

# Sustainable planning for space tourism

Annette Toivonen

*University of Lapland, Multidimensional Tourism Institute (MTI)*

## Abstract

This article concentrates on planning and development for future space tourism. It focuses on environmentally oriented sustainable ways of operating and introduces a new framework for creating a feasible sustainable future. The framework can be used as a theoretical basis in research that introduces new perspectives into a sustainable future in space tourism. Weak sustainable development planning sets the needs of mankind above all other ecosystems and space tourism appears to fall into a category envisioning optimistically all natural resource problems to have a human-based solution. The oil consumption and intensity of tourist transport are, however, set to increase due to space tourism. This kind of development is at variance with the current sustainable trends and actions practised in the tourism industry. The article discusses the need for sustainability awareness for development in the space tourism sector by pointing out some necessary elements needed for future planning processes.

*Keywords: space tourism, sustainable development, planning*

## Introduction

New forms of organisation and production, the development in transport and mobility and the rise of information technologies have resulted in an intense time-space compression, allowing new experiences of space and time (Harvey, 1989). People on the earth are not only space travellers, but also time travellers (Bell, 1997). This metaphor reflects well on the fact that the travel industry is currently taking the next step forward towards the future.

Harvey's (1989) time-space compression involved a marked increase in the pace of economic and everyday life and a phenomenal acceleration in the movement of information and capital. This intensification is encapsulated as "capitalists are seeking to overcome the barriers of distance and quicken the circulation time of capital to sustain profits" (Mowforth & Munt, 1998, p. 27). It is often presented with crises of presentation and capital accumulation leading towards postmodernism, which helps to encapsulate the profound, slowly emerging cultural

changes. Those experienced changes are rooted in everyday life and cannot be ignored (Harvey, 1989). The middle classes in particular are no longer only significant as cultural intermediaries, but also heavily represented in political alignments concentrating on issues such as the environment and sustainable lifestyles.

For example, the trends in adventure travel have blurred the boundaries between adventurous activities and tourism (Beedie & Hudson, 2003). Mountain climbing, previously practised only by the experienced elite, now shares the same place with holidaymakers attending a guided and safety-checked experience. Space has previously been accessed only by trained astronauts and scientists, not by ordinary tourists watching the planetary movements.

Tourists' desire for unique and challenging experiences has been one of the driving forces behind the demand for public space travel, pushing for the development of a new adventure tourism sector entering a virtually untouched new space. Developing a space tourism industry is paradoxically at variance with current trends in environmental protection and sustainable development goals in the tourism industry. This article concentrates on sustainable planning and development for future space tourism and analyses, on the grounds of different sustainable development theories, the ways of operating available for space tourism to become a sustainable form of tourism in the future.

## Space tourism

With the exploratory nature of man, the earth is no longer an adventurous enough place for some experienced tourists. Space tourism is a new sector of adventure tourism, which in the near future will be fast becoming a new opportunity for experiencing the unknown. If space tourism is able to reach the mass tourism phase, due to improved safety and decreased operation costs, a future space tourist will possibly only need minimal training to cope with the zero gravity, but otherwise space travel itself will become no different to current aviation.

According to Carter, Garrod, and Low (2015), space tourism is related to extraterrestrial phenomena involving a wide range of space-related travel. The typology of space tourism consists of terrestrial space tourism, atmospheric space tourism and astrotourism (Carter et al., 2015). Terrestrial space tourism involves specific space tourism sites on the earth, for example tours of the space facilities at the Kennedy Space Center (USA), and non-site-specific space tourism consisting of virtual gaming environments, space movie-related travel and eclipse tours. Atmospheric space tourism currently involves high-altitude jet flights up to 20 km with Russian MIG flights and weightless flights offered by the Zero G corporation. Astrotourism, in turn, takes place both in in-earth orbit and beyond earth orbit. According to Carter et al. (2015), terrestrial space tourism is quite well established with visits to space attractions and launch sites, while astrotourism, so far, has been restricted to a handful of wealthy elite trips to the International Space Station.

However, according to Davenport (2015), the breakthrough for starting commercial astrotourism is closer than ever before. Virgin Galactic is introducing suborbital flights up to 100 km and Space Adventures trips to the International Space Station up to 350 km. These both operate inside the in-earth orbit. Lunar and Martian voyages are not yet available, operating beyond the

earth's orbit, but Google has set a special Lunar X price award to financially encourage private companies to make the first move towards them (Google Lunar X Price, 2017).

The first space adventure tourist paid over 20 million dollars for his orbital adventure departing from Russia. However, if space tourism reaches the mass market phase the estimated cost will drop to 2,000 dollars per trip, making space tourism affordable to many travellers. Weaver (2005), however, argues that the majority of new destinations never reach the mass phase, and if the cost does not rapidly decrease, this may be the case for the space tourism industry as well. In the near future, space tourism is expected to become a multi-billion dollar business targeting engineers, scientists and entrepreneurs as well as the general public.

In 2004, newly established space tourism companies were given an extended learning period, which allowed them to develop their rockets and space vehicles without federal regulations in the USA. The Congress even hailed the passage of the Space Act preventing the Federal Aviation Administration from stunting the growth of the industry and paving the way for entrepreneurs and businesses (Davenport, 2015). In Europe, even fewer commercial space companies have been formed.

In June 2017, the Queen of England spoke about the development of spaceports in the UK. The ports could function as bases from which both the paying public could be launched into space and suborbital flights could be taken, reducing the flight time drastically between the cities of the world. The British government's commitment to becoming an attractive place for commercial space flights will eventually allow more space research to be accomplished (Rincon, 2017). The Arctic city of Kiruna in Sweden already offers a spectrum of space-related operations and competences, providing an existing hub for ground stations for launching satellites – and possibly also a base for European commercial space flight activities in the future (Spaceport Sweden, 2017).

The important question now is how this growing industry should be regulated. Could this be the start of something similar to the beginning of the aviation industry, making space travel possible even for the masses? So far it has been difficult to regulate something that has not yet been fully understood. However, according to the president of the Commercial Spaceflight Federation, Eric Stallmer (2015): “The future legislation should expand the American experiment and environment that led to only pioneer railroads, automobiles, and planes, but to turn these technological advancements into sustainable businesses” (Davenport, 2015).

## Sustainable space tourism?

According to Fawkes (2009), the idea of space tourism is opposed by a large part of the sustainable development industry, because the creation of a space tourism industry is working against current sustainable tourism trends, where sustainability actions provided by different industry operators and slow-travel movements have become trendier than ever. The risks of the space tourism industry must be mitigated from the start by introducing sustainability into operations and systems and making the case that space is a vital part of sustainability.

Tourism interacts and overlaps with a range of other policy areas such as transport, regional development and environmental management. According to Dredge (2015), the policies and actions aimed at implementing sustainable space tourism should therefore be situated within a

broader policy framework of which tourism is only one component. Regulations for the tourism industry are often a combination of many sources and an effective partnership and rapport between these governmental sources will impact on the future sustainable formation of space tourism (Mowforth & Munt, 2015). Sustainable tourism suffers from a theoretical fragility, not only calling into question its universal applicability, but also leading to a specific focus on tourism resource conservation and protection. However, Sharpley (2015) claims that sustainable tourism development has failed to fulfil expectations and even acted as a barrier to development as a result of its theoretical weakness.

According to Carter et al. (2015, p. 457), similarly to adventure tourism, “space tourism presents an important philosophical challenge that can be harnessed for sustainability, forcing participants to consider their place in the universe, relationship to other beings, and especially concepts on time”. The sustainability discourse itself includes assuming objectivity towards environmental issues and the intellectualisation of travel. Sustainable development for space tourism may at first appear to be an impossible task to accomplish due to the elements commonly associated with both tourism and space travel as trendy practices in tourism concentrate on keeping nature and destinations as untouched as possible (Mowforth & Munt, 2015).

Traditionally, tourism development and tourist activities have become sustainable when a business is not only concerned about its economic success, but also considers environmental and social aspects as part of its activities. In space tourism, there are social sustainability issues present; for example, the industry has targeted the wealthy elite, the cost of the trip acting as the discriminating factor. Also, from the planning point of view, the location of the launch sites has an impact on the locals.

Nowadays it is a major business risk not to include sustainability in the business model as it can cause market perception risk, regulatory risk and social pressure risk. According to Fawkes (2009), in space tourism, the forecasts for economic revenue are \$100 billion by the year 2030 and \$1 trillion by 2060. Therefore it would be a costly miscalculation not to include sustainable planning in different aspects of space tourism, as the industry is only beginning to form itself and establish the rules of action.

Space tourism will intrude into completely new space, possibly leaving orbital debris and permanent infrastructure behind. One rocket launch uses vast quantities of natural energy and the economic cost at the current pioneering stage is enormous for all the parties involved. According to Bradbury (2010), the particles of black soot emitted by spacecraft can impact on the surface temperature of the earth and the launch of a spacecraft may leave black carbon particles that will stay in the stratosphere for 10 years. Space is already colonised by satellites and other measuring equipment providing support for daily life on earth, hence there have been negotiations regarding co-operation in taking new satellites to space by using the vehicles designed for space tourism.

Virgin Galactic, Blue Origin and SpaceX are currently the pioneers and industry leaders in commercial space tourism. Elon Musk, who is the entrepreneur behind the Tesla electric vehicle, is responsible for SpaceX, and Richard Branson, who already owns the sustainably operating Virgin transportation chain, is responsible for Virgin Galactic (Human Spaceflight, 2017). There is a large chance that they will include similar sustainable and green attitudes in their

space company operations. For example, SpaceX has already achieved the world's first reflight of an orbital class rocket in March 2017, which represented a historic milestone in rapid rocket reusability (SpaceX Updates, 2017).

Blue Origin will operate using the launch pads at the Kennedy Space Center and Cape Canaveral, using the same physical space that was once exclusively the government's domain. Their rockets have been designed so that the booster stage, which is the most expensive part of the rocket, can be recovered and reused, instead of being dropped into the ocean (Blue Origin Technology, 2017). At the governmental level, the National Aeronautical Space Agency (NASA) has already adopted a more sustainable approach to space flights in the earth's orbit by developing mitigation standards aimed at reducing orbital debris (Sustainability 101, 2017).

## Tourism planning

Tourism planning is about predicting and requires some estimated perception of the future (Gunn, 1988). Gunn (1979) was one of the first to define tourism planning as a tool for destination area development. Getz (1986) classified it as predominantly a project based on solving a problem. According to Dredge and Jenkins (2011), planning and policy research has quite recently developed from the growing influence of critical research approaches and post-disciplinary perspectives focusing the attention on explaining tourism planning processes.

According to Hall (2007), there are five traditions in tourism planning: boosterism, an economic-industry-oriented approach, a physical/spatial approach, a community-oriented approach and a sustainable approach. The physical/spatial approach, where tourism acts as a division of space allocating specific activities to specific areas, and the sustainable approach, where the provision of long-lasting and secure livelihoods reduces resource depletion and environmental degradation, could in particular present suitable features for sustainable space tourism planning. This is because the sustainable approach offers tools for a sensible development of a new industry right from the beginning and the physical/spatial approach concentrates on the activities taking place in specific areas, such as building up a spaceport hub.

In the Western developed economies, the approaches to tourism planning and policy are linked to profound changes in ideological and socio-political landscapes. Governments offset their responsibilities through commercial agreements with external providers, such as corporates with financial power (Dredge & Jenkins, 2011). The discourse itself includes assuming objectivity towards environmental issues and the intellectualisation of travel.

The interdependence among humans through the protection of set values and the paradigm change in its relation to nature need to be taken into consideration (Helne & Silvasti, 2012). According to Salonen (2010), it is important to acknowledge the importance of natural politics and decision-making in evaluating their environmental, social and cultural impacts. The legislation and management plans for space tourism are just forming, thereby providing a perfect opportunity to plan the rules and practices to meet sustainable criteria.

There are existing development models for sustainable development and planning in tourism research literature. In Butler's (1980) Tourism Area Life Cycle model, the number of tourists can

be measured against the rejuvenation or decline of the destination. The steps include exploration, such as the discovery of the destination, moving on to involvement, development and consolidation of the destination. After the stagnation stage, the destination typically rejuvenates or declines.

In space tourism, the number of tourists, as measured in Butler's (1980) Tourism Area Life Cycle model, will not automatically reflect the success of "space" as there are certain limitations regarding reaching and living in the destination. Access to space can currently be accomplished by a space vessel designed for transporting a limited number of people. The success of the destination in this case is more bound to the favourable political and economic climate that enables investment in technological solutions, providing access to, and ensuring suitable living conditions in, space, than to the interest in the destination itself.

The involvement stage is bound up with the future global legislation set for space exploration. If the trends become in favour of privatising parts of space and letting private companies have access to areas previously considered a common treasury, such as building infrastructure on the surface of the moon, then the development stage of space tourism may increase rapidly. To enable the building of the infrastructure, suitable future technological discoveries are an obvious necessity, and environmentally friendly ways of operating should play an important part in this technological planning process. The current pioneering stage provides an opportunity to plan for, and focus on, controlled sustainable alternative tourism, which could at a later stage be expanded to the concept of sustainable mass space tourism.

The methods of access, cost, built infrastructure, technological solutions and safety factors all have their impact on the consolidation of space as a destination. If all the targets related to these factors are successfully met, space as a destination may even reach the stagnation stage, where the original facilities become old and run down, leading space as a destination either to rejuvenate or decline.

Saarinen (2014) questions the meaning of a decline or new cycle of rejuvenation in the development of a tourist destination, and whether it is just the result of internal practices or the outcomes of development actions. The attempt to follow the regional development discourses for space tourism creates an obvious challenge as space is a vast concept and not a traditional destination with characteristic landmark features to guide the implementation processes. However, learning from the examples of the successfully completed rejuvenation cycles in some environmentally fragile areas, such as Arctic towns, could lead to the creation of some tools that are needed for future scenario planning for the development of space tourism. Ma and Hassink (2013) similarly claim that new evolutionary perspectives on tourist destination development should focus on analysis of the changing characteristics of, and especially the underlying reasons for, destination development in a changing operational environment.

## Ways of operating for sustainable tourism planning

It is essential to establish some guidelines on how to operate in an environmentally friendly manner in order to preserve the long-term health of the environment and untouched areas. According to Becken (2015), environmental assessments should always be undertaken prior to

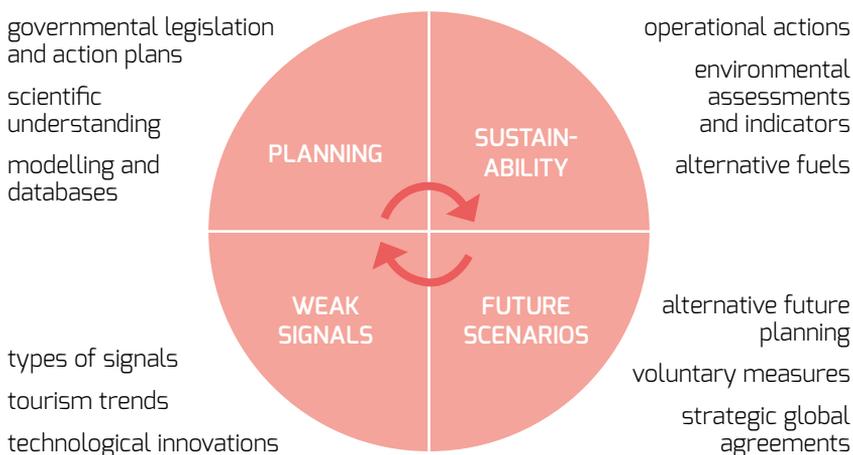
any development of tourism activities and projects. The resources of the area, including local people's considerations, should be highlighted in the framework of sustainable tourism planning to achieve satisfactory results in the development area. Absence of planning or short-term planning, which does not anticipate a sustainable future, could result in serious inefficiencies.

The knowledge gained from reflective practice and attention to ethics and values has stimulated critical theoretical developments in sustainable tourism planning. For example, the framework of Dredge and Jenkins (2007) for understanding tourism policy and planning presents a conceptual analysis of tourism planning and public policy. The framework treats the developing knowledge of tourism policy and planning as an iterative process and includes the institutional context, issues, drivers and influences, actors and agencies, and policy dialogues as essential elements in understanding policy making (Dredge & Jenkins, 2011).

Wilkinson (1997) proposed that strategic thinking should be incorporated into planning as a definition of continual processing of external and internal information and adjusting to changing situations. Sustainable planning is increasingly becoming a requirement in the tourism industry and importance is given to research designed to model a sustainable tourism future (Mojic & Susic, 2014). To enhance sustainable planning for future tourism, more research tools need to be created to assist in the future planning process. In the tourism industry, there are already existing environmentally sustainable schemes consisting of a wide range of measurements. The question is: how could these assist the future development of sustainable space tourism?

A Sustainable Future Planning Framework (Figure 1) could assist in foreseeing the likely implications of human actions and their impacts on future sustainability and in creating feasible possible futures. Similarly to other tourism planning models, it provides forward-looking planning and identifies the principal elements of sustainable development. The framework indicates that "sustainability, planning, weak signals and future scenarios" should act in synergy with each other and hence formulate the future aspects of space tourism.

**Figure 1.** Sustainable Future Planning Framework.



Tourism planning and policy practice can be organised into five traditions – normative, predictive, procedural, descriptive and evaluative – offering a mixture of knowledge, methods and analytical tools (Dredge & Jenkins, 2011, p. 14). The procedural tradition provides advice on how to plan and manage tourism, placing the Sustainable Future Planning Framework under this tradition, as it targets specific elements to act in synergy to achieve sustainable planning.

The Sustainable Future Planning Framework concentrates on the future sustainable planning of a futuristic subject, such as space tourism. In the framework, the “planning” involves governmental legislation and action plans, scientific understanding, as well as modelling and databases. Space tourism could be viewed as an objective or political consensus resulting from discussion among stakeholders (Rametsteiner, Pülzl, Alkan-Olsson, & Frederiksen, 2011). Tourism planning and policymaking are also a result of the ideas, actions and collaboration of diverse agencies and drawn from many disciplines including politics, economics and history (Dredge & Jenkins, 2011, p. 14).

Duval and Hall (2015) introduced a development and planning discourse for future space tourism and suggested that the critical questions in the policy implementation process should include: “Who will be in charge of enacting global policy and governance, the future agreements developed by the political and private sectors, and is there actually a mutual willingness to leave some parts of space as tourism locations completely untouched?” (Duval & Hall, 2015, p. 451).

Butler’s (1980) Tourism Area Life Cycle model of destination development elements can assist in the policy planning for space tourism as it clarifies the different stages of destination development, thereby acting as a guideline for the development process. Saarinen’s (2014) considerations on the impacts of larger global economic situations and political relations may also benefit the policy formulation; as the identity of a destination is a changing product of transformation, the postmodern values of tourists and the current sustainable goals of the tourism industry have an impact on the policy planning processes.

Space tourism and sustainable development research may seem incompatible, but they link in five different levels: operational, cultural, economic, resources and survival (Fawkes, 2009). As defined in the Evolutional Tourism Planning Theory’s disciplines, such as “caution and knowledge”, they can provide perspectives for the planning and development process of the space tourism sector (Sharpley, 2015).

“Sustainability” in the Sustainable Future Planning Framework involves operational actions, environmental assessments and indicators as well as alternative fuels. There are already existing sustainable operation examples available within the tourism industry as it is nowadays a major business risk not to include sustainability in the business model. For example, the aviation industry practises sustainable planning by concentrating the focus on a more energy-efficient fleet and voluntary carbon offsets paid both by the industry and the customer (Broderick, 2009). Many space tourism operators also recognise a travel career ladder, known as “Steps to Space”, whereby lower-order activities may develop a travel interest that may be capitalised on in future behaviour towards costlier forms of space tourism.

According to Weaver (2005), indicator-based sustainable tourism strategies are complicated due to the actual process of selecting, measuring, monitoring and evaluating a set of relevant

indicators. Future tourism, including space tourism, will contribute even more emissions and therefore there are indicator-based international agreements, such as the Kyoto Agreement (2013) and Paris Agreement (2015) on climate change, aimed at strong governmental actions to reduce these global emissions.

According to Carter et al. (2015, p. 457), there is ongoing research on alternative fuels, such as rubber-base propellants, in the space tourism industry that may lower the impact of the emissions. Becken (2015, p. 164) suggests that there is a strong need for purposeful integration with the disciplines of transportation research and engineering to develop more renewable energy technologies and fossil-fuel-free efficient transport systems. The focus should be on sustainable science and this is to be achieved by understanding the sociology and psychology of the new types of tourism behaviour. Future spaceship models could, for example, operate by using renewable fuels or solar power.

“Weak signals” in the Sustainable Future Planning Framework include the types of signals, tourism trends and technological innovations. In generative dialogue about the future, as well as adaptive planning, the continuous transformation is not focused on what already exists, but on what is emerging. According to Smyre and Richardson (2015), weak signals are emerging ideas, intentions, discoveries and innovations that are not yet trends, but have the potential to impact on local areas within three to five years. They have certain characteristics such as surprise, visionary discoveries and acceptance of the trend through learning and developing (Coffman, 1997).

Uskali’s (2005) theory of weak signals distinguished four types of weak signals, including “feeling, uncertain, almost certain and exact” signals. Recently in space tourism there have been some technical development problems in the implementation process, but those have been solved as they have appeared. As the infrastructure for space tourism has now been created, the industry has passed “the feeling and uncertain” stages and is heading towards “the almost certain” one as most of the infrastructure needed is now available for passenger usage. Weak signals therefore suggest that sustainable research and indicator forming to assist the policymaking process urgently need to take place to ensure a sustainably sensible beginning for this new tourism sector.

The space tourism industry has been developed as a reflection of current adventure tourism trends. Even though the idea of the creation of space tourism is working against the current sustainable trends, the implementation of the industry could be even more towards the transmodern eco-luxury. There are already actions practised by other tourism sectors, such as aviation, to make even a small step of the process more sustainable and environmentally friendly.

Space tourism is in the wave of current trends in technology among electric cars and innovative start-ups. The space race decades ago had already let the public benefit from different technological innovations developed for both the astronauts and the inhabitable space stations. Future space vessels may provide sessions enabling more comprehensive research to inform the design of experiments regarding the longer-term physiological changes due to space flight. These discoveries could eventually help the human species to colonise the Moon or Mars (Caplan, Winnard, & Lindsay, 2017). SpaceX has already started to develop a habitable Dragon capsule to take tourists around the Moon.

In the Sustainable Future Planning Framework, “future scenarios” involve alternative future planning, voluntary measures and strategic global agreements. According to Kahn (1965), future scenario planning is a strategic planning method that can be used to make flexible long-term plans. Pauwels and Berger (1964) defined contractual futures of impossible possibilities to be part of the planning scenarios as there could be four generic alternative futures leading to continued growth, collapse, society discipline or transformative scenarios. The future scenarios could, for example, involve sustaining values to avoid a collapse and planning for radical options, such as the development of space colonies.

In the space tourism sector, there are already some voluntary measures being taken, for example, to ensure operational-level security, as well as global agreements, such as the Paris Agreement (2016) on climate change, to be followed. However, there needs to be a further legal framework to decide on the most prominent issues, such as the definition of outer space and the demarcation of a boundary between outer space and airspace, which is currently governed by different legal regimes, but not commonly agreed upon. Space tourism will be a private sector participator in the space environment besides the previously exclusive national and military usage, causing many legal issues to be resolved quickly or alternatively voluntarily pursued. These issues include, for example, voluntary guidelines for space debris, equitable access and the use of the Geostationary Orbit commonly used by communication satellites, a mechanism for settlements of disputes and a regulated flow of technologies (Sharma, 2011).

The Sustainable Future Planning Framework will be subjected to empirical research by the author within the next few years. In a hermeneutically oriented mixed-methods research design, both qualitative and quantitative data on space tourism will be gathered and analysed. In order to provide in-depth understanding of this new phenomenon and to strengthen the theoretical framework, five space tourism professionals will be interviewed. To engage space tourism professionals in the discussion on sustainable space tourism development, a Delphi technique panel questionnaire will be completed with approximately 20 participants. Finally, a detailed quantitative questionnaire will be targeted at a wider audience of approximately a thousand people to gather data on the public opinion of space tourism. The findings will assist in formulating in-depth knowledge of this new tourism industry sector and introduce new perspectives on achieving a sustainable future in space tourism.

## Conclusion

This article has explored sustainable ways of operating in relation to space tourism. The focus was on environmental sustainability, however the aspects of economic and social sustainability were also given some consideration. Forecasting the future is always uncertain, but with an active attitude the future development of this new adventure tourism sector can have a purpose-built focus. The attitude can be critical, but also adaptive by developing different scenarios and taking actions in relation to predicted consumer megatrends. As a new phenomenon often starts with almost science fiction-style idea creation followed by elite awareness, the mass will eventually follow.

For decades, aviation has been the main pollutant of the tourism industry by causing various environmental impacts, such as CO<sub>2</sub> emissions. The space tourism industry will increase these levels drastically if the current energy sources remain the same. Currently, to reach earth orbit, a rocket must accelerate over 20 times faster than the cruising speed of a passenger jet using energy that rockets carry in the form of propellants. The sustainable actions accomplished with other substances will simply not be enough to justify the emissions caused by space vessel launches.

There is ongoing research on alternative fuels that would have an enormous impact on the amount of emissions created by space tourism. By finding the most energy-efficient and recyclable way of operating, space tourism companies can eventually start to introduce this new way of travelling to the mass tourism market. Meanwhile the sustainable planning in space tourism should concentrate on a “cradle to grave” life design, planning the ground-based facilities with a sustainable approach and operating all functions as efficiently, in terms of energy and resources, as possible.

As tourism was originally seen to coexist with its environment, the research models concentrating on new resources and survival planning are able to open up new environment-based discussions in the space tourism discourse. Similarly to Butler’s (1980) Tourism Area Life Cycle model, the Sustainable Future Planning Framework, introduced in this article, can be used to assist the process of future destination development. The framework acts within the procedural tourism planning tradition of targeting “sustainability, planning, weak signals and future scenarios” to act in synergy to achieve sustainable future planning.

In the Sustainable Future Planning Framework, “planning” involves governmental legislation and action plans, scientific understanding as well as modelling and databases. “Sustainability” involves operational actions, environmental assessments and indicators as well as alternative fuels. “Weak signals” include the types of signals, tourism trends and technological innovations, and “future scenarios” involve alternative future planning, voluntary measures and strategic global agreements.

For example, weak signals emerge from the postmodern lifestyle behavioural trends or from the new technological discoveries and inform processes to adapt a different future. The infrastructure needed for the start of the commercial space tourism industry is in an ongoing development stage and at this stage it is still possible to influence the sustainable values and actions to be included at all operational levels. Over the next few years, there will be more mixed-methods research to come with a view to introducing new perspectives to achieve sustainability in space tourism and to update the elements possibly lacking from the Sustainable Future Planning Framework.

Sustainable planning for space tourism is challenging as it currently has an image as an adventure tourism activity for a small number of super-rich people, whose motivations for space travel may be far from environmentally conscious actions. There is therefore a need for critical thinking about whether space tourism will ever have the potential to become sustainable despite the possible efforts made. Would future space tourists, for example, be willing to pay more for their ticket if space tourism companies offered environmentally friendly options to support their long-term sustainable ways of operating?

Future thinking, project management skills and dealing with complexity and uncertainty are some of the major competencies required for governing sustainability. Controlled tourism development requires special organisational structures and regulations, and governance, cultures and resources influence the decisions made regarding the space tourism sector at both local and global levels.

Webber (2013) claims that space tourism represents an idealised experiment for international and domestic policy implementation, as it reflects an opportunity, to discover whether the private and public valuation of an environment can coexist and simultaneously generate some profits, such as measuring externalities, from the development of a fragile environment from the early state. To enhance sustainable planning and development, the space tourism industry should adopt a long-term perspective for short-term actions, and simultaneously consider different policy domains at multiple levels and embrace pragmatism as well as critical thinking.

## References

- Becken, S. (2015). *Tourism and oil: Preparing for the challenge*. Bristol: Channel View.
- Beedie, P. & Hudson, S. (2003). Emergence of mountain-based adventure tourism. *Annals of Tourism Research*, 30, 625–643. [https://doi.org/10.1016/S0160-7383\(03\)00043-4](https://doi.org/10.1016/S0160-7383(03)00043-4)
- Bell, W. (1997). *Foundations of futures studies: Human science for a new era. Vol. 1, History, purposes and knowledge*. New Brunswick: Transaction Publishers.
- Blue Origin Technology (2017). Inspired by the potential of space and the incredible human feats that technology enables. Retrieved from <http://www.blueorigin.com/technology>
- Bradbury, D. (2010). Space tourism – A final frontier worth exploring? *The Guardian. GSB Editorial Network*. 23.11.2010.
- Broderick, J. (2009). Voluntary carbon offsets: A contribution to sustainable tourism? In S. Gössling, C. M. Hall, & D. Weaver (Eds.), *Sustainable tourism futures: Perspectives on systems, restructuring and innovations* (pp. 169–199). New York: Routledge.
- Butler, R.W. (1980). The concept of a tourist area cycle of evolution: Implications for management of resources. *Canadian Geographer/Le Géographe Canadien*, 24, 5–12.
- Caplan, N., Winnard, A., & Lindsay, K. (2017). Here's what space tourism could do for science and health research. *The Conversation*. 22.6.2017.
- Carter, C., Garrod, B., & Low., T. (Eds.) (2015). *The encyclopedia of sustainable tourism*. CAB International.
- Coffman, B. S. (1997). Weak signal research, Part III: Sampling, uncertainty and phase shifts in weak signal evolution. *Journal of Transition Management*.
- Davenport, C. (2015). Space tourism is closer to taking off, but how should it be regulated? *Los Angeles Times. Business/Technology*. 24.11.2015.

- Dredge, D. (2015) Tourism and governance. In G. Moscardo & P. Benckendorff (Eds.), *Education for sustainability in tourism: A handbook for processes, resources and strategies* (pp. 75–90). New York: Springer Heidelberg.
- Dredge, D. & Jenkins, J. (2007). *Tourism policy and planning*. Brisbane: Wiley.
- Dredge, D. & Jenkins, J. (2011). *Stories of practice: Tourism planning and policy*. Surrey: Ashgate.
- Duval, T. & Hall, C. M. (2015). Sustainable space tourism: New destinations, new challenges. In C. M. Hall & S. Gössling (Eds.), *Routledge handbook of tourism and sustainability* (pp. 450–460). New York: Routledge.
- Fawkes, S. (2009). *Space tourism and sustainable development*. BIS European Developments in Space Tourism Conference. 29.11.2006.
- Getz, D. (1986). Models in tourism planning: Towards integration of theory and practice. *Tourism Management*, 7, 21–32. [https://doi.org/10.1016/0261-5177\(86\)90054-3](https://doi.org/10.1016/0261-5177(86)90054-3)
- Google Lunar X Prize (2017). Retrieved from <https://lunar.xprize.org/news>
- Gunn, C. A. (1979). Resources management for visitors. *Fish and Wildlife News*, 20 (Oct–Nov).
- Gunn, C. A. (1988). *Tourism planning* (2nd ed.). New York: Taylor & Francis.
- Hall, C. M. (2007). *Introduction to tourism in Australia* (5th ed.). Pearson: South Melbourne.
- Harvey, D. (1989). *The urban experience*. Baltimore: The John Hopkins University Press.
- Helne, T. & Silvasti, T. (Eds.) (2012). *Yhteyksien kirja: Etappeja ekososiaalisen hyvinvoinnin polulla*. Tampere: Kelan tutkimusosasto.
- Human Spaceflight (2017). Retrieved from <http://www.virgingalactic.com/human-spaceflight>
- Kahn, H. (1965). *Thinking about the unthinkable*. New York: Horizon Press.
- Ma, M. & Hassink, R. (2013). An evolutionary perspective on tourism area development. *Annals of Tourism Research*, 41, 89–109. <https://doi.org/10.1016/j.annals.2012.12.004>
- Mojic, J. & Susic, V. (2014). Planning models of sustainable tourism development destination. International Scientific Conference. The Financial and Real Economy: Towards Sustainable Growth. Faculty of Economics, University of Nis, 17.10.2014.
- Mowforth, M. & Munt, I. (1998). *Tourism and sustainability: New tourism in the Third World*. London: Routledge.
- Mowforth, M., & Munt, I. (2015). *Tourism and sustainability: Development, globalisation and new tourism in the Third World* (4th ed.). Abingdon: Routledge.
- Pauwels, L. & Berger, J. (1964). *The morning of the magicians*. New York: Harper Torchbooks.
- Rametsteiner, E., Pülzl, H., Alkan-Olsson, J., & Frederiksen, P. (2011). Sustainability indicator development – Science or political negotiation? *Ecological Indicators*, 11, 61–70. <https://doi.org/10.1016/j.ecolind.2009.06.009>
- Rincon, P. (2017). Queen's Speech: Plan Aims to Secure Space Sector. Retrieved from <http://www.bbc.com/news/science-environment-40354695>

- Saarinen, J. (2014). Transforming destinations: A discursive approach to tourist destinations and development. In A. Viken & B. Granås, (Eds.), *Tourism destination development: Turns and tactics* (pp. 47–62) Surrey: Ashgate.
- Salonen, A. (2010). *Kestävä kehitys globaalien ajan yhteiskunnan haasteena*. The University of Helsinki Research Centre.
- Sharma, G. D. (2011). *Space security: Indian perspective*. New Delhi: Vij Books.
- Sharpley, R. (2015). Sustainability: A barrier to tourism development? In R. Sharpley & D. J. Telfer (Eds.), *Tourism and development: Concepts and issues* (2nd ed.) (pp. 428–452). Bristol: Channel View.
- Smyre, R. & Richardson, N. (2015). *Preparing for a world that does not exist – yet: Framing a second enlightenment to create communities of the future*. UK: John Hunt Publishing.
- Spacesport Sweden – Your Next Adventure (2017). Retrieved from <http://www.spaceportsweden.com/mission/>
- SpaceX Updates: Reusability: The key to making human life multi-planetary (2017). Retrieved from <http://www.spacex.com/news/2013/03/31/reusability-key-making-human-life-multi-planetary>
- Sustainability 101 (2017). Retrieved from <https://www.nasa.gov/agency/sustainability/index.html>
- Uskali, T. (2005). Paying attention to weak signals – The key concept for innovation journalism. *Innovation Journalism*, 2(11), 3–17.
- Weaver, D. B. (2005). *Sustainable tourism: Theory and practise*. Oxford: Elsevier.
- Webber, D. (2013). Space tourism: Its history, future and importance. *Acta Astronautica*, 92, 138–143. <https://doi.org/10.1016/j.actaastro.2012.04.038>
- Wilkinson, P. F. (1997). *Tourism policy and planning: Case studies from the Commonwealth*. New York: Cognizant Communication.