Earth Observation for Forest Management

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

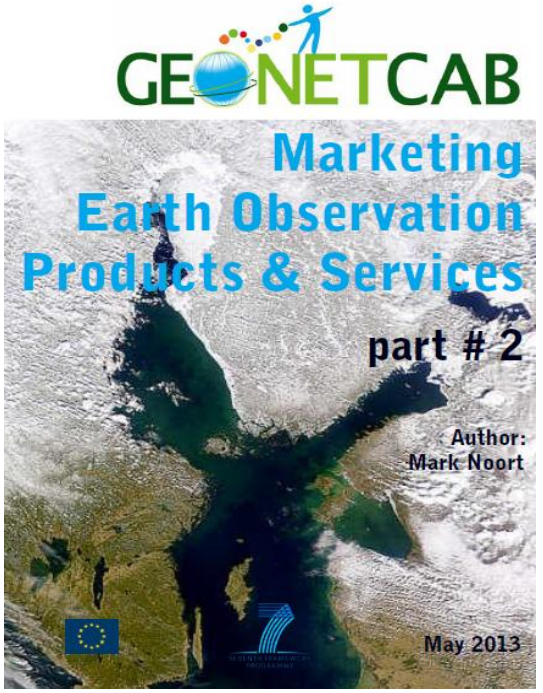
System analysis & design

Rapid prototyping

System development

Implementation

Post-implementation



Scope

Forest:
a dense growth of trees, plants, and underbrush covering a large area (very simplified definition/description)

Forest management:
is a branch of forestry concerned with the overall administrative, economic, legal and social aspects and with the essentially scientific and technical aspects, especially silviculture, protection, and forest regulation.

Climate aspects are dealt with more in detail in the climate toolkit, forest fires in the disaster management toolkit, environmental aspects in the environmental management 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 forest management

Issues & trends in forest management

- Increased attention for **forest governance**, including **certification**
- More detailed and accurate (**global) monitoring of forests and deforestation**
- More involvement of the general public**: participation, interactivity** and **citizens' observatories**
- Possible effects of deforestation and sustainable forest management on **climate change** (including carbon accounting)
  -> in climate toolkit

Drivers

- (Increasing) demand for timber and wood as fuel;
- Increased pressure on land, conversion of forests into agricultural (and urban) land;
- Recognition of cardinal role of forests in carbon sequestration;
- Increased attention for biodiversity loss and conservation of ecosystems;
- Esthetic and recreational value of forests.

Forest governance and certification

Based on three pillars:

- Policy, legal, institutional and regulatory frameworks
- Planning and decision-making processes
- Implementation enforcement and compliance

and a number of cross-cutting aspects:
accountability, effectiveness, efficiency, fairness/equity, participation, transparency + description of subcomponents and indicators

The International Tropical Timber Organization (ITTO) and the Forest Stewardship Council (FSC) developed **criteria and indicators for sustainable forest management and certification**: FSC label required by customers and therefore by producers

More information:

Framework for assessing and monitoring forest governance (PROFOR, FAO; 2011) *Framework for description, diagnosis, monitoring, assessment and reporting on the state of governance in a country's forest sector.*

Impact of the global forest industry on atmospheric greenhouse gases (FAO; 2010) *Assessment of the influence of the forest products (roundwood, processed wood products and pulp and paper) value chain on atmospheric greenhouse gases with the aim to make management practices more sustainable*

Sustaining forests - investing in our common future (UNEP; 2011) *Assessment of forest assets values, threats and policy and market solutions for sustainable forest management*

More information (2):

Forest sourcebook (World Bank; 2008) *Comprehensive overview of forest management, including a discussion of remote sensing applications + cost comparison between RS and conventional monitoring*

ICT for data collection and monitoring & evaluation - Opportunities and guidance on mobile applications for forest and agricultural sectors (World Bank; 2013) *Discussion of (feasibility of) remote sensing applications, challenges and opportunities*

The High Conservation Value Forest toolkit (Proforest; 2003) *Toolkit for identification of high conservation values, with the aim to improve decision making, management and protection of forests*

Forest and deforestation monitoring

FAO Forest Resource Assessment 2010 outcomes:

- improved knowledge on land cover and land use changes related to forests, especially deforestation, afforestation and natural expansion of forests;
- information on the rate of change between 1990 and 2005 at global, biome and regional levels;
- a global framework and method for monitoring forest change;
- easy access to satellite imagery through an internet-based data portal;
- enhanced capacity in many countries for monitoring, assessing and reporting on forest area and forest area

More information:

Global forest resource assessment (FAO; 2010)
Global assessment of status and trends for all types of forests; comparison between 1990, 2000, 2005 and 2010

Global forest land-use change 1990 – 2005 (FAO; 2012)
Remote sensing analysis of global forests, comparison with FAO forest resource assessment

Global ecological forest classification and forest protected area gap analysis (UNEP; 2008) *Update of the 2000 UNEP-WCMC global forest map and assessment of ecoregions, forest cover and gap analysis of protected areas to indicate priorities for conservation and promote sustainable forest management*

Participation, interactivity and citizens' observatories

- Increased flow of open and accessible data and information (government to individuals, CSOs to individuals, social media).
- Increased awareness and involvement of general public (changing consumer preferences -> certified products, reasonable labour conditions, sustainable exploitation of resources), public opinion, participation in monitoring).
- Community forest management (sustainability, income generation from natural resources or payment for ecosystem services, attention for biodiversity, health, culture).

More information:

Interactive forest cover atlas of Cameroon (WRI) http://www.wri.org/publication/interactive-forestry-atlas-cameroon-version-2-0

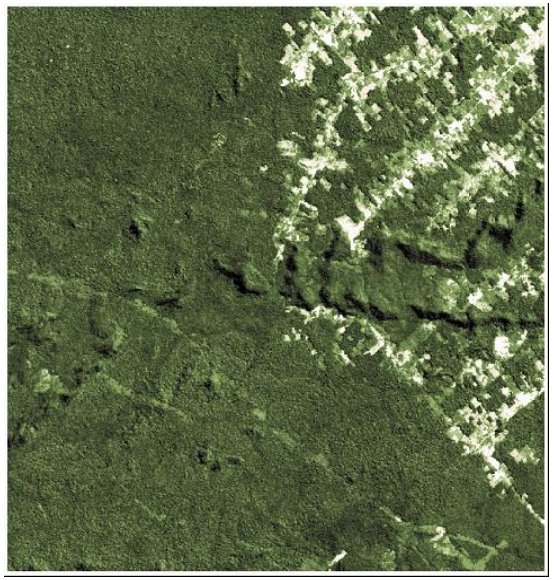
Forestracker: http://cincs.com/research/trackers/

Marketracker: http://carboncreditcapital.com/resources-publications/market-trackers/

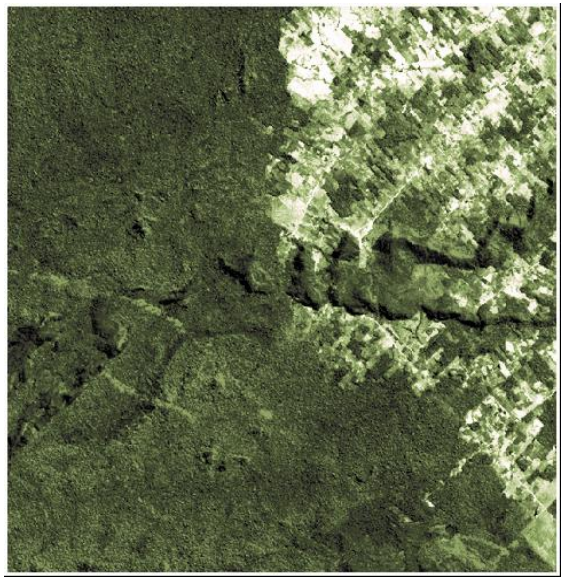
REDD+ and community forestry: lessons learned from an exchange of Brazilian experiences with Africa (World Bank; 2012) *Description of an exchange between Brazil and Africa on lessons learned about the role of community forestry as a strategy to achieve the goals of REDD+*

2. Earth observation applications

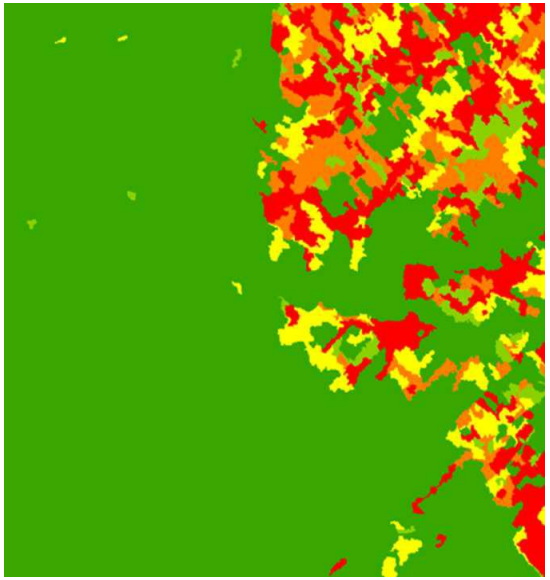
Earth observation for forest management



Landsat 1992



Landsat 2001



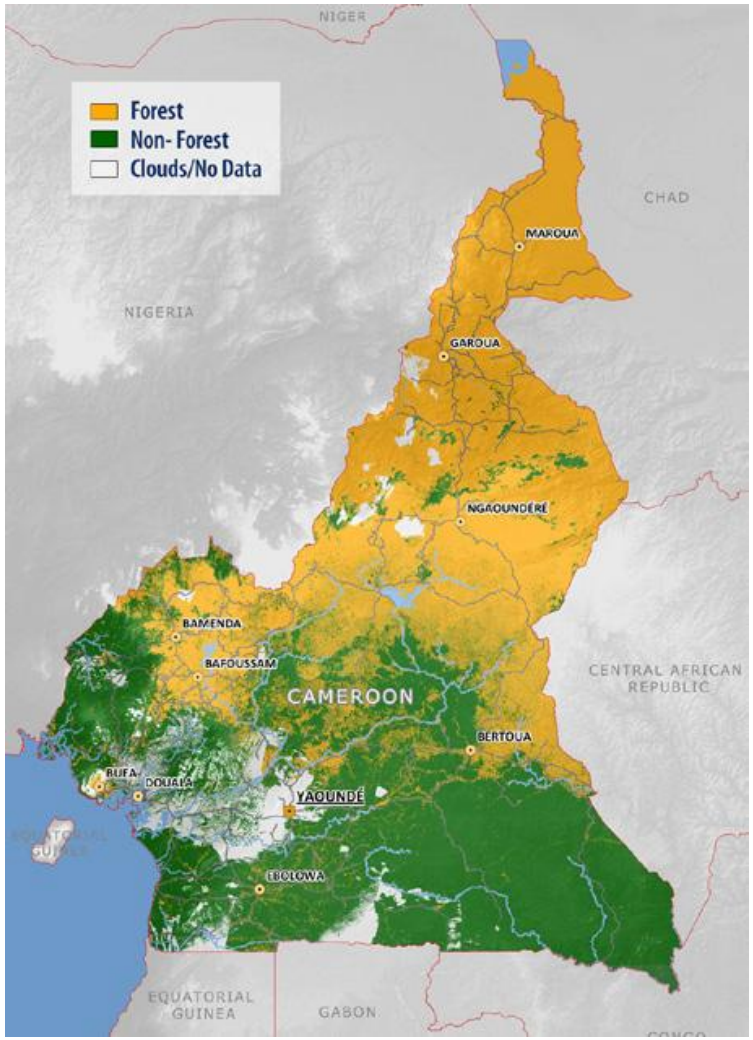
Likely areas of deforestation

Automatic change detection

Earth observation contribution

- **Global / regional forest monitoring**
- **National / local forest monitoring**
- **Support to operational forest management**
- Fire monitoring and prevention
  (see disaster toolkit)
- Carbon accounting
  (see climate toolkit)

Example global / regional forest monitoring



Map of forested areas in 2000 produced on the basis of Landsat satellite data. White areas show where no cloud-free images were acquired over the course of the year. (by GAF AG, source: Copernicus; 2013)

Global / regional forest monitoring

- Earth observation provides a comprehensive view for forest classification and monitoring
- Data series are available for historical and statistical analysis and analysis of whole regions
- Earth observation provides a solid basis for verification and reporting
- Earth observation supports biomass estimation
- Cost estimate: mapping different forest types, data 1,500 k€ / 100,000 km^2, mapping 350 – 500 k€ / 100,000 km^2
- Main challenges: business model.

Examples:

Integrating remote-sensing and groundbased observations for estimation of emissions and removals of greenhouse gases in forests (GFOI; 2014) *Methods and guidance from the Global Forest Observation Initiative*

Global forest resource assessment (FAO; 2010)
Global assessment of status and trends for all types of forests; comparison between 1990, 2000, 2005 and 2010, including a remote sensing forest survey

REDD+ *Reducing Emissions from Deforestation and forest Degradation in developing countries*

GOFC-GOLD *Global Observation for Forest Cover and Land Dynamics*

Preserving forests, cutting carbon (Copernicus; 2013)
Brochure on earth observation support for objective measurement, reporting and verification of information on forests

Example national / local forest monitoring

A Landsat TM image shows in detail houses that have been built and fields that have been cleared along parallel "fishbone" lines in the tropical rainforest of Brazil. (Source: NASA)

National / local forest monitoring

- All aspects of the global / regional forest monitoring apply
- Earth observation facilitates identification of the different stages of forest development
- Earth observation can be used for detection of illegal logging and more detailed classification
- Cost estimate: see global / regional forest monitoring, index forest fragmentation on case-by-case basis
- Main challenges: cost, business model.

Examples:

Earth observation for sustainable development of forest (EOSD)(Natural Resources Canada; 2010) *Building a next generation forest measuring and monitoring system for Canada: description of land cover mapping, applications, change monitoring and a forest information system*

Land system modelling for a sustainable world (INPE; 2013) *Presentation showing deforestation monitoring and forest modelling in Brazil*

Monitoring of tropical forests and agricultural areas with radar (SarVision: 2011) *Methodology overview by the Dutch company SarVision*

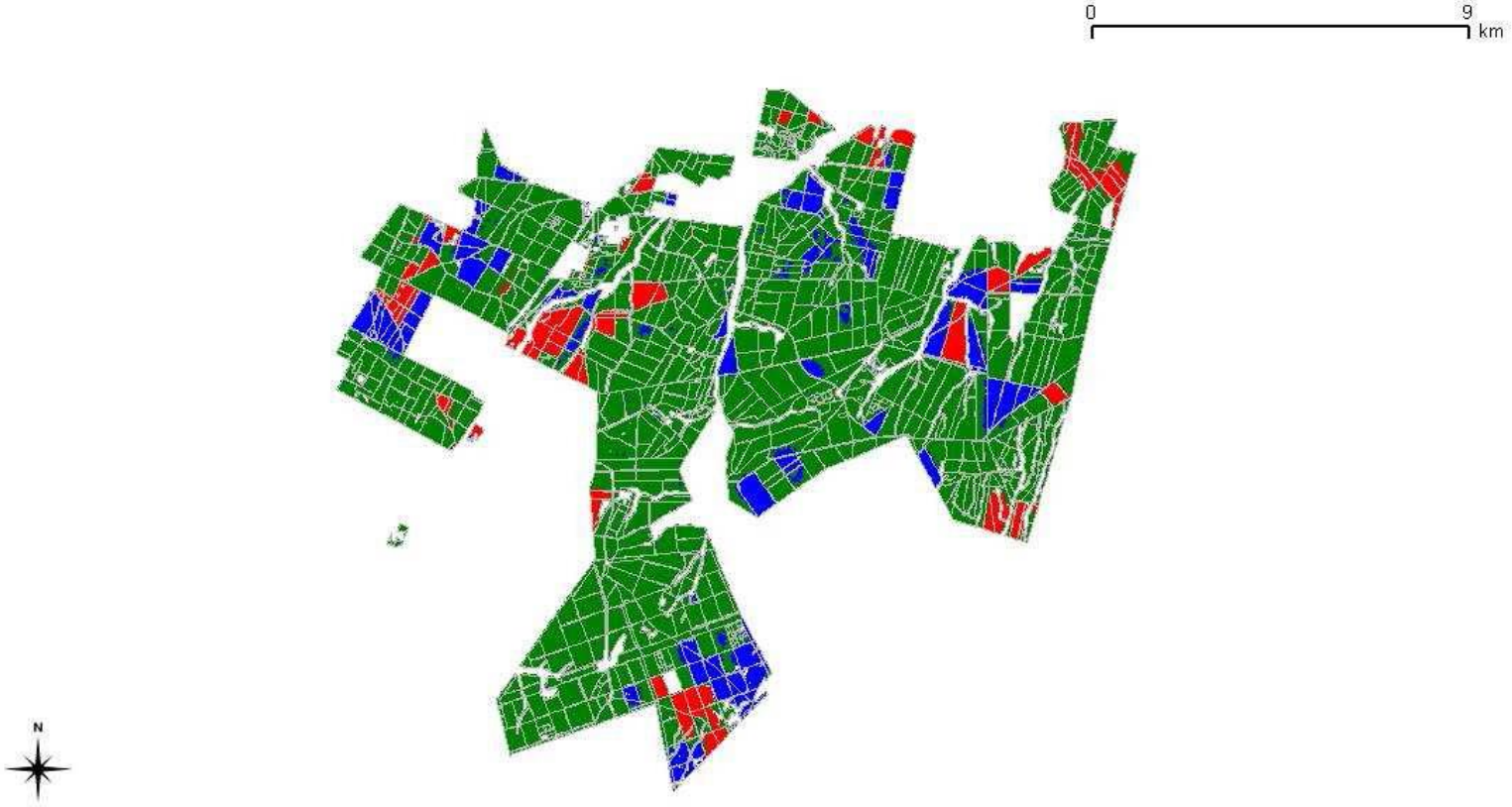
Examples (2):

Forestry and forest management (Earth from Space; 2009)
Articles on remote sensing for forest monitoring in Russia by the company Scanex

Satellites support monitoring of Europe's green lungs (Copernicus; 2013) *Brochure on earth observation for forest monitoring in Europe*

Forest cover and deforestation in Belize 1980-2010 (SERVIR; 2010) *Use of remote sensing for change detection and analysis*

Example support to operational forest management



Clear-cut and re-growth based on multi-temporal ALOS PALSAR-1 data (August 2007 - August 2008). Red colour corresponds to harvested before 2008 and re-establishment, brown to harvested before 2008 and no re-establishment, blue and cyan harvested in 2008 and no re-establishment. (Source: Case studies for ASI/FSC, service delivery report; 2011)

Support to operational forest management

- All aspects of the forest monitoring categories apply
- Earth observation supports identification of new plantings, road systems, total annual cut, overcutting, illegal logging, etc.
- Earth observation facilitates early detection of disasters (fire) and pests and diseases
- Cost estimate: mapping different forest types, data 1,500 k€ / 100,000 km2, inventory 4 € / ha optical + 4 € / ha SAR, monitoring 4 € / ha optical + 4 € / ha SAR (FSC)
- Main challenges: cost, complexity (data calibration), elegance, capacity.

Examples:

Sustainable forest management- Support to the Forest Stewardship Council - Service delivery report –Top down case studies for ASI/FSC + reports on Swedish, Russian & South African trials (FSC; 2011) *Results of a feasibility study on the use of earth observation for operational and sustainable forest management + reports on different trials with evaluation by forest management*

The experience of applying high resolution radar imagery for monitoring of logging in Moscow Region (Earth from Space; 2010) *Description of the use of radar images for illegal logging detection and forest management*

Earth observation capacity building activities in the Giant Mountains national park (CUNI; 2013) *Description of the use of earth observation for forest health assessment in the Czech Republic*

Growth potential for earth observation

- **Monitoring for environmental and certification purposes**.
  Main clients: governments, international organizations, NGOs.
- **Support to operational forest management**.
  Main clients: forestry companies.

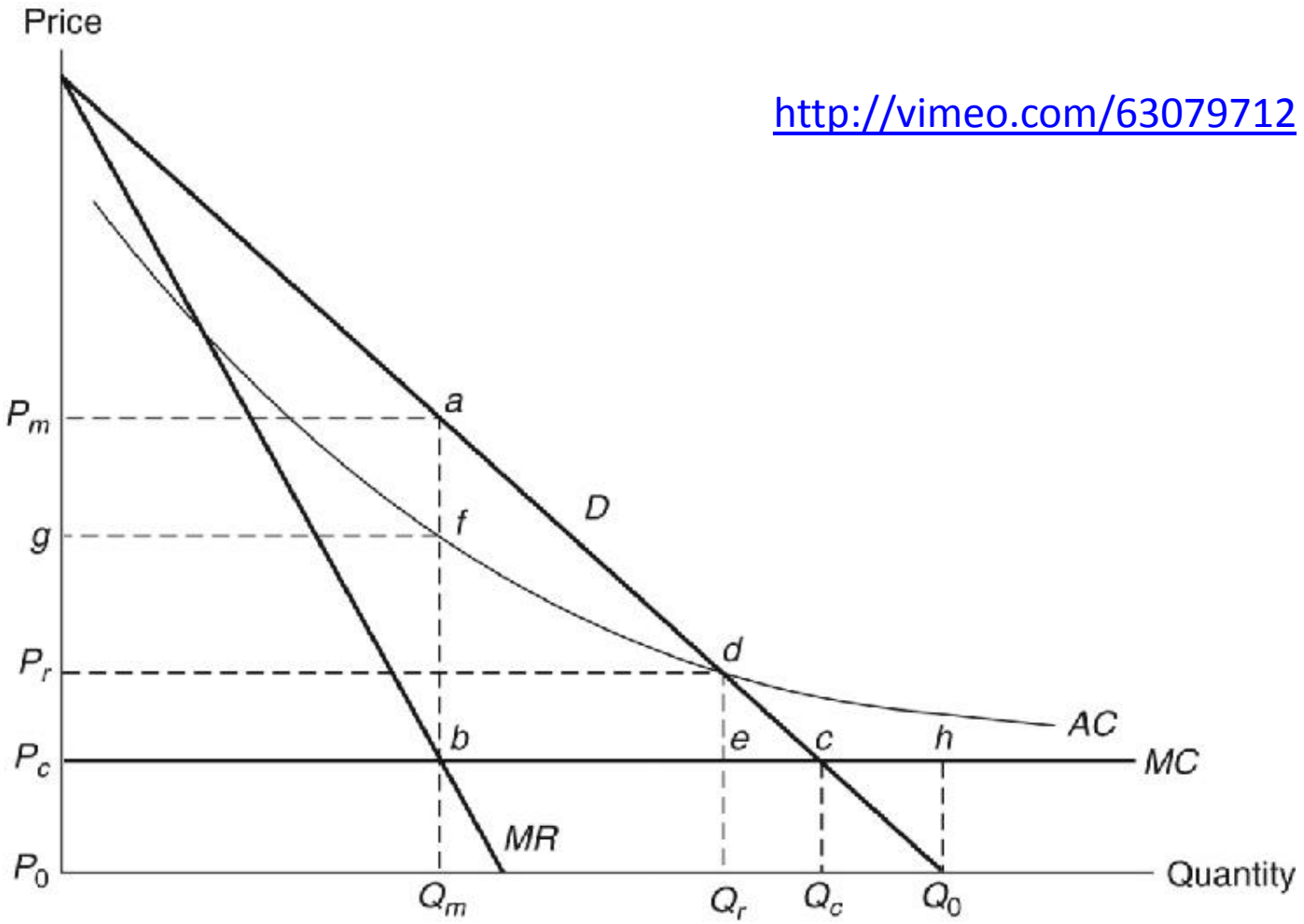
3. Business development

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).

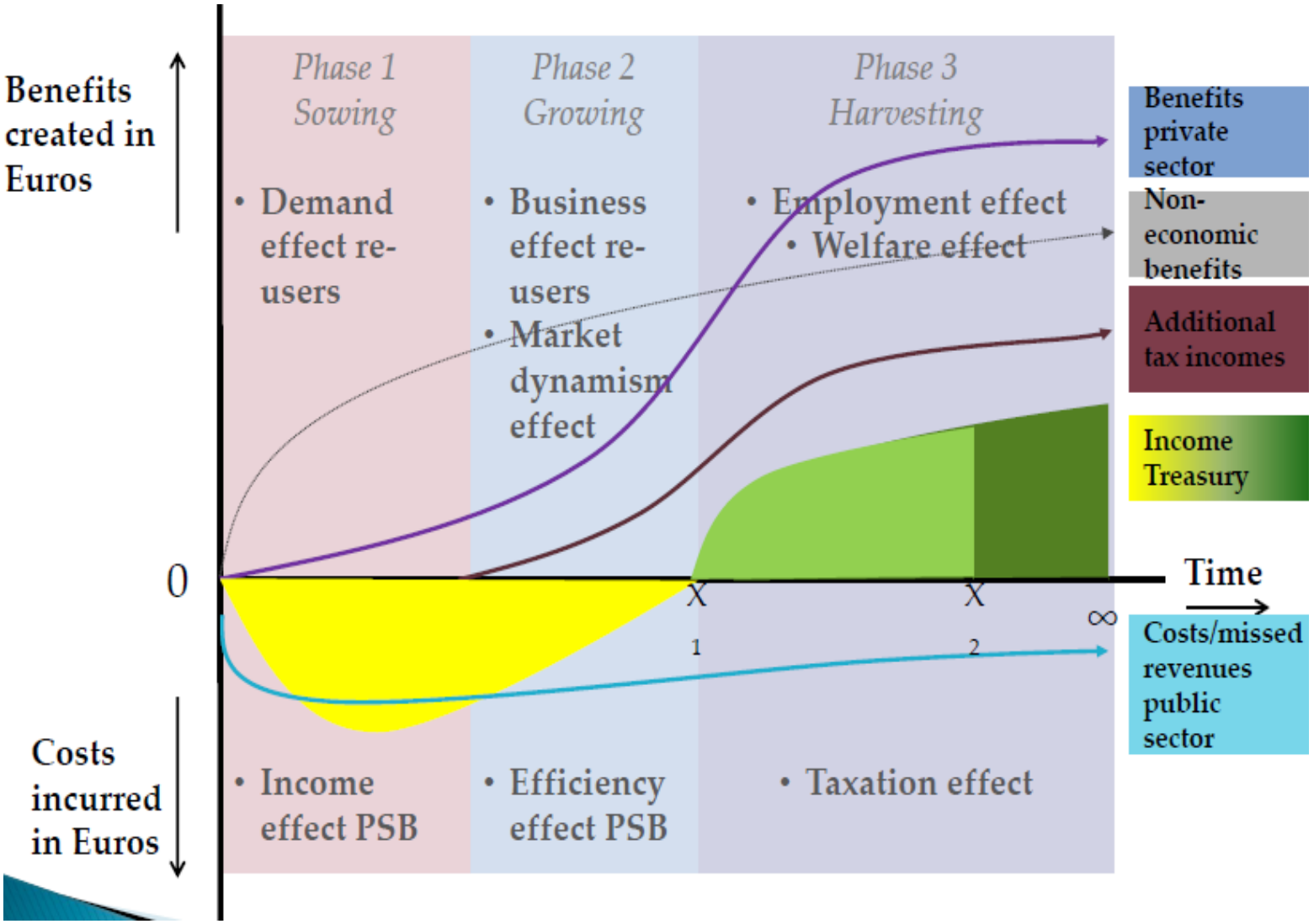
Supply & Demand Public Sector Information



http://vimeo.com/63079712

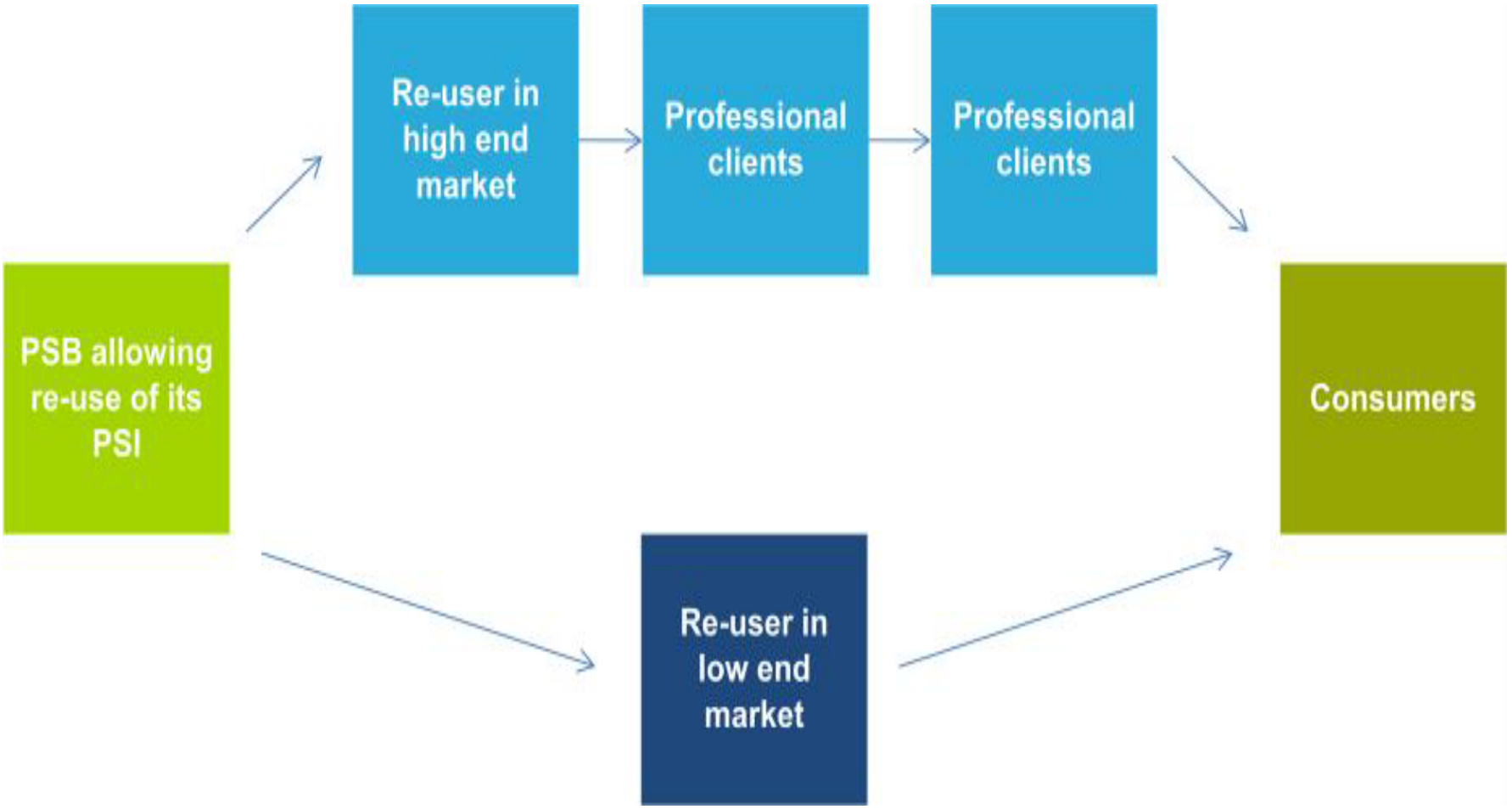
Source: About GMES and data: geese and golden eggs (Sawyer, de Vries 2012)

Cost-benefit Public Sector Information



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

Re-use of Public Sector Information



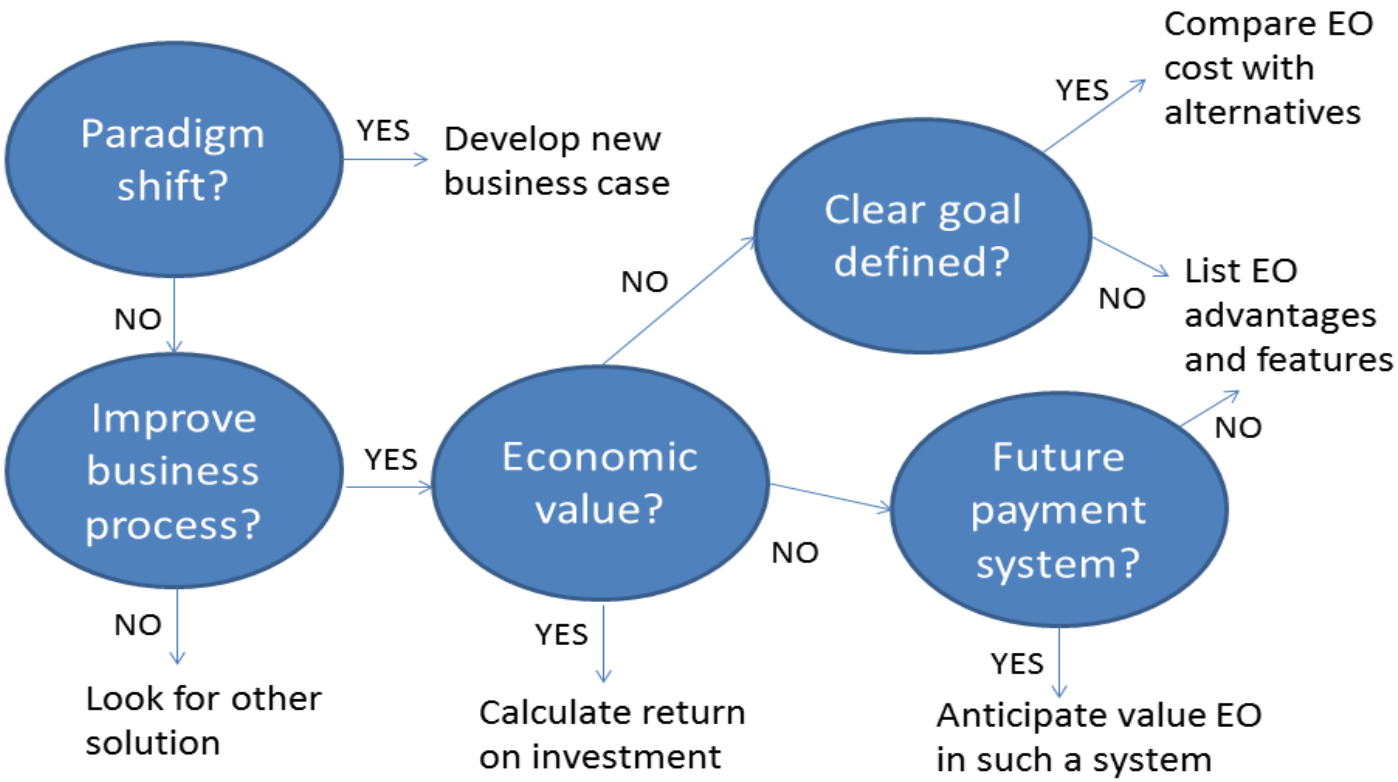
Source: About GMES and data: geese and golden eggs (Sawyer, de Vries 2012)

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 benefit EO



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

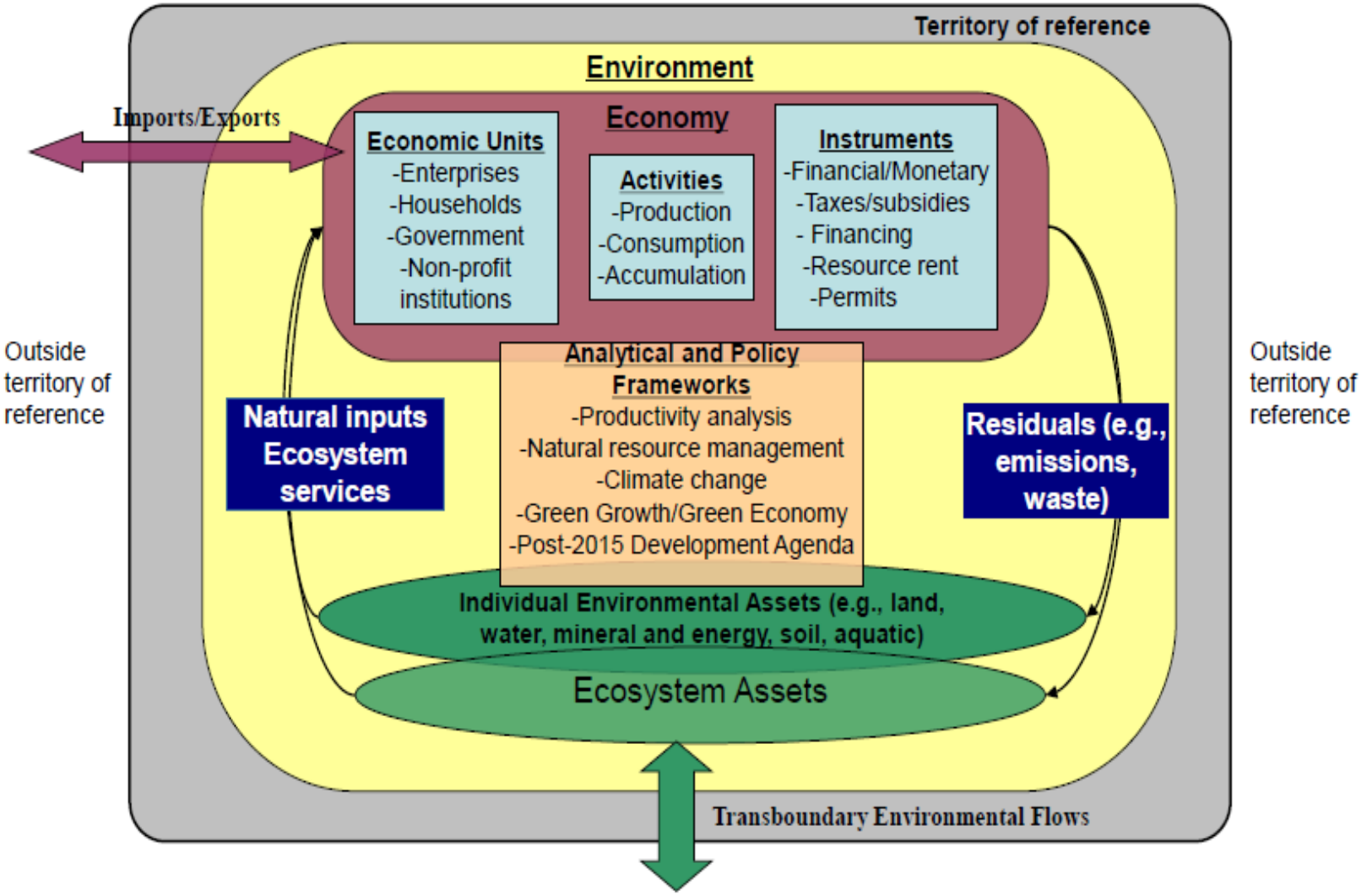
Several attempts have been made to introduce environmental accounting and to enlarge the sphere of the conventional economy to include and quantify impact on ecosystems.

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)

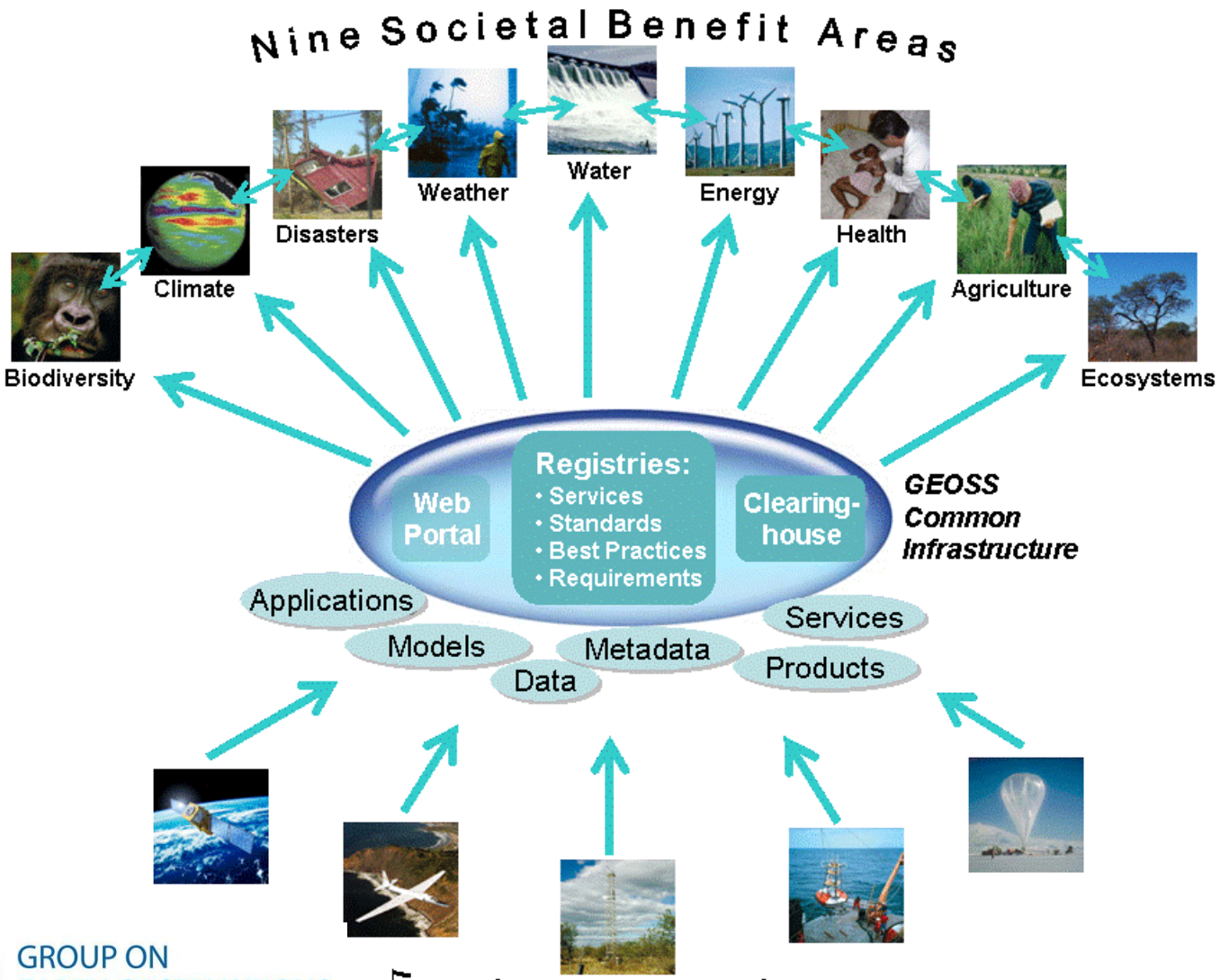
SEEA Conceptual Framework



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

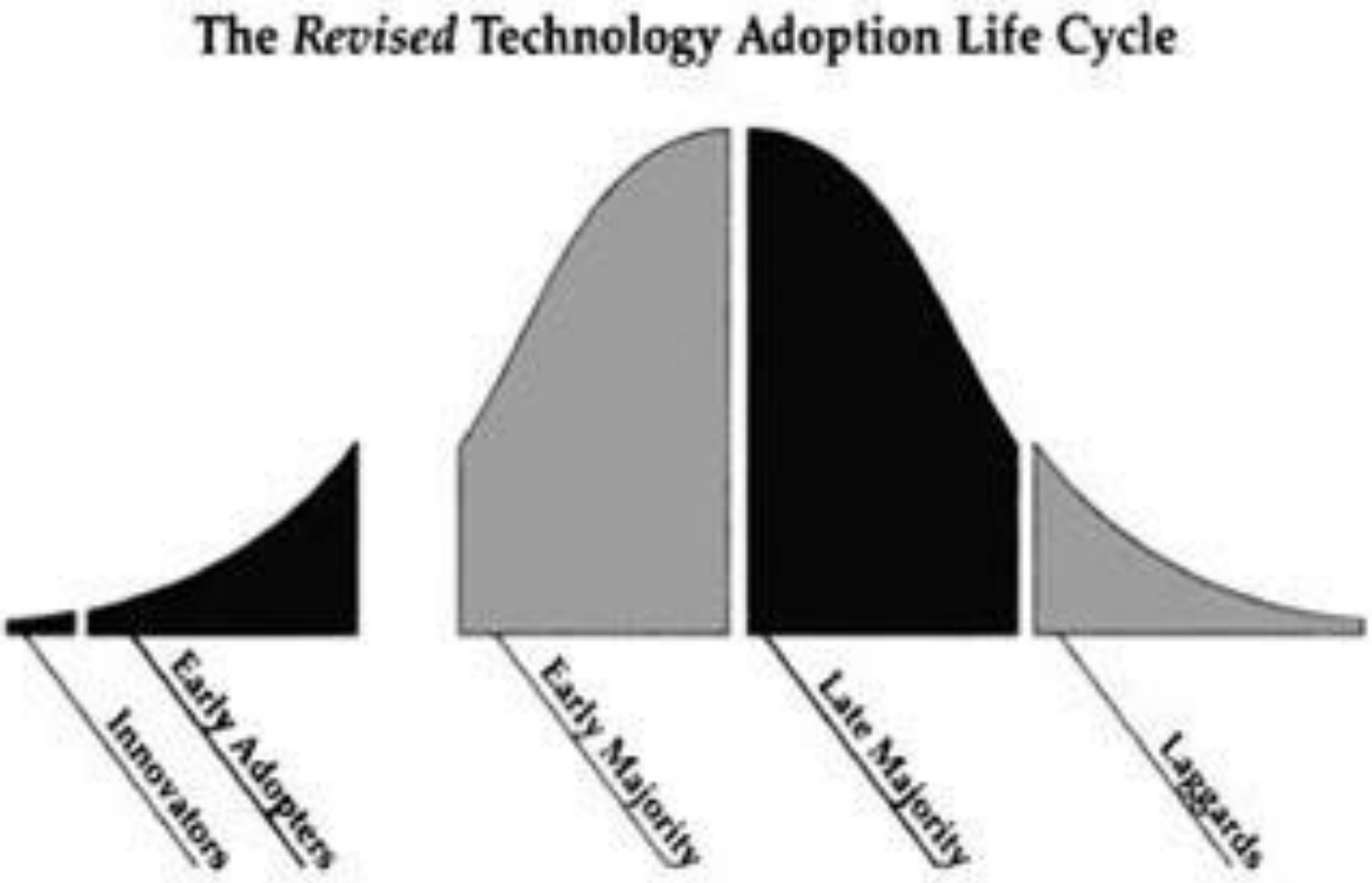
Type	Buyer behaviour	Motivation
Transactional sales	Intrinsic value buyers: “keep it cheap and easy to do business”	Understands the product Perceives it as substitutable Cost focus Resents time ‘wasted’ with sales people
Consultative sales	Extrinsic value buyers: “I don’t know the answer: help me analyse 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
www.seos-project.eu

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

Capacity building resources for forest management:

The forest governance toolkit (WRI; 2009) *General toolkit for sustainable forest management*

Sustainable forest finance toolkit (PwC, WBCSD) *Financial toolkit for sustainable forest management*

The High Conservation Value Forest toolkit (Proforest; 2003) *Toolkit for identification of high conservation values, with the aim to improve decision making, management and protection of forests*

Remote sensing applications – Chapter 3: forest and vegetation **(NRSC; 2010)**

Sustainable forest management (FSC; 2011) *Feasibility study on the use of earth observation for operational and sustainable forest management*

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