



Entrepreneurship Beyond Earth: Innovation and Commercialization in the Space Sector

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ABSTRACT

The New Space Economy represents a shift from government-dominated space activities toward an entrepreneurial, innovation-driven, and commercially oriented ecosystem. The article examines entrepreneurship through entrepreneurial agency, innovation ecosystems, dynamic capabilities, combinatorial novelty, and digital ecosystem orientation. It highlights emerging technologies such as artificial intelligence, robotics, small satellites, Earth observation, additive manufacturing, big data, and cloud computing as key drivers of innovation and commercialization. Commercialization follows a non-linear process involving idea generation, R&D, prototyping, testing, funding, market entry, revenue generation, and scaling. Emerging business models include B2B, B2G, platform-based, subscription, satellite-as-a-service, data monetization, and public-private partnerships. Major challenges include high investment requirements, technological uncertainty, lengthy development cycles, regulatory barriers, funding constraints, and sustainability concerns. The article emphasizes collaboration among governments, industries, universities, investors, and intermediaries. Future opportunities include autonomous systems, space manufacturing, agriculture, healthcare, tourism, lunar economies, and space-based solar power.

1. INTRODUCTION

The space economy is transforming from a historical period based on government-led missions into a new one: the “New Space Economy” of private entrepreneurship. This represents a pattern of strategic change in other highly-regulated, state-led sectors where new innovative capacities are becoming more likely to be generated than in official doctrines, and where such change is being “forced” by actors who are ready to act, but who lack capacity because of institutional and fiscal constraints [1]. In this context, innovation-driven commercialization is key, via digital innovation networks to narrow the gap between R&D and market introduction, and spread the huge risks and costs of frontier technology development [2]. This research reviews what space power entrepreneurial agency entails and what kinds of tasks it is to be applied to, and will investigate how identifiable “champions” can identify unexploited opportunities and bring together various resources to produce new technological, doctrinal and organizational combinations [3]. The next sections provide a basis for understanding the dynamics of asymmetric partnerships between startups and “hub firms,” and how both parties maneuver their way through the bureaucracy to gain institutional and competitive advantages, and how the new capabilities are “institutionalized” with the startups [1].

1.1 Key Concepts

1.1.1 New Space Economy: The new innovation model is a mixed physical/digital space in which the elements involved or protagonists (start-ups and large companies) take the advantage of digital tools to overcome traditional geographical and administrative barriers [4].

1.1.2 Entrepreneurial Ecosystem: A group of interdependent actors, such as researchers, venture capitalists, and prime contractors, whose interactions and attitudes shape the system's ability to develop complex capabilities in the face of strategic challenges [4].

1.1.3 Commercialization: The ability to take innovations and turn them into working solutions, which involves startups accessing the resources, market presence and legitimacy of large firms to enter the market and grow its business [2].

1.1.4 Innovation: use of technologies to enhance products, streamline processes or change business models, which fundamentally depends on "combinatorial novelty" for the creation of new combinations that substantially increase the military effectiveness and strategic position of a state [1].

2. EVOLUTION OF SPACE ENTREPRENEURSHIP

The development of space entrepreneurship is a shift from a traditional space economy, which was characterised by "rigidly regulated bureaucratic structures" and "multi-year acquisition cycles", to a dynamic commercial space market, which can be described as a "hybrid physical–digital arena" where "space of flows" gradually takes the place of "space of places" [1]. Private space companies and a new space start-up revolution are behind this change, as agile "champions" of innovation use agentic initiative to 'force' change under strategic pressure, creating operational effects ahead of official doctrines [1]. Current investment trends worldwide point to a new "risk-acceptance dimension," and VC is employed to "accelerate growth," as seen in the high-tech world, where more than \$1 billion was invested in addressing immediate needs [4]. This change is supported by entrepreneurial orientation, which is seen as an entrepreneurial process in which political, organisational and operational risk is taken in order to bring about "combinatorial novelty". Opportunity recognition is a key element of this process, in which the "operational frictions" or technical or other constraints are "entrepreneurial triggers" that enable actors to identify their unexploited strategic opportunities under constraint [1]. In a sense, these actors create markets by "option creation" and develop new combinations of technology and organization that "expand the range of strategic choices", in turn producing an "improved strategic position" [5]. In the end, this agency contributes to the diffusion of innovation and can be called a "transmission mechanism" that makes it possible for the innovation to "propagate rapidly" throughout the international system, which is the basis for the distribution of "first-mover advantages" [1].

3. INNOVATION ECOSYSTEM IN THE SPACE SECTOR

The space sector innovation ecosystem is a "hybrid physical–digital arena". in a "military-innovation complex". Mutually dependent actors such as Governmental departments as "nerve centres". This is the time to attend universities that support academic entrepreneurship [4]. And agile start-ups must be able to bring together diverse resources to create advanced capabilities [6]. Venture capital and private investors take high risk to support this system in order to achieve "acceleration of growth". Incubators and innovation spaces offer the physical and social environment for new dynamics of interaction [4]. International cooperation, including technology transfers or international factor mobility; and, further extend such networks, with breakthroughs spreading quickly throughout the international system. Theoretically, these dynamics are grounded in the synergistic relationship between government, industry and academic actors, described by the Triple Helix Model, and the Innovation Ecosystem Theory, which describes the influence of these actors on the performance of the system [7]. Moreover, Open Innovation Theory proposes that achieving success requires going beyond the boundaries of their own organizations to share resources and reduce the very high cost of high-tech R&D [2]. By means of continued cooperation and mutual learning These actors, by generating 'combinatorial novelty' (new combinations of tech and organization that enhance strategic position), drive tech development. In this process, a considerable amount of R&D is required, with more than \$1 billion in funding being allocated to reduce development time and tackle the "complexity and uncertainty" of frontier research [1].

4. DRIVERS OF INNOVATION IN SPACE ENTREPRENEURSHIP

When it comes to space entrepreneurship, drivers of innovation are frequently linked with the most innovative commercial space activities, but they are also part and parcel of the technology and how it fits into the market. The followings are the drivers of the existing innovation landscape:

4.1 Technological Drivers

4.1.1 Artificial Intelligence (AI): AI is a key enabler, especially in automated systems and data processing. In the defence industry, AI can be used for onboard target identification for drones, enabling them to function even in GPS-denied or jamming conditions, for example, allowing them to operate even in GPS denied or jamming situations. It is also key in industrial robotics for process optimization and handling complex data streams [1]. As such autonomy spreads, accountability for algorithmic decisions and their effects on work become governance questions in their own right [8].

4.1.2 Robotics: Robotics - originally, moving robots on land, but now advanced unmanned platforms. The sources stress the creation of specific military formations, such as the Ukrainian "Unmanned Systems Forces," combining aerial, ground, and marine robotics in order to provide asymmetric combat power [7]. In industrial robotics, the development of 'engineering competency portfolios' has become a key requirement for high-tech companies to stay competitive [7].

4.1.3 Satellite Miniaturization & Earth Observation: The emphasis of the sources is more on application, however, they mention the estimation of a large-scale environment and agriculture monitoring, such as calculation of crop water requirement in an irrigation scheme, using the satellites and models [9].

4.1.4 Additive Manufacturing: Additive manufacturing (including CNC and composite materials) is a critical engineering competency that is essential for the production of complex hardware that can be rapidly prototyped and produced, particularly for space-related technologies that are iterative in nature. The "space of flows" represents the transition toward a new environment where gigantic quantities of data created by new technologies such as sensors and satellites are the key ingredient for urban and industrial growth [10]. The resources can be restructured into several value-creation pathways thanks to big data and cloud computing [7].

4.1.5 Navigation Services: AI-based visual navigation systems, such as Bavovna.ai, and inertial systems that enable autonomous mobile robots to navigate without GPS signals are examples of modern innovations in navigation [1].

4.2 Market Drivers

Under extreme strategic pressure and in resource-poor environments, Defense needs act as a strong catalyst for "defense entrepreneurship," which is the innovation of actors under conditions of national security. This need frequently leads to operational solutions being realized in a quicker time frame than institutional reforms can be formally authorized in a mandate [1].

4.2.1 Climate Monitoring & Disaster Management: Innovation at systems level driven by the need to tackle "planetary boundaries" and social-ecological crises. Indeed, new public/private partnerships have led to the development of such schemes as regional forecasting or climate insurance, which help to reduce the financial effects of nature's disasters [11].

4.2.2 Precision Agriculture: Technological and communication progresses are developed according to the concepts of a "cleaner and greener" agriculture, through the improvement of efficiency and reduction of energy production, by applying satellite data and advanced indices [9].

4.2.3 Technology Readiness: The Technology Readiness Level (TRL) is a common way of measuring innovation trajectories. High tech companies and Art Science collaborations often develop prototypes that need a lot of institutional support to get from the lab to market validation [6].

4.2.4 Digital Innovation & Market Demand: Cloud computing and high internet penetration has dramatically changed business models and organizational forms in the global economy. The market demand for "distributed innovation patterns" enables a market that enables citizens in different locations to join in high-stakes technological development. In the face of these tumultuous environments, firms must be able to identify, allocate, and coordinate resources to adjust to the swift changes of technology, which they possess through "dynamic capabilities" [5]. This encompasses "digital ecosystem orientation" (DEO) in which hub companies redefine their resources and create inter-industry connections [2]. Moving to these data-driven, technology-led business models is also a leadership and change-management task for the firms involved [12].

5. STRATEGIC AGENCY AND RISK

The sources highlight that innovation is not an automatic result of the structural incentives but is a result of the agentic initiative and risk-taking by the agents. In defence and high-tech industries, "entrepreneurial leaders" have to deal with often formalistic bureaucratic environments, making personal and institutional risks to generate tangible material and material capabilities in an urgent time frame. It is this

"combinatorial novelty" (the incorporation of hardware, software and new working concepts at the same time) which gives a strategic edge [1].

6. COMMERCIALIZATION PATHWAYS

Innovation to a viable and sustainable business model in the high-stakes environment of space entrepreneurship is a multi-faceted and non-linear process, with a strong element of "agentic initiative" by actors who identify strategic opportunities in an environment of extreme constraint (Figure 1).

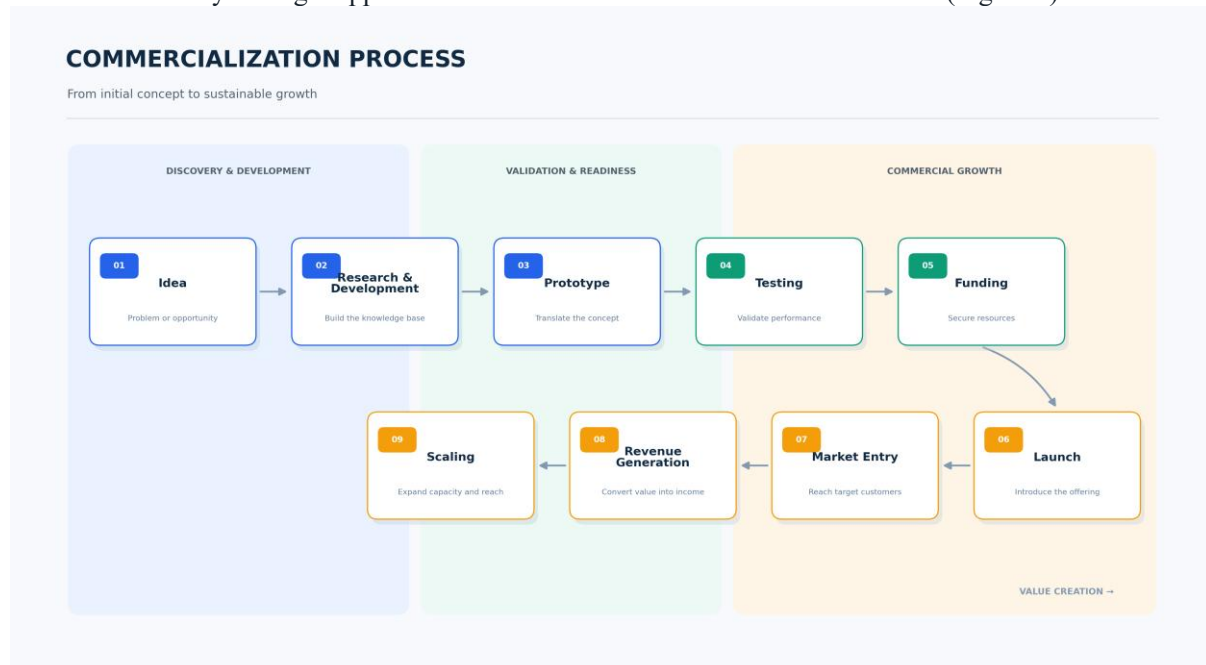


Figure 1. Commercialization Process.

This Commercialization Process usually begins with the basic Idea, in which entrepreneurial leaders look at the gaps in what they can currently do, and the new technological realities to determine the relevance of the gaps [1]. After the idea stage, companies implement intensive Research & Development (R&D) activities that include the creation of "engineering competency portfolios" built with the help of "university-industry collaborations" that allow cutting-edge scientific knowledge to be transferred into various fields, such as robotics, mechatronics, and artificial intelligence [1]. In order to move from the lab to the market, the development of a Prototype is necessary, and can be defined as a version of Novelty in which multiple streams of innovation - hardware, software, and operation - are combined into a single coherent program [1]. The prototype needs then to be extensively tested in dedicated "innovation spaces" or hybrid labs, where "boundary spanners" and "curators" function as mediators to guide the "fuzzy front end" of innovation toward the required "technology readiness levels" (TRL), which are identified as a technology's ability to be developed and implemented in various real-world situations [1]. Getting Funding to move from the prototype to a market-ready solution is often hinged on 'asymmetric collaborations' with large corporations via corporate venture capital (CVC) or 'risk-sharing' schemes with the government for high-cost space ventures, which deliver the funding and 'organizational legitimacy' [4]. Funding secured, the Launch phase takes place when the technology moves from experimental R&D to tangible material capabilities, typically through the agency of "intermediary organizations" such as Bravel (Ukraine) or MAFAT (Israel), linking military and civilian end-users directly with technology developers to avoid traditional, slow procurement cycles [1]. Market Entry strategies then shift to the development of a high and strong digital ecosystem orientation (DEO), where "modular design" is used to enable new ventures to secure a competitive position in the global market [3]. At this stage, the Revenue Generation comes from a clear-cut Revenue Model, such as Subscription Models for cloud based services, Licensing of core intellectual property or the formal Technology Transfer of innovations to wider industrial areas [6]. Once the venture matures, the key is Scaling: firm building up the "dynamic capabilities" of identifying, allocating and mobilizing resources to respond to the challenges of fast-moving technology and "multilateral" ecosystem demands [1]. Commercial Models such as Satellite-as-a-Service and Launch-as-a-Service are among the pathways that have emerged to reflect the growing trend of 'servitization' and the

offering of infrastructure-as-a-platform in the sector [1]. Earth Observation Services and the whole Space Data Business make use of the huge amount of data and cloud computing to build a "space of flows" where data can be used as a key input to several value-creation processes in agriculture, climate monitoring and disaster management [3]. Such innovations as In-space Manufacturing with additive manufacturing and robotics, and the speculative model of a Lunar Economy reflect "mission-oriented" approaches looking for "new paths to progress" that "challenge human-nature relations [6]. Even if the model is consumer oriented such as Space Tourism, the Value Proposition is focused on the "experience" and transformation is the core concept. Most importantly, the ability of these models to succeed is dependent on having a strong Commercialization Strategy that embeds Business Model Innovation to have a well-defined value proposition for a specific set of Customer Segments, so that innovation is not an end in itself, but a conscious effort to meet strategic needs [1]. Finally, it is the "strategic agency" of these actors, their ability to take political, financial and operational risks, and their ability to introduce innovations into "institutional norms", all of which turns a fledgling idea into a strategically significant business [13].

7. ENTREPRENEURIAL BUSINESS MODELS

Entrepreneurial business models in specialized and high-tech industries, like defence and energy, are characterized by the way value is created, opportunities spotted and resources organized [14]. These models can be compared and contrasted using the Business Model Canvas (BMC), and can be contrasted by their Customer Segments, Value Propositions, and Revenue Streams, to understand the unique strategic orientations of each [15, 16].

7.1 Comparison of the Entrepreneurial Business Models

7.1.1 B2B (Business-to-Business): This model focuses on value exchange with other businesses, often using social media to network and strategically brand yourself. B2B models are oriented toward servitization, in which companies offer industrial products (such as robotics) in a service package to other companies, to enable industrial innovation [3, 17]. Here the BMC Value Proposition is often operational efficiency and risk sharing in the form of "firm agreements" or strategic alliances [18].

7.1.2 B2G (Business-to-Government): These are models predominately found in the defense and infrastructure industries where the firm is the "entrepreneurial leader" and meets the needs of the military end-user or state agencies. For instance, Bravel in Ukraine serves as a hub where entrepreneurs can directly engage with government procurement agencies, thereby speeding up innovation processes. The Value Proposition is different from the commercial ones, because it focuses on improving national security, military effectiveness [1].

7.1.3 Platform Business Model: These businesses are "hubs" that coordinate digital innovation ecosystems, connecting supply and demand [3]. They employ modular design that enables several players to get involved in the platform to build a "space of flows" in which knowledge and data are "recombined". The revenue model for platforms can typically be built on network effects: the more users/complementors are using the platform the more valuable it is to them [4].

7.1.4 Subscription Model: This one is used to show transition from ownership to access. H&M is a brand that has tried a subscription-based rental model for clothes in the fashion industry, which is part of the circular economy. In the case of high-tech businesses, it may come in the form of "servitization" – paying subscription fees to access software or hardware upgrades – and thus generating a steady and consistent Revenue Stream [19].

7.1.5 Space Infrastructure Model: This model is based on infrastructure projects on earth, such as Energy Islands (collection and redistribution points) and is applicable to the space sector with "Satellite-as-a-Service" or the creation of large-scale space deployable mechanisms [20]. The Value Proposition is the offering of basic platforms (such as launch pads or satellite constellations) which other companies can use to develop specific applications [21].

7.1.6 Public-Private Partnership (PPP): This is a model for tackling complex societal challenges, like making affordable housing or energy transition, where both financial and societal targets are taken into account. The private sector is usually tasked with raising capital, providing development and management skills, and the public sector offers land or regulatory assistance via long-term concessions. Some cities, such as Madrid, with their Plan Vive, have units built to be owned and managed by private companies, that offer prices lower than market rates (Fernández-Cuesta et al., 2026).

7.1.7 Data Monetization: This is where companies transform their operational data and scattered datasets into new primary assets or streams of income [3]. These companies combine big data and cloud

computing to change users' consumption habits and enhance "data value," and the space of flows becomes a business asset [2].

8. SUPPORTING FRAMEWORK: BUSINESS MODEL CANVAS INTEGRATION

The Business Model Canvas helps these ventures to systematically draw out how they transform an idea into a scalable business. The following are some important elements within these models:

Key Partners: Startups often need large companies' resources to gain legitimacy and scale their operations, and they are equally crucial to companies for accessing cutting-edge technology [4].

Value propositions: Sustainability is becoming a "social license to operate" in modern ventures, adding ESG (environmental, social and governance) to the value proposition [22].

Customer Segments: They include military end-users for defense entrepreneurship, as well as underserved populations in slum-based networks with digital vouchers [1].

Revenue Streams: Multiple, such as licensing, technology transfer, or suggestion-based donations (as with SEN projects, such as works in juvenile detention centers).

Finally, it is a question that depends on the dynamic capabilities of the firm, namely on its capacity to adjust its strategic orientation (Dominant, Cooperative or Multilateral) according to the changing requirements of the digital and institutional context [3].

9. FINANCING SPACE ENTREPRENEURSHIP

Financing space entrepreneurship, which is a branch of the high-stakes 'defensive' and high-tech entrepreneurship, involves extreme financial, operational and strategic risks. These ventures are typically "combinatorial novelty" involving hardware, software and new operational concepts and thus need multiple and specialized funding sources to progress from prototype to market ready capability [1].

9.1 Financing Mechanisms

Venture Capital (VC): Venture capital is a critical element of the contemporary "military-innovation complex," specifically for startups that can yield "strategic" benefits in an "asymmetric" way [1]. Israel's defence-tech startups raised more than \$1 billion in investment capital in 2025, fueled by dedicated venture capital firms such as Protego Ventures and the \$19 million Dare to Defend Democracy fund, which was created by former Google CEO Eric Schmidt [1].

Angel Investors: The high-net-worth individuals, which are less detailed in the sources, are sometimes described as "entrepreneurial leaders" or backers of a specialized fund (e.g., MITS Capital), that are the sources of the initial capital for ventures in active "war zones" or in high-uncertainty situations where institutional trust is not high [1].

Government Grants: Government supported clusters like Bravel in Ukraine function as institutional bridges for fast-track technologies and offer grant funding to them. Bravel awarded \$40 million in grants in 2024 – eight times that of the previous year – to robotic complexes and unmanned systems [1].

Public Funding: Public institutional support is needed to enable entrepreneurial action in large-scale initiatives. This encompasses the European Investment Bank's military funding programmes and suggestions about the possibility of closing the "digital gap" in infrastructure through national subsidies, government special funds and local bond financing [2].

Corporate Investment & CVC: Corporate Venture Capital (CVC) is a key source of funding for early-stage startups, providing access to the resources and networks of established companies [4]. This model can, however, have dependency issues, with the possibility of CVC strategic influence affecting the autonomy or direction of innovation of a startup [4].

Strategic Alliances: "Asymmetric collaborations" between start-ups and major companies, from a critical point of view, introduces the topic of strategic alliances that supply crucial resources, 'infrastructure', and 'organizational legitimacy' for start-ups [4]. The alliances frequently involve "university-industry collaborations," which in turn are often vital to developing the "engineering competency portfolios" needed for more complex initiatives, such as industrial robotics [7].

Crowdfunding: Crowdfunding is a tool for securing resources in digital innovation networks and enterprises can undertake campaigns on digital platforms to raise small investments from their citizens. An "exit route" for entrepreneurs and investors is to go public and sell their shares in what is known as an IPO (Initial Public Offering) [18].

9.2 Financial and Strategic Challenges

Long Gestation Period: in these sectors, technological changes take time to occur on a large scale. The typical procurement process and the research and development process can span decades and even "fast-track" programs can have to pass through the "fuzzy front end" of innovation. Ventures need to become more creative and find a way to "compress time" to get from an idea's inception to a material capability that is strategically relevant prior to its becoming irrelevant [1].

High Investment Risk: Entrepreneurship in these areas is "staking political, organizational and operational risk" on initiatives where the payoff is uncertain. The investor has to take the high risk of the possibility of spectacular success or total failure, and sometimes be able to invest in "active war zones" or highly unstable geopolitical conditions [1].

Capital Intensity: Projects can be capital intensive: it is a very hands-on approach and the size of the investment can make it hard for a state or firm to adopt a major innovation. However, smaller and less-resourced actors may find it difficult to replicate the institutional investment that is needed to sustain a sophisticated system such as Israel's Iron Dome [13, 15]. As ventures grow to the technology intensive stages (carbon capture or large-scale robotics) the cost of improvement increases, requiring even more capital-intensive strategies [10].

9.3 Regulatory and Policy Environment

The Regulatory and Policy Environment for space entrepreneurship is increasingly moving from the traditional, formally structured and regulated bureaucracy to "enabling-oriented" structures, with the aim of speeding up the cycles and time compression of innovation. The sources do not contain specific information on the Outer Space Treaty, on the Space Governance architectures at the global level or on the legal aspects of Space Resource Rights (information which is beyond the scope of the sources and should be done independently and should be verified), but a parallel with the polycentric governance systems, which coordinate experimentation and adaptive responses on multiple levels of scale. In these international contexts, Intellectual Property (IP) serves as an important strategic asset that grants "organizational legitimacy" and "competitive advantage", but at the same time, it also generates power asymmetries, such as the ability to have knowledge freely dispersed by well-established corporations, which does not occur with startups, and therefore requires policy strategies to create reciprocity. In the sources, on National level, the emphasis is laid on the application of regulatory strategies of managing technical uncertainty and data privacy, such as Licensing and the "regulatory sandboxes" to stimulate the industrial growth, without excessively inhibiting its development [1, 4, 23]. Governments also help to incentivize Private participation by implementing Public–Private Partnership (PPP) schemes and "asymmetric collaborations" in which the state supplies the general structure of the project and a "social license to operate" while the private sector brings in funding and development knowledge [4]. Such initiatives are put into practice through specific Start-up policies, such as the "Defence City" scheme in Ukraine that cuts red tape for manufacturers, and "intermediary organisations" like the Israeli defence company MAFAT or Brave1 that create quick certification routes and "military acceptance" procedures, which are alternative to the long and time-consuming procurement process [3]. Finally, a state's "dynamic capabilities" to adjust its strategic posture in response to the changing institutional and digital environment are crucial to the success of this setting.

10. CHALLENGES TO COMMERCIALIZATION

Breakthrough innovations in the space and high-tech markets are hindered by a combination of Technological, Economic, Legal, Environmental and Social challenges that require strategic agency to deal with entrenched Innovation Barriers. The perception of technological challenges is driven by high R&D costs and extreme capital intensities, such as the high investment needed to achieve big-scale solutions such as 'Energy Islands' and complex defence systems where the cost of making 'low hanging fruit' mitigation gets higher with the more advanced solutions [7]. This is exacerbated by deep technical uncertainty and the "competency trap" – switching from proven or well-developed competencies to uncertain ones such as autonomous robotic navigation, neural network data collection or embedding of "living matter" in industrial processes. In addition, long product cycles and inflexible, bureaucratic procurement procedures, which can span decades, can cause "relevancy gaps" – where a technology can become strategically obsolete before it is fielded – so that "time compression" is necessary: by centralizing the decision-making process and bringing together resources to bypass the normal lines of procurement, an idea can be turned into a material capability. A second type of economic issues are the substantial funding

gaps that exist between start-ups and the validation infrastructure in pilot facilities and the capital needed to implement the product in the market, commonly referred to as the "valley of death" [1, 22]. In "defense entrepreneurship" contexts, including areas of active conflict, where outcomes may be highly variable and investors are at risk of spectacular success or obvious failure, and the ownership structures are often opaque and would not attract investors in more benign markets, market uncertainty is more pronounced [2]. On a Legal level, the problems of ownership and liability are intensified through "asymmetric collaborations" between smaller startups and larger corporations, where power inequalities in the exploitation of the knowledge may be in favour of the large companies, potentially leading to the capture of knowledge without reciprocation. Innovation can be hampered by National licensing and Space policies (or their terrestrial, high-tech equivalents), when regulations reduce the interoperability of platforms by making them rigid and non-harmonised [24]. Environmental issues, a social goal that can be framed as the management of space debris (as an extension of the "planetary boundaries" concept), and the overall responsibility of Sustainability have moved from optional social aims to strategic imperatives. Ventures need to gain the "social license to operate" by showing a desire to be good stewards of the environment to ensure a commercial viability that is attractive to socially conscious investors [22]. Social challenges involve dealing with ethical issues about the AI systems used to identify materials that are autonomous, the perception of 'growing' materials using bacteria and the need to make them accessible to everyone to ensure the 'digital divide' is not widening or that urban policy is not driven by economic competitiveness rather than the needs of socially vulnerable groups. Finally, true Sustainability requires a "strong sustainability" paradigm that goes beyond "green economics" or "environmental economics" to the active reconstruction of social-ecological systems and the reorganisation of value logics that lie at the heart of economics and all economic activity. This includes the concept of a "dynamic equilibrium" and the balancing feedback loops that often sustain undesirable "states of inequality" and ecological degradation which require intentional "systems disequilibrium" by entrepreneurial leaders to catalyze "path breaking transformations" [6]. Entrepreneurs can build up "hybrid-oriented" entrepreneurship that over time balances and integrates competing economic, social and ecological value logics, and can use "boundary spanners" to assist with transdisciplinary innovation in "specialized innovation spaces" to establish the "dynamic capabilities" needed to cope with a global environment that is volatile and complex. The path to this 'regenerative' form – as the transition from extractive systems toward circular systems – relies on the 'institutional embedding' of the innovations in new norms, and the 'symbolic disruption' of society's ability to imagine alternative and sustainable futures. This is an intellectual, not a technical, and an agentic (and political) challenge that must be tackled by known agents willing to place their political, organizational and career wagers on new business ideas that are pro-collaborative and pro-planet health. The ability to create and maintain this multi-dimensional innovation will become the game changing factor in the strategic landscape of the modern world, where capability attribution time is valued more. The concept of "space debris" is not explicitly mentioned in the provided sources, it is an application of the environmental sustainability and planetary boundary drivers mentioned in the sources [1, 6, 11, 18].

11. GLOBAL CASE STUDIES

The analysis indicates that, while the global space sector displays several key examples of how innovation and funding are linked to competitive advantage, the Indian space industry is still in its early stages of growth, with details regarding the companies mentioned (SpaceX, Skyroot, etc.) provided from external sources. SpaceX, Blue Origin, and Rocket Lab, among others, have set themselves up as global leaders in terms of innovation, specifically combinatorial novelty. In contrast, while Indian startups like Skyroot Aerospace, Agnikul Cosmos, and Bellatrix Aerospace focus on satellite miniaturization, 3D-printed cryogenic engines, and cost-effective, high-frequency rocket launches, reusable launch vehicles and heavy-lift hardware are integral components of their efforts in Russia [1]. Investment funding for global companies, however, is dominated by very large Venture Capital (VC) investments, corporate venture capital (CVC) deals, and B2G (Business-to-Government) investments with long gestation periods and high investment risk, while Indian startups such as Pixxel, Dhruva Space, and Skyroot are funded partly by Venture Capital (VC), Angel Investors and more and more government grants (IN-SPACE) [3]. Both groups are working on a variety of business models, ranging from the traditional hardware sales approach to servitization (Launch-as-a-Service, Satellite-as-a-Service, Space Infrastructure, etc., such as Axiom Space) [25]. Another data monetization model that is important for companies like Planet Labs and Pixxel, who use huge data for Earth Observation Services in agriculture and climate monitoring. In these enterprises, the strategic agency of the entrepreneurial leaders who spot "relevancy gaps" and break traditional procurement processes by making asymmetric partnerships with government and big companies

is key to commercial success [1]. A key learning from these cases is the need for dynamic capabilities (capabilities that can be used to coordinate the resources and adapt to quick technological changes) and the need for institutional embedding to make experimental prototypes into sustainable and marketable capabilities [26]. Plus, successful enterprises show how the practice of environmental and social stewardship (ESG) is becoming more and more essential for a company to earn a "social license to operate" in today's world [22].

12. FUTURE OPPORTUNITIES

The horizon of future opportunities in space entrepreneurship is shifting towards mission-oriented innovation and towards strategic agency, that is, toward acting within extreme conditions and making speculative ideas material and operational. An integral part of this transformation is the emergence of Autonomous Space Systems powered by local AI that can function in GPS-denied scenarios using onboard target identification systems and visual navigation, thus giving them asymmetric strategic capabilities [1]. High performance computing and immersive IT infrastructure are expanding the use of Digital Twins for Space Missions, and are being adopted to simulate and test the complex hardware prior to physical deployment to space, in order to develop "human-centric collaborative assembly systems" for large-scale space-deployable mechanisms. This technological underpinning enables the development of a Lunar Economy and Asteroid Mining as "new paths to progress," speculative envisioning and design of socio-technical systems, going beyond mere economic value [7]. These initiatives involve an "Orbital Logistics" and a "space of flows" in which information, knowledge, data and resources are continuously reshaped and reassigned among different value-creating trajectories, thus allowing to overcome the structural rigidity of the traditional vertical integration. In this ecosystem, Space Manufacturing effects a paradigm change toward the "biologization" of industrial processes: as in terrestrial examples, bacteria are grown in order to "grow" materials within a regenerative and circular economy, where by-products are valued and a finite-resource way of doing things is abandoned. This regenerative logic is extended in Space Agriculture, where the resource requirement estimation for terrestrial precision irrigation is being adapted for the estimation of water and nutrient needs in closed-loop systems; and where GIS-based multi-criteria decision analysis is used to identify a suitable cultivation zone; having analogies to precision irrigation on Earth [6]. In addition, the shift to Space Healthcare is made easier by the use of Metaverse technology and "Healthcare 5.0" frameworks that enable immersive training, remote monitoring, and AI-powered rehabilitation through VR and AR, thus linking up the concept of technological readiness with institutional trust and regulatory dynamics. At the same time, the emergence of Space Tourism is fuelled by the experience economy, in which consumers look for more than just consumption – they want "transformation" and to participate in the customs and character of the places they are visiting, making culture a catalyst for "strong sustainability. For most of these activities, the approach of Space-based Solar Power will call for a "green transformation" strategy, similar to the solutions being pursued on Earth for wind, solar and hydrogen storage, in order to reduce carbon intensity and create an intelligent and low-carbon manufacturing system [27]. The opportunities, however, come with a number of innovation challenges, such as the "competency trap" of legacy systems, expensive R&D and the "Valley of Death" in funding. They are overcome through agentic initiative and by establishing intermediary organizations as institutional bridges that facilitate grant funding, testing facilities and fast certification process, shortens time and reduce market uncertainty [6]. Importantly, the sustainability of future markets will be strongly linked to how successful they can achieve strong sustainability: restructuring value logics to remain within "planetary boundaries" and to avoid further tensions through a scarcity of natural resources provoked by the expansion of human presence into space. Firms can build their dynamic capabilities, which involve the ability to identify, mobilise and structure resources in a way that enables them to adjust to the dynamic technological and institutional environment, and ensures their innovations become institutionalised in new norms and force structures. The strategic opportunities in the international system are, however, going to be realized in the future depending on the relative speed of the innovation cycle and the willingness of entrepreneurial leaders to stake their organizational capital on bets on innovations [1].

13. CONCLUSION

The space of acquisition cycles has shifted from a set of rigid, multi-year cycles of bureaucracy to an "operational space of flows" where operational solutions have emerged before official doctrines. This change is fueled by the digital technologies, including artificial intelligence, big data, and cloud computing, that are reshaping the notion of innovation. Innovation-driven Entrepreneurship: Innovation here is meant

to be agentic initiative, where actors with a will to change "force" highly regulated systems to create a capability that is of relevance for security. It is based on combinatorial novelty, which is the integration of technological, doctrinal, and organizational changes at the same time, resulting in a decisive strategic gain. The process of innovation being turned into a business is a non-linear process (from Idea and R&D to Prototype and Scaling), and is often aided by "university-industry collaborations" and "asymmetric collaborations" with larger corporate or government hub firms. Commercial models are now in transition to become more servitization and platform-based business models, including Satellite-as-a-Service and more, to align supply with the demand in the maturing digital innovation ecosystem. The development of intermediary organizations (e.g., MAFAT or Brave1) as institutional bridges that offer speedy certification processes and grant funding are critical to success. Governance structures need to move from control to enabling and allow for iterative experimentation and learning from productive failure. Entrepreneurs encounter numerous challenges and opportunities when dealing with the "Valley of Death" in the funding area, high costs of R&D, technical uncertainty, and more. New mission-oriented opportunities like space-based solar power, mission-oriented autonomous systems, and the Lunar Economy provide fresh avenues to progress built on commercial success and robust sustainability and planetary stewardship. Further research should examine the development of typologies of defence and space entrepreneurs and systematic comparisons between successful and unsuccessful innovation ecosystems, as well as examine the nature of hybrid-oriented entrepreneurship. Furthermore, research focusing on the development of "digital twins" and Metaverse-related technologies in high-tech industries needs to be done over a longer time period. Finally, the ability to develop and maintain this multi-dimensional innovation has emerged as the key element of the balance of power in the global world.

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