



# Broad exploration of space technology's added value in the Netherlands

## *Management summary*

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# Management summary

## ***Introduction: space technology is ubiquitous***

Unwittingly, in society we are becoming more and more reliant on space technology and its applications. Our dependence on for example satellite communications, satellite navigation and earth observation, is now immense. In places on earth where there are no terrestrial networks, satellite communication is essential. And satellite navigation already forms part of many consumer electronics and professional applications where place and time matter. Currently, earth observation is applied in a wide range of fields, including precision agriculture, defence, environmental crime detection and monitoring the compliance of international agreements such as the Paris Agreement. Other applications are providing insight into the spread of diseases (tele-epidemiology), wetting and dehydration, as well as monitoring the subsidence of infrastructures and buildings. Also the quality of day-to-day services such as weather forecasting continues to improve thanks to the increasingly greater use of satellites.

## ***Exploring the main questions***

The Ministry of Economic Affairs and Climate Policy commissioned research agency Dialogic to conduct a broad exploration of space technology's added value within its departments and "associated sectors" in the period April to July 2020. The reason for this government request was the Dutch Lower House Motion Amhaouch c.s. in October 2019. Two main questions were formulated for this exploration: 1) What are the current 'narrow' economic benefits of the space sector in the Netherlands compared to 2014? 2) What is the added value – now and in the near future – of space technology for the various departments and related sectors and how could the government exploit any untapped potential?

## ***Research approach***







To answer these questions, a survey was carried out among space companies. The economic significance of the space sector was (again) determined in a narrow sense, using CBS microdata and an input/output analysis. In addition, a literature study, interviews and eight workshops were conducted to gain a better understanding of the potential of space applications in six domains, namely: agriculture & food; water & infrastructure; defence & security; environment, climate & sustainability; transport & logistics; and public health & well-being.

## ***Space sector demarcation***

The demarcation of the space sector is not trivial. This highly diverse sector ranges from the development and launching of rockets, satellites, space stations and all the ancillary requirements (the so-called upstream), to the processing of raw data from space by ground stations, then turning this data into usable/interpretable information (downstream). This study determines the economic benefit of just the upstream and downstream. To complete the picture, ideally the investigations would include a layer of 'space-enabled' services and applications such as navigation services, satellite television (including the installation and procurement of equipment), precision agriculture and financial services (using the timing component of PNT services as GPS). Many domains have applications with a larger or smaller space component and thus relevant dependence on space technology. This layer of space-enabled services and applications is not yet quantifiable. What we can determine, however, is that such dependence and consequently the economic importance of space technology is expanding more rapidly than its significance defined as a narrow economic sector.

## **Overall conclusions**

- a) At the end of 2018, the space sector in the Netherlands was estimated at approximately 10,500 FTE, EUR 1.9 billion production value and EUR 1 billion added value. Of economic significance is that these figures represent the direct and indirect total (of supplies, expenditure on foreign employees and multi-day visits from abroad). In addition to the FTE attributable to the space sector and amounts in companies, these estimates include the space activities of university research groups, TNO, NLR, SRON, ASTRON, KNMI and ESTEC.
- (b) The figures are considerably higher than the 2014 estimates. On the one hand, we could consider this as simply the economic growth of the space sector. On the other hand, more sophisticated research methods enable us to form a complete and more accurate picture of the space sector. We can review more space agencies and obtain more accurate figures for the economic metrics. If we apply precisely the same method for 2014 to 2018, we see that the space companies existing in both years grew considerably (400 FTE and EUR 70 million production value).
- c) To a significant extent, space technology is science-based. The survey underlines the importance of a good scientific foundation, sufficient knowledge exchange and collaboration in innovation between companies and knowledge institutes.
- d) The survey also highlights that the most commonly experienced bottleneck in the sector's development, is the perceived insufficient support from the government. This applies to both policy and financial resources. In addition, survey respondents frequently mention the lack of opportunities to participate in (inter)national programmes. A third of the companies sees the availability of qualified staff as a bottleneck.
- e) Space technology generates higher social added value in four ways: 1) through direct spin-offs whereby technologies, materials and products designed to function under extreme conditions in space trickle down to all kinds of technologies and applications on earth; 2) through PNT – positioning, navigation and timing services (better known as satellite navigation or GPS). This is essentially a utility facilitating entire sectors through the system synchronization that enables them; 3) satellite communications and satellite TV; 4) earth observation using satellites and the generated satellite data. This category of applications is becoming increasingly meaningful in many domains (see overview below).
- f) Of the six domains with space applications we examined, those that have made the most progress are agriculture & food, water & infrastructure and partially defence & security. Concerning the three other domains, public health & well-being appear to be lagging behind when it comes to utilizing space technology. The chart below presents an overview of applications in these domains and the main trends. One generic trend is that ground data, satellite data and models are being combined more often.

	Domain	Societal challenges	Examples of (potential) applications	Application trends
	Agriculture & Food	Sustainability, food safety, food security	<ul style="list-style-type: none"> <li>• Precision agriculture</li> <li>• Control of agricultural subsidies and sustainable production</li> <li>• Identifying and monitoring landscape elements</li> <li>• Crop support, insight in damage and supervision of sustainable production</li> </ul>	From controlling and monitoring to forecasting and warning. More focus on entire worldwide foodchains. Applying AI.
	Water & Infrastructure	Safety, sustainability climate resilience urban and rural areas	<ul style="list-style-type: none"> <li>• Chart/monitor quantity, quality and safety of water</li> <li>• Chart subsidence of infrastructures e.g. dikes, gas pipelines (important for construction, maintenance and (preventative) replacement)</li> <li>• Determine rising sea levels</li> </ul>	More targeted and continuous inspections and better forecasts. Higher resolutions.
	Defence & Security	International peace and safety, safety in and from space, tackling organised crime, protection against natural disasters.	<ul style="list-style-type: none"> <li>• Worldwide telecommunication with associates</li> <li>• Exact location and time references for operations</li> <li>• Monitor effects of space weather</li> <li>• Identification of environmental crime</li> <li>• Support services in emergencies</li> <li>• Provide information for preventing/combating natural disasters</li> </ul>	Shift to early warning and forecasting. Use of micro satellites. Best possible provision of information safety professionals on the ground. Use of time series/historical data.
	Environment Climate & Sustainability	Circularity, sustainable land use, biodiversity, environmental pollution, CO2-free electricity system.	<ul style="list-style-type: none"> <li>• Monitor changing living environment e.g. use of land and space</li> <li>• Chart greenhouse gases, particulate matter and nitrogen emissions</li> <li>• Identify locations for wind turbines and solar panels</li> <li>• Monitor compliance with international agreements on the environment, climate and sustainability</li> </ul>	Global and consistent picture over time. Insight in individual sources of pollution such as power stations and seagoing vessels.
	Transport & Logistics	Sustainable, safe and autonomous transport. Efficient logistics.	<ul style="list-style-type: none"> <li>• Satellite navigation for aircraft and seagoing vessels</li> <li>• Precise tracking &amp; tracing in logistics chains</li> <li>• Autonomous driving</li> <li>• Monitoring the state of transport corridors</li> </ul>	Even better utilization of real-time data for safe (and efficient) driving, flying and sailing. Synchromodal transport.
	Public health & Wellbeing	Countering unhealthy living environment & lifestyle. Reducing the spread of infectious diseases.	<ul style="list-style-type: none"> <li>• Weather and air quality forecast</li> <li>• Monitor spread of infectious diseases</li> <li>• Monitor quality of living environment (water, soil and air)</li> <li>• Monitor changing habitat (heat islands, blue algae, pests)</li> </ul>	Higher resolutions in monitoring quality of living environment (air, water, soil).

### ***Critical success factors for scaling up space applications***

Five critical success factors have been identified for scaling up space applications, namely:

- 1) Existing laws, regulations and procedures. These do not yet adequately take into account the observations and measurements that are possible from space;
- 2) Awareness and space technology's current image. In many societal domains, executive agencies as well as policymakers are still insufficiently aware of space technology's potential and the significant role it already plays. Space technology is still seen as complex and costly, despite becoming increasingly accessible;
- 3) Demonstrable added value and integration in existing work processes. The business case for space applications should be obvious. Space technology applications must have clearly demonstrable added value in the form of a lower cost work process or greater effectiveness (or both), and at the same time be easy to incorporate in existing work processes. In other words, they must resolve a real organizational sticking point;
- 4) Collaboration to create space applications (including data sharing). The extent of cooperation for creating space technology applications, in particular information facilities and data sharing, is lagging behind. In the majority of cases, space technology applications are still being created (and even distributed) at individual organization level and are relatively limited in partnerships. This means that demand bundling (and associated pooling of budgets) occurs less frequently than is possible and the wheel is often reinvented.
- 5) Developing a space technology marketplace. The market for space applications – especially satellite data applications – is still young and to some extent immature in the Netherlands.

### ***Recommendations***

In order to make greater use of the broad application potential of space technology in the Netherlands – and in particular the use of satellite data alongside satellite navigation and communications – more efforts are required by the government, industry and knowledge institutions. The exploration resulted in six recommendations, summarized as follows:

- a) Improve awareness of what is (im)possible with satellite data;
- b) Be ambitious regarding the deployment of space technology and include demand articulation and demand bundling in innovative procurement policy;
- c) Promote the creation of a digital basic registration of the physical environment as starting point for diverse satellite data applications;
- d) Decide how to further develop the Satellite Data Portal (SDP);
- e) Engage in a dialogue with satellite data application providers;
- f) Encourage the creation of a (virtual) centre of excellence in satellite data applications combined with targeted efforts to increase knowledge institutions' impact in this field.

### ***Supervisory committee members***

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