



Sustainability scenarios for the New Space tourism industry

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The following piece is based on the *lectio praecursoria* presented at the defence of the doctoral dissertation 'The emergence of New Space: a grounded theory study of enhancing sustainability in space tourism from the view of Finland', which was publicly defended on 22 April 2022, at Rovaniemi, University of Lapland. The full version of the dissertation can be found at <https://urn.fi/URN:ISBN:978-952-337-311-2>

Throughout history there have been stories, such as those about space exploration, which have eventually become true, as science fiction has a history of influencing popular culture and inspiring engineers to turn ideas into reality, by asking 'what is real?' and 'when does something become real?' (Rovelli, 2019). Since the 1950s space race between the United States and the Soviet Union, there have been many futuristic visions of what space travel and tourism would entail: for example, what kind of conceptual designs and passenger space infrastructure would be available, those visions basing themselves on people's desires to experience the Hollywood science fiction styled image of the space environment (Toivonen, 2020). During the 1960s, a general assumption was that ordinary people would be able to afford space travel once it reached the same level of maturity as the airline industry, and that high-speed air transport via space would also become available (Launius, 2019). Such visions for space tourism developments were in symbiosis with science fiction films and literary writings, some dating back over hundreds of years. During the 2010s, for the first time in history, space became a new operative environment for privately owned businesses and attention was drawn to the global power of wealthy individuals, influencing and accelerating the technological revolution both on Earth and in space environments (Toivonen, 2020). In 2018, a private space company, SpaceX, achieved the world's first repeat flight of an orbital class rocket, presenting a historic milestone for full rocket reusability; hence, demonstrating operational level sustainability in a way that had not been seen in the previous governmental-led 'Old Space' industry.

The evolving concept of space tourism

The term 'New Space' refers to commercial space markets, which are characterised by start-up and privately funded space companies that service both governmental and non-governmental customers (Hay et al., 2009). This new era of commercial space activity, due to rapidly advancing technological developments, has enabled new countries, such as Finland,

for the first time to join the global space business market. Finland became a space nation in 2017 with the launch of the Aalto 1 research satellite, and the government issued the first 'Act on Space Activities' in 2018, encompassing a positive approach to space sustainability (Ministry of Economic Affairs and Employment of Finland, 2022).

The global New Space market includes an adventure tourism sector, which has emerged through the technological developments of the industry. The first operational space tourism flights took place in 2021; Blue Origin, Space X and Virgin Galactic becoming the world's pioneering companies. This new type of touristic adventure, at first taking place in sub-orbit, is aimed at people without a need for previous professional space training, to satisfy postmodern traveller's desire for new tourism experiences and sensations (Toivonen, 2020). With a more expanding space tourism experience palette, the New Space tourism industry is forecasted to be developed as a multi-billion dollar tourism sector in the future. There are various types of space tourism, including terrestrial space tourism, such as Earth-based activities from visiting space museums to watching the Northern Lights; atmospheric, such as high-altitude ballooning and low Earth orbit tourism in space-jump experience style. Additionally, space tourism involves beyond the Earth astrotourism, referring to Lunar and Mars experiences (Cater, 2019).

Space tourism is part of a new postmodern phenomenon of the space environment being transformed into a New Space industry business platform. Previous trends in adventure travel have already blurred many boundaries between adventurous activities and tourism (Beedie & Hudson, 2003). For example, mountain climbing, previously practised only by experienced professionals, has for a long time already gained popularity with holiday-makers, who attend guided and safety-checked experiences, even on Mount Everest. The desire of affluent tourists to undertake more unique and adventurous travel experiences has been one of the driving forces behind the demand for public space travel, enabling such tourists to visit a new untouched environment, to experience the sense of bodily weightlessness and witness the Earth from a unique angle – all such activities difficult for the masses to copy (Wittig et al., 2017).

Future tourism planning and climate change

The global growth of the tourism industry has led to an increase of different environmental impacts, which can no longer be ignored (Gössling et al., 2015). Such concerns are also being highlighted in recent years' global reports, such by the Intergovernmental Panel on Climate Change (2018). Therefore, there is obvious apprehension about environmental issues (i.e. the creation of new emissions and space debris) at the start of the New Space tourism industry. Hence, there is currently good momentum with which to include practises of sustainability as an ordinary approach to future New Space tourism actions. Early adapted and regulated sustainable development practises will be especially important if this new sector expands to mass space tourism in the future. It needs to be noted that besides the environmental context, adaptation to climate change also requires ethically-based competences among the tourism industry operators involved (Carter et al., 2015).

Climate change crises place major transformational demands on all industries on Earth. In order to achieve sustainable global tourism, there is a need to acknowledge future uncertainties and their relation to developments in future tourism (Benckendorff, 2008; Boston, 2017). As tourism planning is about prediction that requires estimations of the future, sustainable tourism, including adaptation to climate change, must become better planned, as governance, institutions and resources all impact holistically on operations of the New Space tourism industry. Up-to-date scientific knowledge and practical actions serve as tools for tourism operators, stakeholders and policymakers, in order to convincingly react to future climate change challenges and support the Earth's environmental longevity. Existing practises originating from the tourism industry should validate sustainable development as an essential concept for inclusion in future scenario planning for the New Space tourism industry.

Study contexts of New Space tourism and sustainability

As an interdisciplinary study in the field of tourism and futures studies, this doctoral thesis pioneered the creation of alternative future scenarios to enhance elements of sustainability in the New Space tourism industry. The focus of the research was on investigating how elements of sustainability could be included in development planning for the New Space tourism industry, on identifying concepts relating to the contexts of space tourism and sustainability that could be highlighted through future research, and identifying how space tourism and sustainability is envisioned by the public and professionals in the field in Finland.

The data were gathered through theoretical readings from tourism and futures studies' fields and empirical research, which was conducted through in-depth interviews, a public survey and a professional Delphi panel. The findings were collated into two peer reviewed articles and a book chapter between 2017–2021. In order to prompt answers to the research question of 'How can sustainability be included in future space tourism planning?', a new future tourism framework was created to guide the future planning process. Theoretical readings from the fields of both future and tourism research assisted in the formation of the framework's main themes and sub-themes. The 'Sustainable Future Planning Framework' demonstrated that planning, sustainability, weak signals and future scenarios should act in synergy with each other and thus, formulate a contextual framework for future space tourism planning. For the second question of 'What concepts relating to the context of space tourism and sustainability can be highlighted through research into a future that doesn't yet exist?', an existing future model, the 'Futures Map' (Kuusi et al., 2015), was utilised to place the thematical concepts gained from five in-depth professional interviews on two different time horizons to illustrate possible futures. The concepts placed on the planning horizon were economic effects, legislation, alternative energy sources and the circular economy, as those represented either historical or current ways of living in the developed world, or current global megatrends. The concepts of contemporary trends, health

space tourism, space colonies, virtual travel and robotisation were placed on the mapping horizon as those were either acceptable trends, or existing yet in visioning minds.

Four different sustainability dimensions for New Space tourism, which were first derived from the quantitative estimates from the public survey and then conceptually advanced from the Delphi panellists' views, were identified to find out answers to the question of 'How space tourism and sustainability is envisioned by the public and professionals in the field in Finland?'. The dimensions were named as virtual reality, comparative fairness, technological innovations and ecopolitics. Virtual travel was named to reflect the Delphi panellists' mutual view of such activity to represent the most sustainable way of experiencing space tourism; comparative fairness to reflect the increased concerns voiced about the world's equality issues; technological innovations to reflect concerns, in light of climate change, about the future of the Earth and humans; and ecopolitics to reflect mutual concerns over the lack of New Space industry legislation. From a scientific perspective, this study contributed to creating new knowledge on elements of sustainability related to New Space tourism and from a practical perspective, it contributed to a change of mindset in regard to virtual space tourism as well as illustrating new frameworks to conceptualise sustainable interrelationships in the context of New Space tourism.

Alternative scenarios

The findings indicated that sustainability in the context of New Space tourism can involve various concepts and dimensions. The principles of grounded theory were utilised to create three future scenarios, through which elements of sustainability could be increased in the future New Space tourism industry: through planning global space regulations; through recognition of the need to improve fairness; and through the implementation of virtual and technological innovations, that as a side product, may also assist in the prevention of climate change on Earth. Currently, there is extremely limited global space legislation involving any New Space industry operations. However, as technological evolution continues to advance the New Space industry business palette, new tensions will result if regulations start lagging behind. Hence, it is important to predict policy creation timescales to be the most beneficial in accordance with a sustainable future perspective. Feelings of awe regarding the Earth could have positive consequences in terms of creating a feel of protection towards the Earth's future wellbeing. Additionally, regulated (or at least volunteered) compensations to environmental schemes, replicating current aviation industry practises, coming from either New Space tourism companies or their passengers, could further support climate change prevention on Earth.

Social norms increasingly determine the kind of travel that is socially acceptable, and in the context of space tourism, this includes implications for those who are excluded or otherwise left behind (Spector & Higham, 2019). There has also been criticism regarding the new environmental impacts of the New Space tourism industry, and also the ethical synthesis of influential private sector commerce and publicly funded infrastructure, especially relating to the concentration of power. Similar concern also exists regarding the

backgrounds of the pioneering space tourists, coming from already-privileged segments of society. This raises new questions such as whether the understanding of an authentic space environment will be a new separating power of knowledge, increasing the gap between the wealthy and everyone else even further. Additionally, it will also create a need for further research on equal access factors and commercial exploitation of the space environment.

Technical innovations for creating virtual reality environments in tourism already provide alternatives for travellers to join different travel adventures via a virtual environment (Guttentag, 2021). Thus, this could potentially democratise the space experience for the wider public in the future. In the pioneering phase, the authentic physical space experience is limited only to those who are able to afford the cost of the space flight ticket. Virtually experienced tourism could eventually compete with real-world travel and alter future tourism patterns more broadly. Investments and innovations in virtual tourism in the context of space tourism can therefore benefit the entire tourism industry and assist in addressing sustainability issues more comprehensively: for example, to develop more authentic 'non-flying' tourism experiences. For example, in Finland, experiencing the Northern Lights in Lapland could include traditional eye-viewing with other space-related, virtual multisensory possibilities; hence, also enhancing both local tourism employment and Finland's global technological competence in regard to operations supporting New Space tourism sustainability.

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