



## Space Sustainability Through Design Thinking: A Strategic Approach to Developing a Commercially Viable Solution for a Sustainable Space Environment

NICO MÜLLER, VIVEK SELVARAJU, SARAH HERRMANN, SHANKHO BORON GHOSH

### About Us

PeriSpace is a student-driven aspiring startup participating in the Green Space Challenge, hosted by the ESA Business Incubation Center Reutlingen. Our mission is to make sustainability the standard in space, ensuring that future generations can benefit from the advancements in the space industry. We truly believe that sustainability is not at odds with growth, but rather a driver for innovation in space exploration.

### Introduction

As the space industry shifts its focus toward sustainability and a circular space economy, addressing the challenges of responsible space exploration has become more urgent than ever. However, despite the growing awareness, there is a significant gap in commercially viable solutions that can effectively tackle these issues. Therefore, we utilized the design thinking methodology, which allowed us to not only identify the critical challenges and pain points of the space industry related to space sustainability but also discover opportunities for developing a viable business model that addresses the rising concerns of space debris.

### Problem Definition (Empathize & Define)

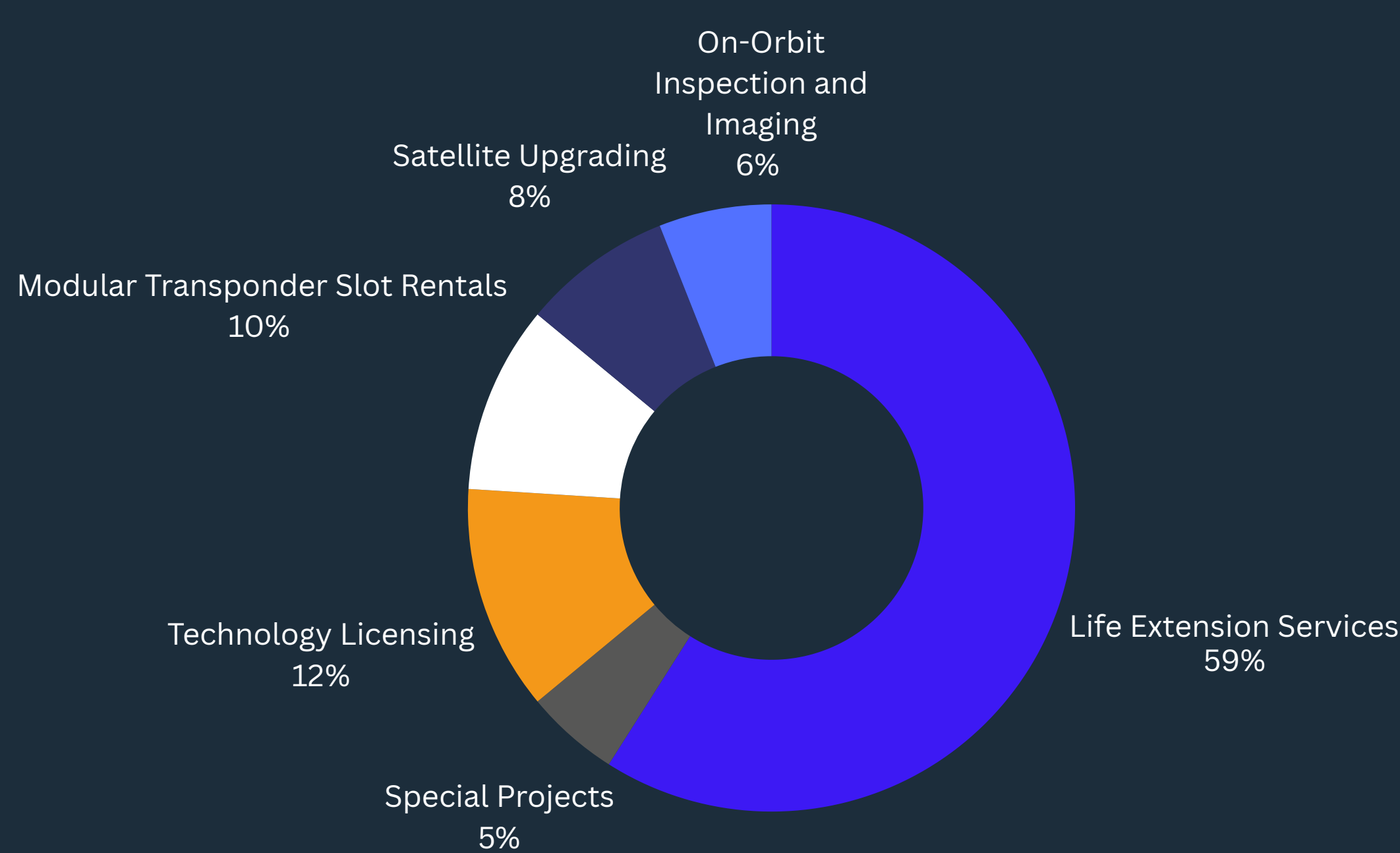
We engaged with industry experts across various space sectors, including engineering, insurance, space law, and government agencies, to gain valuable insights and better understand space sustainability. Through this process, we identified a fundamental problem: the **lack of effective solutions to reduce space debris generation by maximizing satellite utilization**. As satellites are often decommissioned prematurely, they pose an increasing risk to space infrastructure, and addressing these concerns is crucial for ensuring the long-term sustainability of space exploration.

### Solution (Ideate & Prototype)

Building on our problem definition, we identified in-orbit servicing, more specifically **life extension services**, as a key solution. Life extension services focus on prolonging the operational lifespan of satellites by performing station-keeping & relocation, thereby minimizing the need for premature decommissioning and reducing the generation of space debris. These services **offer a strong business case** by creating significant value for satellite operators through cost-effective asset utilization, making it a commercially viable solution that simultaneously addresses the growing space debris problem. In the long term, we also plan to expand our portfolio to other in-orbit services, such as maintenance, refueling, and upgrading.

### Potential Revenue Streams

Total annual revenue potential: 202 million €



Cost reduction through diversified sources of revenue

### Value Proposition

#### Cost Savings:

- Life extension services cost approximately \$70M–70% less than developing a replacement satellite.

#### Increased Revenue:

- By extending a satellite's lifespan, operators can secure up to \$214M in additional revenue over 5 years, translating into significant financial returns.

#### Maximized ROI:

- Operators can maximize the return on their existing satellite investments while focusing on launching next-generation satellites instead of expensive replacements.

#### Sustainability Focus:

- Unlike competitors' single-use models, our solution prioritizes reusability and sustainability, driving long-term cost reductions.

#### Operational Continuity & Reliability:

- Operators ensure uninterrupted service, maintaining customer satisfaction and avoiding costly downtime. This improves service reliability and brand reputation.

### Competitive Advantages

#### Pioneering Sustainable Satellite Servicing:

- Our reusable space servicing vehicles can service multiple satellites.
- This reusability enhances mission efficiency and reduces the environmental footprint, contributing to a sustainable space economy.

#### Maximizing Utilization to Lower Costs:

- Our vehicle architecture is designed for maximum operational use, offering additional services like in-situ inspection and relocation.
- This drives down service costs, allowing us to offer more affordable services compared to current market prices (\$70M–\$100M).

#### Targeting Untapped Markets:

- Focus on underserved European and Asian satellite operators.
- Represent a large portion of GEO satellites.

#### Driving Innovation in Europe:

- Europe lags behind the U.S. and China in the field of in-orbit servicing technology.
- We aim to boost Europe's space capabilities and technological sovereignty and reduce dependency on non-European solutions.

### Mission Architecture

The mission architecture is split into two components that ensure maximum cost efficiency and scalability. These components are:

#### Mothership:

- Centralizes complex operations to support multiple servicers.
- Manages sophisticated tasks such as RPOD (rendezvous, proximity operations, and docking), refueling, and orbital transfer.

#### Servicer:

- Focuses on primary tasks: station-keeping & relocation.
- Remains simplistic and efficient by offloading complex responsibilities to the mothership.

### Conclusion

After extensive research using the Design Thinking Methodology, we have learned that satellite life extension services not only solve a critical technical problem but also present a strong business case and a clear value chain for satellite operators, aligning environmental goals with the economic incentives of the space industry. We believe founding a space startup focused on life extension services—and broader in-orbit servicing—is crucial for driving both technological accessibility and innovation in the space sustainability industry. By democratizing the technology and making it more affordable, we aim to lower the entry barrier for all satellite operators, thus making space operations more sustainable and cost-effective. Furthermore, by accelerating the development of in-orbit servicing technology in Europe, we can enhance Europe's position as a global leader in space innovation, fostering new collaborations, boosting economic growth, and advancing human space exploration on a broader scale.

## Concept of Operations

