ASTROPRENEURS

The Galactic Guide to Space Entrepreneurship

EXECUTIVE SUMMARY

Team Work Makes the Dream Work

Acknowledgments

The Astropreneurs are an international, interdisciplinary, and intercultural team of space enthusiasts, participating in the International Space University Space Studies Program 2017 (ISU SSP17) at the Cork Institute of Technology (CIT) in Cork, Ireland. Together, we have created *The Galactic Guide to Space Entrepreneurship* for our team project.

ISU and the Astropreneurs Team Project wish to express their sincere appreciation to **Lockheed Martin** Corporation for its sponsorship of this project.

The Astropreneurs would like to extend their heartfelt thanks to ISU, CIT, and their staff who have worked tirelessly to guide and encourage us. We would especially like to thank our co-chairs **Gary Martin** and **Norah Patten**, who helped us through many challenges and kept us focused and working together as a team. Our teaching assistant, **Jacopo Panerati**, was always there for us and helped us reach our goals. Thank you to our staff editors, **Ryan Clement** and **Laura Rose**, for their incredible support and contributions throughout the development of our final report and executive summary. We would also like to express gratitude to the design team, **Wendy Mensink** and **Andrée-Anne Parent**, for collaborating with us on this project.

We also thank the following visiting lecturers who gave us precious insights into the space startup environment:

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Mission Statement

The Astropreneurs will provide the aspiring space entrepreneur with comprehensive tools, guidelines, and best practices that will promote sustainable success and mitigate unnecessary risk, while creating a community driven and enduring resource.

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Pack Your Bags

Introduction

The space sector is growing and changing, allowing startups to disrupt the industry and fill market niches by providing more affordable and higher quality services. A prospering market has been created for startups by removing technical and financial barriers to entry, encouraging private investment and governmental support.

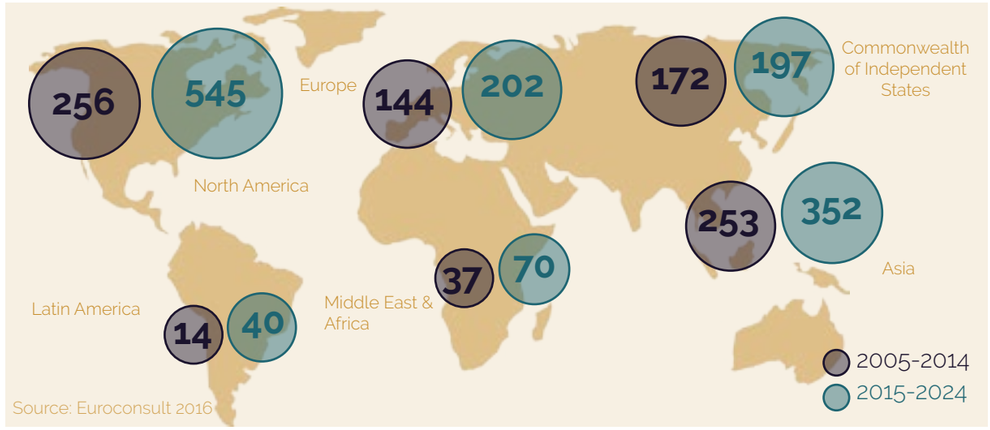
The Galactic Guide to Space Entrepreneurship takes the reader on the journey through starting a company in the space sector. It includes resources, guidelines, and best practices for the aspiring space entrepreneur. The handbook and the web tool were created to offer an overview of the critical topics and elements for a successful space startup. They will not only provide a global perspective on terrestrial, suborbital, orbital, and deep space enterprises, but will also provide comprehensive inputs and recommendations for understanding market opportunities, business essentials, fundraising, laws and regulations, and programs within the space sector.

> *"Not surprisingly, many space startups tend to have intriguing ideas and excellent engineering acumen, but can miss the mark when it comes to defining markets and other business fundamentals."*
> *- Robert Jacobson, Space Entrepreneurship Advisor, SSP16*

Panorama of Opportunities

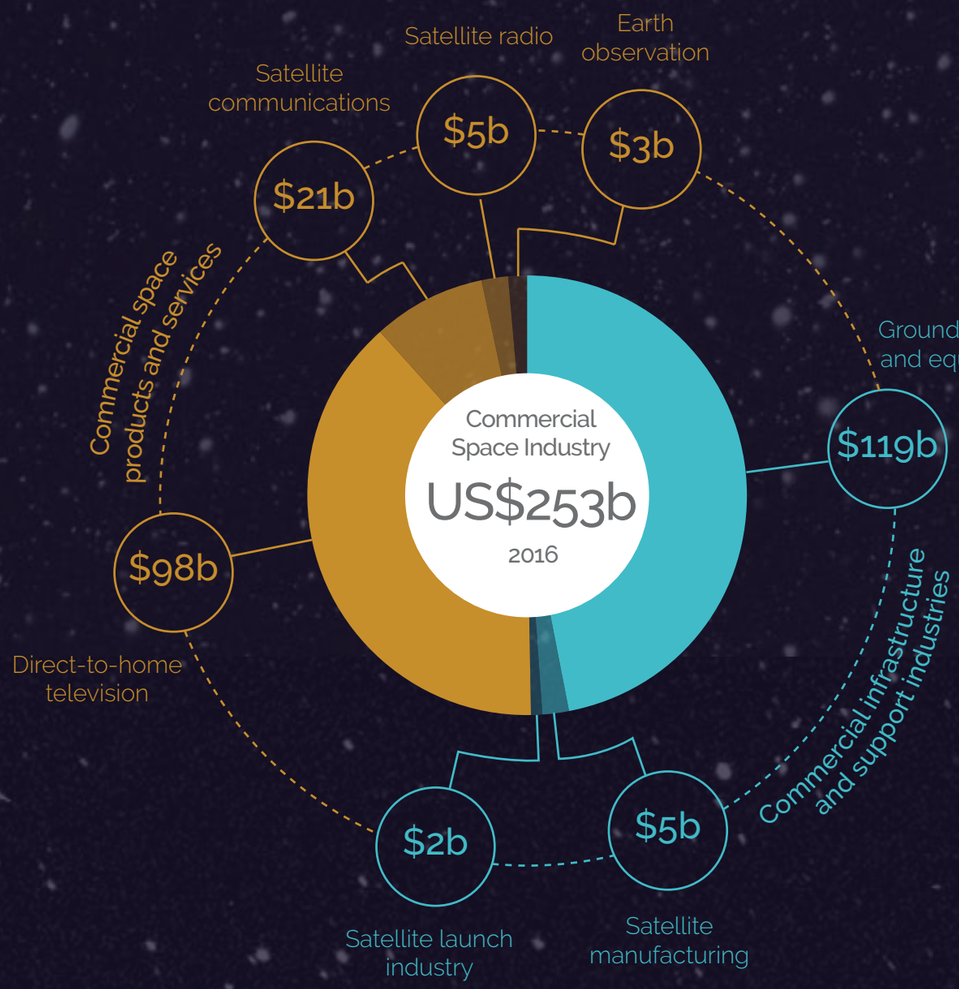
Market Research, Landscape, and Space Segment Applications

The commercial space economy has been growing in the last several years with opportunities emerging as advanced technologies appear and evolve. This section looks at the different segments of the space market with an overview of satellite launches.



Estimated number of satellite launches over 50 kg excluding two mega constellations (OneWeb and Steam, Euroconsult, 2016).

Panorama of Opportunities



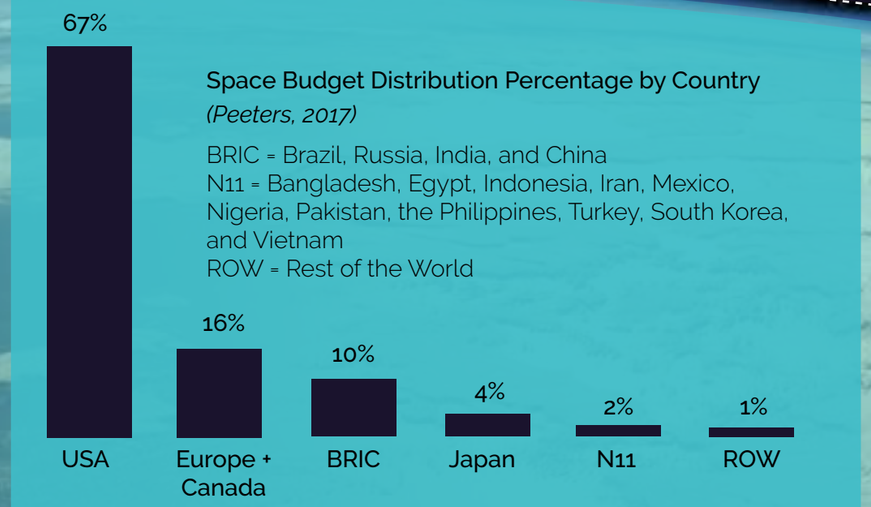
Our four segments of the space industry are terrestrial, suborbital, orbital, and deep space. The terrestrial segment aligns with both the upstream and downstream sectors including data services, navigation, communications, ground stations, and other facilities necessary to support space missions. Flights that reach the boundary of space and return directly to Earth are suborbital. Orbital space missions exceed the boundary and stay in orbit. Deep space comprises any opportunities beyond geostationary orbit such as those involving the Moon, asteroids, and potential space mining and manufacturing.

Deep space

Orbital

Suborbital

Terrestrial



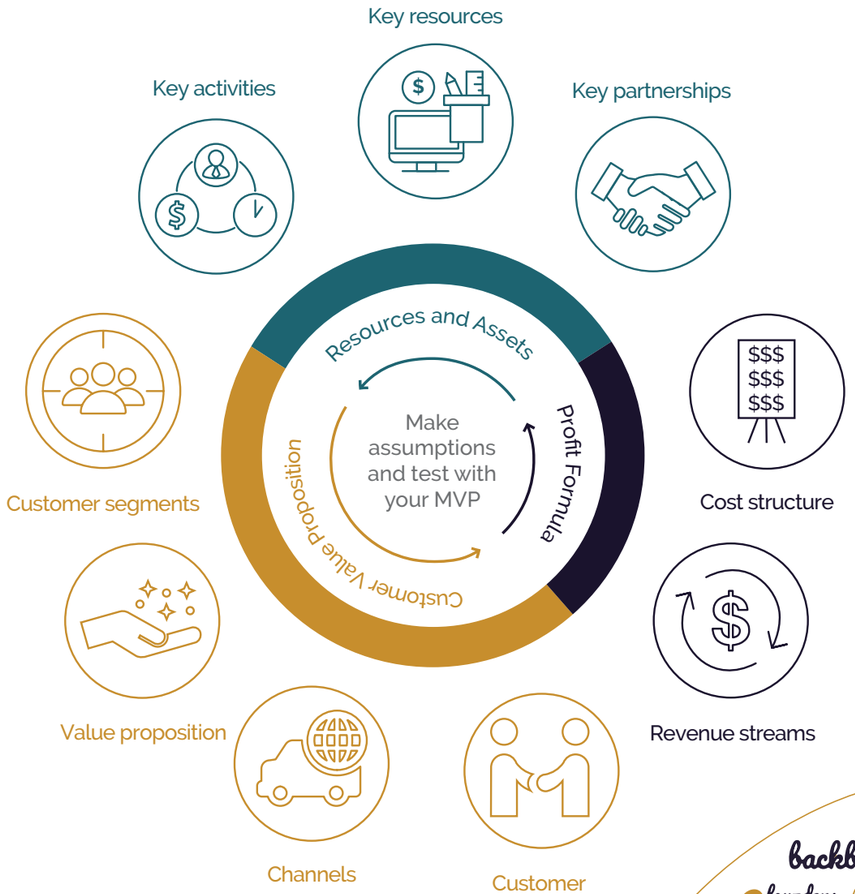
Space Budget Distribution Percentage by Country
(Peeters, 2017)

BRIC = Brazil, Russia, India, and China
N11 = Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, the Philippines, Turkey, South Korea, and Vietnam
ROW = Rest of the World

Mind Your Business

Business Model Canvas (BMC)

BMC is a tool that companies use to identify how they are providing value to customers, how their internal activities contribute to value creation, and how they can profit from it. It has nine components, which are part of three key drivers: customer value propositions, resources and assests, and profit formula.

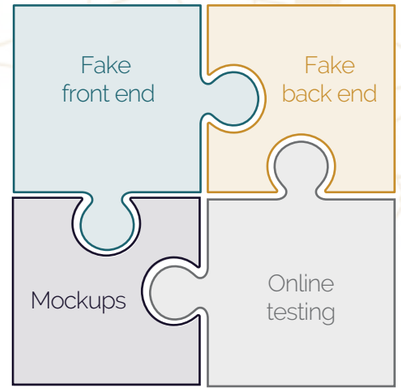


Business Plan

This plan is a written document which guides the space startup towards a desired business model. It forms the backbone of the company strategy and provides information on the team, the opportunity, the market context, the risks, and the expected rewards.

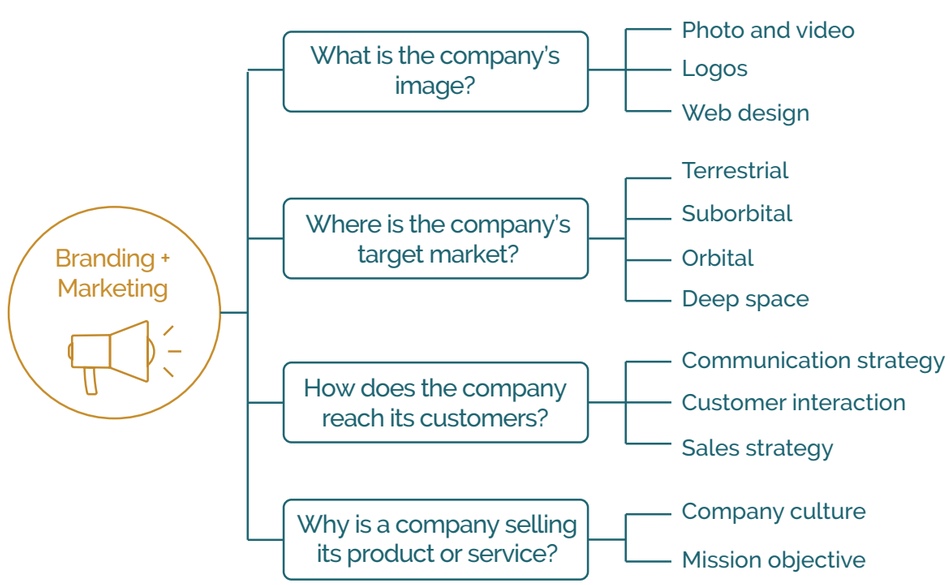
Minimum Viable Product (MVP)

The MVP is a strategy used for testing and iterating a value proposition, product, service, or feature. It tests key assumptions underlying the business model as quickly and affordably as possible. An MVP is not always a smaller or cheaper version of the final product or service. It can also be a creative solution with few of the final essential features. Based on the application, there are different types of MVP, including the examples seen to the right.



Branding and Marketing

Branding and marketing are key elements a space startup must consider when creating its own image and promoting its products or services to the space industry. Intended clients could include the general public, other businesses, or government entities. Effective branding and marketing connect everything from logos, web design, and company culture, to market research approaches, product pricing, and communication strategies. Creating an effective company language is critical when attempting to link a product or service with a legitimate market in the space industry.



Money Matters

Fundraising and Funding Sources

Angels and FFF

FFF = Family, friends, and founders
Angels = High net-worth individuals who provide capital for early stage startups

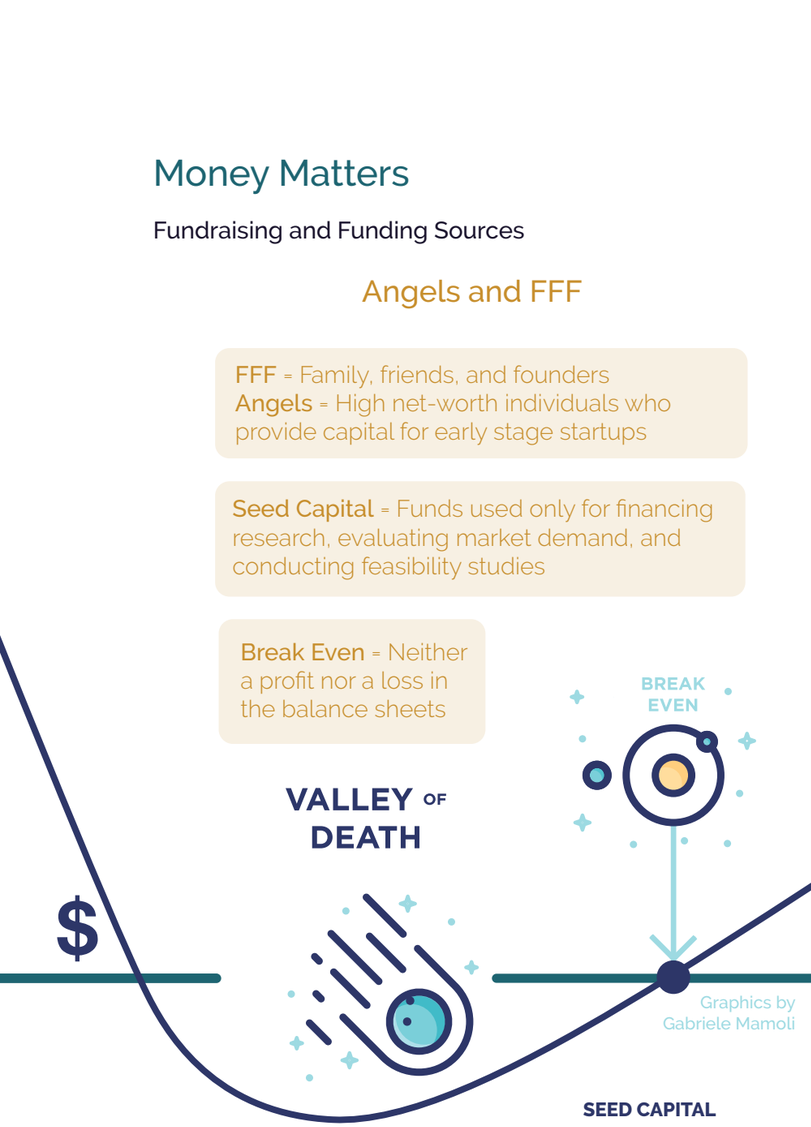
Seed Capital = Funds used only for financing research, evaluating market demand, and conducting feasibility studies

Break Even = Neither a profit nor a loss in the balance sheets

VC = Venture capitalists
Round A/B/C = subsequent rounds of VC growth funding
Mezzanine = round designed to help the company pay off its VC investors and prepare for an IPO, or an acquisition of or merger with another company

VC Aquisitions and Strategic Alliances

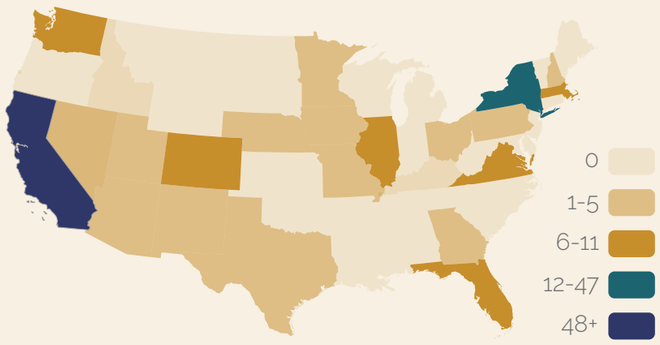
IPO = initial public offering - The first listing of a company on a public stock exchange
Exit = The selling of a founder's or investor's stake in a company



Graphics by Gabriele Mamoli

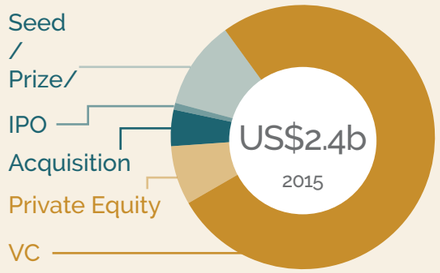
Investors in Space Startups Headquartered in the US

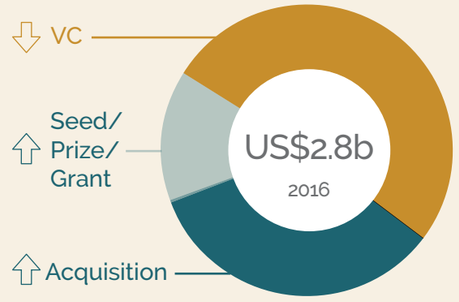
There are 439 recorded investors in space startup companies: the United States has 63% of them, mainly in California. The remaining 37% are based in 32 other countries (Bryce, 2017).



Space Startup Investment Sector

Startups investment grew about 1% in 2016 (Bryce, 2017).





We Have the Tools

[NASA Small Business Innovation Research Program]
Eligibility: US Located Small Business, >50% owned by a US Citizen or Permanent Resident
What: Funding for research, development, and demonstration of technology required by NASA with significant potential for commercialization
Value: Phase I: US$125k, Phase II: US$750k, Phase II-Expanded: US$2m
Other Info: Available once per year, Phase I for proof of concept, Phase II for initial prototyping

USA

Luxembourg

[ESA Business Incubation Center (BIC)]
Eligibility: Company, less than five years old, located near ESA BIC, primarily for space technology spin-offs for the non-space market
What: Access to ESA technical support, facilities, branding, and business support
Value: EU€50k (US$58k) to EU€500k (US$580k), depending on location
Other Info: There are 16 centers, programs vary, select location to match objectives
Link: www.esa.int/Our_Activities/Space_Engineering_Technology/Business_Incubation/ESA_Business_Incubation_Centres12

China

[Space Exploration Masters Competition]
Prize Name: Luxembourg Prize
Eligibility: Open to entrepreneurs who found a company in Luxembourg
Prizes: Prize 1: support for a Phase 0/Phase A study, Prize 2: crowdfunding campaign with SpaceStarters
Value: Prize 1: EU€400k (US$470k), Prize 2: EU€30k (US$35k), incubation in Luxembourg
Details: Submissions due 8 September 2017, Winners announced 16 & 17 November 2017
Link: www.space-exploration-masters.com

[National Science Foundation Grant]
Eligibility: Chinese citizens with advanced degrees and experience in science
What: Support for new and existing technical fields of study including space
Value: CN¥250k (US$37k) to CN¥1.7b (US$255m)
Other Info: Available once per year, research must conclude within two years
Link: www.nsfc.gov.cn/publish/portal1

Laws and Regulations

[USA:]
Regimes: Terrestrial, suborbital, orbital, deep space
Why incorporate here:
- Comprehensive national space regulation
- Space mining regulation
- Encouraging private investment in space
- Targeted R&D programs for key technologies
- Potential government contracts
- Scale up opportunities
- Loan guarantee and tax credits for buyers
- Direct subsidies

[Luxembourg:]
Regimes: Terrestrial, orbital, deep space
Why incorporate here:
- Proven expertise in the commercial satellite services industry
- High governmental interest and support
- Legal framework on the exploration and use of space resources
- Aspiring European center for the exploration and use of space resources
- ESA member state

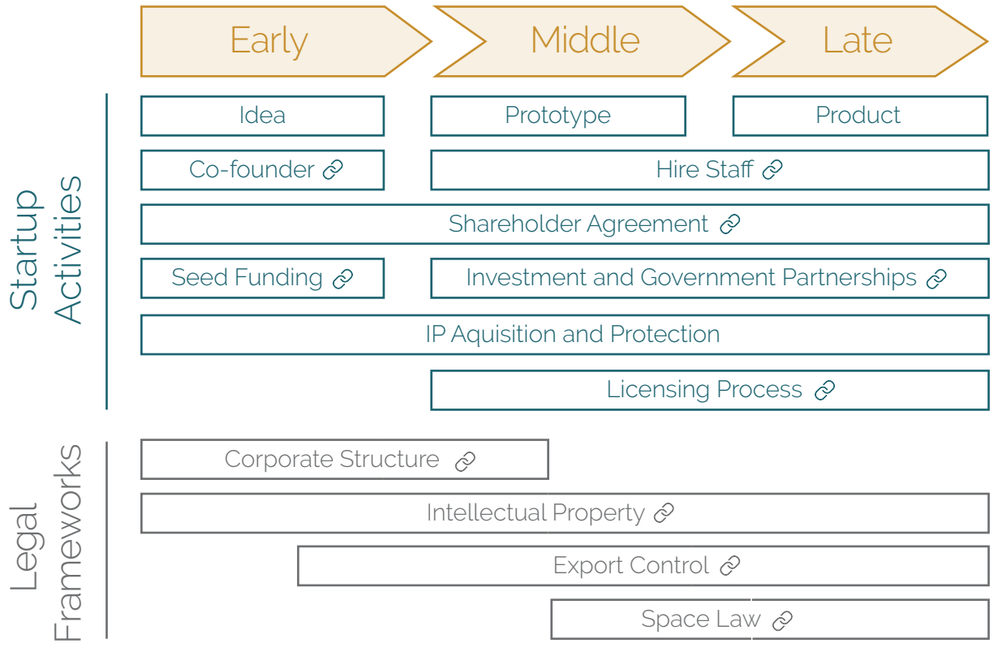
[Singapore:]
Regimes: Terrestrial, orbital
Why incorporate here:
- High level of STEM education
- Government support
- No dividend or capital gains taxes
- Strong trade and investment opportunities
- Competitive Asian country for startups
- Emerging space industry

[New Zealand:]
Regimes: Terrestrial, suborbital, orbital
Why incorporate here:
- Ease of incorporation
- Educated workforce
- No payroll, social security, or capital gains taxes
- Existing space agency
- Established regulatory space regime

Rules of the Game

Laws and Regulations

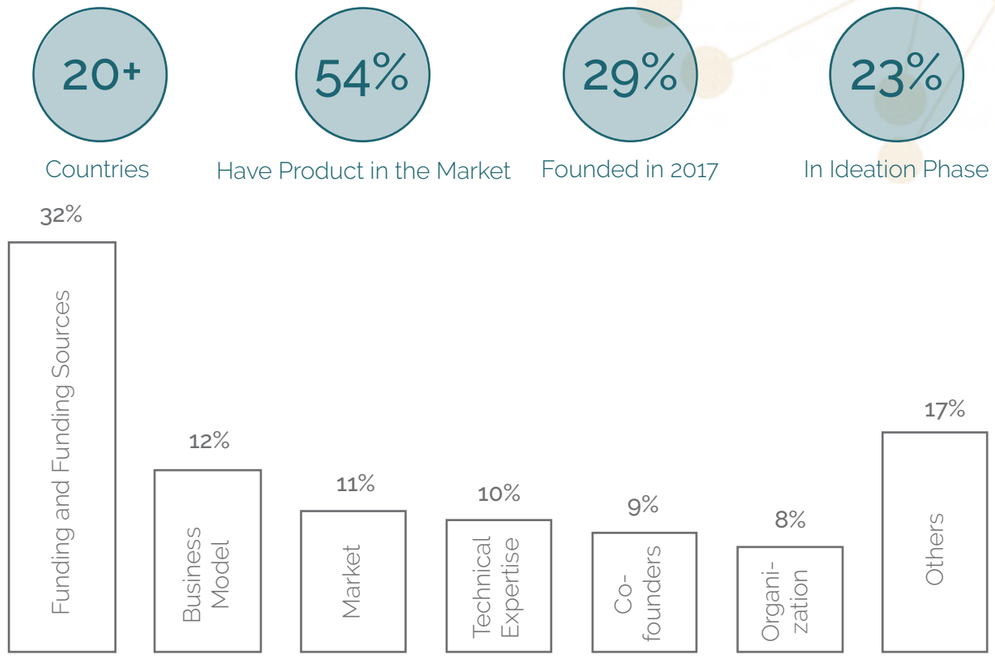
To help entrepreneurs get started, we created a guideline based on the early, middle, and late stages of a space company life cycle. This timeline provides an overview of the importance of various regulatory frameworks to each phase of development.



Moral of the Story

Lessons Learned

We sent out a survey to help focus our efforts on what would be most useful for space entrepreneurs. Of the respondents from over 20 countries, 54% already had products in the market, while 23% were still in the ideation phase, confirmed by 29% being founded in 2017. Respondents cited experience with major challenges by the percentages indicated in the bar graph.

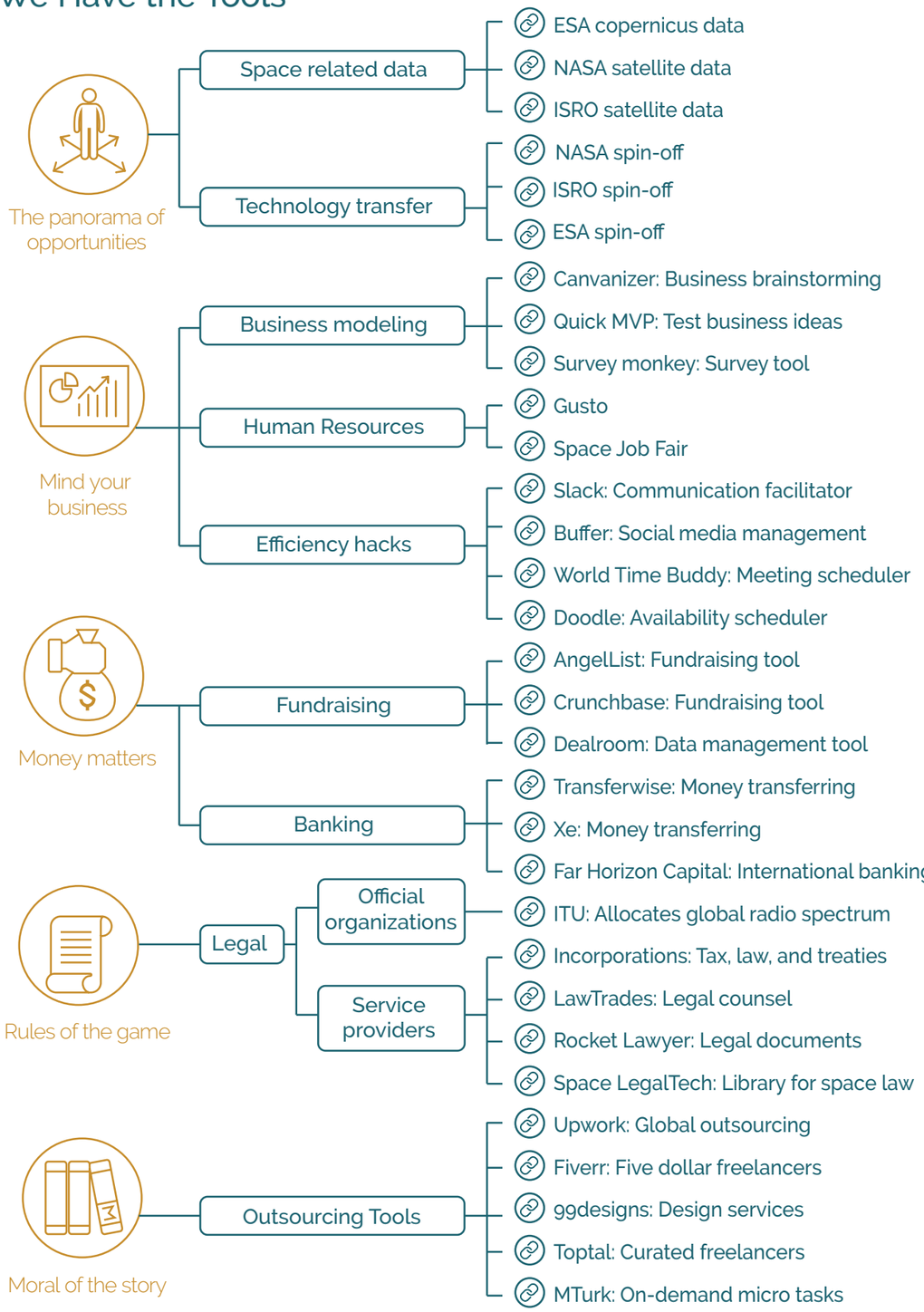


Yellow Brick Road

Long-term Web Tool Plan

	Stage 1 ISU SSP 2017	Stage 2 September 2017-April 2018	Stage 3 May 2018 - December 2019	Stage 4 January 2020 - Onwards
Corporate structure	Astropreneurs	Astropreneurs and Volunteers	Overall Managers, Topic Leaders, and Volunteers	All Employees
Incorporation	Astropreneurs	Selection between Profit and Non-Profit Model	Establish Legal Entity	Establish Legal Entity
Funding	Astropreneurs	Donations and Crowdfunding	Grant Funds and Customer Revenue	Customer Revenue
Partnerships	Individual Contributions, ISU, and Lockheed Martin	Individual Contributions and ISU	ISU, Universities, LinkedIn, Career Websites	ISU, Universities, LinkedIn, Career Websites
Features	Web Information Resources, Key Contacts	Add Trial Matchmaking	Deploy Full Matchmaking	Online Space Incubation

We Have the Tools



The Journey Begins

Conclusion

The New Space segment is a growth market and is considered a new frontier of opportunities. Higher returns and new technologies have attracted venture capitalists and business angels to invest in the sector. Space entrepreneurs are using all these new options to embark on the journey of creating their own companies. There has been no better time! The Astropreneurs want to offer guidance and resources to help them on their way.

Opportunities are infinite and ideas need courage to fly.

> *"Stop waiting for the perfect time. It doesn't exist. Just start. Now. And run hard. And if it fails – that's just fine."*
> *- Samuel Harrison, Director, Nebula Sciences*

> *"Miniaturization of hardware and the decreasing cost of access to space are creating a new wave of space startups. This handbook will be an important component to enable and guide new startups through some of the challenges required to start a new business in the field."*
> *- Omar Hatamleh, Director, ISU SSP*

> *"Make sure you have the technical expertise within your founding team and try to identify a 'launch customer'."*
> *- Ed Chester, Director, Catena Space*

Additional tools can be found on our live web tool:
www.astropreneurs.space

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Additional resources available @
www.astropreneurs.space

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