Earth Observation for Marine Resources & Environment

International trends & developments

Earth observation applications

Business development

Capacity building

0. Introduction

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HCP international:
consulting, marketing of earth observation

Project director EOPOWER:
project for promotion & capacity building of earth observation applications

Sequence:

- General assessment of the state-of-the-art of earth observation
- Major trends and developments in the application field
- Description of earth observation solutions
- Assessment of market potential for earth observation solutions and marketing instruments
- Capacity building for successful application of earth observation solutions

Earth Observation helps you:

save money

save lives

save the environment

Earth observation applications

- On the verge of reaching new user communities
- These new user communities need to be involved
- Weakest link / last mile aspects are important
- Marketing needed: promotion & capacity building

Life cycle of products & services

Initialization

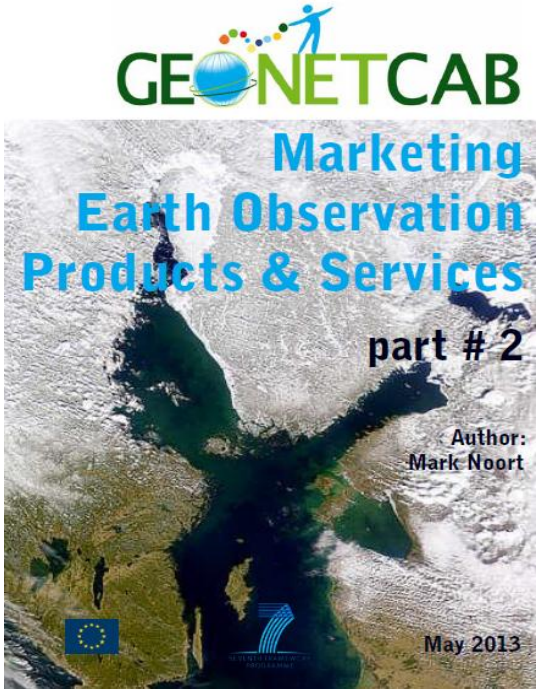
System analysis & design

Rapid prototyping

System development

Implementation

Post-implementation



Scope

Marine resources are
physical and biological entities that are found in seas and oceans that are beneficial to man

The "**marine environment**" can be described as:
the oceans, seas, bays, estuaries, and other major water bodies, including their surface interface and interaction, with the atmosphere and with the land seaward of the mean high water mark

Climate aspects are dealt with more in detail in the climate toolkit, disasters (hurricanes, flooding, tsunamis, etc.) in the disaster management toolkit and offshore wind and tidal energy in the energy and mining toolkit. Other aspects of coastal zone management are part of this toolkit.

Assessment of business & funding opportunities

- Categories of environmental management products & services
- Life cycle phase of product or service
- Regional context, level of technological & economic development
- Optimum marketing mix

1. International trends & developments in marine resources & environment

Issues & trends in marine resources & environment

More attention for:

- (sustainable) **fisheries management**
- management of **extreme events** (flooding, safety, pollution, etc.) -> in disaster management toolkit
- management of **marine and coastal ecosystems**
- effects of **climate change** -> in climate toolkit
- more effective and efficient **exploitation of resources** (oil, wind, tidal, etc.) -> in energy and mining toolkit
- **community participation** and **public awareness**

Drivers

- Increased urbanization and population growth in coastal zones;
- Increased pressure on land use in coastal zones;
- Overexploitation of fish stocks;
- Pollution of oceans (acidification, oil spills, plastic soup, etc.);
- Adverse effects of climate change, including sea level rise;
- Increased exploitation of natural resources, including in arctic zones.

Sustainable fisheries management

- Priorities: **protection of fishery resources**; fostering **food security** and **improving livelihoods**; management and **reduction of resource-use conflicts**;
- Climate change: **availability of aquatic foods** will vary; **stability of supply** will be impacted; **access to aquatic food** will be affected; **utilization of aquatic products** will be impacted;
- Goals: more **food is produced sustainably**; **demand for** the most **resource-intense types** of food **is contained**; **waste** in all areas of the food system **is minimized**; the **political and economic governance** of the food system is **improved**.

More information:

The state of world fisheries and aquaculture (FAO; 2012)
comprehensive overview of actual situation and trends

Climate change implications for fisheries and aquaculture (FAO; 2009) *overview of current scientific knowledge*

Fisheries management (FAO; 2011) *marine protected areas and fisheries*

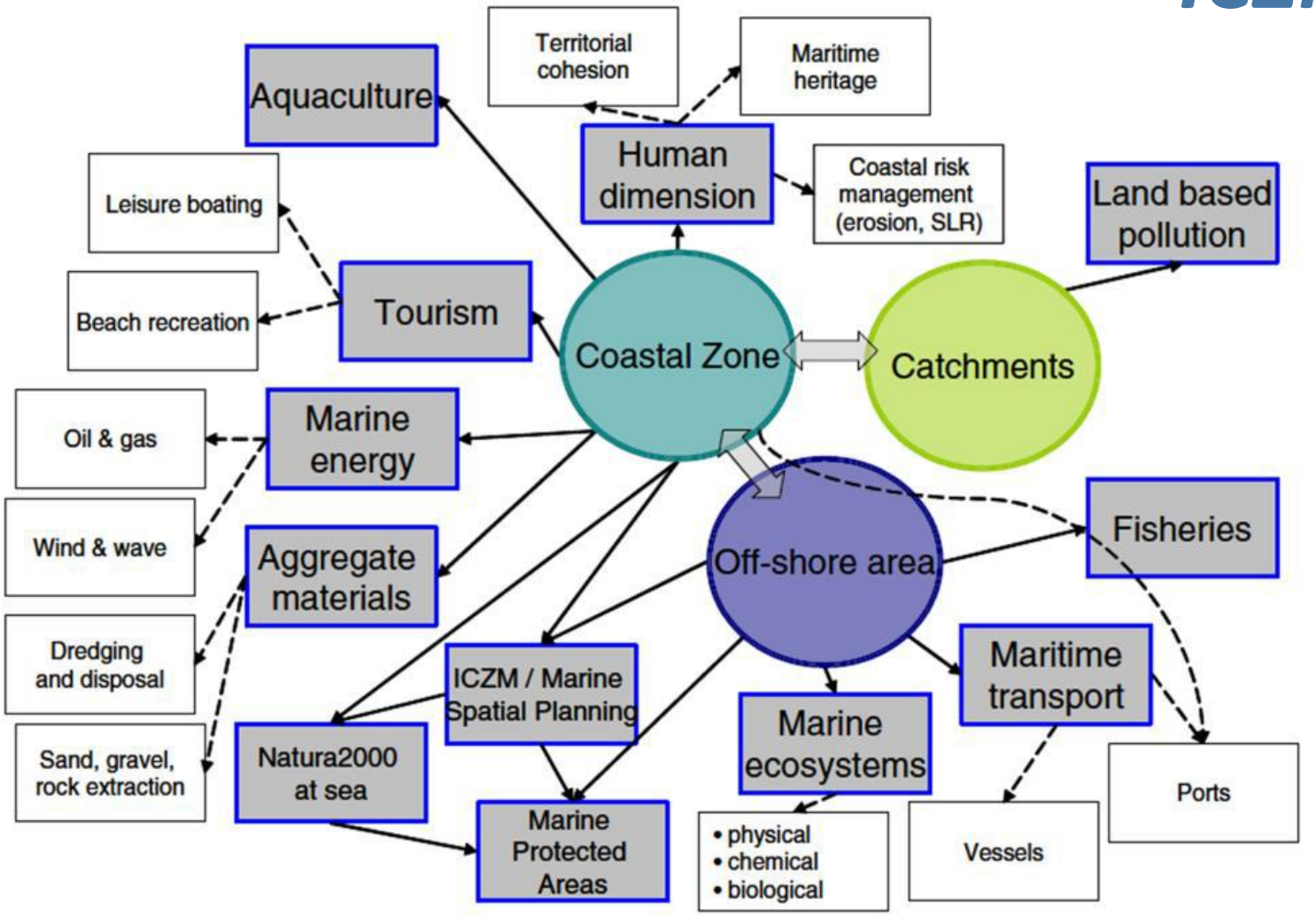
Marine protected areas (FAO; 2011) *country case studies on policy, governance and institutional issues (Brazil, India, Palau and Senegal)*

Technical guidelines for responsible fisheries (FAO)

Management of marine & coastal ecosystems

- Protection of: biological diversity, individual species, habitat, restoration of degraded areas;
- Improvement of livelihoods and non-monetary benefits;
- Maintenance of effective management and legal structures and strategies;
- Development and implementation of integrated coastal zone management (ICZM) and ecosystems approach;
- Biodiversity and ecosystem monitoring, leading to ecosystem valuation as input for better governance that reconciles the use and protection of the marine and coastal environment.

ICZM



The coastal zone as the "hinge" between terrestrial and maritime spaces
(Source: PEGASO project, 2013; Meiner, 2010: Integrated maritime policy for the European Union)

More information:

Green economy in a blue world (UNEP; 2012) *overview of options to combine economic development with sustainable management of the marine environment*

Census of marine life (CoML; 2010) *highlights of a decade of discovery and summary of the first census: overview of global inventory of marine life in the past decade* www.coml.org

SAHFOS (global marine) ecological status reports 2010/2011, 2009, 2008 *overview of monitoring marine biodiversity by means of the continuous plankton recorder survey: trends for each of the world's oceans with respect to ecosystems and climate change*

More information (2):

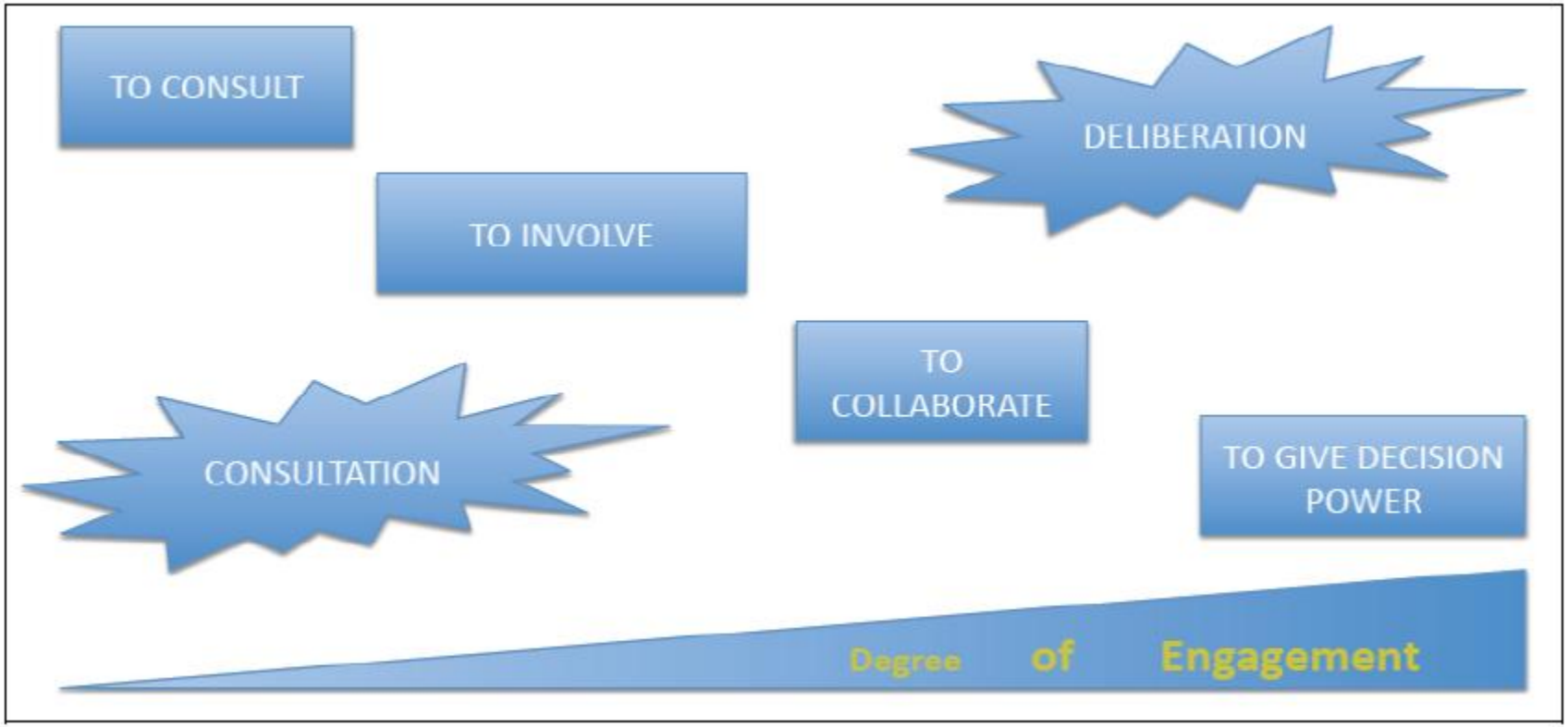
Large Marine Ecosystems (Swedish agency for marine and water management; 2012)
study of the concept of large marine ecosystems and its institutional relevance for ecosystem-based management and development

IGBP marine ecosystems and climate change
overview of changes due to human intervention and/or climate change

Community participation & public awareness

- Take into account changes in livelihoods and catching or farming opportunities;
- Some societies and communities will need to adjust to species not traditionally consumed;
- Enhancement of awareness and knowledge about sustainable use and effects of climate change (with local producers and with consumers);
- Attention for compatibility management and local cultures;
- Stakeholder participation and representation;
- Capacity building to improve technical and organisational structures.

Community participation & public awareness

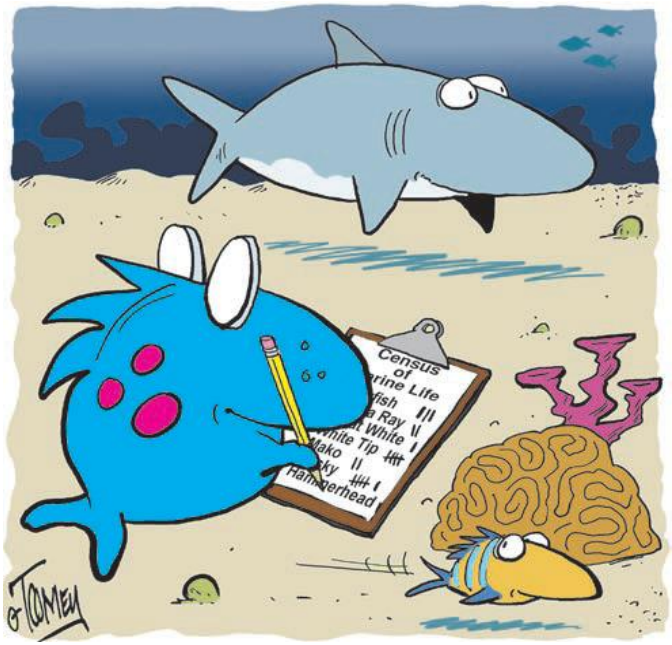


The relation between participation steps and engagement power (Source: PEGASO project, 2013)

More information:

Participatory methods for ICZM implementation (PEGASO; 2011)

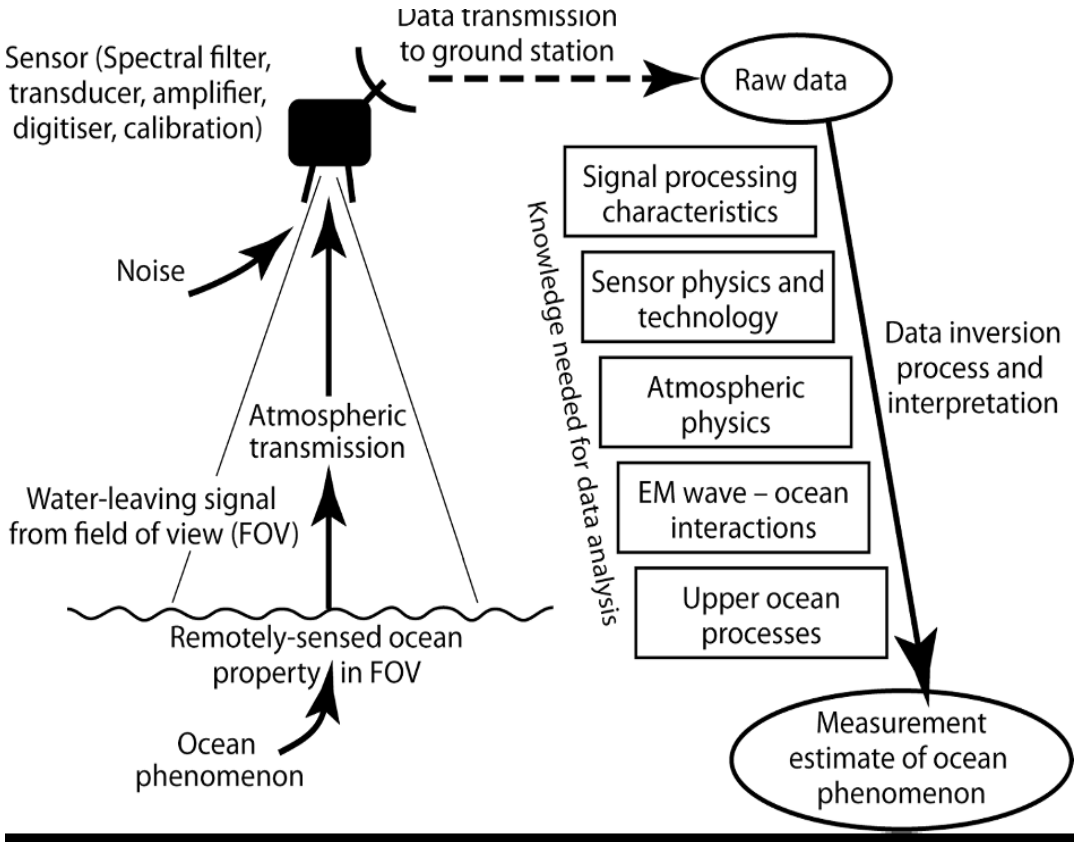
Other references: see previous slides



Source: Census of Marine Life; 2010

2. Earth observation applications

Earth observation for marine resources & environment



Source: Ocean from space (Robinson;2010)

Earth observation contribution

- Analysis and monitoring of **marine and coastal ecosystems**
- **Ocean topography, temperature and currents**,
- **Satellite-based fishing,**
- **Marine and coastal safety,**
- **Ocean weather,**
- **Climate change** (in climate toolkit)**.**

Example marine and coastal ecosystems

Extensive blooms of blue-green algae in the Baltic Sea were captured by the MERIS sensor on Europe's ENVISAT satellite on 11 July 2010 (Source: ESA, the plague of toxic algae, Copernicus, 2013)

Marine and coastal ecosystems

- Measurement of environmental parameters: chlorophyll concentration, transparency, sediment concentration, algal bloom occurrence
- Metocean and hydrographic information, coastal morphology
- Assessment of coastal habitats such as sea grass beds, coastal mudflats, mangroves and coral reefs
- Water quality monitoring and pollution detection
- Cost estimate: on case-by-case basis, monitoring of national waters: 50 – 150 k€ / country, historical analysis of environmental conditions: 2k€ / region
- Main challenges: acceptance, capacity

Examples:

MyOcean www.myocean.eu
marine safety, marine resources, coastal & marine environment, weather & seasonal forecasting

SAHFOS (global marine) ecological status reports 2010/2011, 2009, 2008 *overview of monitoring marine biodiversity by means of the continuous plankton recorder survey: trends for each of the world's oceans with respect to ecosystems and climate change*

Census of Marine Life www.coml.org

Argo floats www.argo.net
collection of 1,000,000 temperature/salinity profiles, each of which consists of up to 1,000 measurements of temperature and salinity at varying depths

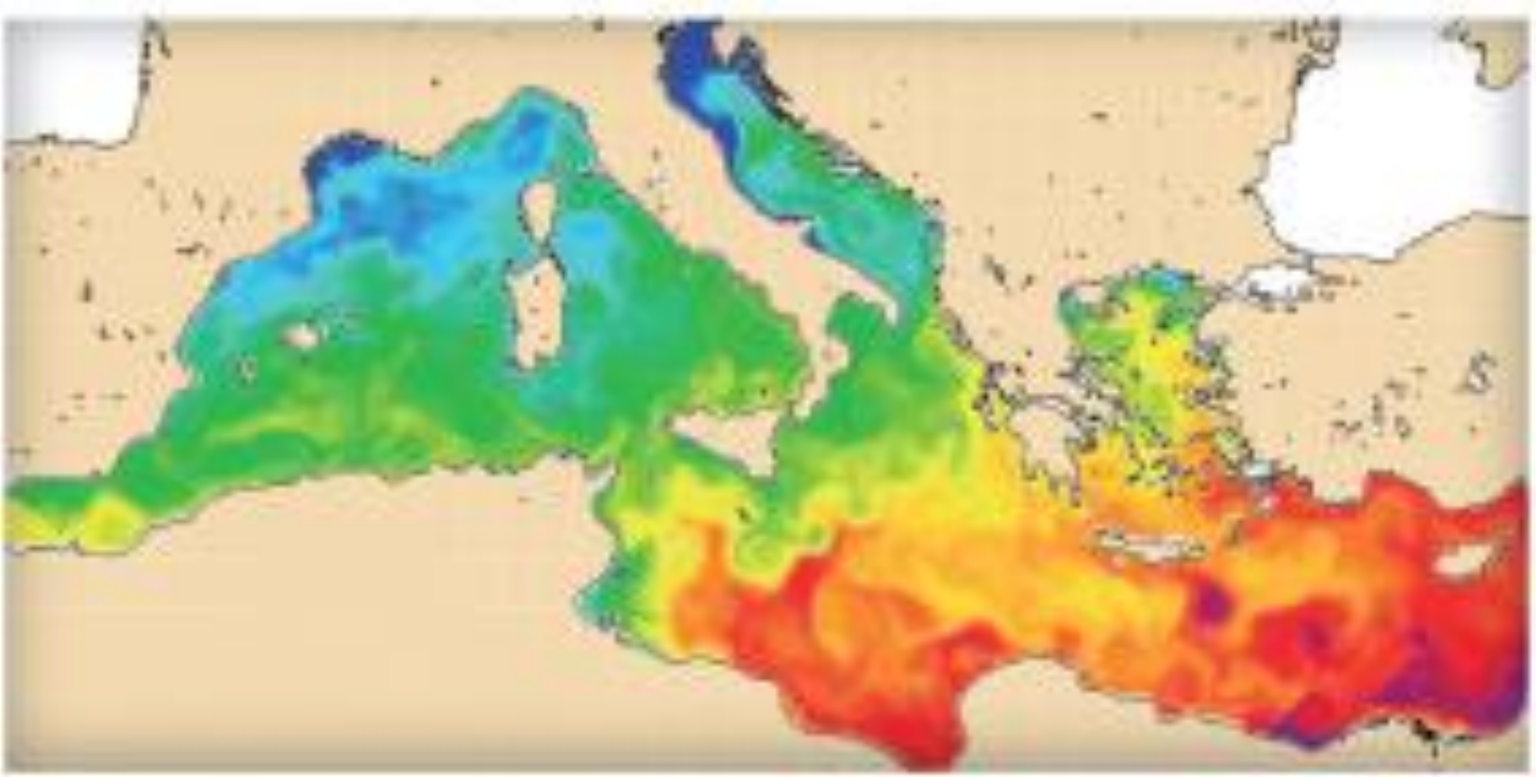
More examples:

Earth observation for aquatic ecosystems (CSIRO; 2012)
presentation with examples on coral reef and ecosystems monitoring in Australia

The plague of toxic algae (Copernicus; 2013)
factsheet/brochure

Development of satellite method for Baltic ecosystem monitoring (SRC PAS)
GEONetCab success story

Example ocean topography, temperature and currents



Sea surface temperature in the Mediterranean (source: MyOcean)

Ocean topography, temperature and currents

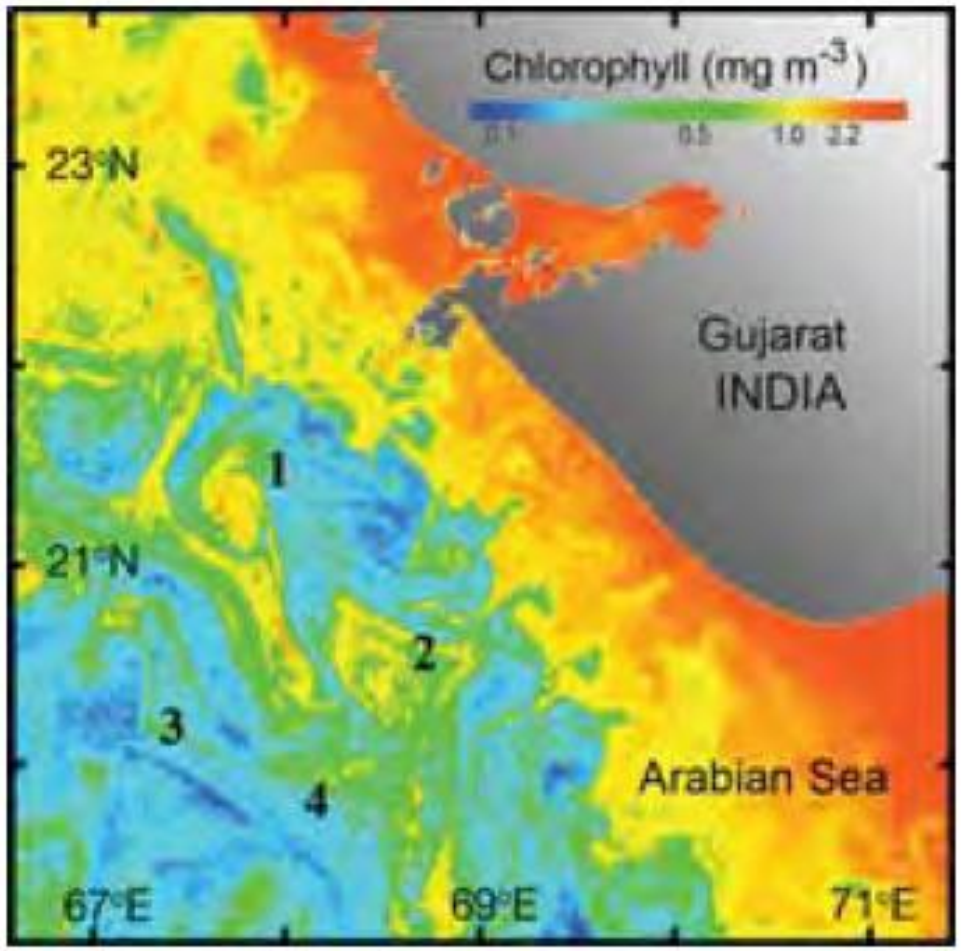
- Measurement of sea surface height, sea surface temperature, ocean colour, wind vector, sea state (significant wave height & directional wave spectra) and sea ice parameters
- Used for sea level change, ocean circulation, ocean tides, ocean surface wind wave studies, El Niño studies, cyclone/hurricane studies, rainfall studies, weather forecasting, storm detection, near-shore modelling
- For the benefit of ship routing, oil production, maritime safety, satellite based fishery & sustainable fisheries management, ecosystem management, coastal zone management and solutions, pollution tracking and mitigation
- Cost estimate: on case-by-case basis, general forecasts are free
- Main challenges: cost, complexity.

Examples:

MyOcean www.myocean.eu
marine safety, marine resources, coastal & marine environment, weather & seasonal forecasting

Global ocean data assimilation experiment (GODAE)
improved standardisation, modelling, forecasting and a cost-effective and sustainable ocean observing system (ended 2009)

Example satellite-based fishing



Chlorophyll image of northwest India on 29 February 2006 generated from the Indian OCM sensor. Oceanic features such as cyclonic eddies (1 and 2 on the image) and fronts (3 and 4) are known to be productive sites and are hence relevant for fishery exploration

(Source: IOC, 2008 / Credit: R.M. Dwivedi, Indian Space Research Organisation, India)

Satellite-based fishing

- Earth observation helps identify optimum fishing grounds and conditions
- Through earth observation and GIS data are combined on bathymetry, light houses, landing centres, sectors, Potential Fishing Zone (PFZ) lines, sea surface temperature and chlorophyll
- Earth observation supports detection of illegal fishing
- Earth observation enhances monitoring of aquaculture activities
- Cost estimate: on case-by-case basis
- Main challenges: capacity, data access, revisit time.

Examples:

Ocean Data and Information System (ODIS, INCOIS)
www.incois.gov.in/Incois/marine_fisheries_main.jsp
web-based provision of potential fishing zone information and ocean state forecast in the Indian Ocean

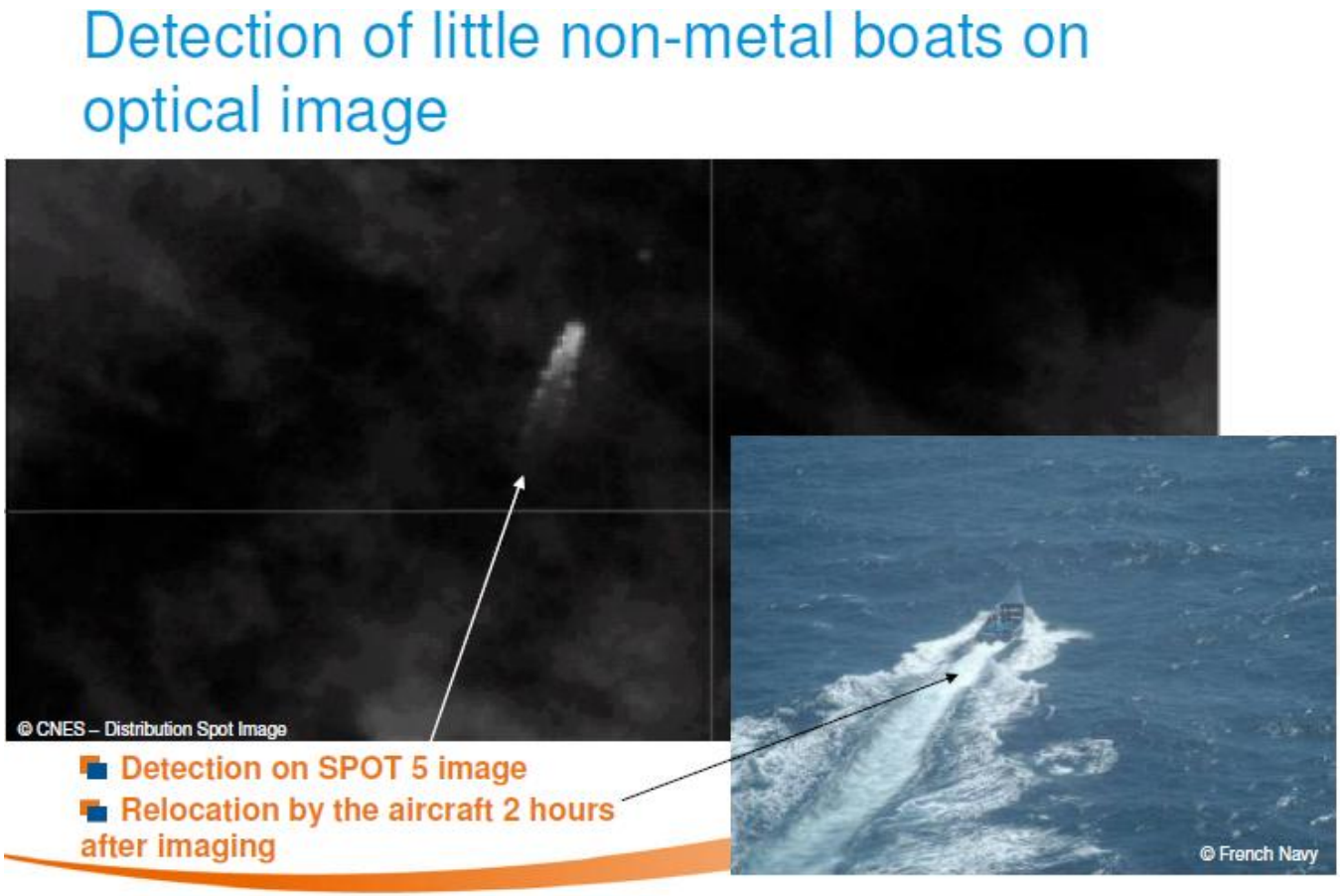
Ocean colour radiometry and fisheries (IOC; 2008) *description of use of satellite data that characterize oceanic properties of habitat and ecosystems that influence living marine resources at spatial and temporal resolutions that are impossible to achieve any other way*

Satellites support sustainable fishing (Copernicus; 2013) *factsheet/brochure*

Satellites support sustainable aquaculture development (Copernicus; 2013) *factsheet/brochure*

FARO www.faro-project.org *research on sustainable fisheries management*

Example marine and coastal safety



Maritime surveillance (Source: Airbus Defence and Space, 2011)

Marine and coastal safety

- Earth observation facilitates situation awareness of the overall maritime domain, effectiveness from early warning to interception and optimised operation planning at sea
- Application areas: ship routing, maneuvering & performance traffic control, smuggling, illegal fishing, oil dumping & pollution monitoring, illegal immigration, piracy, safety, search & rescue
- See also ocean weather: waves, hurricanes, squall, sea ice, etc.
- Cost estimate: on case-by-case basis, near real-time detection of bigger vessels 0.5 – 1 k€ / day, detection of anomalous behaviour 3 – 6 k€ / day, monitoring object of interest: 2.5 – 5 k€ / day
- Main challenges: cost, complexity, revisit time.

Examples:

MyOcean www.myocean.eu
marine safety, marine resources, coastal & marine environment, weather & seasonal forecasting

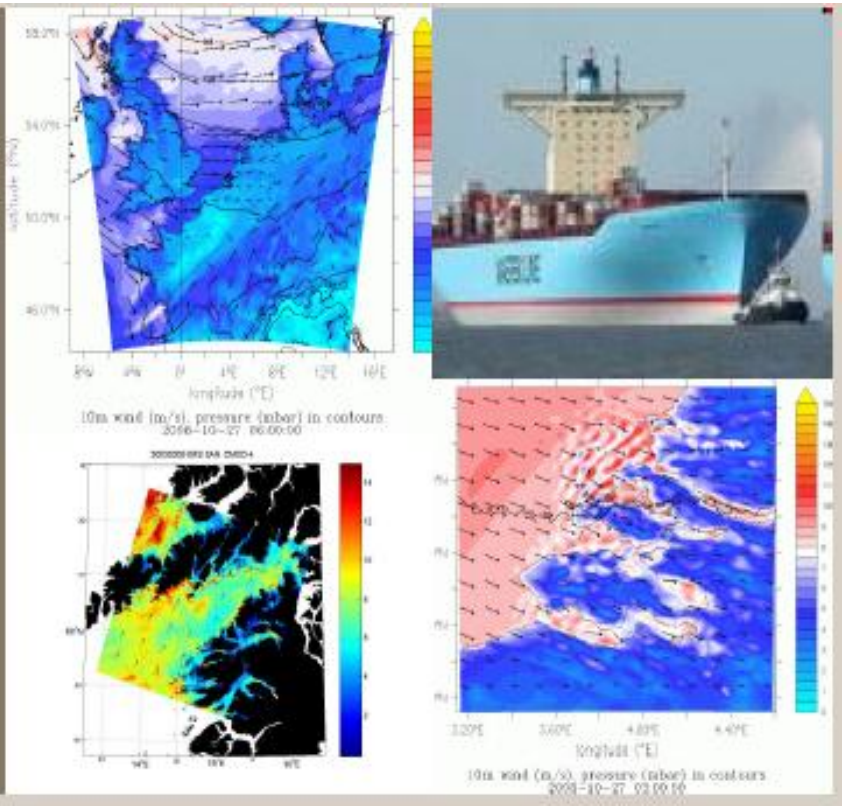
Pirate ship tracked by satellite (Copernicus; 2013)
factsheet/brochure

Fugro, BMT Argoss, Airbus Defence and Space
company brochures on marine safety

Example ocean weather

- GTS measurements
- WRF (mesoscale) modeling
- Characteristics (forecasts)
  - Calculated up to 4 times a day
  - Spatial resolution as fine as 1 km
- Fine resolutions achieved through nesting
- Data available up to a 10 minute time interval
- Up to 120 hours ahead

Contracted to support 20 wind parks for daily production forecast



High-resolution weather forecasting (Source: BMT Argoss, 2011)

Ocean weather

- Earth observation provides wind and wave data, surface currents, sea surface temperature, marine frontal structures
- Weather forecast products and services: 3-day or 5-day site-specific or route specific weather forecasts - once or twice daily in a range of formats, regional wave model data for weather sensitive areas, hurricane forecasts, squall warning service, hindcast studies of weather events for insurance purposes, provision of extensive climatology data, sea ice forecast
- Cost estimate: most general weather forecast data and information are provided for free
- Main challenges: capacity, complexity, business model.

Examples:

MyOcean www.myocean.eu
marine safety, marine resources, coastal & marine environment, weather & seasonal forecasting

Fugro, BMT Argoss
company brochures on weather forecasting

Growth potential for earth observation

- **Support to management of marine and coastal ecosystems**.
  Main clients: governments, NGOs.
- **Satellite-based fishing.**
  Main clients: government, fishing companies.
- **Marine and coastal safety.**
  Main clients: government, energy companies, shipping companies.
- **Ocean weather.**
  Main clients: energy companies, shipping companies, government.

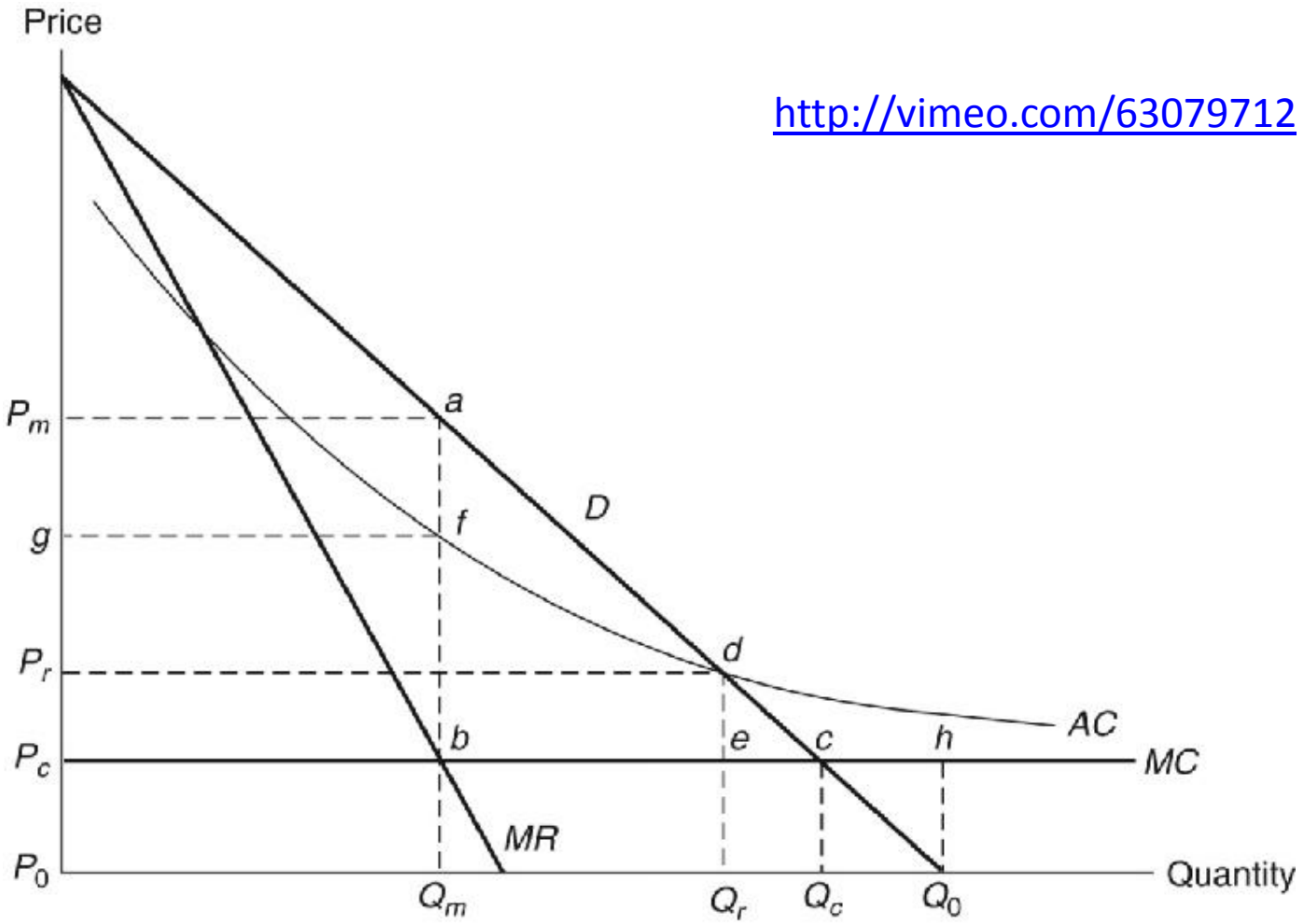
3. Business development

Why is marketing / promotion of earth observation needed?

- Public sector information (PSI)
- Externalities (environmental accounting & payment for ecosystem services)
- Global datasets, open access, data sharing, compatibility (GEO)

If public sector information is made available free-of-charge, demand will increase and, in the end, government revenue also, as companies will derive income from value-added products and services, and consequently pay more taxes (see figures in following slides).

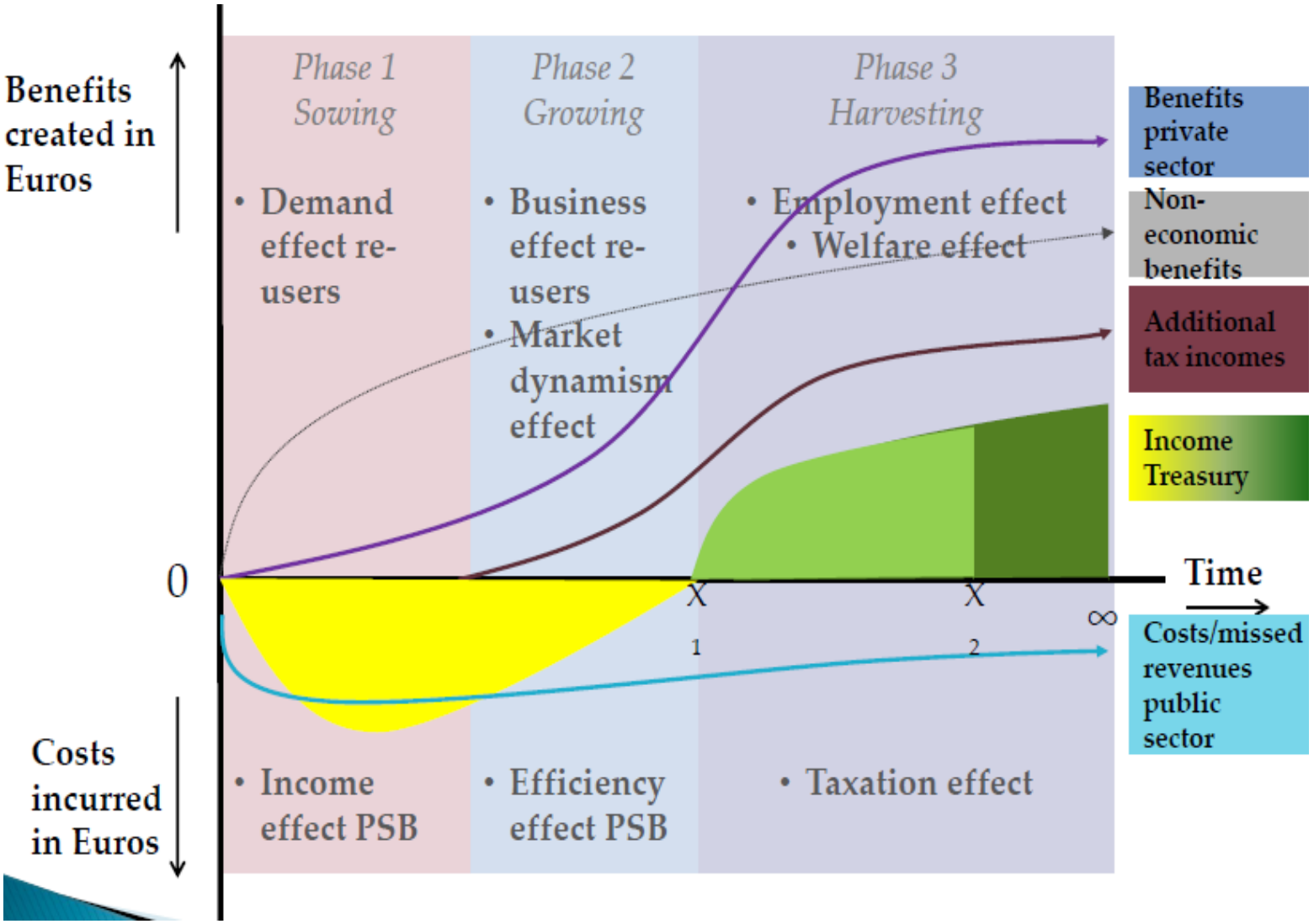
Supply & Demand Public Sector Information



http://vimeo.com/63079712

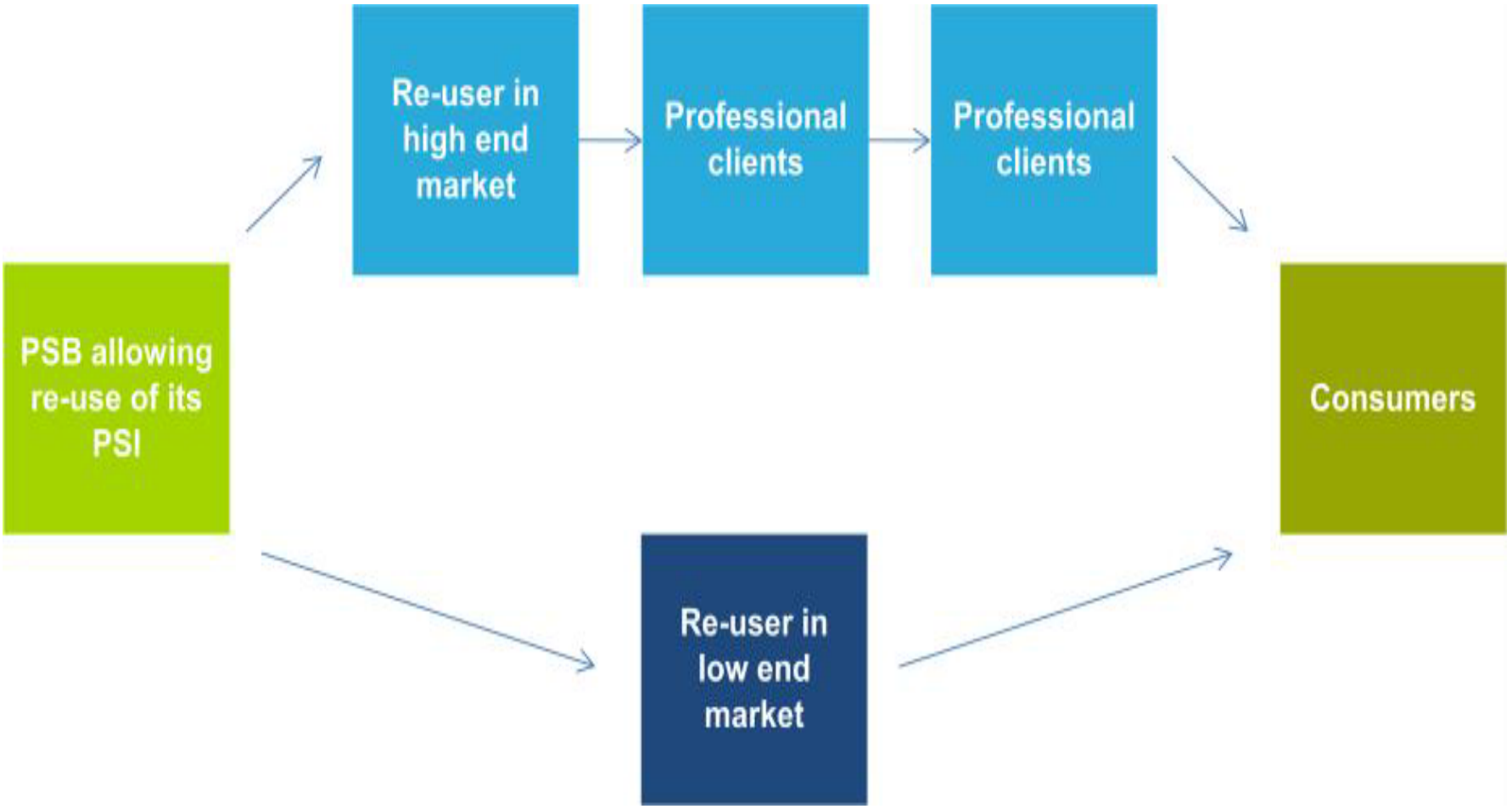
Source: About GMES and data: geese and golden eggs (Sawyer, de Vries 2012)

Cost-benefit Public Sector Information



Source: About GMES and data: geese and golden eggs (Sawyer, de Vries 2012)

Re-use of Public Sector Information

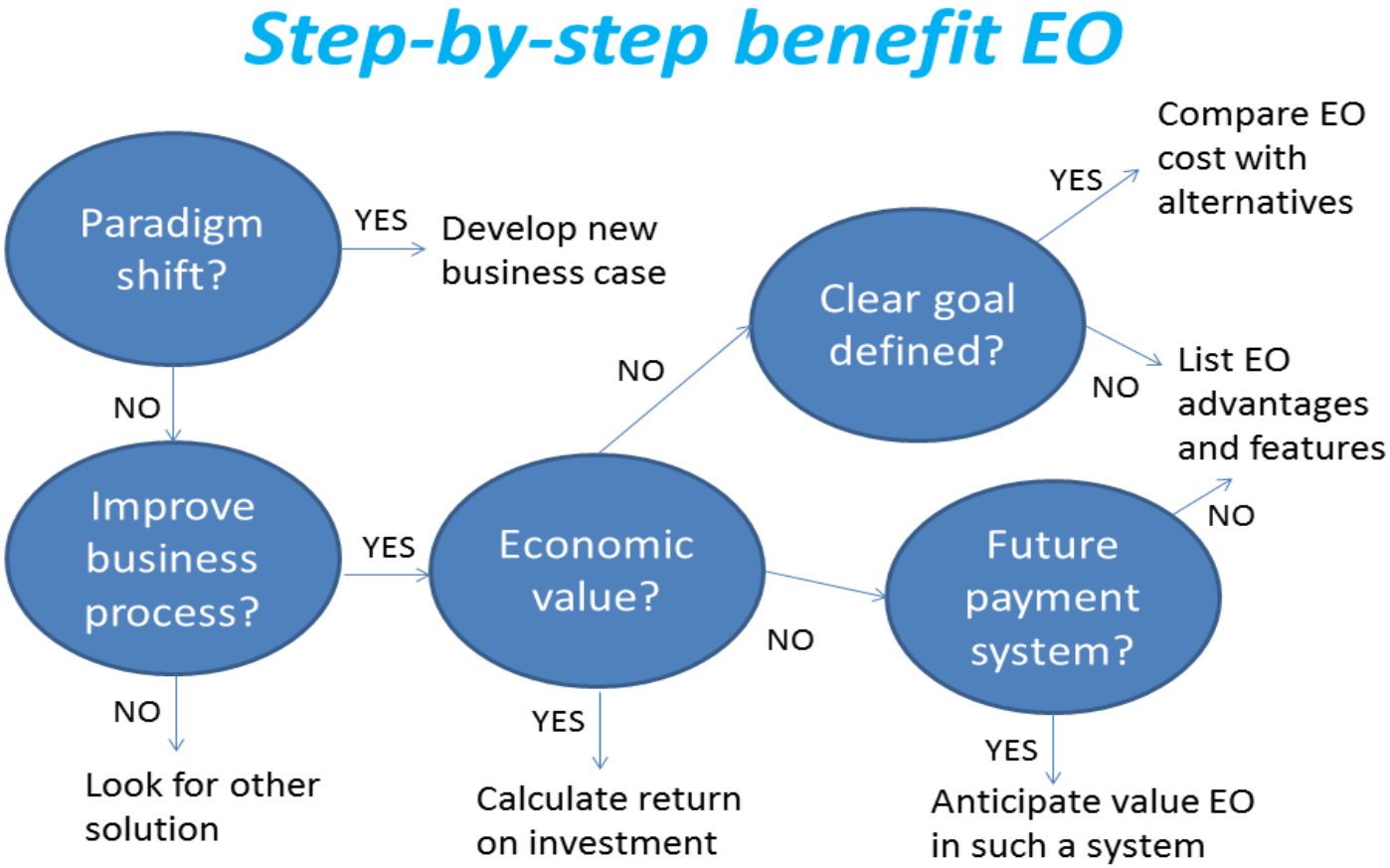


Source: About GMES and data: geese and golden eggs (Sawyer, de Vries 2012)

Most earth observation applications deal with so-called externalities, such as impact on the environment.
It is difficult to capture these in terms of conventional cost-benefit models.

To tackle this, the following framework for analysis of earth observation applications is developed:

Framework for analysis



Step-by-step analysis of the benefits of earth observation (source: GEONetCab, 2013)

Key questions

- Does the new application cause a paradigm shift?
- Is the current business or organization process improved?
- Does the application provide economic value that can be quantified?
- Is a clear measurable goal defined to which the earth observation application contributes?
- Is a future payment scheme or other economic mechanism foreseen in which the earth observation application fits?

Assessment of geospatial solutions

Rating of **characteristics** of geospatial solutions:

- fit-for-purpose
- comparative advantage
- complexity to user / ease- of-use
- elegance
- cost-benefit,
- sustainability
- resilience
- reproduction capacity / flexibility
- acceptance
- level of knowledge transfer required
- ethics, transparency, public accountability, objectivity & impartiality

Rating of **business environment**:

- **Willingness to pay** (by clients)
- **Embedding** (in organizational processes)
- **Openness** (transparency and ease of doing business, access to markets)
- **Institutions** (is the institutional environment conducive to doing business, acceptance of new solutions?)

Fit-for-purpose

An important, but often forgotten requirement:
Does the product or service do what it is supposed to do to solve a certain problem?

In other words: is it really a solution or just an attempt towards a solution?

- Quantitative: not applicable
- Qualitative (on scale of 1 to 5): based on description of what the EO solution actually does

Comparative advantage

What it does significantly better than other solutions to the same problem.

For earth observation usually the comparative advantages of greater accuracy, better resolution in time and space, comprehensive overview of large areas and near real-time information provision are mentioned as comparative advantages.

- Quantitative: calculation of degree in which the EO solution is better than alternatives
- Qualitative (on scale of 1 to 5): based on listing of comparative advantages

Complexity (to user) / ease-of-use

At all levels in the value chain the users (professionals and end-users) are able to work with the product or service.

- Quantitative: not applicable
- Qualitative (on scale of 1 to 5): based on user testimonials and user surveys

Elegance

Once you get the idea behind this product or service, you want to be part of the community that uses it.

This sense of belonging facilitates the formation of user groups that provide valuable feedback.

- Quantitative: none, or it should be the size of the user community
- Qualitative (on scale of 1 to 5): based on user testimonials and user surveys

Cost-benefit

The cost-benefit of the product or service is quantified and sufficiently attractive, also in the long-term.

- Quantitative: cost-benefit calculation
- Qualitative (on scale of 1 to 5): based on quantitative assessment

Sustainability

The product or service can be delivered when it is needed.
There is a long-term perspective that guarantees delivery.

Sustainability concerns the following aspects:

- ✓ Long-term data availability
- ✓ Availability of finance/funds to provide the solution continuously for present and future use
- ✓ Long-term institutional / governmental interest and support
- ✓ Long-term user interest for a solution that addresses real needs

- Quantitative: not applicable
- Qualitative (on scale of 1 to 5): based on sensitivity analysis of the EO solution

Resilience

In case of extremes or breakdown in the value chain, the product or service can still be delivered at an acceptable level. Alternatives (plan B) are available (and developed).

- Quantitative: cost-benefit calculation of plan B
- Qualitative (on scale of 1 to 5): based on risk analysis of the EO solution

Reproduction capacity / flexibility

The product or service can be easily applied or adapted for use in another region or another situation, while still providing the solution without (too much) extra cost.

- Quantitative: calculation of reproduction costs for application in other regions or situations; measurement of spreading of actual use
- Qualitative (on scale of 1 to 5): based on quantitative assessment and description of EO solution

Acceptance

The users intuitively get what the product or service is about and are interested. They accept it as a solution to their problem.

- Quantitative: none, or survey results about acceptance. After introduction of the solution: number of clients and/or users
- Qualitative (on scale of 1 to 5): based on user testimonials and user surveys

Level of knowledge transfer required

The training requirements for professionals and other users along the value chain are clear and associated costs and efforts are acceptable.

- Quantitative: cost and time required to get the users at the desired knowledge and skill level
- Qualitative (on scale of 1 to 5): based on knowledge transfer plans and evaluation of training activities

Ethics, transparency, public accountability, objectivity & impartiality

Application of Earth observation increases the level of objectivity and impartiality in decision-making processes, including conflict resolution. The application improves transparency and public accountability. It raises no ethical issues or if it does, as in the case of privacy concerns, these are resolved in a satisfactory way for all parties concerned.

- Quantitative: not applicable
- Qualitative (on scale of 1 to 5): based on user testimonials and user surveys

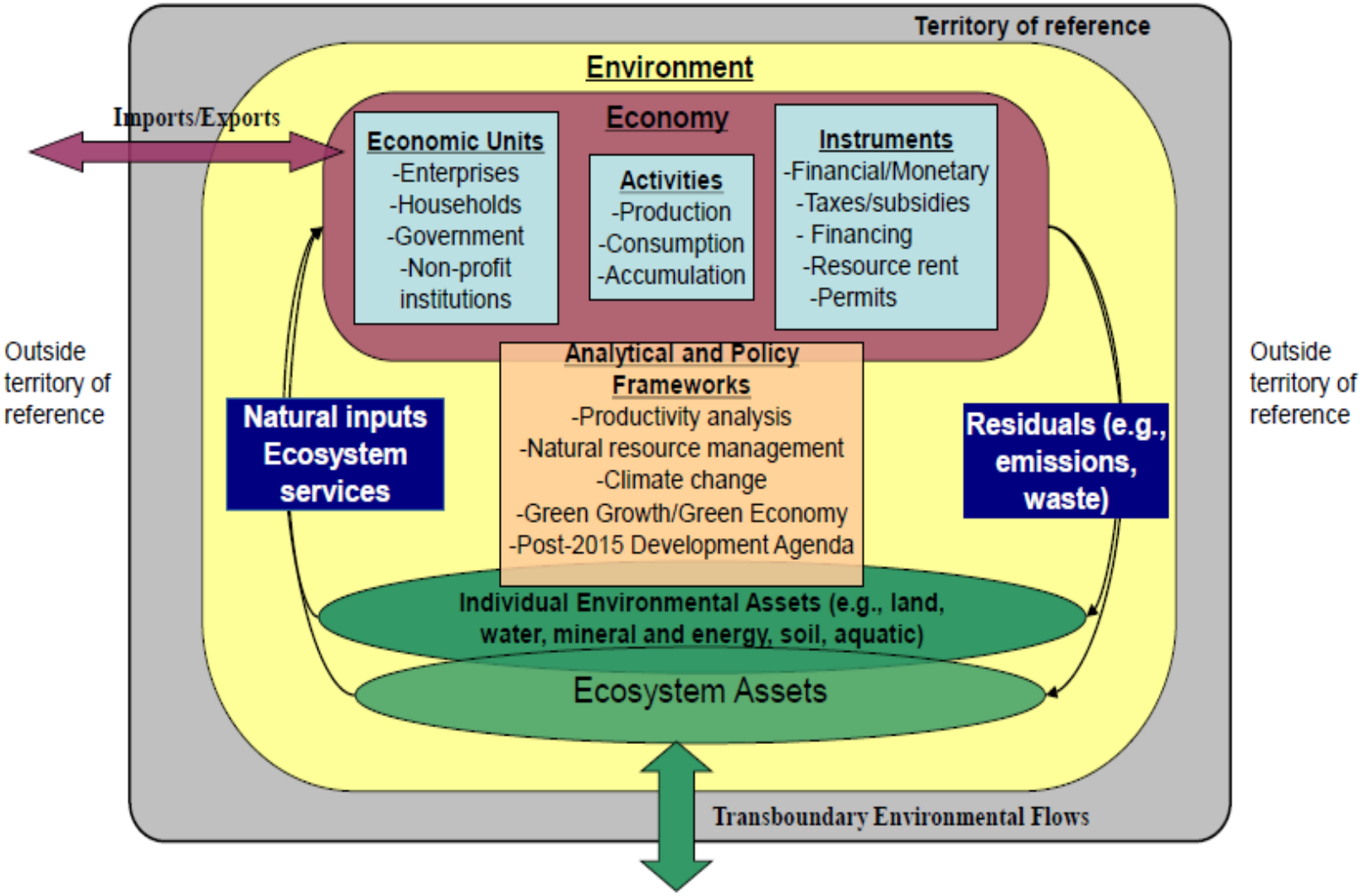
Several attempts have been made to introduce environmental accounting and to enlarge the sphere of the conventional economy to include and quantify impact on ecosystems.

The following slides give some examples:

Environmental accounting & payment for ecosystem services

- **SEEA:**
  System of Environmental-Economic Accounts
  (EC, FAO, IMF, OECD, UN, WB)
- **WAVES:**
  Wealth Accounting and the Valuation of Ecosystem Services (global partnership, led by World Bank)
- **TEEB:**
  The Economics of Ecosystems and Biodiversity
  (group led by UNEP)

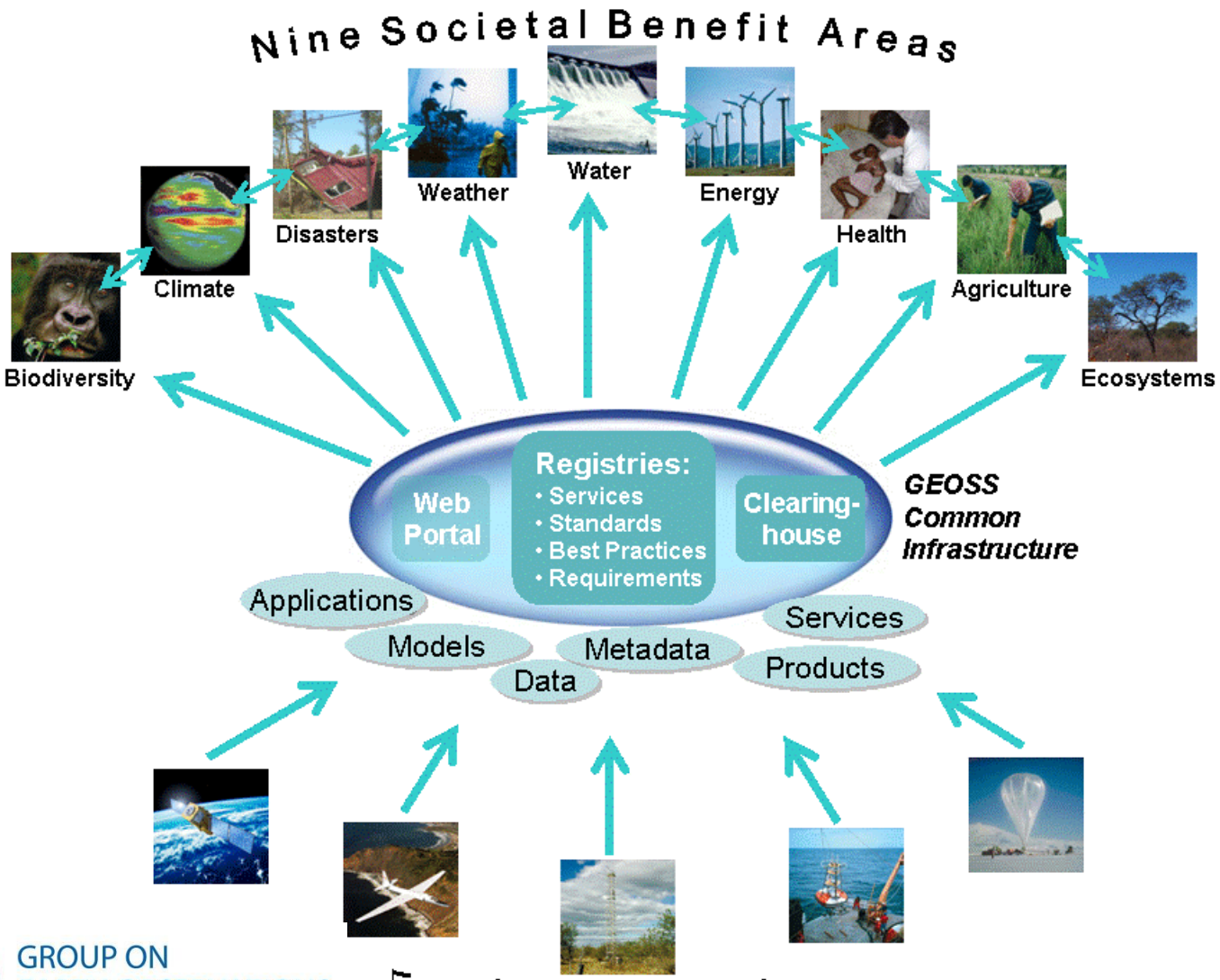
SEEA Conceptual Framework



Source: SEEA conceptual framework report (EC, FAO, IMF, OECD, UN, WB 2012)

For earth observation the work of the Group on Earth Observations (GEO) is essential to achieve the goal of a Global Earth Observations System of Systems (GEOSS), resulting in the shared GEO common infrastructure (GCI):

Group on Earth Observations



GROUP ON EARTH OBSERVATIONS

Marketing elements

- Customer value propositions
- Crossing the technology chasm
- Creating shared value
- Promotion tools

Customer value propositions capture the unique value of a product or services as perceived and appreciated by the customer.

Interestingly, they can differ completely from the features that the provider considers most important:

Customer Value Propositions

VALUE PROPOSITION	ALL BENEFITS	FAVOURABLE POINTS OF DIFFERENCE	RESONATING FOCUS
Consists of:	All benefits customers receive from a market offering	All favourable points of difference a market offering has relative to the next best alternative	The one or two points of difference whose improvement will deliver the greatest value to the customer
Answers the customer question:	"Why should our firm purchase your offering?"	"Why should our firm purchase your offering instead of your competitor's?"	"What is *most* worthwhile for our firm to keep in mind about your offering?"
Requires:	Knowledge of own market offering	Knowledge of own market offering and next best alternative	Knowledge of how own marketing offering delivers value to customers, compared with next best alternative
Has the potential pitfall:	Benefit assertion	Value presumption	Requires customer value research

Source: Customer value propositions in business markets (HBR 2006)

Buyer behaviour & motivation

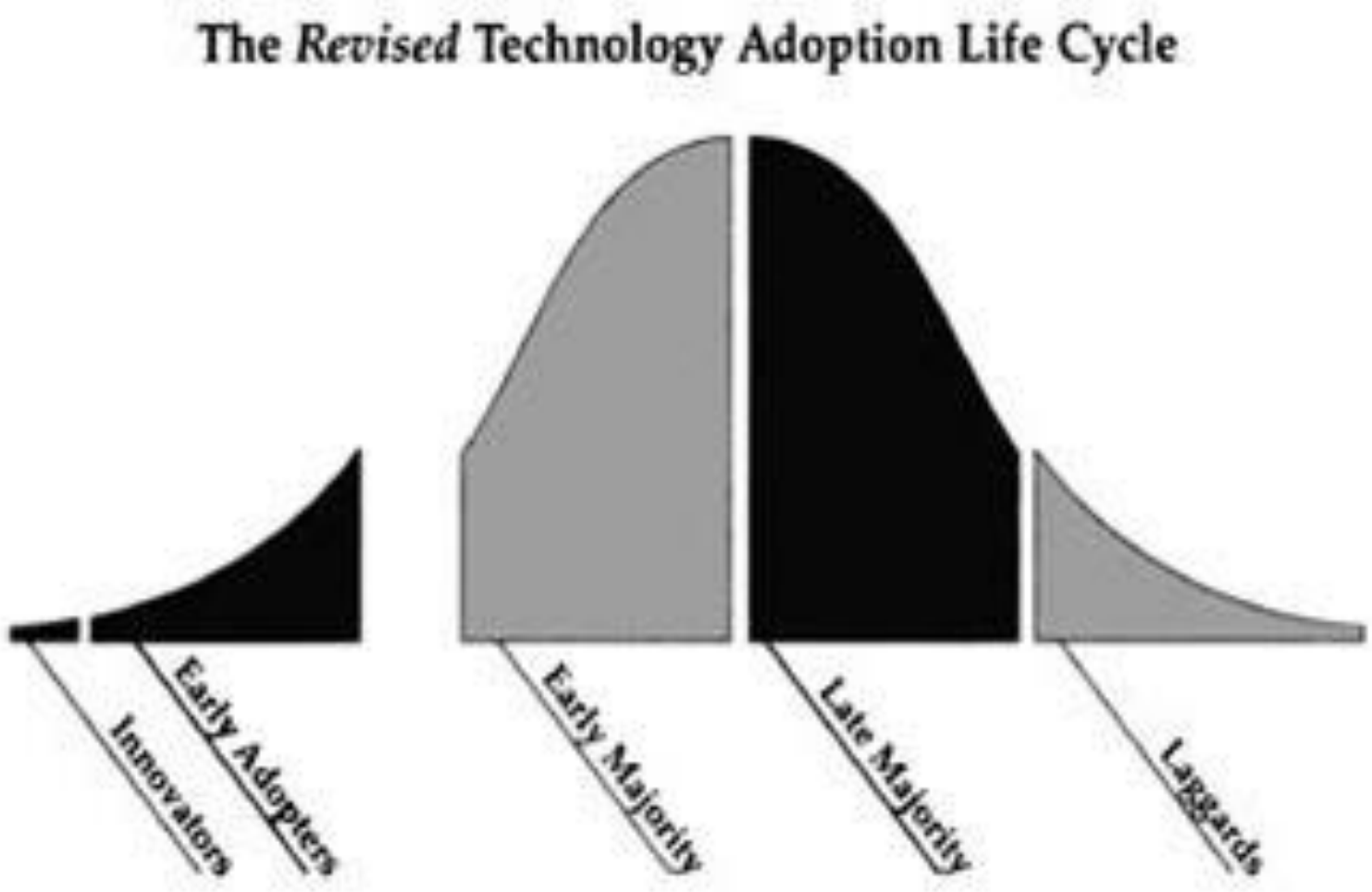
Type	Buyer behaviour	Motivation
Transactional sales	Intrinsic value buyers: “keep it cheap and easy to do business”	Understands the product Perceives it as substitutable Cost focus Resents time ‘wasted’ with sales people
Consultative sales	Extrinsic value buyers: “I don’t know the answer: help me analyse and solve the issue	Focus on how the product is used Interested in solutions and applications Values advice and help Needs the sales person

Source: Rethinking the sales force (Rackham, de Vincentis 1999)

Even when customer value propositions are well captured and formulated, introduction of solutions that involve new technology will have to overcome some hurdles.

This is called “crossing the technology chasm”:

Crossing the technology chasm



Source: Crossing the chasm (Moore 1991)

Crossing the technology chasm

- Most clients of EO products and services belong to the early and late majority,
- They are pragmatists and are not prepared or willing to take substantial risk: the solution should work and be reliable.
- Once convinced, the pragmatists will be long-term clients.

Source: Crossing the chasm (Moore 1991)

More information:

Creating & delivering your value proposition
– managing customer experience for profit
(Barnes, Blake, Pinder; 2009)

Customer value propositions in business markets
(Anderson, Narus, van Rossum [Harvard Business Review]**; 2006)**

Rethinking the sales force:
refining selling to create and capture customer value
(Rackham, de Vicentis; 1999)

Crossing the chasm
– marketing and selling high-tech products to mainstream customers
(Moore; 1991)

Creating shared value is a key element of successful implementation of earth observation solutions.

To achieve this, in most cases earth observation applications have to be integrated into more general (business or organizational) processes:

Create shared value

Involves cooperation between:

- **Public sector**
- **Private sector**
- **Social sector**

Opportunity for earth observation (integrated) solutions:

- Integrate EO in general business / organizational process
- Integrate different EO (and GIS and navigation) functionalities

Based on all considerations dealt with in the previous slides, there are some practical approaches that can be applied in combination to promote earth observation applications:

Tools for earth observation marketing:

- Success stories (in non-technical language, feasible, replication capacity, sustainable)
- Marketing toolkits (international trends, earth observation examples, references)
- Pilot projects, innovation funds, quick-wins (demonstration that EO actually works)
- Promotion outside EO community (fairs, seminars, lunch-bag meetings, magazines)
- Resource facilities for reference and capacity building (distributed, but connected, in different languages)

Source: Marketing earth observation products and services (Noort 2013)

Business elements

Business elements:

- **Proposal writing**
- **Business procedures**

Proposal writing is an art in itself.

During the GEONetCab and EOPOWER projects templates have been developed for writing successful proposals:

Proposal outline

1. Introduction / relevance
2. Objective(s)
3. Activities
4. Output
5. Management & evaluation
6. Risk assessment
7. Time schedule
8. Budget

Annexes

(more detailed version in separate document,
see www.eopower.eu or www.hcpinternational.com)

Other guides that may be useful:

- Civicus: writing a funding proposal
- Michigan State University: guide for writing a funding proposal
- ESRI: writing a competitive GRANT application
- REC: project proposal writing

If you run a company, compete for assignments and manage projects, a structured approach towards responsibilities, tasks, implementation and documentation is needed.

The following business procedures may be helpful:

Business procedures

1. On acquisition
2. On offers
3. On negotiation
4. On contracts
5. On project management
6. On travel & deployment
7. On deficiencies & complaints
8. On internal organization
9. On finance

(more detailed version in separate document,
see www.eopower.eu or www.hcpinternational.com)

Again:

- **SHARED PROBLEM**
- **SHARED LANGUAGE**
- **SHARED SOLUTION**

4. Capacity Building

General

Marketing is promotion + capacity building.

Especially for the introduction of new technologies capacity building is important at all levels.

Capacity building is the instrument to increase self-sufficiency and make solutions work.

General references for capacity building, open data and success stories

GEO Portal: www.earthobservations.org

Capacity building resource facility www.eopower.eu
compilation of tutorials, references, open-source software, etc.

Satellites going local: *share good practice* **(Eurisy handbooks)**
www.eurisy.org

Earth observation for green growth (ESA, 2013)

General references for capacity building, open data (2)

Bringing GEOSS services into practice:
how to use data from the GEO portal and how to provide input
www.envirogrids.net

Science education through earth observation for high schools:
basic tutorials on all kind of subjects, including coral reefs, ocean colour, currents and maritime pollution www.seos-project.eu

Copernicus briefs:
information on satellite applications for different topics
www.copernicus.eu/pages-secondaires/publications/copernicus-briefs/

MetEd: *tutorials and courses on meteorology and related subjects*
https://www.meted.ucar.edu/training_detail.php

Capacity building resources for marine resources & environment (1):

PEGASO project
background documentation, tutorials, indicators and factsheets for integrated coastal zone management
www.pegaso.eu

Handbook of satellite remote sensing image interpretation (IOCCG; 2011)
case studies on air/water quality, phytoplankton and macro algae, fisheries and aquaculture, marine ecosystem characterization + exercises
www.ioccg.org/handbook.html

BILKO
learning and teaching system for remote sensing to oceanography and coastal management, includes free software
http://www.noc.soton.ac.uk/bilko/

Capacity building resources for marine resources & environment (2):

African Marine Atlas
geoportal for marine and coastal information on Africa
www.africanmarineatlas.net

Remote sensing applications chapter 9: Oceans **(NRSC; 2010)**

Discovering the ocean from space - the unique applications of satellite oceanography **(Robinson; 2010)**

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