses tasks in sequence must be reflected in the text of the Chapter. Each of the major tasks must include instructional information concerning the important subtasks, which are outlined here as follows:

1) Issue Resolution

a. Reach agreement on Policy Issue(s) and associated scenarios, indicators, descriptions and criteria.
b. Identify what dysfunction (impacts) in the natural system is implied by this Policy Issue and prioritize them in the case of multiple impacts.
c. Identify social concerns and public perceptions relative to the Policy Issue(s).
d. Identify economic activities directly impacted and those potential economic effects including non-market impacts.

2) System Definition

a. Define the CZ System to be studied by ascertaining that all primary functionality is within its boundaries, i.e. leaving within the system all of its major interactions.
b. Specify the necessary boundary conditions, i.e. identifying information/data needed for prescribing the external boundary conditions, anthropogenic drivers. Specify the relevant

internal inputs, controls, constraints, and social and economic demands relative to the proposed Policy Issue(s).

c. Anticipate characteristics of potential risks (e.g. geological, ecological, social, economic) that should be evaluated and estimate the resources required.

d. Synthesize the state of the impacted ecosystem relative to its function, knowledge gaps, and major component interactions.

3) Conceptual Models

a. Construct conceptual models of the CZ system's response to the Policy Issue(s) that will allow visualization of its primary characteristics in relation to each other, e.g. external boundary conditions, major compartments, and those internal processes that control the flow of mass, energy and information through the system.

b. Use these models to indicate the primary cause & effect relationships; specify the key forcings, variables, and processes; identify external inputs (mass, energy, & information), internal inputs; and indicate the social and economic interactions, controls, processes, and components and their interactions relative to the cause & effect chain; and specify expected CZ system outputs.

c. Provide a sample format in the form of examples for these conceptual models by adapting various in-use methodologies.

d) Specify the system outputs for both qualitative and quantitative analyses.

4) Methods and Information Required

a. Identify the methods suitable for resolving the various quantifications and qualitative interpretations needed.

b. Acquire existing information/data on the major HAs relative to their controls and constraints on the ecosystems – link WP 9.

e. Specify any auxiliary models needed to link with the systems model considered necessary – link WP 8.

c. Obtain data inputs for external forcing (not having strong interactions) –link WP 9.

d. Indicate the format for storing the CZ relevant data – link WP 9.

5) Problem Scaling

a. Scale all processes and streamline the problem to the first-order linkages and interactions of the cause-&-effect chain; Simplify methods if the effort required to utilize them is out of balance with respect to the overall effort.

b. Iterate on the scope of the problem to ensure feasibility and reduce if necessary.

c. Specify the SAF Portfolio contents: simulation output, qualitative information, and the formats required by the natural, economic, social sciences, and public users interfaces.

d. Specify the format of output for presentations and visualizations (for policy-makers, stakeholders, and public) recommended for use in WP 6.

WP4 System Formulation – Leader, P.1, IFREMER

This WP authors the CZ System Formulation Step for the SAF Protocol through an iterative process of initially following the SAF methodological rationale (Sects. 6.1.1-3) and subsequently modifying it based on feedback from the SSAs. This WP constitutes the preparatory link between the problem definition of WP 3 and the appraisals of WP 5. Its purpose is to explain how to systematically organize the quantification and interpretation of the CZ system. The contents must explain the importance of representing the CZ system's function in quantitative terms and how one selects the best possible representations of key system processes, inputs, and internal interactions, and how one assembles these into functional components. Of particular importance to SPICOSA is the inclusion in the CZ system of the essential social and economic components, for which the Chapter must explain how to adapt the respective methodologies passed from WP1 & WP 2 to quantitative and qualitative assessments pertinent to the studied Policy Issue(s) in the context of the CZ feedback loop and/or as interacting with the specific cause & effect chain. In the event that spatial resolution is needed, the contents must provide guidance on the necessary set-up procedures, data requirements, and resource costs for the relevant methodologies (WP 8).

The Chapter must include information on how to debug and validate of all formulations and to calibrate them with real data at choke points in the system. Explanations must be included concerning the quantification of those transformation processes that alter the input data parameters in relation to the specific system and issue(s) studied. Guidance must be provided on how to rescale or adjust the scope and scale of the simulations, since it is the last point in the SAF sequence when modifications can efficiently be effected. The Chapter must instruct the user on the procedures for archiving the validated process and component models in conjunction with WPs 8 & 9.

The Formulation Chapter will be organized with separate sections dealing with each of the major tasks outlined below. It is expected that some modifications will be necessary relative to the information provided by the Design Step. However, major revisions or additions would require consent by the Node coordination. The importance of respecting sequential nature of these tasks must be reflected in the text of the Chapter. Each of the major tasks must include instructional information concerning the important subtasks, which are outlined here as follows:

1) Inputs. These represent the introduction of mass, energy, or information into the system considered, i.e. externally or internally.

a. Describe the degree to which the input functions are independent of internal and external dependencies and whether or not the appropriate information is included with the input data and whether it is switched through an information feedback loop internally or externally to the system. Express these quantitatively.

b. Evaluate the relevance, for all possible inputs, regardless of whether they are listed in the first and second order cause-&-effect relationships. Pay special attention to the interactions of relevant HAs to these relationships and to the information controls on them due to social and economic preferences.

c. Set up the social and economic analyses by planning their scope and by acquiring the data for their implementation. Note some analysis requiring long time for acquisition of data may be initiated during this step, with approval of Node Coordination.

2) Internal Interactions. These refer to all interactions that affect the quantity, quality, or conversion of the key variables being simulated in the cause & effect chain.

a. Following the Conceptual models of WP3, describe how each process or interaction will be formulated, e.g. deterministically, empirically, statistically, etc., and write out their formulations that express their full functionality, Describe the needed descriptive information needed for understanding the role of these processes and their dependent interactions with other processes in the cause & effect chain.

b. Explain for each formulation the necessary dimensional checks and expected validation procedures. Evaluate any approximations included in these formulations, e.g. range of validity, omission of any independent variables, and the origin (reference) of each formulation used.

c. Construct process models, validate with the best data available, and document/critique the model according to procedures of WP 8. Provide some examples in the EXTEND, or other, software environments.

d. Formulate and simulate the dynamics of the economic and social processes/controls and their position in the cause & effect chain (to be replaced with real results later).

3) Functional Components. Processes can be grouped to form major functional units within the system, which will facilitate their calibration and representation in the larger systems models of WP5.

a. Consult the Conceptual Model, select the first and second order processes, assemble them into functional components, and define their interactions with other components in the cause-&-effect chain. Identify and quantify how the social and economic variables interact with the cause & effect chain(s).

b. Specify any thresholds, tolerance levels, and functional limits affecting the function of a component relative to its expected use in SSAs.

c. Define and evaluate all external controls that are not included in the already defined key variables.

d. Assemble the respective process models, using the previous steps, into component models paying close attention to the dimensions of the variables and any tolerance or functional limits that may be exceeded.

e. Construct social and economic component models to test their interactions with the components in the cause & effect chain, where appropriate and using reasonable representations of the CZ system output, in order to estimate in order to estimate the sensitivity and any nonlinearities in these interactions.

f. Conduct sensitivity tests and validate the formulations with known results, and if possible, provide criteria for validating their accuracy. The completed components should be transferred to the Model Library in conjunction with WPs 8 & 9.

4) Documentation

a. Validate each of these functional components using available data and iterate as necessary. Acquire available data useful for hindcast validations and calibrations of process, components, and systems models.

c. Critique the social and economic interfaces as foreseen in the WP3 and make any modifications necessary in order that the results of the WP5 appraisals will function within the scope of the planned simulations.

e. Provide a scientific critique of these components including error estimates, sensitivity to inputs, quantitative indicators that might be useful in the output, and qualitative assessments for output. Include a revised conceptual model with respect to the initial model of the system design step.

WP 5 System Appraisal – Leader, P.2, CSIC

This WP authors the CZ System Appraisal Step for the SAF Protocol through an iterative process of initially following the SAF methodological rationale (Sects. 6.1.1-3) and subsequently modifying it based on feedback from the SSAs. The purpose of this Step is simulation and interpretation the CZ system's response to the selected Policy Issue(s). Thus, the contents must describe the implementation procedures for the types of assessments specified in WP3 and formulations constructed in WP4 and prepare them for delivery to WP6. Because the Policy Issues and the CZ system will differ from one CZ application to another, the contents of the Chapter must be general but must also cover the major types of variations expected in CZs. These will be extracted initially from historical examples and eventually from the SSAs. The contents must describe how to couple the ESE component models without losing information or accuracy relative to the defined system, how to utilize these models for producing simulations and qualitative information specific to the desired System Output (WP3 & WP6), and how to perform quality controls and error estimates for the outputs. Most of the component models would come from WP5, as developed specific to the application, and some generically applicable models may come from the Model Library. The System Output will have been described in the Design Step, but some interactive overlap must be established with the Output Step. The contents must include options for situations in which the quality or error exceeds projected thresholds.

Thus, this Chapter must provide guidance on how to keep the resource expenditure within the prescribed limits, since both the effort devoted to model appraisals and to the interpretive analysis can easily surpass the limits associated with conventional research. Explanation will be given on how to provide limits in the context of the Systems Approach hierarchical structure (postpone further resolution to a later iteration) and in the context of the operational priorities inherent in the SAF objective (research response within prescribed resource limits). The Chapter will provide assistance on separating the accompanying interpretive analyses, where the emphasis is on integrating existing knowledge specific to the defined problem rather than on developing new analyses of generic value, which should be encouraged but outside the scope of the SSA. Similarly, the contents will include instructions on utilizing default methodologies (models and analysis) in the case that existing methodologies are not in place and to allow improvement through experimentation to better prescriptions. This is justified under the SAF concept of auto-improvement, through updating with better models and new knowledge in successive iterations.

The Appraisal Chapter will be organized with separate sections dealing with each of the major tasks outlined below. It is expected that some modifications of these tasks will be necessary relative to the information provided by the Design of Formulation Steps. However, major revisions or additions would require consent by the Node coordination. Unlike the previous steps, the order of completion for these tasks need not be strictly in sequence but must be tightly coordinated in order to support the objectives and stay on schedule. Each of the major tasks must include instructional information concerning the important subtasks, which are outlined here as follows:

1) ESE Components

a. Construct the simulation model of the natural system using existing MMBs wherever necessary. Run the model using static economic and social inputs. Conduct hindcasting and calibration tests on a known policy change or observed environmental event. If a linkage model has been prescribed, conduct linked runs and critique and modify as necessary.
b. Analyze the results of the social assessments, first separately, with interpretive comment. Then construct and run the social-model component with linear/constant simplifications for the interactions with the natural and economic components. Critique results and modify as needed.
c. Analyze the results of the economic assessments, first separately, together with interpretive comment. Then construct and run the economic-model component with linear/constant simplifications for the interactions with the natural and social components. Critique results and modify as needed.
d. Synthesize qualitative information acquired in support of these ESE models restricting them as much as possible through relevance to the Policy Issue and special attention to interactions not previously noted or understood.
e. Prepare model simulation input data, historic, simulated, and prognostic.

2) System Simulations

a. Link up the simulation model from the assembled components. Test and validate all model interfaces, and input data. Carefully evaluate linkages to distinguish between dynamic versus non-dynamic.
b. Conduct sensitivity test regarding conceivable variations of input values - to explore the models range of validity and sensitivity to input errors and to key variables omitted or approximated.
c. Run simulation model adapted to the Policy Issues and recent data inputs. Note and describe any strong feedbacks between the natural, social, and economic components, and review the validity of these occurrences.
d. Run prognostic simulations as prescribed or as considered useful to the Policy Issues, i.e. due to changes or selected alternatives.

3) Output Preparations

b. Review and assemble the alternatives and options relevant to the SSA policy issue, as provided for by Node 4, and indicated by on results of the appraisals.
a. Synthesize the quantitative (model) and the qualitative (interpretive) results. Prepare further analyses for options as prescribed for the Output Step.
c. Provide indications of which simulation runs remain feasible in response to requests by Policy during the Output Step. Maintain an interactive connection with the Output Step

WP6 System Output – P.24, KMGNE

This WP authors the CZ System Output Step for the SAF Protocol through an iterative process of initially following the SAF methodological rationale (Sects. 6.1.1-3) and subsequently modifying it based on feedback from the SSAs. The purpose of this Step is to integrate and organize the qualitative and quantitative information resulting from the SAF for written and interactive presentations with policy/stakeholders and endusers. Basically, the Step translates the information coming from the three previous Steps in various forms into three primary formats: an SAF Portfolio to be presented to the decision-making clientele that originated the studied Policy Issue(s) for the SSA assisted by (mostly as Decision Support Tools of WP1.2); for insertion into the SAF Users Centre of the SPICOSA website (assisted by WP9 & WP11); and for the final edition of the SAF Protocol User's Manuel (assisted by an edit committee to be nominated). The Chapter must clearly prescribe the procedures for translating the material to meet the specific needs of several different types of clientele. For example, the contents must describe how to synthesize the response information into non-scientific formats and in a manner flexible enough to serve both the organized deliberations and the ad-hoc interactions with policy and endusers; how to present the combined ESE analyses to stakeholders and the public in a manner coincident with their interest levels; and how to condense the SAF experiences into a useful format to promote continued improvements in the SAF for the utility of ICZM. In addition the information content, the Chapter must devote considerable guidance on the information management (link WP9&11) and logistical coordination of the deliberative interactions with the decision-making groups and other endusers (link WP1).

The Output Chapter will be organized with separate sections dealing with each of the major tasks outlined below. It is expected that some modifications of these tasks will be necessary in adjustment to changes made in the previous Steps. However, major revisions or additions would require consent by the Node coordination. Each of the major tasks must include instructional information concerning the important subtasks, which are outlined here as follows:

1) CZ System Response. This task completes the integration of the assessments regarding the change in the system in response to the Policy Issues.

a. Run Simulations of 'what-if' scenarios based on priorities provided in the discussions with Policy makers and established in the Design Step and prepared in the Appraisal Step.

b. All scenarios should be accompanied by an interpretive text, uncertainty envelopes, documentation of each simulation run, Some of this material would be converted to interactive displays for subsequent dissemination and deliberations (below).

c. Interpret and critique the scientific results, both quantitative and qualitative, with respect to supporting the Policy Issues, to the specific to knowledge & data gaps revealed during the application, the effectiveness of the application from the perspective of assisting ICZM decision making and from the perspective of anticipating the response of a CZ system.

2) Deliberations. Most of the interactive information exchange between the research and the decision-makers will follow the deliberation methodology tailored to the SAF by WP1.

a. Prescribe the content and procedure necessary for preparing the DST information to be used for policy/stakeholder deliberations.

b. Provide the instructions for conducting the Deliberation Forum for the integration of research results with decision-makers and stakeholders.

c. Provide guidelines for continued interactive dialogues with the end-user groups.

3) Dissemination.

a. Provide instructions for formatting inputs for training and outreach efforts (with WP11 &WP13).

b. Oversee the final production of the SAF Protocol User's Manuel (with edit committee).

c. Coordinate with WP9 and WP11 for the final ICZM web site for SPICOSA.

4) SAF Portfolio Products. In addition to information central to the four steps of the SAF, the final Portfolio will contain other products. This material would be generated by each of the SSAs and later would be included in the SAF Protocol User's Manuel. The Output Chapter would suggest scope and formats for these products.

a. Present a synthesis of what policy strategies and technical alternatives were used in the SSA and some indication of their costs for implementation, long-term benefits of their use and tradeoffs, and solution classification (i.e. adaptive, counteractive, or preventive) – link WP10.

b. Create of a set of guidelines for policy regarding the use of systems indicators, regulation of input variables, and observational recommendations for monitoring the CZ system for periodic real-time assessments – link WP10.

c. Suggest procedural templates for engaging CZ managers into the SAF application regarding Issue negotiation, policy-stakeholder participation, fostering complementary research funding, and facilitating continued use of the SAF for ICZM – link WP1.

d. Summarize the problems and improvements recommended for standardizing aspects of the SAF application for future users in the form of shared website material (Model Library, system independent problems, validation data, etc.) – link WP9 & 11.

NODE 3, Study Site Activities (SSA)
Coordination: P.30 DTU-DIFRES, P.2 CSIC, P.22 SAMS

This Node consists in 18 Study Site Applications. It encompasses all of the SPICOSA objectives and connects with all of its activities

***Objectives*.** The primary objective of this Node is to implement and critique the SAF over a wide range of Study Sites, in order to accommodate the variability in geomorphic type, in environmental conditions of these CZ systems, and in the Human Activities (HAs) driving these systems. A significant number of CZs are considered necessary in order to promote consistency in research and policy approaches for different European regions, with different policy stakes and social, economic, or ecological characteristics. Another major goal is to understand the degree to which the natural characteristics of a particular CZ system make it more, or less sensitive, to similar HAs and/or Policy controls in other systems. In other words, CZ diversity is sought to better evaluate the response of a CZ system to various policy changes and to evaluate the sensitivity of policy to changes in patterns of use and in public perception. The overall complexity of these systems in their natural diversity and in their interactions with human society is sufficiently large such that we feel the SAF must be tested over statistically significant subset of CZ systems. This exposure also fulfils an additional requirement of SPICOSA-IP: that of involving a critical mass of researchers and stakeholders through out European CZs. We admit some risk in having such a large community involvement from the point of view of reducing the resources for implementation; however, we expect this to be offset by a greater commitment and contributions on the part of the partners, local, and national authorities. Representing the interests and gaining the participation of decision-makers, local stakeholders and endusers is of paramount importance to the success and design of SPICOSA.

Selection. There are four main conditions that help explain the rationale for the SSA selection. First, the primary goal of the Project is to develop a methodology (SAF) rather than to research aspects of CZ systems. Second, this SAF must not be dependent on the type of system to which it is applied in order that it have general applicability to ICZM; and this SAF must be implemented by a critical mass of CZ institutes and by a critical mass of CZ researchers in order that it can evolve to be a common approach for ICZM. Third, each SSA should have sufficient complexity and information available such that both the characteristics of diversity and redundancy are present in the suite of SSAs in order that each SSA overlaps and contributes others within the suite. Fourth, a necessary condition for a successful SAF is that it must have the capacity to be negotiated and re-dimensioned for each application in order that feasibility and resolution are balanced.

The actual Study Site selection itself was governed by the needs and constraints encountered during the proposal writing process, which involved meeting a set of criteria, linking Sites with responsible Partners, and remaining within a resource limit. These needs and constraints are outlined as follows.

1) *Criteria***.** The initial Study Site selection was based the following criteria:
- a) A critical mass of expertise for a SAF team,
- b) A well-established relation with stakeholders and managers of that system
- c) A long time-series of systems variables for hindcasting,
- c) Some change in Policy during this time series,
- e) Comprehensive spatial observations taken within the same period,
- f) Targeted process or impact studies also conducted within this period, and
- g) Sufficient input data on both natural and anthropogenic forcings.

2) *Participation***.** We considered essential that the primary activity of the Project be that of implementing and critiquing of the SAF. As a consequence, the major partners have either a SSA and/or a strong involvement in the methodology development.

3) *Resource*. The primary tradeoff in the number of SSAs selected was in the amount of funds available. In order to best accommodate this tradeoff, we have introduced into the Project: several economizing features:
- a) That no funding would be designated for additional data acquisition
- b) That methodology development is suitably ambitious.
- c) That partners would be encouraged to seek additional funding
- d) That specific assistance could be mobilized through external expertise or data (dedicated funding managed by study site coordinating partner)

4) *Number***.** We felt it essential to have a significant number of SSAs for achieving our objectives:
- a) We placed a high priority on involving as many European member states as possible in order to promote integration and consistency in research and policy approaches.
- b) We needed a statistically significant number of SSAs in order to analyze and improve the SAF from the results of these experiments.
- c) We needed a wide range of Study Sites, in order to accommodate the variability in geomorphic type, in environmental conditions of these CZ systems, in the economic role

of their use, in the Human Activities acting to stress them, and in public perception of their value.

The selected group of SSAs includes all major impacts, has varying types of watersheds, marine environments, and has a wide range of causal HAs and policy concerns. With the application of the SAF to each of these, we will create a significant SSA data set from which we can credibly distinguish those HAs that have the most impact and those types of CZ Systems that are most vulnerable to HAs. These applications will also allow us to understand which policy controls can be considered as independent of the natural characteristics of a CZ system, which controls need to be made specific to a particular CZ, and to which policy changes are public perceptions most sensitive.

Guiding Principles. We wish to stress several points about our strategy in conducting the SSAs.

1) *Issue Focus.* The SPICOSA focus is on delivering the SAF methodology, which within the context of ICZM should not be system or issue dependent. Therefore, this proposal did not choose SSAs with a bias for any particular research activity, policy issue, or CZ system.

2) *Policy Participation.* The SAF intends to be question driven, and in this case, it is primarily policy 'question' driven. The SAF development must remain open and not pre-select for the more tractable problems. For any policy question, it is designed to provide best assessments possible with uncertainties indicated. The serious dialogue with policy and end-users at the very beginning of the project will determine the policy questions for a particular SSA that the SAF will address. Thus, its wide application will uncover the more difficult issues to address and the more difficult impacts to simulate. It will also provide an optimum review of the entire application of assessment to CZ systems.

4) *Multiplicity.* The SPICOSA approach intends to expand our knowledge and policies past single-issue scenarios, in which policy responds to a single impact, is informed by a single indicator, or is governed by a single regulation. The adage, that "every action creates a reaction", belies the reality of complex systems where an action can have multiple reactions and where multiple actions (damaging) can cause irreversible reactions (costly degradation). SPICOSA intends to provide a framework for evaluating these complications where optimizations of cost effectiveness and policy options are fundamental to any sustainable solution.

5) *Hierarchical Level.* The SAF can be applied at various levels of complexity and resolution allowing us to compromise between uncertainty of results and effort per application (hierarchical level). The immutable aspect of these SSAs will be that each application, no matter how simplified, will complete all the components of the SAF. Generally, the more reduced the scale of the problem, the more uncertainty and value will be associated with the assessment. A priori, the hierarchical level of complication cannot be completely foreseen and, for this reason, the SAF allows for iterations on the scope of the assessment (WP 3).

Implementation of Individual SSAs. A host organization will be responsible to form a research team, using if necessary other Partners of the consortium to ensure the implementation of SAF according to Node 2 protocol. International collaboration is encouraged. The SSA teams formed by partners are listed in Table 4. The host may request assistance from other organizations having resources of potential interest to SAF development, some being already identified (see Annex B). A small discretionary sum is allocated to Host Partner responsible for each SSA in order to finance the acquisition of databases or mobilize external expertise from these organizations. The Host partner is singly responsible for maintaining the progress, and report, associated with the implementation set by the SAF protocol prescribed by Node 2.

Coordination and Integration. The WP will be led by the three Node Coordinators, who will divide the 18 SSAs into groups of 6 SSA per coordinator. They will decide the division. Together they will coordinate the SSA activities with the assistance of a committee of representatives from each SSA. Primarily, they will monitor progress, facilitate personnel and information exchange, ensure good disciplinary balance within the SSA Teams, and solve problems on the Node level. This SSA Committee will ensure that each SSA Team is properly constituted and is adequately represented in Node 2. For problems concerning performance, the SSA committee will report to the Executive Coordination Board, and those concerning science or interactions will be referred to the SPICOSA Scientific Steering Committee. In general, the objective of this WP is provide a 'problem solving' mechanism and stimulate a 'sense of community' among the participants that will facilitate their accomplishment of the SSA's goals as efficiently as possible.

Table 4: SPICOSA Study Site Applications

WT	**CZ System**	**State**	**Organization**
7.1	Riga Gulf	EE, LV	**EMI**-UT, IAE-UL
7.2	Gulf of Gdansk	PL	**MIG**, DEEMO-UoG
7.3	Oder Estuary	DE, ES	**IOW**, IOeW, KMG, EUCC-Med
7.4	Himmerfjärden	SE	**SU**, NUE, ENVECO
7.5	Limfjorden	DK	**DTU-DIFRES**, NERI-AU, SDU
7.6	Sonderled Fjord	NO	**IMR,** BUC, NCFS
7.7	Clyde Sea	UK	**SAMS**, NUE, UoP
7.8	Cork Harbour	IE	**NUIC**, CU, ENVISION
7.9	Scheldt Delta	NL, BE	**DELFT**, RIKZ, VITO, IVM
7.10	Pertuis Charentais	FR	**IFREMER,** CEMAGREF, UBO, SOGREAH
7.11	Guardiana Estuary	PT, ES	**UALG**, CSIC
7.12	Barcelona Coast	ES	CSIC
7.13	Thau Lagoon	FR	**IFREMER,** GEYSER
7.14	Taranto Mare Piccolo	IT	**IAMC-CNR**
7.15	Venice Lagoon	IT	**CORILA**
7.16	Thermaikos Gulf,	GR	**HCMR**, AUTH, EREOPE
7.17	Izmit Bay	TR	**TUBITAK-MRC**
7.18	Danube Delta	EU,RO,BG, UA, UK	**IES-DG-JRC**, IO-BAS, INCDDD, HMI, UoP

(In bold letters, SSA host partner, responsible for SSA team coordination)

WT 7.1 - 7.18 Study Site Applications – Leaders, SSAs Hosts

The Coordinating organization (Host Partner) of each SSA will be responsible for assembling a research team (SSA Team) and conducting the SAF application. It will nominate a qualified researcher as the SSA leader and will be responsible for the timely performance of the SAF deliverables and output. The following topics delineate these responsibilities.

SSA Team responsibilities and organization

1) The Partner Institute(s) must directly or indirectly be responsible for the majority of its SSA Team, that is, researchers directly employed by the Institute, researchers collaborating with the Partner Institute through ongoing research programs, or individual researchers contracted for specific services.
2) Some portion of the SSA Team can derive from other SPICOSA partners. For these cases, researchers in the same country or region should be favoured or those dealing with research area not available within the Partner institute, country, or region. The SSA Committee can judge exceptions.
3) Each SSA Team must follow the SAF protocol and schedule of deliverables, major violations will be result in discontinuation of funds. The SSA Team may request to use other methodologies for major subcomponents of the SAF, but this will require the approval of the relevant WP Leader of Node 2,
4) The SSA Team composition is illustrated in Fig 13; it must be formed and reported in the initial WP status report during Month 1. The Team Leader will have a Steering Committee composed of four of the Team's participants in Node 2, with each of the ESE dimensions present. They must also form two external groups of Policy-Stakeholder participants and of contacts for community outreach activities. They will also nominate researchers to coordinate with the academic field training of WP 13.2; and a person with communication skills to assist the news letter and other tasks of the WP 11.2; and a third researcher to act as the local expert in the EXTEND™ simulation software.

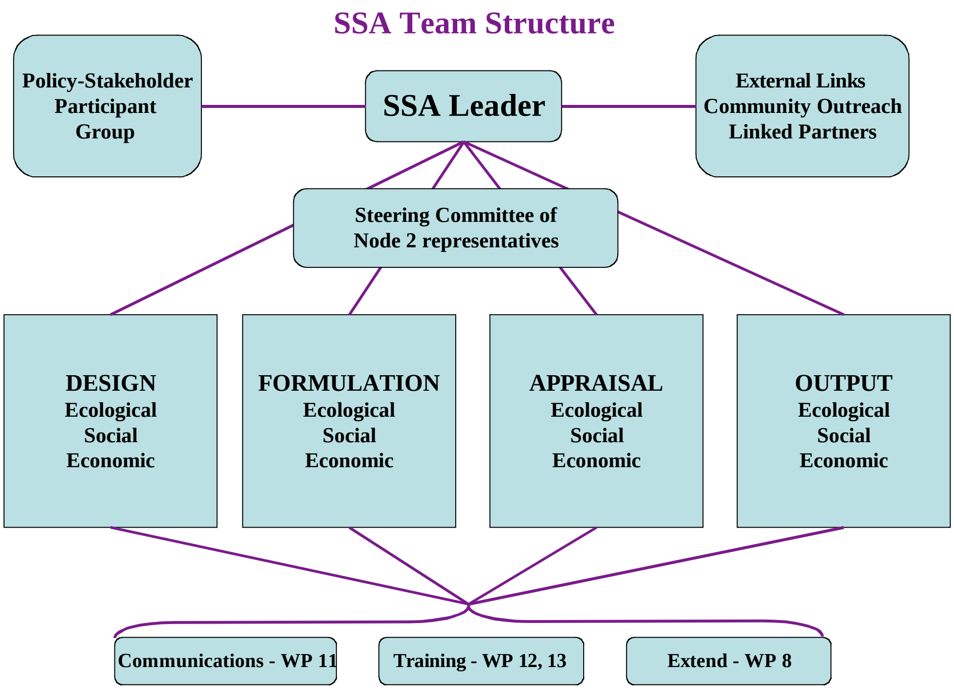

Fig. 13 Organizational chart of SSA team

Tasks for the SSA teams:

1) *SAF*. The primary goal of the SSA Team is to implement the SAF Protocol as best suited to their particular CZ, their Policy Issue, and their resources. For the execution of their WT, they will follow the major guidelines established in the Draft Versions of the SAF (from Node 2). Some examples of these guidelines follow:

- They may manage the work for each Step as they prefer. However, we are encouraging rather continuous communications among SSAs such that problems and the approaches to them can be anticipated.
- The Work Tasks (of each Step) are generally ordered in sequence, however those subtasks of these WTs that are not dependent on previous subtasks may be initiated at the discretion of the SSA Team Leader.
- If they have major modifications (level to be defined), they must gain the permission of the Node Coordination and must document the deviations in order that they can be evaluated.
- The SSAs will adhere to a report-as-you-go format in order to simplify the reporting process and to monitor progress. Electronic modules for this purpose will be supplied.

2) *Deliverables*. The primary deliverables during the course of the SSA implementation involve the submission of the report/critiques for each of the SAF Steps, and the final summary report towards the end of the project. These dates are given in Sect. 8 for the 18-mo plan. These fall into three categories: those reports of readiness and completion that are submitted to the Node Coordination; those report at the end of each SAF step in which the SAF draft chapter is critiqued relative to each particular SAF, and the final completion of the SAF Protocol relative to each SAF application.

3) *Meetings*. In general the SSA Team will conduct four types of meetings: those internal to their team and organized independently, those with other SSA Teams organized with permission of the Node Coordination, and meetings with Node 2 strictly scheduled according to the SAF schedule, and special meetings in which SSA representative(s) would attend on invitation by other components of the Project (e.g. for communications, Extend training, Node 1 interactions, etc.). Scientific or professional meetings presenting SPICOSA results but not formally part of the Project are encouraged on the condition that a summary is provided to WP 11. The Meeting Schedule is given for the first 18-mo plan in Fig. 17, Sect. 8.

NODE 4, Support and Services

Coordination: P.6 VITO & P.3 IAMC-CNR

This Node provides a semi-independent source of technical support and services that are focused on the application of the SAF protocol in the SSAs.

The work packages of Node 4 (Support and Services) serve an important function for the IP. Since the SSAs are necessarily constrained to a prescribed schedule, they will not be able to contemporaneously consider technical options and information services. Furthermore, much of the required support and services are shared in common among the SSAs. Consequently, these common requirements are grouped into this Node as Work Packages dealing with aspects of modelling, information management, alternative strategies, and communication and dissemination. The first two are mostly concerned with internal support and improving the SAF protocol; and the second two have more to do with offering alternative strategies for policy consideration and informing the public and stakeholders about SPICOSA activities and results. The four WPs will interact differently with other Project WPs. In general, they will encourage model diversity, explore options relating to policy choices, improve observational monitoring, and promote researcher-modeller dialogue throughout the project. Furthermore, the Node 4 products will serve a larger community than the immediate needs of the SSAs; that is, some of this information will serve to enrich the final policy deliberations and it will be annexed into the SAF Portfolio for future users of the SAF.

The general Project caveat, which requires us to minimize development effort, applies particularly for this Node. That is, new methodological development and technical (software) generation or observations will be limited to a minimum, and our effort will be devoted to reviewing and adapting the most appropriate methodology, software implementation, alternative strategies, and observational techniques. Because the SAF is designed to be updateable, future applications can evolve through the insertion more sophisticated methodologies as they become available.

WP8 – Model Support - Leader, P.6 VITO

This WP facilitates the use and adaptation of existing models for SSAs in order to avoid major, model development within any particular SSA. It will assist with adaptation and integration of various support models (e.g. regional meteorological models, numerical circulation models, hydraulic watershed models, network analysis, trophic web models, neuralNet models, beach erosion models, input-output models,…) into the SAF simulation software and make them available in a model library. Key elements in the assessment are the capacity to deal with time dependency among sub-models, integrating sub-models operating at different spatial and temporal resolution, synchronization of processes, methods for aggregation and disaggregation of processes at different levels of detail, etc. This WP will review the existing R&D work in the areas of Model Integration, Integrated Assessment Modelling, Simulation software, and related fields with a view to select a state of the art methodology, architecture for SAF modelling needs. It will focus on implementing the concepts of Model Building Blocks (MBBs) and spatial-temporal coupling for use in SPICOSA.

The WP offers a means of testing and comparison of diverse software environments and of locating the best available input data, which again helps to relieve the burden on the SSA researchers. This WP is closely linked to Node 2 (SAF development), Node 3 (Study Site Applications), and WP 9 (SAF Information Management). Any choices of support models are subject to the dual constraint: that their implementation in a particular SSA will not inhibit its implementation relative to the schedule; and that the SAF itself must be flexible and updateable relative to different applications.

In order to specify clearly the work tasks and to expedite the initiation of the Project, we pre-selected the system and spatial softwares to be employed for the SAF. This does not mean that future users of the SAF would be bound to these softwares, as long as the software is easily programmable and not be specific to a particular user or CZ situation. The two softwares selected are 'Extend' for the time-simulation of the Policy Issue and the 'PCRaster' for adding a capacity to compute and visualize on systems variables on spatial grid at a GIS scale. Both of these have several characteristics essential for implementation in the SAF ((cf. Sect. 6.1.2 b) 2)):

- They are user friendly and allow a non-modeller to design a model solution for their specific problem.
- They are flexible and capable of handling and including large amounts of data in differing formats and/or of embedding data into the source software.
- They both have script language amenable to coupling with other computational software.

While this complementariness will enrich our capacity to provide valuable output, we could greatly increase this value and utility to the SAF by constructing an interface between them that would allow them to be run simultaneously (WT 8.2).

WT 8.1 Model Evaluation – Leader, P.6 VITO

This WT reviews existing models and evaluates them relative to SPICOSA applications using a quality assurance approach. A list of potential candidate models for consideration will be compiled in the start-up phase of the Project. The evaluation and availability must be concluded before the initiation of the SSAs with WP3. An overall emphasis for this WT is to work with, not for, the SSAs and to encourage model diversity and the researcher-modeller dialogue.

Besides the classical criteria for evaluating models (cf. Parker et al., 2002), further tools for quality assurance of model implementation have been developed in the ongoing EU Hamoni-CA and Harmoni-IT projects for implementing the WFD, which is described by Scholten et al. (2004). This offers a computer-based guidance for all water management domains, different types of users, different types of modelling purposes (planning, design and operational management), and different levels of modelling complexity. It allows keeping track of all steps and modelling work and facilitates communication and cooperation within modelling groups (http://www.harmonica.info/index.php).

The specific subtasks for WT 8.1 include:

1) An evaluation of potential support models will be made before the beginning of the SSAs and evaluated at the end of the Project.
2) Building model identity cards: list of variables, equations, parameters, forcing functions, boundary conditions, spatial and temporal resolution, range of applicability;
3) Applying quality assurance approach: checklist of model development and application stages, including validation procedure and sensitivity analysis; and
4) Providing guidance for the selection and use of model tools for common CZ issues.
5) Assist in the training and use of the SAF simulation softwares with WT8.2 and 13.2.

WT 8.2 Model Coupling – Leader, P.45 PC Raster

This WT pursues techniques for linking together multi-process models and spatial information models. Its specific objective is to develop a software-interface between PCRaster (a GIS-based environmental modelling language) and Extend (an dynamic simulation software). In accomplishing its goals the WT will collaborate with projects pursuing similar goals, as the aforementioned Harmoni-CA and Harmoni-IT, and will adhere to current standards, or standards under development (such as the OpenMI, Open GIS, etc.).

The PCRaster is a GIS software tool that allows for the creation of spatial models by user experts. Main focus of PCRaster is on model formulation, while it uses a relatively flat data-model. Thus, the focus of the model developer is on process-model formulation, and less on IT-related side issues. The main objective for integrating PCRaster within the SPICOSA project is to make this methodology available for the SAF protocol and provide the necessary documentation and training. PCRaster will develop a scripting environment for model construction, such as to logically integrate the PCRaster modelling framework to the EXTEND modelling environment.

During the project, the linkage between spatial models and EXTEND will be developed at several levels, each with a higher level of complexity and integration. The lowest level, at which we will start developing spatial models, will be a prototype spatial model that will demonstrate the added value of spatial models in the SPICOSA project. An already developed model will be redeveloped in the spatial environment, such that location becomes an important aspect of the modelling exercise. This redeveloping an already existing model should demonstrate the added functionality and value of having the option to develop spatial models in an ICZM-DSS context. An existing model will be used in order to have the focus on applicability of spatial models as such, and not having to discuss model development and model validity as part of a demonstration exercise.

The PCRaster environment will be critically as to whether the PCRaster tool is suitable for the spatial modelling tasks of the Project, and if so, a set of criteria will be developed for the needed functionality of the spatial models, In the expected case that the interface between PCRaster and EXTEND proves successful, we will design and develop a prototype interface between EXTEND and PCRaster. With this prototype interface, several spatial explicit (prototype) models can be developed for the various SSAs.

The specific subtasks for WT 8.2 include:

1) Conduct a requirements analysis relative to the needs of the CZ end-users for the coupling of multi-process models and spatial information models.
2) Adapt the PCRaster software for use as a GIS spatial modelling tool for the SAF protocol, including model training and user assistance.
3) Develop the prototype interface between PCRaster and Extend softwares at several levels of application from file-transfer to parallel-time modes.
4) Develop visualization tools for spatial presentations of SPICOSA results for the SAF Output Step and the Deliberation Support Tools.

WT 8.3 Model Library – Leader, P.6 VITO

This WT assembles and documents a set of generic Model Building Blocks (MBBs) in EXTEND™ or compatible software that represent key processes or components of CZ systems for insertion into a SAF Model Library. It will analyze the extent to which typical ICZM models, techniques and tools can be represented and implemented in a set of pluggable MBBs in a scientifically correct and technically practical manner so that new integrated models can be configured more easily, more reliably, faster, and without the need for rewriting model code. To the extent possible, this Model Library will contain open source material available for free distribution. The work will be carried out in very close collaboration with WT 8.2, which develops the modelling environment for building coupled models utilizing the MBBs from the library.

The Model Library should be considered an extension of the SAF and serve as a mechanism for its greater integration and further development and usage beyond the lifetime of SPICOSA. MBBs will represent key processes, typically required in an integrated model representation of the Coastal Zone, e.g. the process and component models created as part of WP 4 and 5. Other MBBs will be analytical and/or interfacing tools for making large databases accessible, converting data into formats compatible for the SSAs, carrying out interpretive analyses, and post-processing of model output. Each MBB entered into the Library will include their scientific documentation (model identity cards), their validation data together with the environmental conditions in which the model was validated, and all mathematical formulations used in the MMB. That is, the entries in the Library must be prepared for their unambiguous application in SSAs or for future applications. Understandably, aspects these MBB entries may be updated during the project.

The sub-tasks of WT 8.3 are:

1) Provide operational standards, guidelines and procedures for submission of MBBs to the Library and for their scientific documentation. Conduct this in close collaboration with the participants in the WPs 4 and 5 Modelling and with the SSAs as possible.
2) For each MBB entry, include working examples, documentation, validation, and references to the original developers. Describe the model inputs and analytical instruments required for the grounding, calibration, sensitivity analysis and validation of the MBBs as well as for the interpretation and assessment of their outputs.
3) Work with WP 9 to insure proper MMB availability through an Internet based portal for the distribution of model library, its reference material, and a MBB users' page (WT 9.2).

WP9 SAF Information Management Plan (SAF-IMP)- Leader, P.35 Uni-HB.

This WP creates a management plan for the data and information generated both during the project (for SPICOSA Users) and for future SAF users in the CZ. The development of the SAF-IMP to efficiently handle the data collection, archiving, publication, dissemination, and visualization is an essential component of the SPICOSA Project. Scientific information represents an investment asset that needs adequate protection and management. While the SPICOSA research will not acquire much data, in aggregate the SSAs require the use of very large, distributed, heterogeneous sets of CZ data as inputs (i.e. hydrological, biogeochemical, geophysical, ecological and eco-toxicological data), and they will generate a large quantity of data and information output. The SAF-IMP will rely on international protocols and standards to set up an information repository and provide the facility for storage and delivery adapted to the needs of the Project and compatible with GEOSS. As a matter of fact, the partner leading this WP is already involved in and contributing to GEOSS within the GMES initiative, the INSPIRE directive and the MAGI committee. This will continue as a mutual benefit exchange for SPICOSA, which will actively receive information and data from GEO and will in turn deliver information and data to GEO.

In creating the SAF-IMP, we will match up-to-date specifications, follow the fundamental policy of open exchange for scientific and educational purposes, and ensure the condition concerning Intellectual Protection Rights (EU FP6 Guide for IPR, the World Information Property Organisation's copyright treaty). The SAF-IMP will commence immediately during the start-up period in order that sufficient that data and information are available during the design phase (WP3) of the SSAs; and the information necessary for the link with policy and end users is available during the output phase of the SAF in the SSAs.

SPICOSA will rely primarily on work previously performed or ongoing in the ICZM related information sector (cf. EC Theme F: Information needs, INSPIRE, COASTBASE, EUROSION, CoPraNet, ENCORA, COREPOINT). We stress that the SAF-IMP of WP9 will be constructed from existing designs for information search and access and adapted, and to the needs of SPICOSA. The minimum specifications for the SAF-IMP are that it be:

1) Comparable inventory (for global integration),
2) Option to properly secure and preserve data for the long term, and
3) Treated according to international standards and protocols (quality control, meta-information, identifier, release, etc.).

WT 9.1 Data Access & Dissemination – Leader, P.35 Uni-HB

This WP will provide all SPICOSA scientists with support, recommendations, guidelines, and priorities regarding information and data. It will coordinate the establishment of a specific, central electronic Internet-based SPICOSA data portal ("gateway"), promote the SPICOSA data policy, and assist in the development of national SPICOSA data-management efforts. The information/data will have the characteristics of a flexible inventory that will collect the metadata about process formulations, validation data, input data, and output data for every SSA. It has the following sub-tasks:

1) Provide storage for common datasets, supportive observational data, model data, and all other relevant information in compliance with the IPR for the Project and in accordance with relevant international standards and protocols.

2) Rescue historical European data sets, archive scientific information (i.e. data, meta-information, text/image/etc, library/catalogues, etc.) relevant to risk-based management of the water-sediment-soil system at river-basin scale.

3) Develop a flexible, user-friendly, electronic portal/gateway for online access and dissemination of SPICOSA data (process formulations, validation data, input data, and output data for every SSA).

WT 9.2 Interactive Tools – Leader, P.23 DISY

This WP provides web-based tools for the inventory and description of SPICOSA data and information; and it includes a communication facility and visualization interfaces for geographic information, for the output of each SSA, and for the MMB Model Library. Its objectives are:

1) Set up the inventory including communication and visualization interfaces for the SAF Output Portfolio for each SSA and the final project reports, i.e. multimedia information in the form of models, text, graphs, images, animations, multidimensional displays etc.
2) Archive and make available the metadata of the SAF Model Building Block library produced in WT 8.3

WP 10 – Alternative Strategies – Leader, P.3 IAMC

This WP evaluates technical options for management and monitoring to reduce damaging practices of Human Activities and constructs a globally sorted information base concerning the effectiveness for various ICZM policy strategies. The output of this WP will enrich the scenario options during the design phase (WP3) and the output-recommendations during the final Information Portfolio (WP6). This WP is organized in three logical Tasks categorized as: Policy Instruments, Technical Options, and Diagnostic Monitoring.

An effective ICZM requires that national and local political authorities accept and facilitate the implementation of relevant EU policies. This is not an easy task considered the large variability of situations and interests. The involvement of stakeholders is a key point; on one hand, they can simplify the implementation phase of decisions, and on the other hand, they can offer the opportunity of new directions. A logical political planning is possible only if a sufficient number of data is available of good quality (validated data) obtained using reliable and comparable techniques and compatible methodological approaches. This is not always the case. Only after such common baseline is established, it will be possible to compare results and effects of strategic choices. This WP would assist decision makers by costing the effectiveness of new or alternative strategies and techniques and better observational methods for monitoring environmental changes. For example, in considering policy changes directed at reducing the impacts of a pollutant SPICOSA would simulate costs and optimizations for source reduction, buffering processes during the dispersion of a pollutant, strategies to prevent its uptake in the biological components of the system, remedial actions to remove the pollutant to tolerable levels, and effective monitoring to ensure success. Any kind of innovation must be at the same time an improvement with respect to a Business As Usual (BAU) scenario and cost-effective.

In developing the SAF, we are seeking clienteles for the SAF and for its continued improvement. We are not planning that the researches of the SSAs will be the only users of the SAF and its derivatives. We feel that efforts of WP10, together with the other support WPs, will prove cost-effective for the project because they will make the SAF methodology more flexible and marketable. Practically speaking, we cannot ensure these first SSAs, will be able to thoroughly satisfy the Policy/Stakeholder communities, nor can we exhaust the suite of alternative strategies or technologies that might be introduced to provide more complete answers. But by accumulating information (as WP10) and my making it available in the final deliberations will add greatly to the credibility and utility of the SAF. The proper time to conduct such information surveys is to do so when their worth can be appreciated and evaluated, and not after or before the exercise.

WT 10.1 Policy Instruments – Leader, P.8 BUC

This WT reviews advantages and disadvantages of different types of policy instruments (e.g. land planning, taxes and subsidies, market based instruments) and policy implementation schemes (e.g. central management, decentralisation, co-management, polycentric approach) with reference to available literature on ICZM and in reference to ongoing policy experimentation, within the EU region and globally.

This WT focuses on identifying published and unpublished policy research or policy review papers in the area of CZM but also theoretical material on the institutional analysis of public policies in the broad areas of environment and local development. Information about experiences in designing and implementing ICZM policies around the world is much dispersed and not always readably accessible. However, a global review of policy experiences, when sorted in terms of institutional alternatives, is much more feasible. Such a review would provide a good critical background for the effectiveness of policy options at national or local level within the framework of SPICOSA SSAs. This material will first be identified, classified and made accessible for the use of researchers within SPICOSA. Access will be given through an information source developed by SPICOSA IP that will include links to already existing external information sources. This WT will take advantage of the large partnership of SPICOSA to collect material published in different European languages, so that works published in other languages than English can be given visibility that is more international. For this task, competence in policy analysis within the SPICOSA partnership will collaborate with partners in charge of information distribution.

The sub-tasks of this WT will be:

1) Develop a reference database and organize the search for existing sources of information and to collect complementary documentation using SPICOSA partnership as well as contacts with global information bases
2) Generate a dedicated searching tool for policy analysis material.
3) Review this material and prepare a classification structure as well as a dedicated thesaurus.
4) Make the searching tool and interactively available to SPICOSA researchers, particularly during the final deliberations with policy and end-users, WP 6 SAF Output.

Beyond these operational objectives, a further goal of the WT is to create the minimum conditions for and evaluate the feasibility of an European initiative dedicated to institutional analysis both by worldwide information sharing and methodological development for research on institutions and policies (cf. http://www.indiana.edu/~ifri/aboutifri.htm).

WT 10.2 Technical Options – Leader, P.10 MRC-TUBITAK

This WT investigates those advances in available technology (e.g. remediation, pollution reduction, aquaculture, geological risks, etc) that could provide policy options to reduce damaging practices of HAs. The objective is to evaluate technical alternatives that can be inserted and evaluated as policy options for enhanced sustainability. These would include a large set of new alternatives that may not yet have been introduced as options in any given CZM situation, e.g. concerning bio-remediation, pollution reduction, aquaculture, geological risks, biodiversity conservation, system rehabilitation, etc., that could reduce impact of damaging practices of Human Activities or reduce the cost of implementing sustainable strategies. Obviously, the immediate scope of this WT would be restricted to the CZ situations exposed to the SAF applications in Node 3.

In many cases, new technologies and strategies are available but have not been implemented. However, in many other cases there is insufficient application of control measures, which could reduce pollution dissemination and transfer within the CZ, such as: control of sewage disposal, correct land-use planning and buffer-zones specification, severe control of industrial outfalls, benthic-re-colonization, shoreline protection, containment ponds for construction sites. Importantly, the use of integrated technologies can result in much better results than the application of single technologies. The information classified through the SSAs will provide a pool of information out of which it will be possible to trace a baseline for existing technologies and design new interventions that may result in higher performance and better CZ quality, not necessarily at higher costs. The developed and elaborated technical options then will be experimented in selected appropriate SSAs in Node 3 to test and verify their relevance to SAF applications.

During the start-up period, this WT will review the availability of effects of application of BAU technologies and list potential new technologies or combination of technologies. During the Design phase in the SAF, when the Policy Issues are decided, the WT will select a subset of alternatives to evaluate relative to the studied issues. These will determine the specific deliverables. Importantly, not only the technology must be evaluated from the point of view of its implementation but its collateral effects on the system also need to be evaluated with the SPICOSA IP approach. These aspects and criteria will be introduced in the SAF Design step (WP 3) and will accompany the Output (WP 6). In cases where local-regional-national planned actions exist, these will be examined, classified, and analysed for their short-medium-long term effectiveness in order to validate policies and guide their future interventions. Moreover, positively evaluated options from one SSA will be incorporated into the Output and DST of other SSAs, whenever relevant.

In the following list, we outline some examples of technical options that might provide attractive cost-wise options to ICZM and which could be introduced into the simulations:

1) Use of in-situ clean technologies that do not disturb the ecosystems, while reducing the pollutants concentration (like enhanced natural remediation).
2) Requirements for risk-analyses to accompany any intervention.
3) Promotion of natural remediation (by microorganisms, seaweeds, etc.)
4) Implementation of poly-cultures as a means for controlling specified contaminants.
5) Implementation of correct immobilization/mobilization techniques for controlling the bioavailability of contaminants.
6) Use of wise monitoring of point sources from urban and agricultural areas and from industries or construction sites in order to regulate illegal discharges.
7) Use of methodologies for protecting at-risk organisms or communities that are high ecological value and/or high commercial value.
8) Design methodologies that improve the quality of marine protected areas.
9) Long-short term cost assessments of designs for non-invasive Habitat Development.
10) Promotion of Sustainable Water Management and Reuse concept/techniques in connection with decentralized management for coastal zones to cope with water scarcity.
11) Engineering structures that favourable enhance estuarine flushing or that benignly reduce shoreline erosion.

The sub-tasks of this WT will be:

1) Conduct search for demonstrated technical strategies and classify them and cross-reference them relative to CZ issues. Provide information to WP3.

2) Document these strategies with supportive information (e.g. extent of use, up-front cost, evaluations of effectiveness, etc.) concerning these and report to WP4.
3) Work with Node 3 for specific scenarios of each SSA in order that the technical option(s) can be inserted into the appraisal and output portions of the SAF.
4) Summarize the information and its use in a final report.

WT 10.3 Diagnostic Monitoring – Leaders, P.16 UoP and P.3 IAMC.

This WT identifies those advances in instrumentation and sampling strategies that would most efficiently permit diagnostic information concerning CZ ecosystems' function and permit assessments of policy effectiveness.

Generally the purpose for data acquisition of natural systems has been for other than diagnostic purposes, i.e. mostly for spatial/temporal distributions or in response to specific needs, such as process or impact studies, etc. The SPICOSA approach is emphasizing the capacity to make prognostic projections of a natural system's response, which requires a well-designed, efficient data set that extracts information for validation of models that can serve as surrogate data for tracking the system's function. Attention to such diagnostic monitoring would save considerable funds in the long run and would provide in return much better prognostic estimates for better management of CZ resources. It is anticipated that such a shift in observational emphasis will be needed to support the information requirements for EU directives related to sustainable development in the CZ.

The information from this WT is meant to assist SPICOSA during the interactive exchanges with those Policy questions that ask what better techniques or sampling strategies are available to improve compliance with or reduce the costs involved in a policy change and/or to facilitate EU directives related to sustainable use of the CZ. The appropriate observational priorities for improving the process or data input required by the SAF will frequently differ from those conventionally. The SAF data emphasis is on identification of sources, on monitoring the system at 'choke points', and determining spatial inventories of system properties.

Chemical, electronic, and remote analytical techniques have experienced a great improvement in the last decade but they have not been adapted to provide CZ observational support for the SAF assessments. We propose that these assessments could be of much greater utility with the use technologically advanced instrumentation, such as fast monitoring, continuous monitoring, and telemonitoring, and integration of analysis techniques for linking contaminants to their source in CZ systems. Such source identification is of great help for suggesting actions to policy-makers, in order to minimize the negative impacts on the CZ. In addition, the integration of chemical and biochemical essays and technologies must be pursued as a means for understanding the impacts and reducing the effects. New techniques may simply result from a coupling of already known techniques independently used for the observation of the CZ, e.g. satellite continuous monitoring with in-situ checkpoints. Once validated, such techniques could result of great significance in fast and continuous monitoring. There are many areas where better observational techniques could greatly assist in identifying, tracking, or diagnosing issues connected with CZ natural systems, particularly when their use is designed to provide the variables needed for systems indicators as prescribed by SPICOSA and other ICZM recommendations. Thus, by integrating diagnostic observations and systems assessments a much better cost/information-benefit ratio results for both the decision-maker and the researcher. Some examples of these areas are listed, as follows: Land-use mapping, biodiversity conservation, pollution tracing, remote sensing, geological risks, watershed drainage, eco-genotoxicology, sea level, and estuarine flushing.

The sub-tasks of this WT will be:

1) Conduct search for state-of-the-art observational techniques, classify them, and cross-reference them relative to CZ issues.
2) Document the appropriate use of these observations relative to improving input data for SAF models, indicators, and assessments.
3) Construct issue-related observational packages for the SAF Portfolio based on a consensus among SPICOSA, and other EU projects. These would integrate diagnostic observational strategies with dynamic assessments related to the more common issue combinations resulting from the SSAs.
4) Summarize the information and its use in a final report.

WP 11 – Communication and Dissemination – Leader, P.7 EUCC-Med

This WP aims at informing relevant policy makers, related EU project teams and policy initiatives, the broader coastal community, and the public about the concepts, progress, and results of the Project in a way that is easy to understand and relevant to them.

Addressing the public is important, because public support for and pressure towards policy changes need an informed public. Furthermore, this WP also aims at supporting Node 1 in collecting and channelling feedback on interim products from the stakeholders to the project team. As to methodology, a Dissemination and Media Plan (DMP) will outline dissemination tools that ensure efficient and targeted spread of information and knowledge to the various end users of project outputs. Keeping the researchers in the relevant complementary projects and policy operatives well informed about SPICOSA and vice versa will facilitate strategic cooperation.

WT 11.1 Dissemination and Media Plan (DMP) – Leader, P.7 EUCC-Med

This WT develops a structure for efficient dissemination and monitoring of success on the European level. To that aim, a Dissemination and Media Plan (DMP) will be developed and frequently updated, which outlines communication methodology and distributes responsibilities within the team. It will contain, e.g., the format of a Project brochure for the broader stakeholder community that informs about interim and final project result, or the aim and structure of the public project website, which will be integrated with web-based internal project information produced under WP 9. Furthermore, the DMP will list major upcoming expert events and media opportunities at which at least one SPICOSA team member should participate, e.g. in the form of presenting a paper or distributing information material. It furthermore lists publications where SPICOSA papers or articles should appear. The DMP will be frequently updated and its implementation will be monitored.

Implementation of the DMP will start immediately. By the end of the first 18-mo period, one brochure will have been produced, the website will have been updated and integrated with internal web-based information (see WP 9 and WP14), and several SPICOSA presentations will have been given.

This Work Package will facilitate the establishment of a Communication Team with representatives of different Study Site Areas and other Work Packages, which will have the function of screening scientific outputs for their public news value, processing this information in adequate format (news release, popular science news format), and marketing it actively. Special emphasis will be put on outreach to the public in and near the SPICOSA Study Sites as the results of study site applications will be much more tangible than the purely conceptual outputs of the project. The target audience of such outreach activities is also more easily defined. Therefore, each study site team will appoint a Communication Officer who will join the Communication Team and be responsible for developing and implementing a local dissemination and media plan.

For the Communication Team members, a workshop will be organised at the beginning of the project to train them in fulfilling their SPICOSA related communication tasks and to streamline the SPICOSA communication style. During the workshop, the participants will agree on mechanisms for collecting feedback from the stakeholders and channel this information back to the Node 1 team in order to allow for adjustment at the conceptual level. A format for reporting on communication activities will be established.

A SPICOSA Newsletter will be launched and published every four months electronically. It will inform the interested public about achievements of the project and provide practical information such as announcement of expert events or training opportunities. The Newsletter will be distributed to thousands of e-mail addresses making best use of for example the EUCC and the ENCORA databases of coastal stakeholders in Europe. One issue of the Newsletter on four will be a special issue in the format of a policy brief reflecting the state of the art for ICZM policy issues and main findings for the IP. This special policy issue will be printed out and posted to a mailing list of top decision-makers in the area of coastal management in Europe (Ministers, MPs, directors in national and European administrations).

The first interim assessment of public/stakeholder outreach is due at the end of the first 18-month period. It will lead to an adjustment of the DMP for the remaining project period.

This WT encompasses the following sub-tasks:

1) Develop the DMP and coordinate its implementation
2) Conduct a Workshop for the Communication Team
3) Design and maintain a public website for information dissemination
4) Create a Project brochure and an Electronic Newsletter

WT 11.2 Inter-project Exchange – Leader, P.49 RIKZ

This WT organises effective liaisons with international projects of major interest for the objectives of SPICOSA in order to achieve greatest possible synergies.

To this aim, exchange of information will be facilitated, making use of among others the ENCORA project, which coordinates national coastal networks in 13 European countries and 10 trans-national theme networks on specific coastal management issues. The partner search mechanisms of ENCORA will help SPICOSA partners to establish contacts with other relevant projects. Inversely, coastal institutions in Europe that can benefit from work and expertise of SPICOSA will be brought in contact with relevant SPICOSA partners. They will receive information on SPICOSA and will be stimulated to make use of the tools and expertise developed by the project. Links to other projects of obvious relevance to SPICOSA such as SEAMLESS, SENSOR, THRESHOLDS, PLUREL or MOTIVE or policy initiatives such as the EU ICZM Expert Group will be systematically established. Whenever feasible, cooperation with such projects and initiatives will be facilitated, e.g. for the provision of data, exchange of experience, or joint dissemination activities. If necessary and possible, additional funds will be raised to deepen cooperation with such initiatives (see Table 2).

Sub-tasks of the WT are

1) Establish an inventory of the most relevant research projects to be contacted,
2) Inform relevant project leaders, e.g. through ENCORA mechanisms, about SPICOSA results and possibilities for collaboration,
3) Establish and maintain close cooperation with selected projects whenever mutually beneficial.

6.2 Demonstration activities

No demonstration activities are foreseen in this Integrated Project.

6.3 Training activities

All training activities have been group in one Node and divided into two Work Packages.

<u>NODE 5, Knowledge Transfer</u>
Coordination: P.13, NUIC

Effective training is imperative to the integration of new knowledge into the researcher and user populations and to promotion of public awareness about existing options for Sustainable Development in Coastal Zones.

This Node will undertake to develop a comprehensive training programme, with a particular focus on the scientific and methodological approach utilised by SPICOSA. The programme of work described here is targeted specifically towards addressing academic training needs (WP12) and professional training needs (WP13). Training experts will be identified from the SPICOSA community working in the SSAs. This WP provides an important opportunity for adding value to the knowledge base that will be developed over the lifespan of the SPICOSA project.

WP 12 - Academic Training - Leader, P.11 UALG

Society needs a pool of well-trained individuals who are aware and knowledgeable about the links between Science and Policy at the European scale. The general public must also be well informed in order to improve the effectiveness of public participation in policy decision and to support the conversion to sustainability.

Academic training is dedicated to the enhancement of European capacity to deliver sustainable costal systems, within the framework of the EU-ICZM Recommendation and the EU-Water Framework Directive. The SPICOSA methodology acts as a tool to facilitate analysis and interpretation of socio-economic, institutional and environmental information and to promote good governance and management of European coastlines.

This WP reviews and supports the development of academic programmes and curricula in disciplines related to quantifying the interactions between society and natural ecosystems in the coast. This WP will support training-through-research programs for Master, PhD students and post-doc levels within each of the SSAs. It will help partners to seek complementary funding to offer Master, PhD or Post-Doc funding opportunities. This WP will also develop training opportunities for post- graduate students, and promote international mobility. Young professionals in coastal management will therefore be aware of issues across Europe. For example, Portuguese students will learn about the problems of ice formation in the Baltic and Norwegian students about hypersaline lagoons in Mediterranean regions. The WP will employ natural links to university, practitioners and training courses, as well as Distance Learning for Life-Long Training. In addition, it will add an important component involving information about alternative solutions and technologies.

This WP will also enable the development of those research and academic staff within Europe whose work is focused on the integrated management of coasts. It will seek to broaden their skills and enable them to participate more effectively in research and training teams given their exposure to the different needs and possibilities of each of the disciplines within an integrated study. In addition, it will broaden the knowledge base available and enable lessons to be transferred from research into the field and from one region of Europe to another.

Strong links with the EUCC practitioner community and the LOICZ scientific community are important and well developed features of this WP. Accreditation of the programmes will proceed through EAEME, The European Association for Environmental Management Education.

WT 12.1 Academic Curricula - Leader, P.16 UoP

The aim of this WT is to provide graduate-level training across the economic, social and environmental sciences required to develop and implement policies for the sustainable management of coastal ecosystems.

Two approaches can be used to achieve such a result at a master’s level, i.e., either through the development of entirely new degree programmes or through the provision of courses (or modules) for use independently or within existing programmes. Both of these approaches will be explored in this WT. The primary focus of the training will be at master’s level but will be extended on a selective basis to PhD programmes.

A survey of the current provision for Masters level training across Europe in Sustainability Science, Earth Systems Science, Natural Resources, and Environmental Economics, and a review of the curricula of non-European universities will be carried out. The results from this study will highlight where resources should be focused. Based on the survey, the WT will initiate new courses in Europe under the ERA and EHEA (European Higher Education Area) perspective and in particular will consider the development of European masters programmes following the Erasmus Mundus format. The European joint master in “Water and coastal management” is already fully integrated in the framework of SPICOSA, and it is proposed that by drawing on the expertise within the IP, further development and dissemination of such programmes will be assured.

This WT will also participate by contributing new ideas and skills to existing courses, which may be seeking to broaden their disciplinary breadth to include, such as coastal geographical or biological sciences. The addition of one or two courses may be seen as an effective way to broaden a programme, which has a narrow focus to produce a greater understanding of the system as a whole. Particular attention will be paid to the need for understanding of the systems approach used as the basis of SPICOSA, to the integration of natural, economic and social science, and for training in the use of tools appropriate to each of these disciplines. Courses from the Masters in Water and Coastal Management will be made available in a web-based format and widely disseminated.

These courses will also be available at the PhD level and will provide an excellent database for training and development across Europe. In addition, funding will be sought for Doctoral and Post Doctoral training from the Marie Curie actions, as they will be defined in the 7th FP. This will be to enable young professionals to move within Europe, throughout the network of participating partners, and to become aware of the needs of science and policy for coastal ecosystem sustainability across Europe and of the tools available to tackle the problems presented.

WT 12.2 Training Experience - Leader, P.50 SGM

This WT incorporates academic participation and offers training at two levels: Early Stage Training (Marie-Curie EST and European Masters) and Doctoral or Post Doctoral training (Marie Curie Research Training Network as well as hosting Marie Curie Individual Fellowships).

Modifications to this plan may be made to adapt to the Marie Curie programmes under 7FP. The study sites in SPICOSA provide a variety of transitional and coastal waters throughout Europe that have different characteristics. These provide a range of different training scenarios for the young practitioners and researchers who will form the basis of the next generation of European coastal managers, policy makers, academics and researchers. Associated with the study sites are well known academic institutions that will provide the institutional training network. It is important to address the different post-graduate levels of coastal training to involve the whole public-manager-policy maker-academic-researcher continuum. Although this is an oversimplification, the Master level is important because it engages many of the practitioners and coastal managers. The Doctoral level engages many of the policy makers and the Post-Doc level engages academics and researchers.

The Early Stage Training will be used to facilitate the transfer of the young researchers (Master) working within this project to different institutions (in different countries) for a part of their study period. The details of the training will be Study Site specific, but particular emphasis will be placed on ensuring crossover between disciplines such as natural sciences and socio-economics to enable wide exposure to varying research skills. This is not to suggest that all researchers should be able to undertake all aspects of an integrated project but rather to ensure the requirements of the different aspects of an integrated project are understood and thus that the participants are able to facilitate each others work.

The Research Training Network will initially involve all the University partners and other interested institutions in the partnership in the project, although some activities will be open to the wider coastal community. It will enable cross-disciplinary interaction through both electronic discussions and workshops bringing together young and experienced researchers from a wide range of disciplines with a common interest in integrated coastal management. It will enable to development of new skills and updating of old as well as broadening the participants understanding of coastal issues around the EU and the needs of research throughout. Particular foci for the workshops will include research techniques, communication and integration of coastal research. The network will also assist in the development of materials for dissemination of project results. The training offered in second countries will be offered with the prospect of introducing European PhD training through joint-degrees between two institutions from separate countries.

WP 13 Professional Training - Leader, P.15 CU

This WP will expand the available professional training to include exposure to ICZM professionals to the holistic SAF of SPICOSA, it will improve its coherence and quality for long-term capacity building for Europe, and it will develop professional training modules for specific applications.

This Professional Training WP provides a significant opportunity to ensure that the outputs and outcomes of SPICOSA research are incorporated systematically into the SPICOSA Professional Training Programme. Limited training opportunities for coastal professionals in Europe prevent them from benefiting fully from advances in scientific knowledge. This need coincides with the SPICOSA objective of strengthening the link between Science and Policy. This WP builds on existing training initiatives such as CoastLearn (Leonardo da Vinci Programme) and COREPOINT (Interreg IIIB) to develop professional training modules for specific applications.

The dearth of training programmes dealing with ICZM as a multi-functional process and targeted towards professionals suggests that there is a lack of understanding of how to adopt an integrated approach to coastal management that goes beyond sectoral coastal divisions and issues. This training activity provides an opportunistic link to the SPICOSA community involved in the development of:

1) Refined methodologies concerned with the Systems Approach,
2) The application of best practice to Study Sites and
3) The development of decision support systems.

This WP aims to expand on the levels and types of professional training currently available by addressing the need for training activities directed towards professionals working with ICZM practices. Direct experience from ongoing initiatives such as the COREPOINT project will provide a strong basis of understanding of the professional training situation from which to work. The target audience will include coastal practitioners and policy makers across a range of sectors (e.g. fisheries, tourism, shipping) and disciplines (e.g. engineers, planners). The approach is to strongly link the material for these training activities to the SPICOSA Systems Approach Framework and to link participation to the SPICOSA Study Sites throughout the coastal zones of the European region.

WT 13.1 Training Network - Leader P.27 DEEMO- UoG

This WT will establish a coordinated approach to professional training in Europe with links to ongoing programs and making best use of the CoastLearn network and methodology.

Through the participation of training experts across a range of SSAs, the WT will analyze the needs of the ICZM professionals, review the effectiveness of current approaches to training and create a training network database. These steps will provide the backdrop for the development of advanced learning packages linked to the SPICOSA methodology in WT13.2.

The WT13.1 will deliver a methodology to identify and describe the target audience and an approach to identify the training requirements of professionals concerned with coastal management. The requirements for training among sector, type and level of audience will vary with the local CZ setting. These distinctions will be taken into account in the development of a professional Training Programme within this WP. The following sub-tasks will be included:

1) *Survey of training needs and skills pool.* A requirements analysis of the needs for professional training in aspects of coastal management will be undertaken across Europe. The work will build on research in this area undertaken in the Interreg COREPOINT and FP 6 ENCORA projects. The user requirements survey will identify the gaps and issues to be addressed by the SPICOSA community, paying strong attention to cultural, language and accreditation issues in the process. An assessment will be made of the training skills that are available to meet/address these needs during the lifespan of the project. This information will be used to develop WT 13.2 below.

2) *Training Network.* A database of existing and new training initiatives will be developed and refined on an ongoing basis. A Virtual Training Tool will be established using Internet technologies to make the learning packages from WT13.2 available to all potential interest groups at all levels of decision-making in a form that facilitates self-learning. This task will inform management about the protocols developed in WP9. A contacts database and email list for course providers will be established to facilitate a coordinated approach, in addition to the organisation of a Training Assessment Seminar to bring relevant experts together in Year 1. The training network will also consider outreach to international training opportunities beyond Europe.

WT 13.2 Learning Package Development – Leader, P.43 ENVISION

This WP will develop learning packages targeted towards the coastal professionals. It will be based on the experience and output of the SPICOSA project, particularly the SSAs. Coastal professionals will identified in WT13.1 as potential clientele for improved learning opportunities.

These learning packages will include both theoretical and practical training, e.g. in the systems approach, causal linkages, economic and social analyses, simulations and observational considerations. This WT will ensure that training material encompasses both methodological approaches and practical examples of good practice. A combination of teaching methods ranging from traditional classroom approaches, distance-learning, and field-based training will be used. The following sub-tasks will be completed:

1) *Introductory learning package.* Some progress has been made in the last few years in relation to the development of generic training programmes to introduce professionals to ICZM concepts. Nevertheless, cultural and language issues are seldom adequately addressed to ensure that maximum outreach can be achieved. This WT will take these issues into consideration in the development and delivery of a SPICOSA “Introduction to ICZM” learning package, initially in two of the SSA’s in Ireland and Poland.

2) *Advanced ICZM learning package.* – An Advanced ICZM learning package will be developed in consultation with the SPICOSA training partners based on an enhanced understanding of ICZM as a process of management, taking the System Approach and European ICZM policies (e.g. Water Framework Directive & Marine Strategy) into consideration. The learning package will be developed so that it is easily transferable to local situations. It will be delivered initially in the same SSA’s in Ireland and Portugal to enable observations of the progress of professionals who advance from an introductory stage through to an advanced stage of training. The roll out of the learning package into other SSAs will be initiated by the Training of Trainers to facilitate long-term Europe wide sustainable capacity.

3) *Training of Trainers.* All of the professional training partners directly involved in the WT will participate in one early and one advanced training course in Ireland or Poland in addition to the Training Assessment Seminar (WT13.1) and a dedicated Training of Trainers workshop. This will enable the training partners to adapt the learning package to suit local specificity and to build professional capacity for their local study areas. Methodologies will be developed to monitor and assess the impact of the training activities in each of the relevant SSAs.

6.4 Management of the Consortium activities

Management activities are grouped under WP 14 .

WP 14 – Management Activities - Leader, P.1 IFREMER – Co-Leaders, P.3. CNR-IAMC and P.12 UBO

6.4.1 Consortium Activities

The management of Consortium activities are divided into two areas. One is the administrative coordination, which covers all activities related to consortium management such as contracting, progress monitoring, and financial reporting. The other area is the scientific coordination. To ensure collegial and efficient management, strategic decisions regarding administrative and scientific management are made by two committees: the Executive Coordination Board (ECB) and the Scientific Steering Committee (SSC). Activity reporting and planning will benefit by reviews from two external panels: an External Scientific Review Panel (ESRP) and an End User Review Panel (EURP). The Project Coordinator represents the consortium for contracting purposes and two science coordinators are responsible for the day-to-day implementation of the decisions of the ECB and SSC and for the scientific reporting. They are assisted by a Deputy Coordinator, appointed by the Project Coordinator, is responsible for administrative and financial reporting. The Deputy Coordinator and the two science coordinators form the secretariat of the ECB, which has a physical location at IFREMER in Brest, where a local administrative staff supports the Deputy Coordinator in his responsibilities. Further description these aspects of management are found in Sect. 7.

The main responsibilities undertaken in this WP are :
- assisting activity leaders in realizing the objectives of the project and planned activities in a coordinated manner in all aspects related to scientific, administrative and financial matters,
- delivering on time the reporting accordingly to contractual rules, including scientific report and financial reporting for the first year,
- producing the 18 month period detailed work planning.
- monitoring the implementation of dissemination plan, including production and dissemination of project leaflet, e-newsletter, print out of policy special issues

Work Packages have been aggregated into Nodes where scientific management is partly delegated. Node level corresponds to a management responsibility. Node coordinators are responsible to monitor the implementation of the work plan in each Node and the time allocated to this task is accounted under RTD activities. They form the Executive Coordination Board together with the Project Coordinator, the Deputy Coordinator the two Science Coordinators. The Scientific Steering Committee is formed by members of the ECB and Work Package leaders. The External Scientific Review Panel is formed by invited senior researchers from all parts of the world and the End User Review Panel by representatives of user bodies in Europe, including DGs of the European Commission.

The core of the management consists of planning, reviewing, reporting, and monitoring of activities. Planning, reviewing, and reporting are conducted every year by the management structure of the IP. Fig. 14 summarizes the schedule of planning, reviewing and reporting activities. Detailed work plans are elaborated for 18-mo periods according to IP management rules. They are then submitted for acceptance to the Commission before being contractually translated under the consortium rules. The internal review process is put in place based on evaluation of the work planned and the work realized by external reviewers. The evaluation is requested from the External Scientific Review Panel and the End User Review Panel. Node coordination, work packages and work tasks leadership are considered as part of research activities and should not be reported as management activities. The following activities fall under the management cost category:

1) Activities by the Coordinator, Science Coordinators and Project Manager,
2) Meetings of the two committees of the management structure (ECB and SSC) and related activities, (External Review Panels expenses will be taken under RTD activities of partner 1)
3) Preparation and edition of annual reporting at the coordination level.

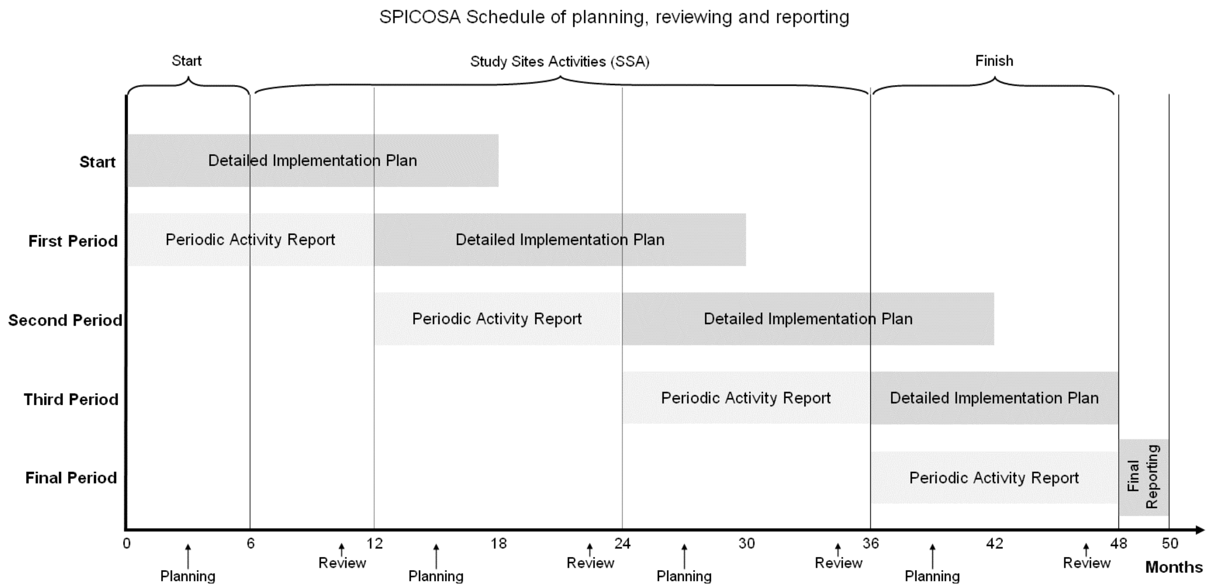

Fig. 14 Schedule of planning, reviewing and reporting in SPICOSA

6.4.2 Responsibilities of activity leaders

Each WP leader will be responsible for the coordination and production of its assigned work tasks through the WT leaders. Each WP will be divided into tasks with each WT having an appointed Task Leader from one partner who will lead a small group of WT member partners in completing the specified tasks. Each WP leader will assume the overall responsibility for the execution of all tasks allocated to that WP and for ensuring good communication between the partner, the Node Coordinator, and the Secretariat, as appropriate to the type of activity. The WP Leader must ensure that its tasks are satisfactorily completed on schedule. Within each activity the WP groups will meet according to the specific needs of the task, under the chairmanship of one of the WP leader within an activity. The Science Co-ordinators and WP leaders, in the format of the SSC, will devise the detailed work plan. In this respect, as far as their administrative structure are adapted to, WP leading organisations will be charged with the funds necessary for their implementation, except salaries of the other participating organisation. The detailed administrative organisation in support of this decision will be formalised case by case into the Consortium Agreement (see below).

6.4.3 Partnership

To construct a balance between this required distribution and a manageable number for the consortium, the partnership was initially limited to one core partner per country, generally a marine research institute, with a few exceptions to augment missing expertise or to ensure a better coverage of issues. Most of these institutes present a wide range of multidisciplinary competence in marine and coastal sciences. Even so, the number of available scientists in the social and economic sectors as well as for land-use was insufficient. For this reason the partnership was extended to a significant number of Universities and other research organisation with personnel active in the needed areas of research. This strategy also greatly increased the Project's academic exposure for a more successful impact in the area training new researchers and professionals. A limited number of SMEs and large private companies have then been invited to join to ensure the participation of commercial interests. They will contribute with the support and methodological activities in the following areas of expertise: modelling, software development, data management, mediation, and conflict resolution in the coastal zone. They have been selected on a complementary basis in order to avoid major conflicts of interest. To a ensure broad dissemination of the results among the end-user communities, a large European network of CZM practitioner and researchers (EUCC-Med) has also been invited to join the partnership.

a) Distribution.

The distribution of the consortium partnership is necessarily large for several reasons:

1) the great range of disciplines that are required to quantify and interpret the desired Information Feedback Loop (Fig. 1),
2) the large range of environmental conditions and policy concerns that must be included in order to render the exercise credibly applicable to the European region, and,
3) the need to integrate academic and applied sciences, to promote training and commercial interests and to generate a level of involvement sufficient to ensure a long-term followup.

On this basis, a consortium of 54 participants has been formed including 17 national research institutes, 24 universities, 10 private companies, the Joint Research Centre of the European Commission, a local consortium of research institutions for Venice Laguna (CORILA) and a European network of end-users (EUCC).

Although it might appear as a large consortium, access to existing knowledge (expertise or data) needed to implement the SAF in SSAs would require that many other organisations participate in SPICOSA activities. To address this problem a specific funding has been allocated to each SSA under the responsibility of SSA coordinating organisation. This fund (15 000 € per SSA) shall be used to acquire already existing data or to temporarily mobilise external expertise by paying for travel expenses or, exceptionally, for external expert fees for participation in working meetings. This aspect adds some flexibility because the Study Site Activities will be run by collaborative teams formed mostly by the local partners which often maintain a high level information on local systems. The organisations from which external expertise may be invited are indicated in the presentation of SSAs (appendix B).

The partnership includes member-states that have recently joined the EU (Estonia, Latvia and Poland), associated candidate states (Bulgaria, Rumania and Turkey), associated countries for the 6th FP (Norway and Israel), and a third country (Ukraine). Similar association has been envisaged for developing countries but could not be implemented within the framework of the IP. The IP will support any initiative from consortium members to develop collaborative programmes with INCO countries that would further contribute to transfer of knowledge to other third countries under FP7.

b) Complementariness in the partnership.

Beside the complementary nature of their activities, research institutes, universities, European ICZM networks and SMEs, the partnerships of SPICOSA generate complementary in competences. The core of natural sciences for the Coastal Zone is found in 17 research institutes of national importance. Most of them have excellent records in the different fields of relevance to SPICOSA activities. Few of them have a constituted team dedicated to social sciences. But these resources are very limited and would not have constituted the critical mass needed to conduct the work devoted to social sciences in SPICOSA. Most Study Sites are under the coordination responsibility of these institutes. It is expected that through the two-application cycle, all these institutes will be able to assume such responsibility.

The ten private bodies participating in SPICOSA are the result of a strict screening of capacity to offer services to SPICOSA and potential for long term development of SPICOSA outputs. Three SMEs work in the area of applied assessment in economic and social sciences (IOeW) in Germany, ENVECO in Sweden and GEYSER in France). VITO in Belgium and PC Raster the Netherlands are major partners for applied modelling development and will assume a WP leadership. SOGREAH and Delft Hydraulics have expertise in the field of coastal technologies. They will bring in SPICOSA their broad view of the alternatives applied in the field and enrich with their experience the identification of coastal issues and policy scenarios. DISY will work in association with the University of Bremen (MARUM) to provide knowledge management services to SPICOSA community. ENVISION and SGM will assist SPICOSA in developing or implementing training opportunities or material.

6.B Plans

6.5 Plan for using and disseminating knowledge

Since the main SPICOSA objective is to develop the SAF as a new, improved method for assisting ICZM decision makers, it follows that its use and dissemination are also of the highest priority to the project. As an IP, we have planned for the maximum participation possible, with respect to resources, in terms of partner and SSA distributions to achieve a critical-mass exposure throughout the European region. We have designed several WPs that contribute to knowledge dissemination and two in particular WPs 9 & 11 dedicated to internal and external dissemination, respectively.

6.5.1 Internal. WP 9 is developing an Information Management Plan for the SAF (SAF-IMP) to efficiently handle the data collection, archiving, publication, dissemination, and visualization of products. While the SSAs will not acquire much data, in aggregate they will require the use of very large, distributed, heterogeneous sets of CZ data as inputs (i.e. hydrological, biogeochemical, geophysical, ecological and eco-toxicological data), and they will generate a large quantity of data and information output. The SAF- IMP will rely on international protocols and standards for information storage and delivery adapted to the needs of the Project. SPICOSA will rely primarily on work previously performed or ongoing in the ICZM related information (cf. WP 11.2), and it be built with existing design for information storage and delivery, but adapted and tailored to the needs of SPICOSA. The minimum specifications for the SPICOSA SAF- IMP is that it be:

1) complete and comparable (for global integration),
2) properly secured and preserved for the long term, and
3) treated according to international standards and protocols (quality control, meta-information, identifier, release, etc.).

WP 8 is evaluating and documenting models used in the SSAs for insertion in a Model Library, which will be displayed and accessible through an interactive website. Likewise, WP 10 will be accumulating useful information on alternative strategies and technologies, which will be internally distributed. While these information products will be for internal use during the IP, they will also be made available as electronic annexes to the final SAF Portfolio for future users.

6.5.2 External. WP 11 is developing a Dissemination and Media Plan (DMP) for SPICOSA. It will function to extract information on the progress and products of the IP, and package this information primarily for external and internal dissemination. The internal part differs from that of WP 9, which is archiving specific data, models, and information products, whereas the DMP will make summaries, integrations, and targeted aspects of interest to both the researchers and endusers. To meet the important need of providing SPICOSA information to the local communities of the SSAs, we have designated a communications officer for each SSA who will ensure a good public exposure in the local language and cover SPICOSA activities in relevance to local issues. This WP will also issue an electronic SPICOSA Newsletter and an electronic journal of SPICOSA articles of interest to the international CZ enduser audience.

WP 11.2 will facilitate collaborations with other international projects in order to inform a wider scientific community and to effect positive research synergisms between SPICOSA and other research efforts. Of particular importance is the Coordination Action project ENCORA, with whom SPICOSA will establish close ties for the purpose of sharing information and results with an even larger CZ research community.

6.6 Gender Action Plan.

Gender mainstreaming will be conducted as part of the internal governance of the project and gender analysis has been included as one dimension of social assessment in the integrated assessment approach developed for Coastal Zone system analysis. The unbalanced proportion of women and men in research is a major concern. The EU is implementing an agenda to promote equal access in research. In line with this objective, the management of *SPICOSA* will conduct a regular evaluation of the involvement of women in *SPICOSA* activities. This evaluation will be provided with annual reporting in terms of contribution to the total effort and in terms of sharing responsibilities. At the submission stage, women represent 24% of the researcher nominated by the partners as key researchers. At the submission-stage, women represent one third of researchers proposed as Node coordinator or WP leader.

6.7 Integrating SPICOSA community

A set of activities and procedures has been specifically designed for integration of SPICOSA community. They are presented here.

6.7.1. SPICOSA Forum

A General Meeting under the form of a Forum will meet in plenary and working group sessions once per annum. The forum will assess the progress of SPICOSA towards its objectives, integrate scientists, end-users and stakeholders, incorporate new Consortium members, and be a place for communication with other programmes. Towards the end of the programme, the Forum will also used as a media for results dissemination. This will again increase the focus, the coherence and the efficiency of each of the WPs. Its content will be adapted during the time course of the project: It will act to be the kick-off meeting in year 1, and to be a final symposium in year 4.

6.7.2 Integration, decision-making process and clearance issue

By its scope, SPICOSA is composed of modules that bring together the highest number of relevant members of the project, allowing a maximum level of integration. Extensive links between Technical Work Packages, Study Sites and Nodes provide additional integrating activity, which is of particular importance provided the basic interdisciplinary nature of the project.

The main risks associated with the proposed programme of activity are linked to the size of the SPICOSA consortium. This size is considered as relevant and adapted with regards to the ambition of increasing multi-disciplinary effectiveness of the project, the fragmentation of Social Sciences in Europe, and the strong interest the SPICOSA initiative met from the partners. Yet, in order to cope with this potential difficulty, SPICOSA is endowed with a number of important integration tools. These include not only the tools, which improve the scientific capacity (training, technical support, system design, information centre), its incorporation in the Study Site Activities, but also the instruments that will facilitate links with end users (teaching, dissemination).

Notably the core partners (e.g. the WP leaders) in SPICOSA have a long experience of collaboration at the European scale and/or management of big project under various programmes, and they are familiar with the rules. Three persons full time will be in charge of both scientific and management implementation with support from the entire Contractor services.

The partners envisage the Governance structure to be straightforward to avoid overloads and misunderstanding of specific coordination roles and decision processes. Decisions concerning modifications of the work plan, adjustments to timing of milestones, redirection of actions and tasks should be agreed by the SSC. In the case of issues arising, the SSC will inform the Chair who will take decisions, with the support of the Secretariat, and these will be communicated to all of the WP/Node leaders for implementation. At the end of each reporting periods (12 months), an assessment of the partner involvement, including the Study Site leaders, will be undertaken by the SSC and in case of insufficiency; a proposal for correction will be made to the ECB. It can be a suspension of funding.

In the event of a disagreement or conflicts of interest arising among the Consortium partners, the Science Co-ordinator chairing the SSC will refer the matter to the ECB, which is the body responsible for Consortium Agreement implementation. In the unlikely event that the disagreement cannot be resolved, the Chair will inform the Commission, and the ECB may be asked by the Chair to consult an external arbitrator.

6.8 Raising public participation and awareness

Beside external communication activities that will be conducted under WP 11 most of the outreach activity in SPICOSA that will ensure some level of public participation and awareness relates to the Study Site Applications. By using or setting participatory forum to develop SAF applications, partners involved in SSAs will contribute to public participation and awareness. It is required that each SSA team designate a person responsible for external communication. Part of this responsibility is to make widely known the objectives and means of intervention developed by SPICOSA.

6.C Milestones

6.9 Major Milestones over full project duration

There will be nine major Milestones over the full project duration, briefly described as follows:

1) Month 3. The organization of a SAF introduction workshop that will complete the startup-familiarization period by completing all further detailed planning and by exposing all teams of the project to the core methodology of the Systems Approach.

2) Month 6. The preparation period for the SSAs ends and the SSAs start.

3) Month 14. Reporting on first year activities and planning for the next 18-mo planning are completed.

4) Month 16. The first SPICOSA Forum of all partners will review of the work completed and that yet to be conducted.

5) Month 26. Reporting on second year activities and planning for the next 18-mo interval are completed.

6) Month 34. The second SPICOSA Forum will be set for another global review of the work to be conducted with the participation of all partners.

7) Month 38. Reporting on third year activities and planning for the next 12-mo interval are completed.

8) Month 47. The third SPICOSA Forum will be set for a last global review of the work completed and also as an opportunity for large dissemination.

9) Month 50. The last milestone is after the end of fourth years when all scientific and administrative reporting is completed.

7 Project Management

A project organisational structure has been designed for a proper management of all parts of the SPICOSA project taking into consideration the complexity and the integration of activities as needed at all levels. In this respect: SPICOSA will establish sufficiently high quality co-ordination mechanisms to ensure that the objectives of the project will be efficiently and successfully addressed. A dedicated SPICOSA Secretariat will contribute to optimising the development and implementation of the project and the provision of research support.

7.1 Organizational Structure.

SPICOSA's management structure will ensure that the work will be efficiently carried out according to the work plan, through the provision of clearly defined responsibilities and reporting paths, as well as requirements to keep within the specific schedule, including milestones and deliverables. In short, overall coordination of technical activities as well as legal, contractual and administrative activities at consortium level will be performed by the Executive Coordination Board (ECB), whereas management of technical details of activities will be done on the node and project level.

The organizational structure of SPICOSA will realized in accordance the following managerial components (see also Fig. 15) :

1) A Chairman (the Coordinator) who will serve to represent the Consortium in the name of the coordinating organisation;
2) Two Science Coordinators and a Deputy Coordinator who will form the Secretariat of the (ECB) and work with the Financial and Legal staff of IFREMER.
3) An Executive Coordination Board (ECB) including the Chairman, the two Science Co-ordinators, the Project Manager and the Node Coordinators, which will make all major operational decisions..
4) A Scientific Steering Committee (SSC), formed by the ECB members and the WP scientific leaders, which will resolve all problems and planning regarding the scientific performance of the Project;
5) An External Scientific Review Panel (ESRP) composed of internationally renowned scientists, which will critique and advise the ECB on the Projects progress.
6) An Enduser Review Panel (EURP) composed of representatives of enduser organisations or forums in Europe, including European agencies and representative of DGs of the European Commission, which will help maintain contact and information exchange between the Project and its external endusers.

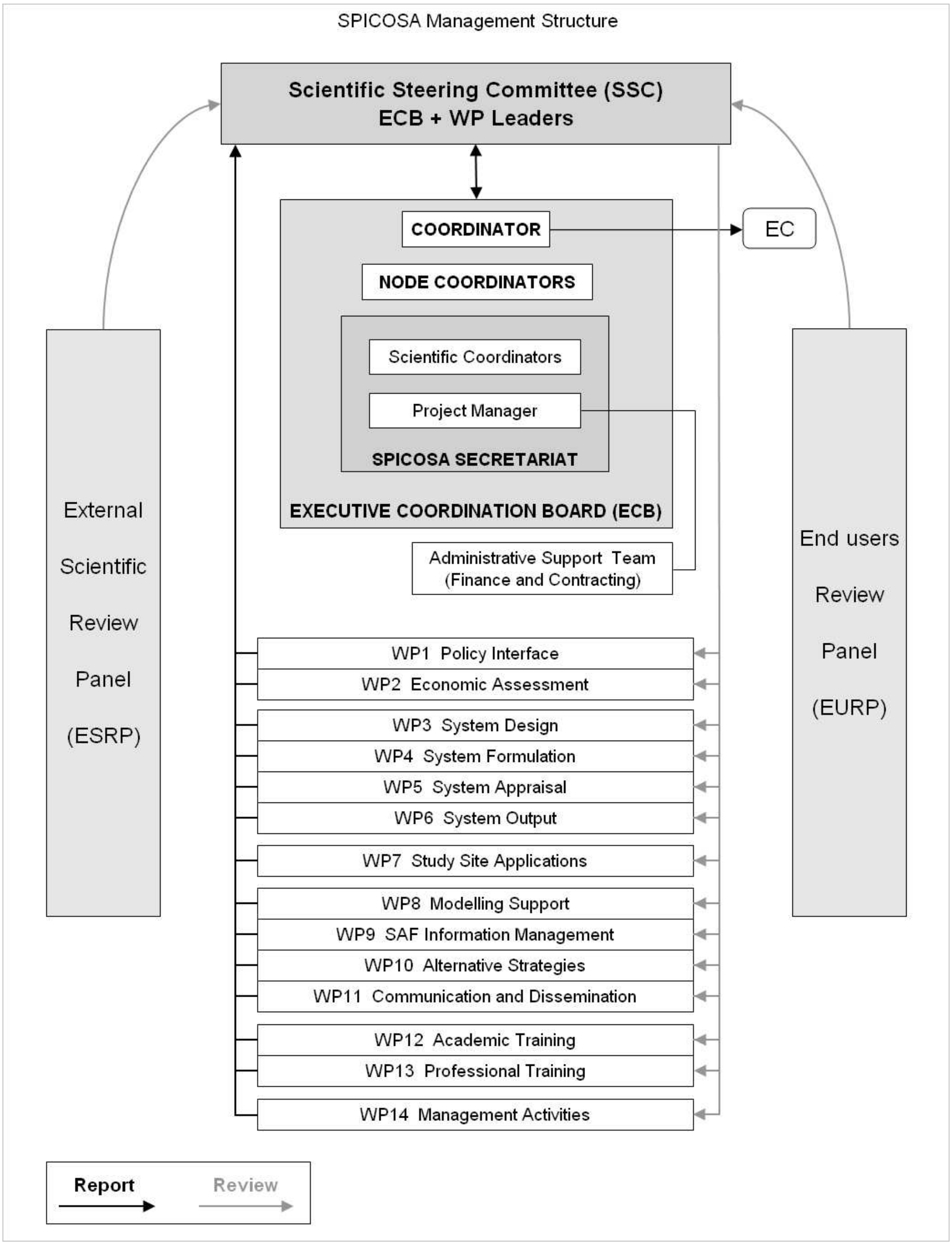

Fig. 15 Management structure of SPICOSA-IP.

7.2 Definitions of Component Entities

This section defines the role, composition and functioning of entities pertaining to the governance structure of the IP. More details are given in the Consortium Agreement that should be considered as the reference document.

7.2.1 The Chairman

The Project Coordinator will act as Chairman of the Executive Coordination Board (ECB) and will ensure that the IP work plan is implemented in conformity with its objectives, methods, and quality standards described in the contract. The Project Coordinator will have responsibility for overall legal, contractual, financial and ethical issues; and he will be responsible for the nomination of a project manager (Deputy Coordinator) and for the establishment of the Secretariat. He will ensure the allocation of funds provided by the Commission in a timely and appropriate manner. He will oversee the adherence to financial requirements of the project, and obtain audit certificates from each of the contractors as requested by the Commission.

IFREMER acts as the Administrative and Financial Coordinating organisation and represents the Consortium for contracting with the Commission. The Chairman or Coordinator of the IP in the legal sense of contracting with the Commission is Dr. Maurice Héral, acting as representative of IFREMER. He is assisted by Daniel Roy, the Deputy Coordinator, who acts in the name of IFREMER. He interacts with the members of the Consortium for administrative and financial reporting and planning and mobilises administrative staff at IFREMER.

7.2.2 The Science Coordinators and the Secretariat

The Science Co-ordinators of SPICOSA are responsible for the overall scientific coordination of the IP. They support the Chairman and the closely collaborate with the Node Coordinators in the ECB and the WP leaders in the SSC. The Science Coordinators will be fully funded through SPICOSA for their contribution to the coordination of the IP. They will form the Secretariat of the ECB with the Chairman and the Deputy Coordinator. Reporting to the Chairman, the Secretariat will oversee the day-to-day operational management of the SPICOSA activities, set up and maintains a database of contacts¸ run project documentation management including information related to pre-existing know-how and knowledge to all Parties concerned. The Secretariat will ensure that timely and effective communication is maintained within the Consortium, between the Consortium and the Commission, as well as between the Consortium and the Scientific Steering Committee (SSC). The Financial and Contractual team component of the Secretariat will be maintained at IFREMER in Brest Centre.

The Science Coordination is placed under the responsibility of two senior researchers, Pr. Denis Bailly and Pr. Tom Sawyer Hopkins. Pr. Denis Bailly is an economist, vice-director of the Centre for the Law and Economics (CEDEM) of the Sea at the University of Western Brittany (UBO) in Brest, France. He will act in the name of the UBO. Pr. Tom Sawyer Hopkins is an oceanographer, specialized in system analysis, Professor Emeritus of the University of North Carolina and presently attached to the Institute for Coastal Marine Environment (IAMC) at the Italian National Research Centre (CNR) in Naples. Pr. Hopkins will act in the name of CNR-

IAMC. For the purpose of interactions with the Commission, D. Bailly acts as the science principal coordinator.

7.2.3 The Executive Coordination Board (ECB)
In addition to the Chairman (Maurice Héral), the two Science Coordinators (Denis Bailly for social science, Tom Hopkins for natural science) and the Project Manager (Daniel Roy), all acting in the name of their organisation, other components of the IP will be represented in the ECB by the Node Coordinators. Each Node will be represented by its coordinators. This makes a total of voting members in the ECB. The ECB may invite any other person that may contribute to improve is decision-making capacity. Invitees will not have voting right.

The ECB will be supported by IFREMER services and chaired by the Chairman. The ECB will meet three or four times each year. The ECB will pass on all major decisions. The ECB will be responsible for delivery of each Work Package and especially for ensuring integration between Work Packages and Study Sites. It will have the ultimate responsibility for ensuring that the project deliverables and objectives are met. It will also have responsibility for gender plan implementation.

7.2.4 The Scientific Steering Committee (SSC).
The Scientific Steering Committee (SSC) will be composed of the members of the ECB and the WP leaders. This makes a total of 21 voting members. Other scientists from the consortium organizations may be invited but they will not have voting right. Members of the SSC may designate a substitute to represent themselves at SSC meeting and act in their name. The SSC will meet after the end of each year to review the progress of work plan implementation and to prepare next 18 months work planning. It will be chaired alternatively by one of the two SPICOSA Science Coordinators.

The SSC will:

1) Monitor the development of the SPICOSA work plan and assess its compliance with the expected scientific and technological goals and standards.
2) Ensure that the appropriate level of communication has been established between the various Nodes and WPs;
3) Review and assess the development and implementation of interactions among Nodes and WPs;
4) Plan or revise the future phases of the work plan; and draft and update initial versions of the detailed work plan for following 18-mo phase;
5) Discuss and evaluate the contents of the main IP Deliverables;
6) Recommend specific dissemination initiatives, and review their implementation.
7) Review the progress and implementation of the various training activities and recommend modifications as appropriate.

Typically the SSC meetings will last two or three days. The SSC may invite experts internal or external to the Project for consultation. The SSC will invite representatives from other IPs, NoEs or ERA-Nets projects to attend meetings and workshops whenever appropriate. The SSC will report to the ECB.

7.2.5 The External Scientific Review Panel (ESRP)

A panel of five highly qualified scientists, representing the diversity of major scientific competences requested for the implementation of SPICOSA, will be established. They will be in charge of reviewing the work plans, the achievements and the governance of the project to assess its overall effectiveness in reaching its objectives. While assessing the progress of the IP, the ESRP may suggest new directions and opportunities for innovation in order to ensure that the project more efficiently reach its objectives. The members of the ESRP will be appointed at the beginning of the project. At least two of them will be invited from outside Europe. They will receive all the documentation of scientific and administrative reporting (annual progress reports and following period plans) and they will be asked to provide a synthetic review of these documents. They will be invited to participate in the first and last SPICOSA forum. The ESRP will report to the ECB.

7.2.6 The Enduser Review Panel (EURP)

An Enduser Review Panel will be formed of about 10 representatives of major organisations or networks representing typical endusers of the kind of services SPICOSA is intending to provide. Most of them will be of international scope, European and beyond. They will be invited every year to review the progress and planning of the project. For this purpose they will be communicated every year the progress report and next period plan. They will also be invited to review the project website as the main external communication tool and to make suggestions for improvements.

7.3 Consortium Agreement

The SPICOSA partners have agreed to subscribe to a Consortium Agreement regulating specific rights, obligations and operational aspects that are not explicitly defined in the EC contract. The Consortium Agreement has been prepared during the negotiation phase of the IP, care of the Secretariat, and in accordance with the guidelines provided by the EC. It includes detailed provisions to deal with critical issues such as rules and procedures for the management of the financial resources and the distribution of the funds received from the EC, decision rules within the Consortium, management of knowledge and Intellectual Property Rights (IPR).

The procedure for management of IPR is in accordance with that detailed through the FP6 Programme, and the relevant national programmes. The rules are set out in the EC Regulation No 2321/2002 of the European Parliament and of the Council concerning participation in FP6 and the dissemination of research results. IPR will be retained by the project partners, with specific IPR for each WP and Task resting with the appropriate WP and Task leader. The documents detailing the IPR procedures for FP6 will be circulated amongst the partners and the consortium agreement addresses these issues, amongst others.

10. Ethical issues

All legal provisions applicable under European regulations regarding the protection of Intellectual Property Rights regarding pre-existing knowledge and the protection of individual data will be respected.

No other specific ethical issue is involved in the work to be conducted under the IP SPICOSA.

11. Other issues

Not applicable

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