User Requirements for the Space Infrastructure Hub

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Space Infrastructure Hub (SIH)

SIH seeks to change the nature of national space-based business, and to significantly grow and transform space-based services, nationally and regionally.

- Development of a set of space application products and services that directly respond to user needs and enable industry.

- Build a core space infrastructure, both ground and space-based, that will enable the delivery of essential space services.

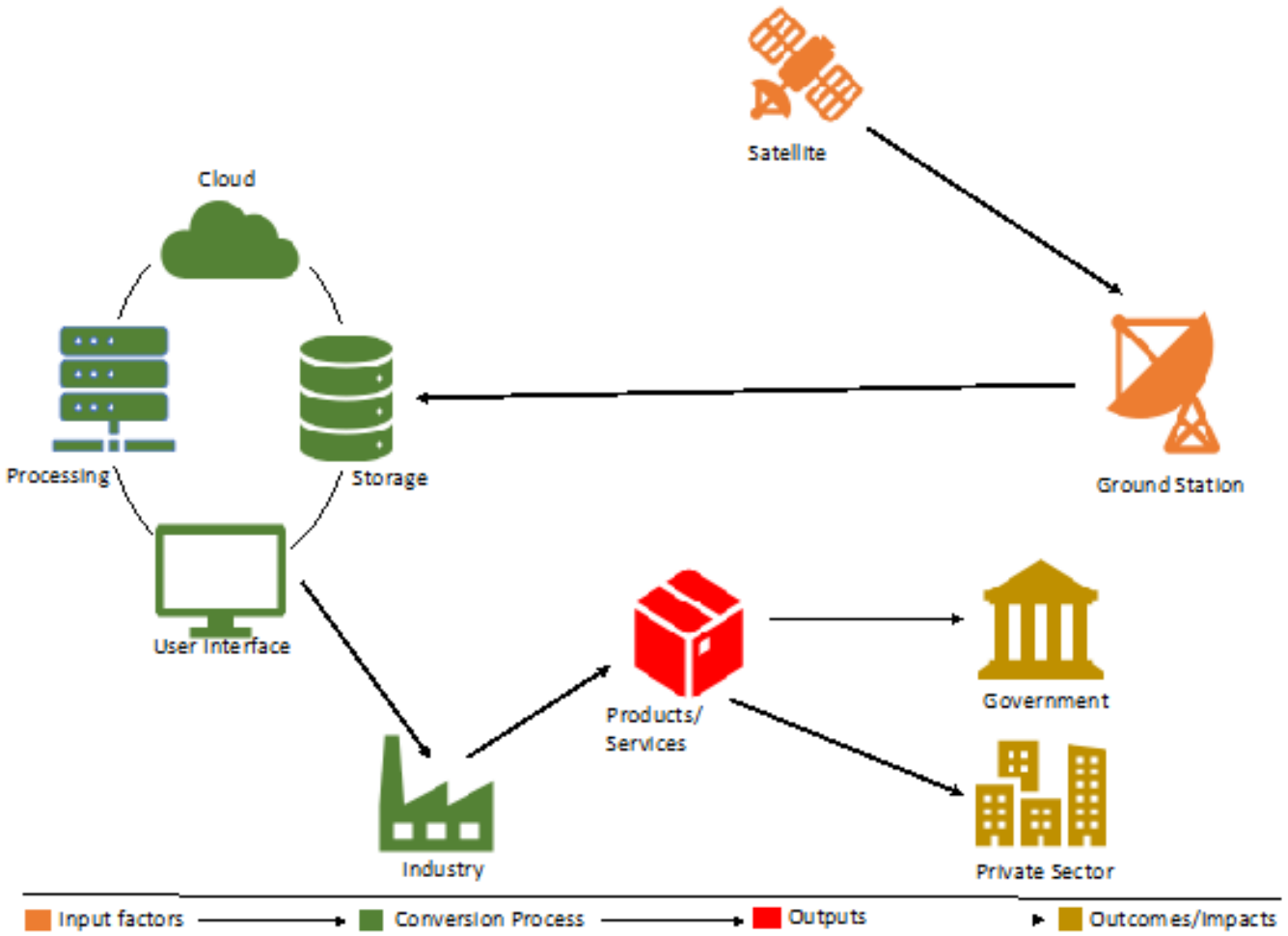
- Generation of space relevant knowledge that supports the developmental agenda.

- Development of requisite human capacity that is needed for the implementation of key space initiatives.

- The positioning of SANSA as a key enabler of government's policy imperatives.

- Space Industry Transformation.

Space Data Value chain from SIH



Defining the Space Infrastructure Hub Communities & Nomenclature

UPSTREAM

Satellites

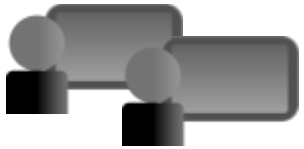
SPACE INDUSTRY

MIDSTREAM

Ground segment & pre-processing

SANSA & SPACE INDUSTRY

DOWNSTREAM :INTERMEDIATE



Processing & value-added services

EO EXPERTS: R&D COMMUNITY, INDUSTRY & SANSA

DOWNSTREAM :END USERS

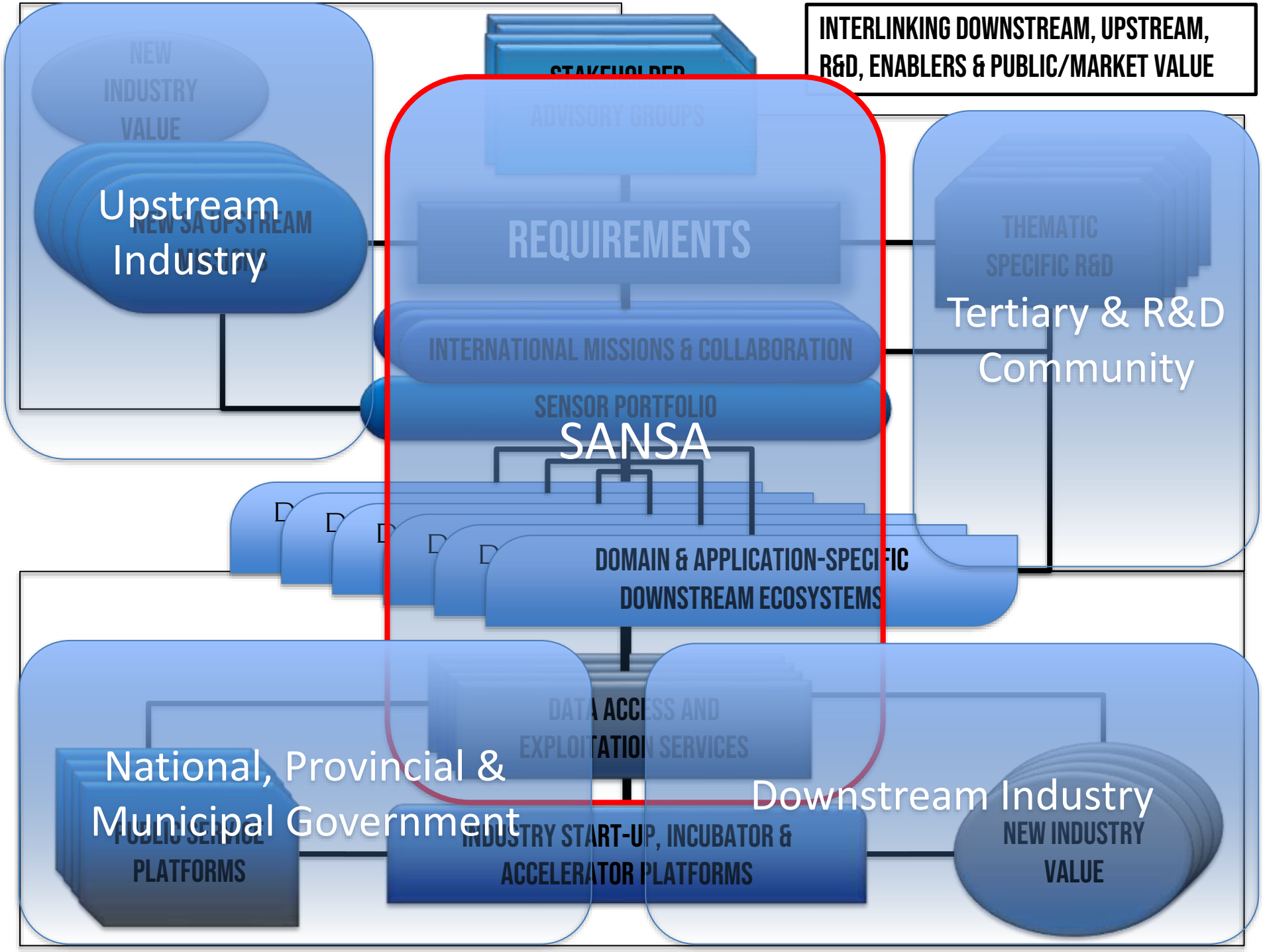
EO based products in business & services

NON EO EXPERTS: WIDE RANGE OF CONSUMERS

UPSTREAM MISSION REQUIREMENTS

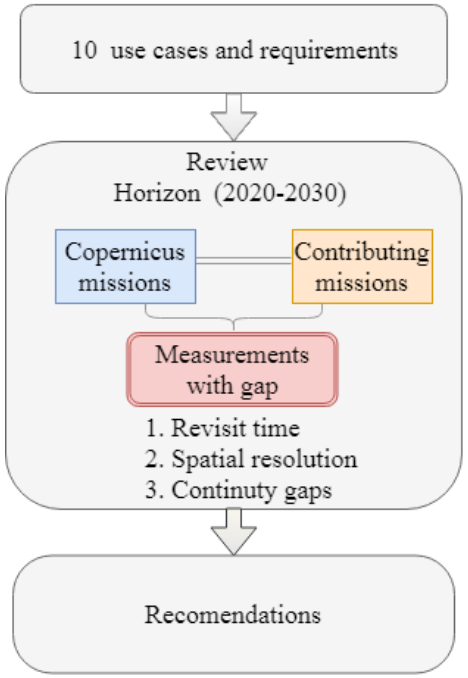
DOWNSTREAM ECOSYSTEM REQUIREMENTS

THEMATIC USER REQUIREMENTS


INTERLINKING DOWNSTREAM, UPSTREAM, R&D, ENABLERS & PUBLIC/MARKET VALUE
NEW INDUSTRY VALUE
Upstream Industry
ADVISORY GROUPS
REQUIREMENTS
INTERNATIONAL MISSIONS & COLLABORATION
SENSOR PORTFOLIO
SANSA
THEMATIC SPECIFIC R&D
Tertiary & R&D Community
DOMAIN & APPLICATION-SPECIFIC DOWNSTREAM ECOSYSTEMS
National, Provincial & Municipal Government
PLATFORMS
INDUSTRY START-UP, INCUBATOR & ACCELERATOR PLATFORMS
Downstream Industry
NEW INDUSTRY VALUE

User requirements study by SANSA

- To determine and understand the needs for key value sectors to be better enabled to use Earth Observation (EO) data.
- Information from this study will be used to better design and position future Earth Observation missions within the upstream and provide relevant data and downstream services.
- User requirements specification should also contain information about constraints, the context of use, goals and tasks to be supported, design guidelines and any recommendations for design solutions emerging from the user requirements.
- If the user requirements are not met the end-user's expectations will not be met.



A quantitative methodology in [1] was applied to select promising use cases. End-user requirements were identified.

Revision of how the future Copernicus and contibuting missions can fullfil the measurement requirements, in order to identify gaps in terms of revisit time, spatial resolution, and continuty gaps

Potential instrument technologies are identified in order to cover the measurement gaps

Methodology applied to define the end-user requirements and measurement gaps.

Lancheros et al. 2018

Importance of user requirements

User Expectation

User Delivery

No consultation

Process run entirely by The developer

User Requirements Process

Agriculture & Forestry

Built Environment (including Human Settlements & Infrastructure)

Marine & Maritime

Water Resource Management

Ecosystems & Biodiversity

Energy

Atmosphere

The thematic user requirements – for existing & future scenarios – are one of the main factors influencing which new missions will be built, and how new downstream systems will be prioritized & developed (i.e. they are very important!)

THEMATIC USER REQUIREMENTS

Decisions
Narrative
Products
Interfaces
Scenarios

UPSTREAM MISSION REQUIREMENTS

DOWNSTREAM ECOSYSTEM REQUIREMENTS

User Requirements Process

The user requirements process has to be very forward looking – examining how users will make decisions and realise value in hypothetical future scenarios, based around new capabilities that the SIH will realise.

SCENARIO 1 : NEW DOWNSTREAM CAPABILITIES

OPTIMISING THE DOWNSTREAM: Realisation of the downstream ecosystem capability, better exploiting the existing international sensor portfolio with new national capabilities for providing user focused products and knowledge based information systems

SCENARIO 2 : NEW UPSTREAM CAPABILITIES

REALISING NEW UPSTREAM MISSIONS: A substantial increase in acquisition frequency, coverage, and data innovation for key EO parameters, e.g. data every 6 hours from new constellations of sensors.

SCENARIO 3 : NEW INTELLIGENCE & PREDICTIVE CAPABILITIES

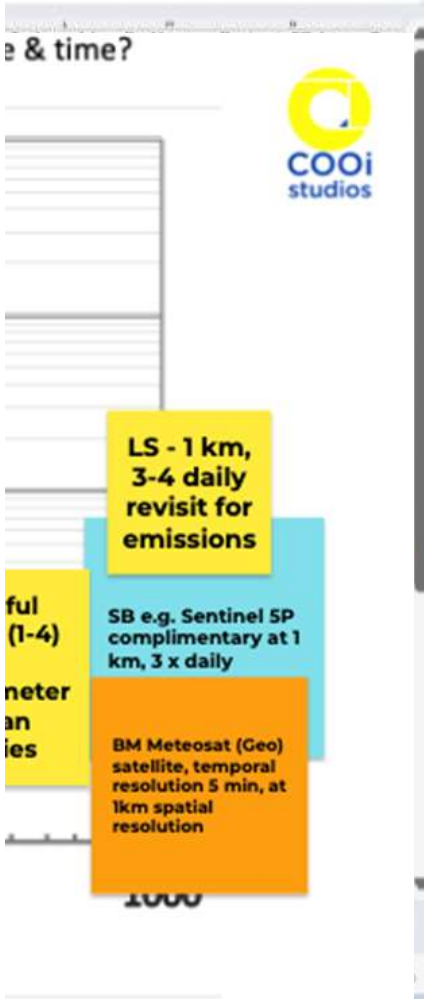
REALISING NEW PREDICTIVE CAPABILITIES: Having access to innovative products based on new predictive capabilities, e.g. time-series based Artificial Intelligence and/or complementary predictive modelling

SIH User requirement process

COOi Studios was appointed to manage the logistics of this study

Interview Questions

1. Tell us more about your company and your role in the company?
2. In terms of Earth Observation (EO) data, what products and services do you offer? – Provider or Consumer (ie. B2B or B2C)
3. What are the critical decisions you use EO to make, in either or both short- and long-term timeframes?
4. What are the critical EO or EO-derived products you use, and where do you currently get these products?
5. How should the EO decision making product be presented to you so that you can most easily understand it e.g. a map, a "traffic light" system, tables, reports etc?
6. What are the most critical aspects of the EO system you use/would like to use e.g. reliability of product, timeliness of delivery, ease of extracting understanding etc?
7. Describe one or two key value aspects of the EO data to your decision making and those affected by it, either positively or negatively e.g. what value loss would occur with no EO data?
8. Have you in the past or currently used the SANSA SAEOSS/GEOSS/DEA platform – if yes, how ?
9. Which tools do you use for processing the data, are they free or do you pay for them?
10. What is working well/challenges in terms of the current mechanisms we have for EO data discovery and data access. What improvements (if any)/features would you like to see in the future in these areas



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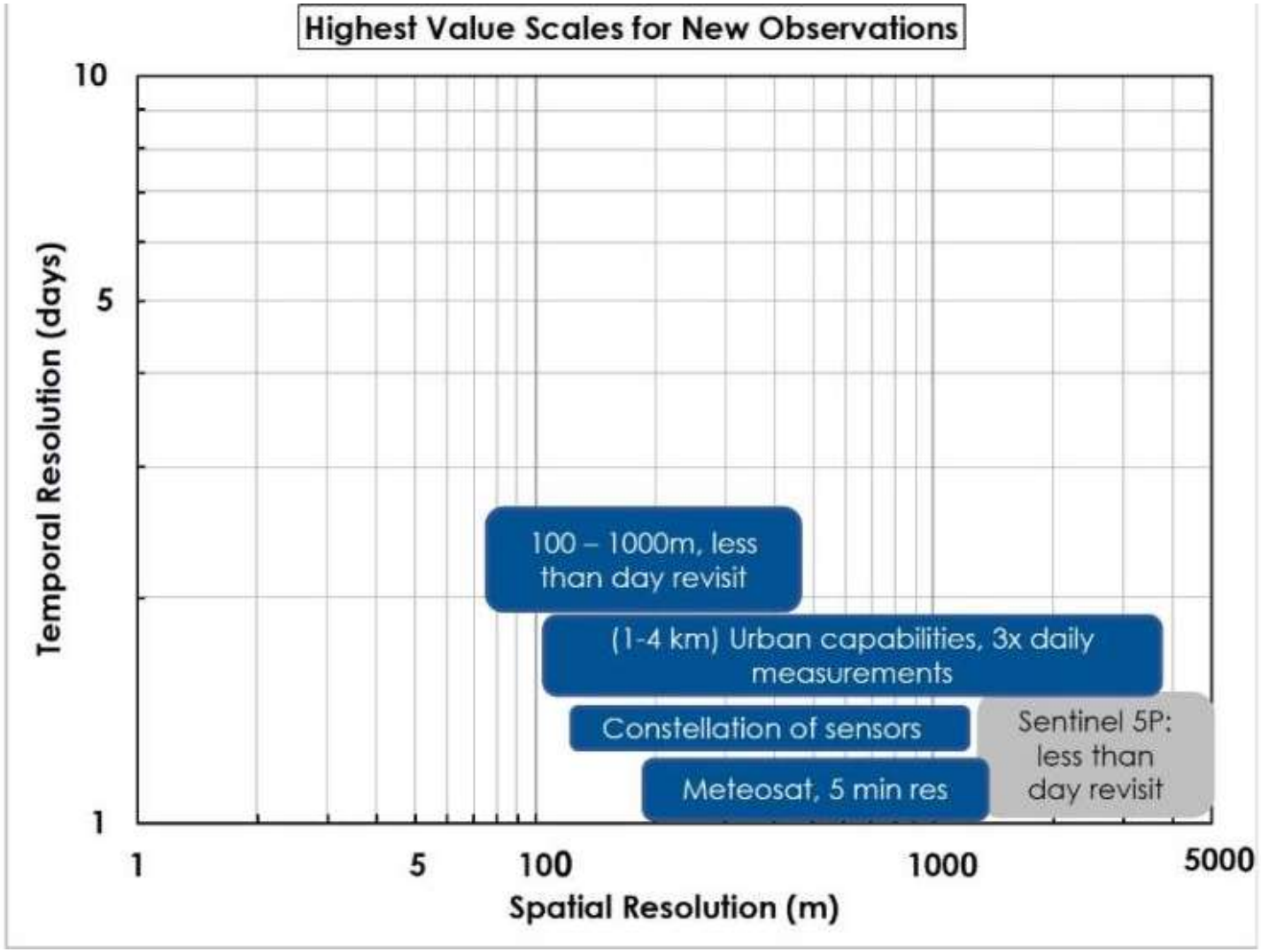
Thematic User Needs: Examples

Thematic User Needs: Atmosphere, Air quality and climate



Highest

Perceived value of new observations within 2-3 years

Highest

Perceived value of existing observations

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Thematic User Needs: Water Resource Management

Table 2.3: Key User Decision Making and User Archetypes relevant to new missions in water resource management.

User Decision Making	Typical User Archetypes
Simplified online water information system, long term availability water availability monitoring	DWS, DFFE, Municipalities, IWRMI-SA, NDMC. Farmers, DBSA, Funding institutions, DALRRD, Insurance companies, Agribusiness
Satellite information used to assist in predicting and reducing impact of drought	DWS, DFFE, Municipalities, IWRMI-SA, NDMC. Farmers, DBSA, Funding institutions, DALRRD, Insurance companies, Agribusiness
Water quality and surface water area monitoring	DWS, Rand water, DFFE, DALRRD, Agribusiness
Satellite information dam volumes calculator used to predict vulnerable communities and ensure water supply supplemented before disaster	DWS, DFFE, DBSA, HDA, DALRRD, Insurance companies, Funding institutions, Agribusiness, DHS, CSIR
Smart EO across water & energy sectors makes SA a water secure country.	DWS, DMRE, DFFE, DALRRD, Farmers, Agribusiness
Mapping of irrigated areas at farm level to know how much water is used for compliance monitoring/ Irrigation water use efficiency.	DWS, DALRRD, Farmers, insurance companies, Legal practitioners
Dam safety monitoring, both in PCBs, Tailing dams and safe infrastructure.	DWS, DFFE, DMRE
Drought monitoring capabilities to indicate progression of possible drought.	DWS, DALRRD, NDMC, Farmers, Funding institutions, Insurers
Satellite imagery used to identify polluters.	DWS, Rand Water, DALRRD, insurance companies, extension officers
EO used to monitor climate impacts and changes.	DWS, DFFE, DALRRD, farmers, extension officers
Long term water availability monitoring	DWS, municipalities, Farmers, DALRRD, DFFE, SANBI
Wetland monitoring	SANBI, DWS, DFFE, DALRRD,

Thematic User Needs: Disaster Management

Table 3.3. Key User Decision Making and User Archetypes relevant to new observations in disaster management.

User Decision Making	Typical User Archetypes
Determining the extent of a flood and the damages that occurred	Disaster officers, Funding institutions, National Disaster Management Centre (NDMC), Insurance companies, Authorities.
Determining community and infrastructure vulnerability and exposure to hazards such as flood, fire & seismic	Disaster officers, Funding institutions, National Disaster Management Centre (NDMC), Insurance companies, Authorities.
Response monitoring and adaptation/capability planning	Disaster officers, Funding institutions, National Disaster Management Centre (NDMC), Insurance companies, Authorities.
The damage of crops and houses due to extreme weather events	Farmers, Funding institutions, Insurance companies, Agribusiness. NDMC
Predictive capabilities around agricultural production failure and food security hazards	Farmers, Funding institutions, Insurance companies, Agribusiness. NDMC
Road, rail and transport infrastructure monitoring for risk reduction and security	Dept of Transport, COGTAs
Detect the existence and formation of sink holes and seismic hazards that can be a big risk in urban areas	Disaster officers, Funding institutions, National Disaster Management Centre (NDMC), Insurance companies, Authorities.
Determine the origin and time of origin of a fire and to determine the extent.	Farmers, Funding institutions, Insurance companies, Agribusiness. NDMC
Multi-thematic monitoring and anticipatory support for humanitarian crises	National Disaster Management Centre (NDMC), DIRCO, Defence & Security Cluster, NGOs and charities, DALRRD
To determine the impact of civil unrest on the urban environment	Disaster officers, Funding institutions, National Disaster Management Centre (NDMC), Insurance companies, Authorities.
To determine the impact of acid mine water on the buildings in Johannesburg	Environmental department, Water department, Authorities
Drought affected settlements.	Department of Water and Sanitation. Department of Agriculture
Drought early warning	Department of Water and Sanitation. Department of Agriculture

Purpose of SIH User requirements

- To gain end user perspectives on where the most thematic value can be found for new EO observations, with regard to the spatial and temporal scales of observations, and the quality of radiometrically derived information,

- To understand and synthesize user perspectives on how new observations find greatest value in the current sensor landscape with regard to both complementarity and innovation,

- To understand and document key user decision making, the typical role of earth observation in the user decision making process, and to document and characterize key national user archetypes,

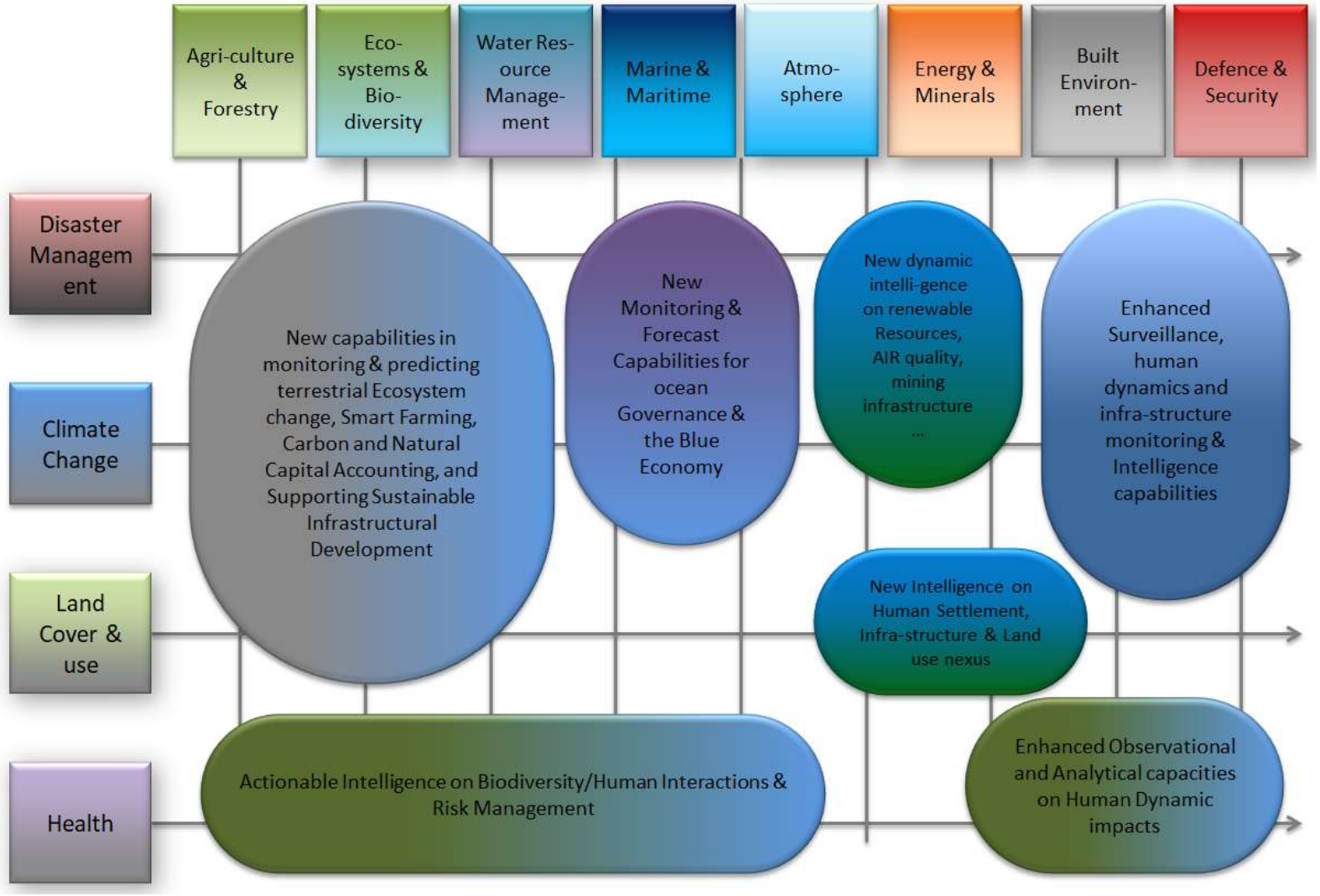
- To understand and synthesize the earth observation value chain for end users from products through analytics to insight and predictive capability, and to gain insight into how users would seek to add value through approaches such as data fusion, artificial intelligence and exploitation of historical data.

- To discover overlaps and linkages within and across the chosen thematic areas.

The following Decision Support Tools are considered to be of the highest priority for further support of existing initiatives, development and implementation:

- **Disaster Management**: Flood Prediction and Early Warning; Land Subsidence Early Warning; Fire Monitoring and Warning
- **Ecosystem and Climate Monitoring**: Drought Monitoring and Warning; Water Resource Prediction and Monitoring; Biodiversity Monitoring; Agriculture, Forestry and Rangelands Support; Fisheries & Aquaculture Support: Extreme Events Prediction and Monitoring including heat waves & storm impacts; Renewable Energy Support
- **Change Detection**: Human Settlement and Land Use Monitoring; Energy, Transport and Communications Infrastructure Monitoring; Large Infrastructure Investment Monitoring; Waste Infrastructure Monitoring; Mining & Minerals Support
- **Public Health**: Air Quality and Greenhouse Gas Monitoring; Traffic & Transport Monitoring; Harmful Algal Bloom and Pollution Monitoring
- **Security**: Maritime Traffic Monitoring; Border Security Monitoring; Domain Awareness Support.

Thematic user requirements



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