



## Global risk & global challenges – Space as a game changer for socioeconomic sustainable development



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### ABSTRACT

The world's societies at the beginning of the 21st century are better off than ever before. (Gapminder, 2015) At the same time, the world is also threatened by global challenges where space as a tool has and can play a pivotal role in meeting those challenges. The challenges range from climate change, over mass unemployment, to terrorism or migration – to name but a few. Space activities have started to respond to this changing world, not only by providing a deeper understanding of our universe, but by using space as an additional sphere and sector, through which humankind can increase and secure its wealth – it is thus game changing in the way we sustain humanity's existence. This paper is meant to capture this development. In the first part, an overview is given on the risks that humankind is facing. The second part describes the way that space can be used as a tool to prevent and manage these risks. The overview in the first part is based on the examination of the most recent reports and overall strategies of key International Governmental Organisations and Non-Governmental Organisations that are involved in agenda-setting, policy formulation and implementation. The second part includes an overview on current activities of the European Space Agency (ESA) that play a role in responding to these risks. To better understand ESA's activities that contain humanity's risks, a standard classification for risks management is used, which distinguishes between four components: Identification, Assessment, Management and Communication (Renn, 2005). The analysis reveals how space activities already today play a pivotal role in all four types of risk management. Space activities contribute very tangible to the management of risks through its space mission, but also in a more indirect way, as providing the technical backbone for stable and reliable cooperation in the international governance arena, and serve as crucial economic stimulator. The overall results show that space activities touch upon every aspect of responding to the humanity's risks. Especially in the identification and the preventive management of humanity's risks, space systems are a crucial enabler. They are also an important part in dealing with risks related to scarcity of resources. It is thus important that current levels of investments into space infrastructure are maintained, as the benefits of space activities is essential to humankind's existence and that upon further programmatic decisions, stakeholders involved with the management of risks are being consulted.

### 1. Introduction

Today's societies are characterised by an unprecedented high degree of wealth around the world, most impressively indicated by all-time highs in the global life expectancy and income per capita [1]. The developments show that all regions of the world, also those suffering by ongoing crisis, are better off than two hundred years ago, and in particular in the last two decades wealth as indicated by income per capita and life expectancy, has risen starkly in most regions of the world.

In 2015, the span of life expectancy ranged from 47.1 years on average in Lesotho to 84.8 years in Andorra, vis-à-vis a range from 23.4 years in Yemen to 42.9 years in Iceland in 1800. Even more recent data shows drastic differences: 24 in Yemen to 72.6 Norway in 1950. Nevertheless, the world is also threatened by a series of global challenges where space activities as a tool can play a pivotal role in mitigating the humanity's risks. Those challenges range from climate change, over mass unemployment, to terrorism or migration. Space activities have started to respond to this changing world, not only by providing a deeper

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**Table 1**  
Overview on risk reports.

Global Challenges Foundation	“Global Challenges – 12 risks that threatens the society” [4]
World Economic Forum	“Global Risks 2015” [5]
United Nations	“Sustainable Development Goals” [6]
European Commission	“Europe 2020” [7]
Organisation for Economic Cooperation and Development	“Space 2030 – tackling society’s challenges” [2]

understanding of our universe, but by using space as an additional sphere and sector, through which humankind can increase and secure its wealth. This paper seeks to give an overview on these space activities and classify them. This is important as space activities are rarely seen in the context of risk management at large. One effort was made by the OECD, which is also considered in this report [2]. Efforts to determine the impact of space activities on the economy and the society are lead at ESA, national agencies and international Organisation [3]. Those studies often focus on a specific space programmes and general added value that space brings to the economy, largely by putting a price tag on the activities. What is missing is an overview of the plethora of activities that relate to the fundamental risks to humanity's existence, and an understanding how space activities contribute to the risk mitigation process. For this objective it is relevant to first understand what these risks are. An objective classification of risks in the sense that one risk is more crucial than the other one is very difficult to achieve as it often relates to the views of an epistemic community. The classification provided here takes this into consideration and thus looks at the risks outlined by major political institutions. By counting the issues that are shared by the different actors, an aggregated list of risks is provided that outlines the most important risks to humanity – as provided by political institutions. The first part thus gives an overview on the most crucial risks. The second part examines the activities of ESA and thus reveals how space is and can be used as a tool to mitigate these risks.

The first part of this overview is based on the examination of the most recent reports and overall strategies of key International Governmental Organisations (IGO) and International Non-Governmental Organisations (INGO), which are leading in the global and regional agenda-setting, policy formulation and implementation. The former include the European Union (EU), the Organisation for Economic Cooperation and Development (OECD) and the United Nations (UN), while the latter include the World Economic Forum (WEF) and the Global Challenges Foundation.<sup>1</sup> This research also considered the World Bank and the International Monetary Fund IMF as actors, but no relevant reports could be identified to be included in this research. Approaching the exercise of mapping risks in such a manner, poses two crucial challenges. First, given the inherent nature of the actors, the INGOs are taking a proactive approach vis-à-vis risks, outlining and identifying them, while the IGOs take a reactive approach, outlining the mitigation actions. Here risks are rather latent in the policy goals and targets. Second, there are different levels of depth and the reports are often more complimentary than conflicting. The results shown in section two of this paper took these issues into consideration. The analysis is based on five reports (Table 1). Following the analyses of the reports, the identified risks have been organised into their common areas to easier distinguish patterns and see which risks are predominant in the on-going discussions.

The second part of the analysis looks at the activities in space. ESA, as an end-to-end space agency that is involved in the full spectrum of space activities together with its Member States and partners, was chosen as the space agency for this research. ESA's activities relate to all space missions that are carried out and planned as well as projects related to technology development or business support, as well as other activities. The term

<sup>1</sup> The Global Challenges Foundation is commonly not considered a global leader in agenda setting, policy formulation and implementation. It is considered here, because it has led an extensive effort in identifying global risks.

**Table 2**  
Table 2 Categorisation of risks.

Known Knowns
Unknown Knowns
Unknown Unknowns

space activities used here spans a wide area and thus serves to show the range of activities that relate to humanity's risks. All activities were considered that have a direct relation to the outlined risks such as missions to observe changing forests or Asteroid detections missions. In addition, activities that indirect relate to the risks were considered, e.g. where possible findings of ESA's Advanced Concept Teams in future technology developments for computer systems might have spin off effects that mitigate or yield the possibility to mitigate risks related to Artificial Intelligence. While this method enables a very comprehensive picture, a qualitative assessment on the impact of these activities on risk mitigation goes beyond the scope of this paper. Thus a qualitative assessment of the specific activities, their actual impact and the relation between investment and impact should be pursued in a further study. This research nevertheless shows the range of risk areas affected by space and classifies them under a standard concept for risks management introduced by Ortwin Renn [8]. This helps to better understand the role that space as a tools has. Renn's concept explains four stages of risks management: identification, assessment, management and communication [8]. The overall theme of communication is present in all stages when handling and addressing risks. The management of risks further has two components, preventing and reactive management.

In Renn's concept, the objective of the first stage identification is to make risks known. Elements of the identification of risks include monitoring the environment, issues that are brought forward by stakeholders and through early warning systems. This is especially crucial, as a large part of risks are unknown unknowns, a term typically enough coined by former NASA Administrator William Graham and famously used by former US Secretary of Defence, D. Rumsfeld. Unknown Unknowns are part of a categorisation of risks (Table 2).

Known knowns refers to the knowledge about the existence of a risk and its properties. It is in contrast to known unknowns that describe the situation, where there is knowledge about the existence of a risk, without knowing more about its properties. Unknown unknowns then are the most critical risks, as one neither knows about their existences nor their properties. These risks often come sudden and leave little room for assessment and management. Identification of risks and making unknown unknowns known is thus a very critical part of risk management.

The second stage, assessment, provides knowledge of the risk, evaluates its impact and the possibility of reducing or containing its consequences. The third stage is management, where preventive and reactive measures can reduce, avoid or retain risks. The fourth stage is communication, which is also an important element for the other first three stages. It refers to the responsibility of both experts and civil society to inform on risks. For experts that are part of the risk management process there is responsibility to inform the different fields of stakeholders, from private management, science and public management. For the civil society, it pertains to the responsibility to inform about the experience of actual risks. An open and inclusive communication is essential in all stages and key to engage both civil society and stakeholders in the reasons behind the risk governance.

The analysis of space activities under this risk-management classification shows how relevant space activities are in all stages of risk management – especially in preventive management. At the same time, many space activities contribute to risk mitigation in the fields of *Resources*, *Unknown Unknowns* and *Climate Change*, but also in the areas of *Technology* and *Transport/Mobility*. As mentioned, previous studies as well as decisions makers have rarely considered space activities as a contribution to contain humanities risks, and the impact that space activities have had is most often a by-product of the stated mission purpose. That they do

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