SUT
Society for Underwater Technology

Discussion Document:

Developing a Consistent, Cross-Sector Approach for Assessing the Impact of Man-Made Objects, Materials and Substances

(*MMOMS*)

on the Marine Environment

www.sut.org

REV A:

September 2010

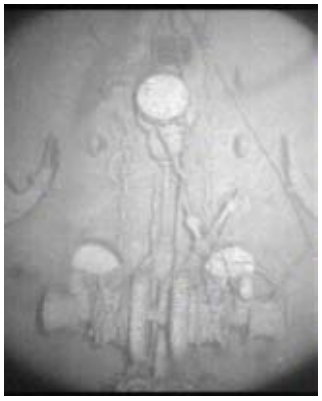
Contents

1.0 PURPOSE OF DISCUSSION DOCUMENT

The purpose of this document is to stimulate discussion, encourage interaction and reach consensus - particularly between the marine salvage, oil and gas, marine renewables and marine science sectors - regarding how to consistently and logically assess the *IMPACT* of Man-Made Object, Materials and Substances *(MMOMS)* on the marine environment.

The magnitude of this undertaking is not underestimated; scientific thinking is constantly being challenged by new knowledge and understanding; and the *VALUATION* of *ECOSYTEM GOODS* and *ECOSYSYTEM SERVICES* is also a developing discipline. Therefore, the contents of the following pages should be taken as a starting point. Sections 4.0 to 8.0 seek to establish a working framework for ASSESSMENT based on underwater experience and observation. The SUT's Salvage & Decommissioning Committee would be interested to receive feedback on the approach from both industry and academia. This shall be considered and incorporated where appropriate, in the planned 2011 review.

EXAMPLES OF MMOMS



ss Persia (sunk 30.12.1915) lying in 3000 metres water depth in the Hellenic Trench System – 1500 tons of mail, situated five decks down, decomposed over time, providing a habitat for 'tubeworms'

mv Torrey Canyon aground on the Seven Stones rocks (18.03.1967) - the first of the modern drivers towards the present UK Government response to incidents involving pollution

Offshore Wind Farms – will the subsea component of such structures – like many wrecks - form new marine colonies over time?

North West Hutton decommissioning (removal) with lift barge alongside

2.0 INTRODUCTION

We all affect the marine environment on a daily basis, many of us without even being aware of it; the carbon dioxide we produce as we breathe; the by-products of engines, industrial processes and fires; the chemicals we flush down our drains and sewerage systems; the crops we grow (which are mostly nourished by nitrates); the fish we consume; the goods we buy from abroad (a huge proportion of which is imported in ships); the ferries and cruises we take…the list goes on. So the concept that those who make their living by working at sea or offshore, are the only ones that change what happens on or in approximately 70% of the planet (by surface area) is inherently wrong – they are simply more easily accountable.

The formation of the Salvage & Decommissioning Group of the Society for Underwater Technology reflects not only this direct accountability, but the will of two major marine sectors – the salvage and oil & gas industries - to better understand the parameters within which they may operate responsibly; prevent irreversible change where it is scientifically considered likely to occur; and keep any harmful impact, where it is unavoidable, to an absolute minimum in magnitude and duration.

This approach, by definition, requires close liaison with the marine science community, in order to quantify the changes that may result from actions, and determine mitigating measures and procedures. As the marine renewables sector faces many of the same issues, it too should be brought into this dialogue.

To avoid a sector or activity based approach, the term 'MAN-MADE OBJECTS, MATERIALS and SUBSTANCES' (*MOMMS*) is used throughout. This recognises that the *IMPACT* on the marine environment of a structure made out of steel, for example, will be the same - if located at the same site - regardless of its purpose or whether it came to rest there either by accident or design.

To achieve uniformity of process and also aid development and implementation, the protocol developed by the Scottish Oceans Institute (SOI) to assess the *IMPACT* of wind farms has been taken as the guiding approach[1]. This has been based on the Millennium Ecosystem Assessment (2003) and expresses ecological processes and resources in terms of the *ECOSYSTEM GOODS* and *ECOSYSTEM SERVICES* that they provide. This is the current paradigm in order that the costs and benefit associated with exploitation of the marine environment can be translated into simple economic terms.

Once the potential *IMPACT* of the *MMOMS* has been established, the practical task of how to deal with it then comes into play. In a number of circumstances there may be a proscribed regulatory/state action that may not be the Best Practicable Environmental Option (*BPEO*) for dealing with the *MMOMS* in question; if this is the case, the policy is to highlight the *BPEO* and then work with authorities to comply with the applicable regulations/coastal state requirements.

[1] Scottish Oceans Institute (SOI) is SOI is an interdisciplinary research institute, studying the marine environment, which forms a key focus for research excellence in marine-related science

3.0 DEFINITIONS

All words that are defined in this document appear in capital italics, and have been included in the table below for ease of reference.

AGENT	An organic or inorganic substance that may result in an *IMPACT* on individual populations or communities of organisms. An *IMPACT* may be positive or negative with the significance of an *IMPACT* being determined at an individual or community level as a significant departure (either in type or in function) from the natural variation
ASSESSMENT	Used to describe the outcome of a measured consideration of the evidence. It is a pragmatic approach to drawing conclusions across a broad range of information types. *ASSESSMENT* allows the inclusion of both quantitative and qualitative evidence, as well as expert opinion, within a single overall conclusion.
ASSUMPTION	A view that is believed to be true, but which is not supported by evidence
BIODIVERSITY[2]	The variability among living organisms from all sources, including, *inter alia*, terrestrial, marine and other aquatic *ECOSYSTEMS* and the ecological complexes of which they are part: this includes diversity between species, among species and of *ECOSYSTEMS*. (It is accepted that this definition may be considered as an over simplification, but it suffices for the purpose of this document)
BEST PRACTICABLE ENVIRONMENTAL OPTION (BPEO)	The option, based upon best available evidence within constrained circumstances, with the aim of minimising environmental damage
COMPONENT	Used to describe a species, species group or habitat within an *ECOSYSTEM*
COST/BENEFIT ANALYSIS	In this context a method of assigning monetary value to environmental *IMPACT* resulting from the presence of *MMOMS,* in order to consistently evaluate their positive/negative influence on the marine environment
DOSE/RESPONSE RELATIONSHIP	The change in effect on an organism caused by differing levels of exposure to a toxin (this may not be linear)
DATA	Direct measurements usually present in Standard International units. Includes uncalibrated measurements and measurements that have not been fully validated in terms of what they are meant to be measuring.

[2] Convention on Biological Diversity, 1993 (CBD) Article 2

ECOSYSTEM[2]	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit
ECOSYSTEM FUNCTION	A term used to describe the combination of processes that occur within an *ECOSYSTEM*. Examples include primary productivity, oxygen evolution, and decomposition of materials
ECOSYSTEM GOODS	Are defined as products directly obtained from the *ECOSYSTEMS.* In the marine environment this would include, but not be limited to, fish, energy, aggregates, oil and gas
ECOSYSTEM SERVICES	Are defined as the conditions and processes through which natural E*COSYSYTEMS* - and the species that make them up - sustain and fulfil human life. *ECOSYSTEM SERVICES* can be usefully divided in to four main categories as used by the Millennium Ecosystem Assessment (2003): ➢ *SUPPORTING SERVICES* are those that are necessary for the production of all other *ECOSYSTEM SERVICES*, but do not yield direct benefits to people. Examples include habitat provision, nutrient cycling, and primary productivity. ➢ *PROVISIONING SERVICES* are obtained from the *ECOSYSTEM* and include food, fuel and bio-prospecting. ➢ *REGULATING SERVICES* are the benefits obtained from the regulation of *ECOSYSTEM* processes, such as climate regulation, flood protection and detoxification. ➢ *CULTURAL SERVICES* are the non-material benefits people obtain, such as knowledge, recreation and aesthetic value.
EXPOSURE	The period of time during which an *AGENT* affects an organism or community
IMPACT	A detectible change which may be positive or negative, depending on its magnitude, direction and duration
INFORMATION	*DATA* that has been calibrated and/or validated to provide a true representation of the variable being measured.
KNOWLEDGE	Usually non-metrical expert opinion, often built from experience but which has never been subjected to formal measurement or verification but which is, by consensus, considered to be an accurate reflection of the state of a variable or a system.

MARINE ECOSYSTEMS[3]	These can be broadly divided into *STATIC MARINE ECOSYTEMS and MOBILE MARINE ECOSYSTEMS.* ➢ *STATIC MARINE ECOSYSTEMS* – are benthic transitional or marine systems that are stable in time and of fixed position. These recognisable habitats tend to change in form with depth from coastal to shallow and then deep water systems, such *ECOSYSTEMS* include*:* o Beaches o Rocky shores o Sea grass beds o Kelp Forests o Warm and cold water coral reefs o Sponge beds o Hydrothermal vents o Cold seeps o Mud volcanoes o Continental shelves and slopes o Submarine canyons and caves o Seamounts o Abyssal hills o Abyssal plains o Trenches ➢ *MOBILE MARINE ECOSYTEMS* (also known as *Pelagic Systems):* are assemblages of planktonic and mobile marine species, ranging from viruses to whales, and their associated water bodies. These assemblages are critical to the global provision of goods and services (e.g. carbon fixation, oxygen production) and are essential to ecosystem function of the oceans
PROCESS	A natural sequence of events that describe changes in an object or transformation of material at an individual or community level that can be observed or measured
MARINE ECOSYSTEM ASSESSMENT	The holistic assessment of *MARINE ECOSYSTEM* change resulting from particular activities, their consequences for the marine environment and human-well-being
MAN-MADE OBJECTS, MATERIALS and SUBSTANCES (MMOMS):	These include, but are not limited to structures, vessels, constructions, equipment and artefacts (whether these be made of natural or manufactured materials) wreck, flotsam, jetsam, by-products, spoils, refuse, fluids and gases (including natural fluids and gases which have been released into the marine environment, either on purpose or by accident)

[3] Based upon Biodiversity and Maritime Transport, Verlaan P, Total Foundation Port-Cros Symposium, 2009

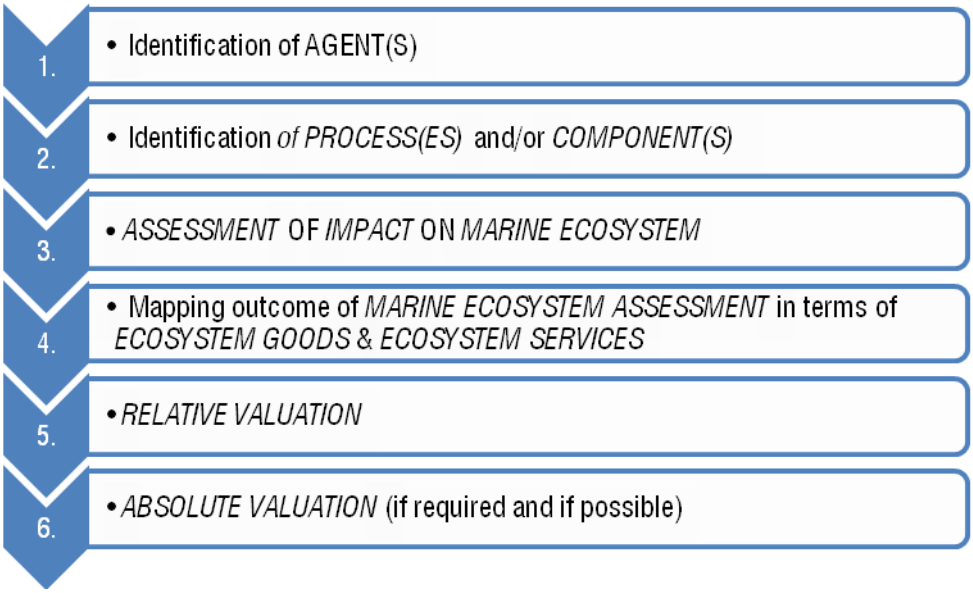
VALUATION	*VALUATION* can either be: ➢ *RELATIVE VALUATION* – a *VALUATION* an *ECOSYSTEM COMPONENT* or a grouping of *COMPONENTS* that is scaled in relation to another *COMPONENT* or group. *RELATIVE VALUATION* does not require a measurement to be made in any currency; instead it requires a judgement to be made about whether one *COMPONENT* is more or less valuable than another based upon their *USE* and *NON-USE* values (see definition of *ECOSYSTEM SERVICES*). ➢ *ABSOLUTE VALUATION* – a *VALUATION* that is scaled in an absolute currency. (The currency highlighted in this document is financial, but *ABSOLUTE VALUATION* can also be scaled using non-financial measures such as carbon or energy costs.)

4.0 ENVIRONMENTAL APPROACH

4.1 Aim

The aim of the SUT Salvage & Decommissioning Committee's approach is to map *IMPACT* on the *MARINE ECOSYSTEM* by Man-Made Objects, Materials and Substances *(MMOMS)*, in a manner that is:

- clear and traceable;
- uniform across a range of human activity; which may be
- spatially mapped;
- scaled; and also
- valued in a common currency.



4.2 Challenges

The three main scientific challenges of this approach are:

4.2.1 determining the magnitude, direction (positive/negative) and timeline of change caused by the *IMPACT* of *MMOMS* on the *MARINE ECOSYSTEM*;

4.2.2 defining the *MARINE ECOSYSTEM GOODS* and *MARINE ECOSYSTEM SERVICES* affected by the *IMPACT;*

4.2.3 expressing the change consistently, in terms of a common currency, that reflects (as far as possible) true financial or economic cost, in order to allow cost/benefit trade-offs to be explored.

4.3 Constraints

The main constraints to the approach are:

4.3.1 Research and Data Gaps - much less is known about even fundamental processes in the marine environment than is generally imagined. This is due to the inherent difficulty in gathering some types of data in marine and transitional systems.

4.3.2 Cost - operations to gather data are often logistically difficult and require substantial infrastructure, as well as organisation of a supply chain of skilled labour.

4.3.3 Complexity of Task - many of the ecological *COMPONENTS* that need to be taken into consideration cannot be quantified - therefore, a categorical approach to *ASSESSMENT*, which matches criteria against descriptors shall be have to be used. (For example, effects would be classified as having 'high', 'medium' or 'low' severity, with these descriptors being assigned a number, on both a positive and negative scale, based on an objective *ASSESSMENT* of the potential *IMPACT*.)

4.3.4 Governmental and/or regulatory disinterest, in some instance, which relates to the level of scientific funding.

5.0 ASSESSING the *IMPACT* of *MMOMS* on the *MARINE ECOSYSTEM*

Overview of ASSESSMENT Process

The objective of the *ASSESSMENT* process is to reduce considerable amounts of *DATA*, *INFORMATION* and *KNOWLEDGE* down to a single Statement of *VALUATION*. This Statement will normally be in the form of an *ASSESSMENT* of the relative costs and benefits, but may in some circumstances be expressed as an *ABSOLUTE* (financial) *VALUATION*. The procedure described here is designed to provide a framework within which it should be possible to conduct a consistent and transparent *ASSESSMENT*.

***COST/BENEFIT ASSESSMENT* Framework**

IMPACT on the *MARINE ECOSYSTEM* shall be defined using a *COST/BENEFIT ASSESSMENT* framework in the following order:

5.1 *AGENT* Identification

For each *MMOMS:*

5.1.1 Identify the *AGENT* or *AGENTS*

5.2 *PROCESS* and/or *COMPONENT* Identification

For the *MARINE ECOSYSTEM:*

5.2.1 List all known environmental *PROCESSES*; and
5.2.2 Specify each of the *COMPONENTS* that may be affected

5.3 *EXPOSURE ASSESSMENT*

For each *COMPONENT*:

5.3.1 Examine the likelihood of *EXPOSURE to the AGENT(S)*; and
5.3.2 Assess what proportion of habitat/population is likely to be affected during *EXPOSURE*
5.3.3 Define the level of certainty

5.4 *EXPOSURE*-Response *ASSESSMENT*

For each *COMPONENT* likely to be exposed**:**

5.4.1 Review evidence for a significant disturbance or *DOSE-RESPONSE* relationship;
5.4.2 Develop an *ASSESSMENT* of threshold levels, if relevant, that could result in an effect

5.5 *EXPOSURE* Characterisation

For each *COMPONENT* likely to be affected, combine the *EXPOSURE ASSESSMENT* (5.3) with the Response *ASSESSMENT* (5.4) to provide an overall *ASSESSMENT* of the significance of the *EXPOSURE* which includes:

5.5.1 Acute/chronic effects
5.5.2 Synergistic/antagonistic effects between multiple *AGENTS*
5.5.3 Synergistic/antagonistic effects between different *COMPONENTS*
5.5.4 Include consideration of how each of the above may change through time

5.6 *MARINE ECOSYSTEM ASSESSMENT*

To assess the *IMPACT* on the *MARINE ECOSYSTEM* caused by the *IMPACT* on a *COMPONENT*:

5.6.1 Assess the role that the *COMPONENT* plays within that *MARINE ECOSYSYTEM;*
5.6.2 Consider the possible breadth (geographical) and depth (trophic/structural importance) of the *COMPONENT* in the ecological structure (this should include possible 'far-field' effects); and
5.6.3 Include consideration how the positive/negative effects may change over time

NOTE ONE: wherever possible, *ASSESSMENT* should be quantitative, but lack of common units of measurement (including common spatial and temporal scales) and absence of the formal estimation of uncertainty, or features of data collection, often mean that formally combining different data sources is not possible. *ASSESSMENT* should also allow experience from other similar situations to be included with appropriate weight.

NOTE TWO: when considering the MMOMS in question, it is essential to identify any specific stages and/or phases in its life cycle, and consider the *IMPACT* of the *MOMMS* on the *MARINE ECOSYSTEM* in relation to each of these stages and/or phases, for example for an object that it being built, the *IMPACT* on the *MARINE ECOSYSTEM* begins with the baseline surveys, and continues through construction, commissioning, operation/production, and de-commissioning to post-decommissioning survey.

6.0 OUTCOME OF *MARINE ECOSYSTEM ASSESSMENT*

The outcome of the *MARINE ECOSYSTEM ASSESSMENT* shall be shown using two, 7-point scales. These scales shall be constructed as follows for each *COMPONENT*:

Table 1: Scale for determining positive/negative IMPACT on the MARINE ECOSYSTEM

Scale point	Effect	Descriptor
+3	High positive effect	Greatly increased habitat quality either in diversity of indigenous species or functional capacity
+2	Moderate positive effect	Moderately increased habitat quality either in diversity of indigenous species or functional capacity
+1	Slight positive effect	Slightly increased habitat quality either in diversity of indigenous species or functional capacity
0	Neutral or no likely effect	Not likely to be affected
-1	Slight negative effect	Slightly decreased habitat quality either in diversity of indigenous species or functional capacity
-2	Moderate negative effect	Moderately decreased habitat quality either in diversity of indigenous species or functional capacity
-3	High negative effect	Greatly decreased habitat quality either in diversity of indigenous species or functional capacity

7.0 MAPPING OUTCOME of *MARINE ECOSYSTEM ASSESSMENT* (6.0) onto *ECOSYSTEM GOODS* and *ECOSYSTEM SERVICES*

Having completed the *MARINE ECOSYSTEM ASSESSMENT, the IMPACT on ECOSYSTEM GOODS* and *ECOSYSTEM SERVICES* should be mapped.

7.1 *ECOSYSTEM GOODS:*

Wherever possible, the effects of *MMOMS* will be measured in terms of changes in the volume of *ECOSYSTEM GOODS* derived from each *COMPONENT* over time. Where an *ECOSYSTEM GOOD*, such as fish, can be broken down into a 'brand', such as cod, or sand eels, that 'brand' will be examined as an independent *ECOSYSTEM GOOD*. This is probably the simplest area of *VALUATION,* as *ECOSYSTEM GOODS* are almost exclusively expressed in monetary terms.

7.2 *ECOSYSTEM SERVICES*:

The effect of predicted changes in *COMPONENTS* will be scored for their contributions to specific types of *ECOSYSTEM SERVICE* (*SUPPORTING*, *PROVISIONING, REGULATING* and *CULTURAL*).

A 7-point scale, similar to that constructed to capture the positive/negative *IMPACT* on the *MARINE ECOSYSTEM* (5.6), will be constructed to describe the effect upon each type of *ECOSYSTEM SERVICE (SUPPORTING, PROVISIONING, REGULATING, CULTURAL)*:

Table 2: Scale for determining positive/negative impact on ECOSYSTEM GOODS/ECOSYTEM SERVICES i.e. same scale is to be used for assessing both

Scale point	Effect	Descriptor
+3	High positive effect	Would cause greatly increased (sustainable) production of *ECOSYSTEM GOODS*/confer highly positive benefit on the *ECOSYSTEM SERVICES* (across *SUPPORTING, PROVISIONING, REGULATING* and *CULTURAL* categories)
+2	Moderate positive effect	Would cause moderately increased (sustainable) production of *ECOSYSTEM GOODS*/ confer moderately positive benefit on *ECOSYSTEM SERVICES* (across *SUPPORTING, PROVISIONING, REGULATING* and *CULTURAL* categories)
+1	Slight positive effect	Would cause slightly increased (sustainable) production of *ECOSYSTEM GOODS*/ confer slightly positive benefit on *ECOSYSTEM SERVICES* (across *SUPPORTING, PROVISIONING, REGULATING* and *CULTURAL* categories)

Scale point	Effect	Descriptor
0	Neutral or no likely effect	Not likely to be affected
-1	Slight negative effect	Would cause slightly decreased (unsustainable) production of *ECOSYSTEM GOODS*/slight harm to *ECOSYSTEM SERVICES* (across *SUPPORTING, PROVISIONING, REGULATING* and *CULTURAL* categories)
-2	Moderate negative effect	Would cause moderately decreased (unsustainable) production of *ECOSYSTEM GOODS*/cause moderate harm to *ECOSYSTEM SERVICES* (across *SUPPORTING, PROVISIONING, REGULATING* and *CULTURAL* categories)
-3	High negative effect	Would cause severely decreased (unsustainable) production of *ECOSYSTEM GOODS*/cause severe harm to *ECOSYSTEM SERVICES* (across *SUPPORTING, PROVISIONING, REGULATING* and *CULTURAL* categories)

NOTE THREE: when undertaking the *VALUATION* process, it is important to differentiate between *IMPACT* on *ECOSYSYTEM GOODS* and *ECOSYTEM (PROVISIONING)* SERVICES. For example, it may be appropriate with cod, which are widely distributed, to use the proportion of total area that is excluded (or made available) to fishing as a result of the *MMOMS* presence, over and above the *IMPACT* on the species as an *ECOSYSTEM GOOD* i.e. the catch. As another example, for more area-specific species such as sand eels or lobster, a proportion of total habitat (sand or gravel) that is excluded (or made available) may be used.

NOTE FOUR: as recommended in Valuing the Marine Estates and UK Seas: An Ecosystem Services Framework[4], pages 37 and 38: 'To enable the framework to be applied at different spatial scales, it is important that as far as possible, qualitative and quantitative information is presented spatially. This is likely to be best achieved by holding information within a geographical information system (GIS) so that information can be evaluated using spatial analysis tools where required. Use of a GIS system will also facilitate consideration of temporal issues...Services provided by the water column can and should be represented separately.'

4 Saunders, J., Tinch, R., and Hull, S (2010) Valuing the Marine Estates and UK Seas: An Ecosystem Services Framework. The Crown Estate, 54 Pages, March 2010. ISBN: 978-1-906410-15-5

8.0 *VALUATION* PROCESS

8.1 ***RELATIVE VALUATION***

A system shall be used to assess the *RELATIVE VALUATION* of the *ECOSYSTEM GOODS* and *ECOSYSTEM SERVICES* that have been affected by the *IMPACT* on *COMPONENTS.*

(A check as to whether the different parts of the *ASSESSMENT* are consistent is easily made because the signs should generally all be similar. For example, *'PROVISIONING ECOSYSTEM SERVICES'* and '*ECOSYSTEM GOODS'* should have the same sign).

Table3: Example of tabulation to derive RELATIVE VALUATION (numbers entered into the table are for illustration only). This illustration has been built around an example of the kind of ASSESSMENT that might be expected for the installation of an oil & gas platform, or a wind farm in the North Sea

PHASE IN LIFE CYCLE: ***Production***	*COMPONENT*	*MARINE ECOSYSTEM ASSESSMENT +/- IMPACT Output from Tables 1*	*ECOSYSTEM GOODS (fish, energy, oil & gas, aggregate, etc* (+/- Value)	*ECOSYSTEM SERVICES +/- Value taken from Table 3*			
				SUPPORTING	*PROVISIONING*	*REGULATING*	*CULTURAL*
Example:	*Pelagic Fish Populations*	*0*	*0*	*0*	*0*	*0*	*+1*
	Demersal Fish Populations	*+1*	*+1*	*0*	*+1*	*0*	*+1*
	Benthic Communities	*+1*	*0*	*+1*	*0*	*0*	*0*

NOTE FIVE: This is a highly simplified example of a matrix to derive *RELATIVE VALUATION*. In practice, the *ASSESSMENT* for pelagic fish populations would need to be cross compared with the *ASSESSMENT* for plankton communities, which could be affected by chemical pollution. Each cell would probably need an explanation of how the number had been derived. Rules could be developed that would allow the derivation to become progressively more objective and consistent, i.e. as the approach was developed, the result would depend less on those carrying out the *ASSESSMENT* and would be driven by a transparent and agreed process.

8.2 ***RELATIVE VALUATION*** **Statement**

This type of matrix of costs and benefits shows where the major and minor *IMPACT*S on the *MARINE ECOSYSTEM, ECOSYSTEM GOODS* and *ECOSYSTEM SERVICES* are likely to be felt. It will be possible to summarise these in a *RELATIVE VALUATION* statement. In the case of the example above, the *RELATIVE VALUATION* statement would be that with respect to the *ASSESSMENT* of the *COMPONENTS shown, the Production* phase of the *MMOMS'* could lead to overall positive benefits for the *MARINE ECOSYTEM*, *ECOSYSTEM GOODS* and *ECOSYSTEM SERVICES*.

8.3 *ABSOLUTE VALUATION* (Common Currency)

In order to translate the *RELATIVE VALUATION* into an *ABSOLUTE VALUATION*, using a common currency, a total *VALUATION* for the *IMPACT* of the *MMOMS* on the *MARINE ECOSYSTEM, ECOSYSTEM GOODS and ECOSYSTEM SERVICES* shall be produced (if required and if possible) using the following financial methods:

8.3.1 Market pricing: uses commercial information about the trade in goods.
8.3.2 Productivity: estimates the contribution to the production of commercial goods.
8.3.3 Damage cost avoidance or substitution: uses economic values based on costs avoided or reduced by substitution.
8.3.4 Contingent *VALUATION*: based on what people are willing to pay.
8.3.5 Choice experiments: based on people's willingness to trade-off among sets of *ECOSYSTEM SERVICES.*

If time and resources do not permit original *VALUATION* work to be undertaken, benefit transfer will be used to estimate these monetary values, where feasible.

8.4 *ABSOLUTE VALUATION* Statement

In an ABSOLUTE VALUATION Statement numbers shall standard accounting methodology shall be used, where possible.

9.0 TREATMENT OF *MMOMS*

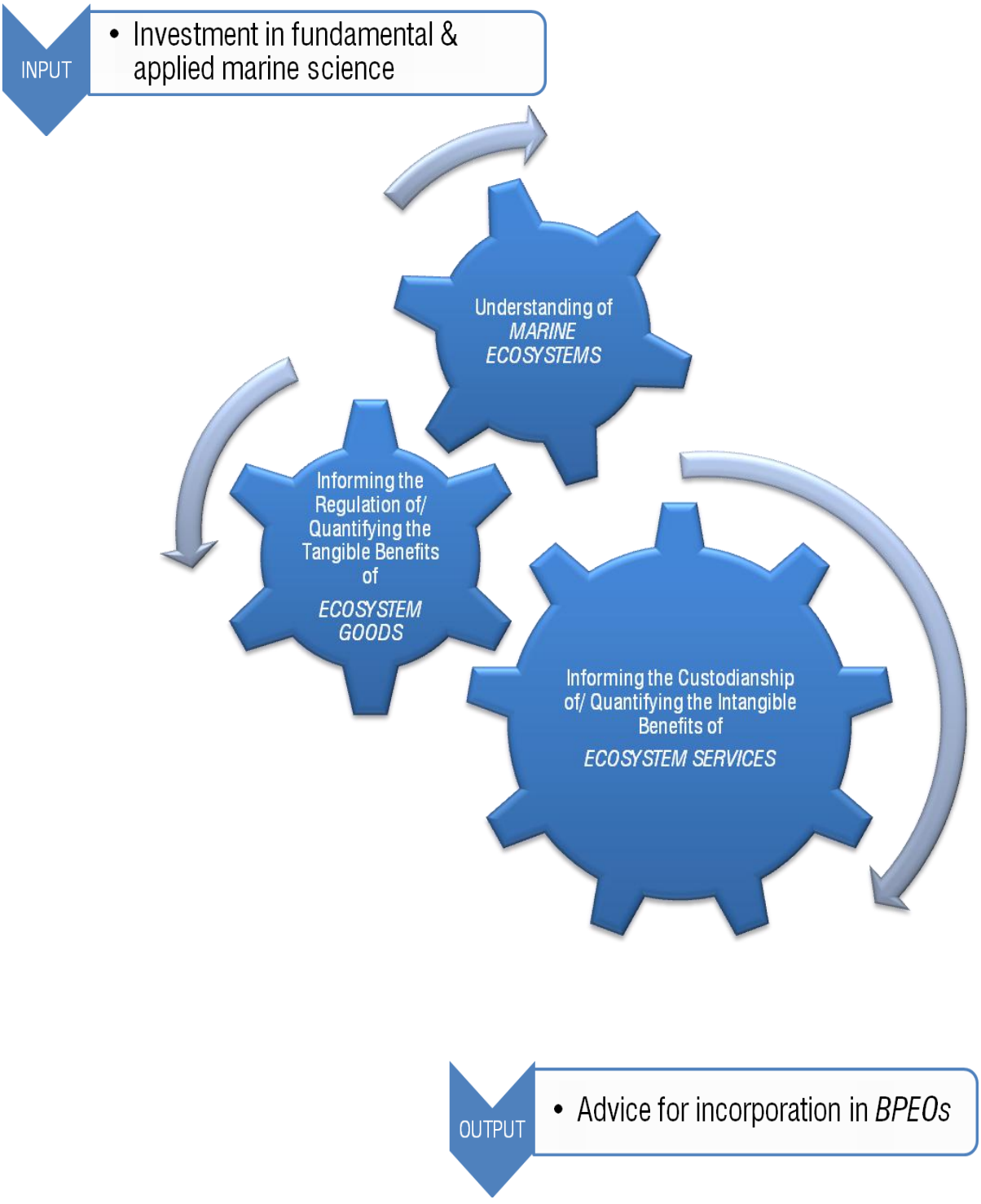
Having established the potential (positive/negative) *IMPACT* of the *MMOMS* on the *MARINE ECOSYSTEM*, *ECOSYSTEM GOODS* and *ECOSYSTEM SERVICES*, and expressed it as a *RELATIVE VALUATION* or an *ABSOLUTE VALUATION* (if required), the aim shall be to deal with them in a consistent, environmentally responsible manner, taking into account:

- Risk involved (including the risk to human life)
- Equipment and energy employed
- Skills used
- Time taken and
- Financial cost

with the aim of conferring proportional benefit. This shall generally be expressed as a *BEST PRACTICABLE ENVIRONMENTAL OPTION (BPEO)*.

10.0 ROLE of MARINE SCIENCE

Establishing the *IMPACT* on the *MARINE ECOSYSTEM* and the subsequent *VALUATION* of *ECOSYSTEM GOODS* and *ECOSYSTEM SERVICES* is a complex task, which lies firmly with the marine science community. Its scientific output is critical to informing the engineering and financial decisions, as expressed in the *BPEO*.



11.0 FEEDBACK

The Salvage & Decommissioning Committee of the SUT should be grateful for all comments, including constructive criticism to be sent to:

info@sut.org