

A satellite image of Sweden, showing the country's geographical features, including forests, water bodies, and urban areas. A semi-transparent map of Sweden is overlaid on the satellite image, highlighting the country's outline and internal regional boundaries. The text "The Strategy of the Swedish National Space Agency" is positioned in the upper left corner of the image.

The Strategy of the Swedish National Space Agency



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Swedish National Space Agency

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The Swedish National Space Agency as an expert authority with expanding responsibilities

In May 2018, the Government of Sweden sent a written communication to the Swedish Parliament (Skr. 2017/18: 259 En strategi för svensk rymdverksamhet – a strategy for Swedish space activities), which was reviewed in the Committee on Education and was endorsed by the Parliament in November. As yet, this written communication has not resulted in concrete proposals for changes to the Swedish National Space Agency's instruction, but this strategy document covers the objectives and orientation that are discussed in the document.

The Government's document follows the work of the commission of inquiry on space (SOU 2015:75 *En rymdstrategi för nytta och tillväxt – a space strategy for benefit and growth*). Both documents consider the increasingly rapid change in the space field. One essential item that was not included in the Government's written communication is the need to review the Swedish National Space Agency's resources to meet the increased expectations placed on the agency.

According to its current instruction, the Swedish National Space Agency should work so that space activities and space research contribute to the knowledge society, as well as to innovativeness and competitiveness of the industry. The Swedish National Space Agency should work so that space activities satisfy societal requirements for space-related knowledge and the development of technology in sectors such as transport, communications, and climate and the environment.

The instruction states that the Swedish National Space Agency should ensure the availability of secure, reliable and – to Sweden

– relevant space infrastructure by providing support for research and technology development. This work should generate open space data that provide added value for Sweden, as well as research results of the highest international quality, making Sweden a leading knowledge nation.

The instruction makes clear that the Swedish National Space Agency should participate in and benefit from European cooperation in the space sector in general, and the Galileo satellite navigation programme in particular. In addition, the agency shall process cases and be the contact body for international space cooperation. European cooperation in the space sector is more comprehensive now that Galileo (1) and Egnos (2) are in operation. Copernicus (3) is delivering large amounts of data and services that are integrated with other data for routine use and work has started on common European space situational awareness. This strategy is in line with both the EU's space strategy and the need to optimise the societal and economic benefits of space activities.

The agency should also help ensure that competitiveness of Swedish actors creates growth and jobs through the provision of usable space data and processing tools via a competitive space industry.

Due to our northern location, the Esrange space centre is an important asset for Swedish space activities. We believe that Esrange has great potential, should there be opportunities for Swedish participation in relevant programmes.

Finally, the Swedish National Space Agency should cooperate with other actors in order to attract young people to education and professions in science and technology. This is an area in which the Agency is very active today with very good results. We note an increasing demand for this cooperation with teachers and schools.

1. Galileo is a global satellite navigation system, comparable with the US GPS and Russia's Glonass. It has been developed by the European Space Agency (ESA) and is operated by the European Global Navigation Satellite Systems Agency.

2. Egnos is a regional augmentation system for GPS and Glonass, providing higher precision for receivers in Europe. The name is an acronym for European Geostationary Navigation Overlay Service. Stations on the ground measure the error in the ordinary signal and broadcast a correction via geostationary satellites. The US has several augmentation systems, but WAAS is the one most similar to Egnos.

3. Copernicus is an EU programme that aims to develop European information services based on Earth monitoring via satellite and (ground-based) field data analyses. This initiative is led by the European Commission, along with the European Space Agency (ESA) and the European Environment Agency (EEA).

Our strategy will respond to new challenges

Space activities are undergoing comprehensive global changes. In many regards, actors in the US are leading, showing the way for the rest of the world. There are many differences between the US and Europe, but there are two of primary importance here: the US administration works in a different manner to the European nations, and private equity is more readily available in the US. Multiple initiatives are underway in Europe to attract funds and private investment in space activities. In brief, the Swedish National Space Agency regards the following developments as important to this strategy.

Paradigm shift on both upstream and downstream markets⁴

A technological shift is ongoing, with new applications using, and demanding, space data. Altogether this brings new business opportunities and opens up new markets.

New markets and changing conditions lead to increased competition over technology and customers.

More actors and increased influx of private equity to space activities have resulted in a number of countries updating their space legislation to attract new actors to do their business in those countries.

Private equity and investment funds have increased in the US and are on the way in Europe

New business models are being developed. For example, development is not only paid for through publicly funded projects, but increasingly through future income.

This affects ESA's role and function in European space activities.

On the one hand, ESA's principle of "juste retour" is the basis of ESA's funding, allowing important and influential projects, but on the other hand it is a potential barrier to the development of a commercial market.

Clearer market demand and reduced technology control leads to new logic and new decision-making paths, which are demanded by the actors exploiting space data. This also places increasing requirements on space infrastructure.

Political attention leads to higher expectations and higher demands

The Government of Sweden has presented the first national space strategy. This has been examined in the Committee on Education and debated in the Parliament, who endorsed the strategy.

Space activities are on the agenda in many countries. Studies of the

socioeconomic effects are being conducted in growing numbers of countries, showing the benefits in the form of increased employment, more businesses, more students and increased cost-efficiency in publicly-funded activities.

It is increasingly common to utilise synergies in the form of shared technology development for civilian and military space infrastructure, known as "dual-use".

The relationship between ESA and the European Commission may, in the long run, entail an entirely new role for ESA. Moreover, expansive EU programmes are increasingly important to Swedish space activities and the Swedish space industry.

There is increasing knowledge and understanding of how to forecast space weather, preventing societal problems on Earth. As society becomes more dependent on space infrastructure, there is a growing need to monitor



IMAGE COURTESY OF: RUAG SWEDEN AB

and mitigate collisions between satellites, space debris and natural objects that move around the Earth.

As space activities increase in both scope and importance, so does the need for international agreements to ensure that space is accessible to everyone in a manner that is sustainable in the long term.

The society is increasingly more dependent on space

Space data is of great value and an important source for knowledge-intensive industries and companies producing advanced information products and services. Copernicus supports several Swedish environmental objectives, established climate targets and the UN's Agenda 2030 Sustainable Development Goals.

Security requirements are generally increasing, and particularly for accreditation, cyber security and information security.

Some space infrastructure, such

as the Galileo satellite navigation system, is critical infrastructure that guarantees vital societal functions. This should be taken into account as regards to monitoring and emergency preparedness.

Space technology works with other technology in areas such as digitalisation and miniaturisation

Increased digitalisation and new data management tools make it possible to handle large amounts of data and have therefore become a strategic resource. Space data is used in more and more societal functions, driving the development of technology in multiple areas. One interesting and rapidly growing area is artificial intelligence (AI).

New technology leads to smaller satellites that solve the same problems in new ways, but which also solve new problems that were not previously addressed using space technology. More accessible technology that provides cost-effective tools changes the role and importance of space activities in society.

Space research is developing and widens to include more disciplines

ESA's science programme is developing as research finds answers that lead to new questions. New disciplines are being added and knowledge is growing, demanding dynamic responses and increased resources.

Developments within research demand increased cooperation between different research funding agencies, including collaborations with non-public actors.

Research results find new means of dissemination, including where and how they are published, and research funding agencies need to review their requirements on researchers vis-à-vis making results accessible.

Space exploration has gained momentum, and both the Moon and Mars are the focus of institutional and private actors.

An investment in space is ultimately an investment in Earth

We like to associate space activities with basic research and advanced technological development. Today, space is also a natural part of the global infrastructure that affects our lives and how we execute different functions. Society's dependence on space increases as the world around us changes. Climate and environmental monitoring, security and efficient communication technologies are a few examples. Sweden is a small country, but an important space nation with successful research and innovative industry. With the right resources, Swedish space activities can maintain a strong international position, thus contributing to both our own societal development and global work on the goals for Agenda 2030.

The image uses the UN's global goals to show how space activities contribute to creating sustainable development, smart use of natural resources and management of natural disasters, as well as promoting peaceful communities.

Sustainable communities, industries, innovation and infrastructure

Sweden is a nation with knowledge-intensive and innovative industry. In modern society, satellites are necessary for well-functioning infrastructure, for example efficient transportation and financial services.

Satellites provide information that facilitates relief work in emergencies such as forest fires, drought, flooding and other extreme weather conditions. In forestry and agriculture, satellite data is used to control the distribution of fertiliser and seeds, land use planning and follow-up. Ice-breaking based on satellite images saves resources, both for merchant fleets and the environment.

Global urbanisation requires new solutions to help achieve sustainable communities, and satellite studies are an important tool in this work.

UN SUSTAINABLE DEVELOPMENT GOALS, NUMBERS 8, 9, 11



Equality and good education for all

To continue being a successful space nation, Sweden should work towards widening participation in higher education to produce new engineers, entrepreneurs and researchers with knowledge of space. As space activities are broadening and being used by more people, further education and activities to increase expertise are needed. The challenge is to strengthen Swedish research and innovation to optimise the available opportunities nationally, while being able to meet international competition.

UN SUSTAINABLE DEVELOPMENT GOALS, NUMBERS 4, 5, 9, 17

Peaceful and inclusive societies in global partnership

Space activities are international, and the Swedish space programme is also largely conducted through international cooperation. The Swedish National Space Agency promotes Swedish interests and development in both ESA and EU contexts. Sweden is also involved in work towards guaranteeing that space activities are accessible for everyone and free from war and conflicts. This includes the issue of how to manage orbiting space debris that threatens satellites in operation.

UN SUSTAINABLE DEVELOPMENT GOALS, NUMBERS 16, 17

Monitoring climate change and follow-up on environmental agreements

Satellites are decisive for monitoring international work on climate and the environment, for example following up agreements such as the Paris Agreement. In Copernicus, Europe has built the world's most sophisticated satellite programme for global environmental and climate monitoring of land, air and sea. Copernicus data and services provide an important basis for decision-making and for follow-up and calculation of the effects of actions in environmental and climate work.

UN SUSTAINABLE DEVELOPMENT GOALS, NUMBERS 3, 6, 13, 14, 15

 **Good health and well-being:** Goal 3 is to ensure that everyone can live a healthy life and promote well-being for all at all ages.

 **Quality education:** Goal 4, to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

 **Gender equality:** Goal 5 is to achieve gender equality and empower all women and girls.

 **Clean water and sanitation:** Goal 6 is to ensure availability and sustainable management of water and sanitation for all.

 **Decent work and economic growth:** Goal 8 is to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

 **Industry, innovation and infrastructure:** Goal 9 is to build resilient agriculture, promote inclusive and sustainable industrialisation and faster innovation.

 **Sustainable cities and communities:** Goal 11 is to make cities and human settlements inclusive, safe, resilient and sustainable.

 **Climate action:** Goal 13 is to take urgent action to combat climate change and its impacts.

 **Life below water:** Goal 14 is to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

 **Life on land:** Goal 15 is to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

 **Peace, justice and strong institutions:** Goal 16 includes promoting peaceful and inclusive societies for sustainable development.

 **Partnerships for the goals:** Goal 17 is to strengthen the means of implementation and revitalise the global partnership for sustainable development.



IMAGE COURTESY OF NASA, ESA, THE HUBBLE HERITAGE TEAM (STSCI/AURA), A. NOBES (ESA/STSCI), AND THE WESTERLUND 2 SCIENCE TEAM

Long-term strategic objectives

The strategic objectives are explicitly long term because, just like the Commission of inquiry for space and the Government of Sweden's written communication to the Parliament, they are linked to the actual content of activities. The strategic objectives have therefore not been limited by or adapted to the Agency's current resources. This strategy corresponds to the Government's written communication that was endorsed by the Parliament.

For the Swedish National Space Agency, it is natural that Sweden must offer equal opportunities for everyone to invest in a career in Swedish space activities: women and men, native citizens or immigrants. Equality is not a strategic objective for the Swedish National Space Agency: it is an essential condition for all areas of activity. It is not affected by the Agency's funding, it cannot be aimed at in part or prioritised in relation to other objectives.

Coordinating expert authority for Swedish space activities

The Swedish National Space Agency identifies a great need to play a role of coordinator of Swedish space activities, gathering Swedish perspectives in order to establish and continually update the basis for Swedish positions on various international issues. The Swedish National Space Agency should:

- Establish meeting places for improving the exchanges of experiences among actors in Swedish space activities. One example is the aspects of foreign and security policy as a basis for international cooperation, another example is conclusions about how delegations and industry can cooperate within the EU to obtain better results for Sweden.
- Be a knowledge bank and a place for the preparation of background information for use as a basis for Swedish positions in international discussions, for example about rules and agreements on conduct in space, or proposals for EU regulations.
- Inspire children and young people to study science and technology, particularly through the development of classroom materials/teaching guides and, in partnership with various actors, through the development of further professional training for teachers who work with space-related subjects.

- Have a leading and coordinating role in civilian-military cooperation, taking the perspective of the total defence and with the intention of realising synergies in the development of individual technologies and complete infrastructure projects.
- Ensure that the Agency has a provision of expertise that is capable of meeting future challenges.

Guaranteeing access to secure, reliable and – to Sweden – relevant space infrastructure

Relevant space infrastructure includes that which is available via the common European programmes of Galileo, Egnos and Copernicus, as well as that developed nationally and through programmes in ESA. Participation in ESA gives Swedish researchers access to vital infrastructure for exploration, space research and observations of the Earth. In addition, there are plans for new infrastructure as a basis for better forecasting of space weather, an area in which Sweden has prominent researchers. Nationally, Esrange is being developed to become part of the joint European infrastructure in more areas than it is currently.

Swedish industrial participation in these infrastructure projects is of utmost importance if Sweden is to be able to participate in and influence the development of these joint projects. Simultaneously, this includes recouping some of the funding we put into these joint international projects. The Swedish National Space Agency should:

- Allocate funding to the development of technology that strengthens Swedish participation in programmes and brings Sweden influence in European partnership projects.

- Contribute to research results of the highest international quality, making Sweden a leading knowledge nation.
- Establish a national satellite programme with innovative research satellites to develop relevant research instruments, support high-quality research and demonstrate the capability of Swedish technology.
- Actively participate in ESA's exploration programme, partly to participate in research that is a global priority, partly because Sweden can contribute through the facilities at Esrange.
- Work towards the appointment of another Swedish astronaut, because human spaceflight has great value as a source of inspiration: humans have always wanted to test their limits and explore unknown areas.
- Make quality assured space data and services available to innovators, entrepreneurs and other developers in Sweden, for increased societal benefits and cost-efficiency in publicly-funded activities (for example, research, climate and environmental monitoring, and better resource utilisation of public assets, including civilian and military cooperation).
- Contribute to the further development of Esrange as an important infrastructure for Swedish and European space activities.

Strengthen Swedish actors' competitiveness for sustainable growth and efficiency measures

Swedish industry and Swedish researchers are competitive in an international perspective. One proof of this is that we have four space

companies on the First North stock exchange. Several companies are also successful on the US market. Likewise, Swedish researchers are recognised as conducting high-quality research on interesting issues, resulting in invitations to take up prominent positions in international projects. Although European cooperation continues to be an important foundation for Swedish actors, increased preparation for a more global perspective is needed.

The overriding objectives are:

- Societal benefit should be at the heart of Swedish space activities, so that user needs for products and services are satisfied and capitalised upon in the requested societal benefits.
- Space data is a natural and important part of Swedish geodata provision.
- Support for the development of competitive innovation and new commercial applications for increased growth.
- To promote the development of working commercial space activities, both in Sweden and in Europe, making Swedish space activities attractive to investment funds and private equity.
- Widen the scope of calls for research applications, so that more disciplines can benefit from space activities, for example in political science and international relations or space law.
- Establish new programmes, where research results that can be directly utilised in societally beneficial applications are requested (demand-driven research).



Strategic objectives will adapt Swedish space activities to changes in the world around us

As established in the section *Our strategy will respond to new challenges*, the space sector is undergoing rapid development and also changing on numerous levels. Some of this development, which is often called “New Space”, means that actors and activities drive the development of space activities in a new way. The North American companies Planet and SpaceX are clear examples that build upon the interaction of technological development and market change. This development also leads to new requirements and conditions for the Swedish National Space Agency’s work on its long-term objectives.

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Technical conditions are changing due to miniaturisation and development in electronics, which enable high functionality in small satellites at a considerably lower cost than previously. The availability of smaller, flexible launchers entails better opportunities for launching small satellites. The need for information of companies and organisations that can be solved using space data creates a demand, and thus a foundation, for a commercial space market. Access to venture capital has led to the privatisation of parts of space infrastructure and its information flow. Public funding for technology development is no longer driven by the needs for interstate cooperation in space.

For private actors to succeed in New Space, a high level of competitiveness is required, but in somewhat different areas than previously. Companies must employ the best scientists and engineers,

work actively with marketing, customer analysis and user-centred software development, whilst also managing to attract venture capital. To maintain competitiveness, actors in the space sector are required to deal with traditional requirements such as space qualification, and produce the highest quality and long lifetime, while also being flexible, scalable and able to attract private equity.

This places huge demands on companies and entrepreneurs, as well as on the Swedish National Space Agency, which has the objective of funding research and development for increased Swedish competitiveness. Promoting innovation and societal benefits in a sector that is undergoing rapid change, and with demands for societal returns on invested capital, requires time and resources. One task that is growing is ensuring that space data can be used to achieve and to evaluate Agenda

2030 globally, and to understand the processes that govern climate change and global emissions of greenhouse gases. Another application that is increasingly significant is the use of space data in the Arctic cooperative actions.

Another significant change in the world is that a number of European countries have updated their national space legislation, especially in order to attract private equity to the space sector. An updated Swedish Act on Space Activities would increase the potential to attract private equity to Swedish space activities, having, for example, an impact on the opportunities to attract international customers to Esrange. This lack of an updated Act on Space Activities has a negative impact on the Swedish National Space Agency’s stakeholders, complicates the Agency’s work and may limit opportunities for looking after Swedish interests in space.



Implementation of the strategy is subject to ongoing evaluation

Investments in space activities have an impact on society as a whole. In order to better describe the effects of Swedish space activities, they should be regularly evaluated by independent bodies. Over the coming years, we intend to evaluate the socioeconomic effects of space activities.

To achieve its strategic objectives, the Swedish National Space Agency will continue to emphasise European cooperation, particularly within ESA and the EU. In the long-term, participation in ESA is estimated to remain at around two-thirds of the Swedish National Space Agency's directed grant. Bilateral cooperation with individual states or groups of states, within and outside Europe, is considered to be of continued importance to Swedish space activities.

The Swedish National Space Agency has a wide range of expertise and we see great potential in establishing meeting places for Swedish actors, both for preparations prior to cooperation and experience assessment, and for improvement work on the development of future working methods.

Activities in space are the Swedish National Space Agency's main responsibility, and we should be

the agency that promotes the development of Swedish space technology as the foundation for business competitiveness and its use in European projects. Strengthening the competitiveness of the Swedish space industry regarding technology in space, i.e. upstream technology, remains an important focus of our work.

