



European Space Policy Institute

European Access to Space: Business and Policy Perspectives on Micro Launchers

Executive Summary

Prepared by the
European Space Policy Institute

Matteo TUGNOLI
Martin SARRET
Marco ALIBERTI

May 2018

Table of Contents

Background and Research Objectives	1
Value Proposition of Micro Launchers for the Small Sat Launch Market	2
Stakes for Micro Launchers Companies	5
Institutional Support for Micro Launchers in the European Context.....	6
Conclusions.....	7

Background and Research Objectives

When looking at recent developments in the worldwide space launch sector, one of the most striking features is the increase in the number of small satellites missions, in particular since 2013. In the span of a few years, technological advancements – among other factors – have enabled small spacecraft to achieve a plethora of missions, which only a decade ago were the exclusive domain of much larger satellites. Even more so, small satellites are being employed in an unprecedented way to support and constitute large-scale commercial businesses, from remote sensing to telecommunications, on top of burgeoning small-scale scientific and educational missions from universities and amateur groups. Equally important, there is a wide consensus that this trend will accelerate the future.

Analysing in detail the small satellite launch market yields further insights into how these trends have developed. In fact, the strategy for launching most of these satellites into Low Earth Orbit (LEO) has been primarily based on opportunity rides alongside main payloads (piggyback), or deployment from resupply capsules and dispensers from the International Space Station (ISS). The relatively low prices charged for these launches have appealed greatly to small satellite developers, enabling their small, cheap, mass-produced satellites to access space at reasonable prices and to quickly start generating data (i.e. business) for the emerging start-ups.

In parallel, and at an unprecedented pace, a great number of launch systems, mostly private-led, are being developed currently, offering a payload capacity that varies from a few dozen to a few hundred Kg to LEO.¹ Indeed, as small spacecraft become increasingly capable, and their potential applications multiply, the limitations of current launch solutions become more evident. Demanding satellite operators are becoming increasingly dissatisfied with factors that ultimately affect the *time to mission/market* of their products, including the lack of flexibility in choosing orbital parameters when launching as “guests” of a main payload; unsatisfactory availability of launch slots in a global space launch industry; and launch manifest delays that result from the main customers’ conditions over which the smallsat operators have no control.

It is in this evolving context that private micro launcher initiatives have started to proliferate globally. Far from being a new concept, these vehicles are being developed at the nexus of anticipated demand for their services and favourable business dynamics, aiming at filling the perceived gaps in the current space transportation offer for smallsats, with targeted and dedicated services.

However, many questions and known unknowns still hover over all these ventures. The consensus is that the prospects for this segment of the space transportation industry are still unclear. The variables include the size and shape of the actual small satellite market to be captured, the feasibility of companies’ business cases, and the level of competition with current small-to-medium scale rockets. This applies also to the European context, where the commercial and institutional utility of micro launchers is still subject to debate among the different interested parties.

This study responds to the need for an objective and comprehensive assessment of the commercial and institutional landscape surrounding micro launchers initiatives in Europe.

- The primary objective of this research is to offer an analysis of the dynamics of the global launch service market associated with small satellites, focusing on developing trends and outlook.
- The second objective is to identify the specific features of this market by characterising customers’ expectations and providing a comparative analysis of the different launch solutions for small sats.
- Finally, and from a policy perspective, the research reflects on the stakes that may compel European institutional actors to become more actively involved in this domain.

¹ For the purpose of this research, a micro launcher vehicle is defined as an orbital-capable rocket with a payload capacity below 500 Kg to LEO. Likewise, a small satellite is defined as any satellite having mass of under 500 Kg.

Value Proposition of Micro Launchers for the Small Sat Launch Market

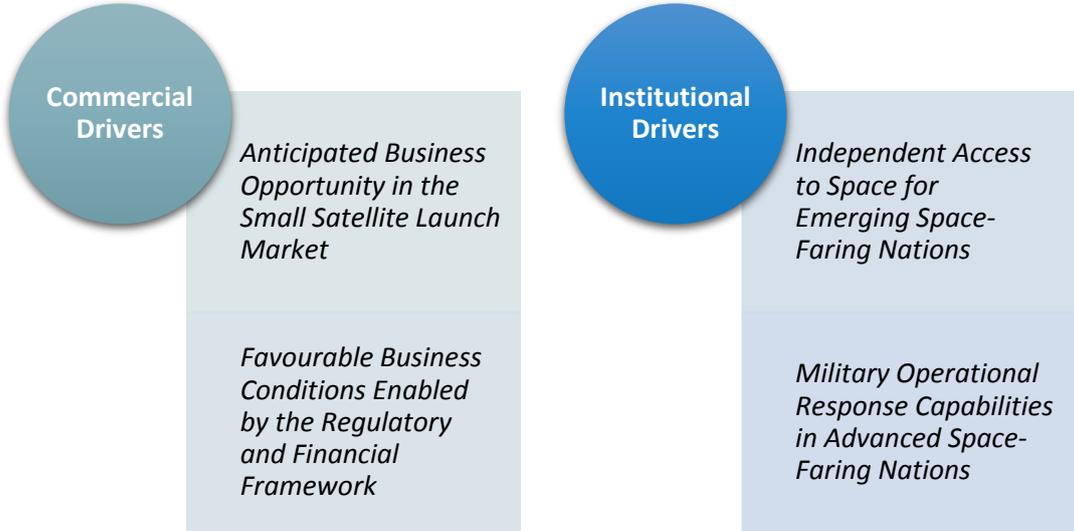


Figure 1: Drivers behind contemporary micro launchers initiatives.

As outlined in the research, drivers behind the development of a micro launcher vehicle are manifold. These drivers originate either in an institutional or in a purely commercial framework, as graphically described in Figure 1, and respond to different stakes.

The value proposition offered by micro launcher vehicles, as discussed in the comparative assessment conducted in the research, is, in principle, clear. By proposing a launch perfectly suited to the customer, constituted by a potential on-demand schedule comprised of numerous launches per year dedicated exclusively to smallsats, as well as full control of the mission parameters, the companies aim not only to fill the gaps in current access to space solutions, but also to open up new possibilities for space activities to be exploited by smallsat developers.

The range of competitive advantages offered by micro launchers – which are yet to be proven – naturally comes at a price. Historically, price per Kg to orbit has been inversely proportional to the capacity of the launcher itself. Although developed at a different time, the very first launcher to offer a micro launcher-sized capacity to LEO was the air-launched Orbital ATK Pegasus: while it achieved relative success, when compared to other launch options, it was also one of the most expensive vehicles in terms of price per Kg to orbit.

The technological landscape for rocket manufacturing has certainly evolved over the past thirty years, and numerous new technologies, processes and engineering approaches have the potential to reduce the price per Kg to orbit for a micro launcher. Most micro launcher companies advertise prices between \$20k and \$40k per Kg, which is noticeably lower than the “previous generation” of micro launchers (such as Pegasus-XL and, to a certain extent, the reconverted ICBM Minotaur-1).

However, it must first be emphasised that these prices are the most optimistic baseline where the full capacity of the rocket is employed, thus ignoring fairing optimisation. Even more important, to achieve those prices a very high launch frequency is planned for the vast majority of them, in order to generate economies of scale that can recover and amortise the development costs. This consideration leads to the question of which segment(s) of the smallsats market micro launchers will effectively cope with their expected high launch frequency.

With their rather limited payload capacity, micro launchers will not be the most efficient way to deploy the largest upcoming commercial smallsat large constellations. For these missions, a rideshare approach (by employing the entirety of medium to heavy sized rockets) will most certainly

be more effective in the deployment of constellations, as their initial focus will be on the timely deployment of the whole system to quickly generate business and revenue.

Subsequently, demand will veer towards constellation replenishment, with a focus on reaching the specific orbits of the system. In this segment, micro launchers could play an important role. However, this option would be weighted by operators with respect to the possibility of simply launching spare satellites (as they are relatively cheap to produce), or replacing complete orbital planes, two options for which rideshare options would be preferred. With both micro launchers and – even more so – megaconstellations still to materialize, at this stage it is premature to quantitatively assess this factor. Nonetheless, dedicated replenishment for large constellations is one of the potentially substantial future market segments in which micro launchers could play a role.

Setting aside this aspect pertaining to very large smallsat constellations, the added value of micro launchers lies in terms of their availability and flexibility with respect to traditional launch strategies, as described in Figure 2. Such added value would in principle still strongly appeal to a variety of smallsat customers, particularly to those for whom cost is not the main decision-making parameter.

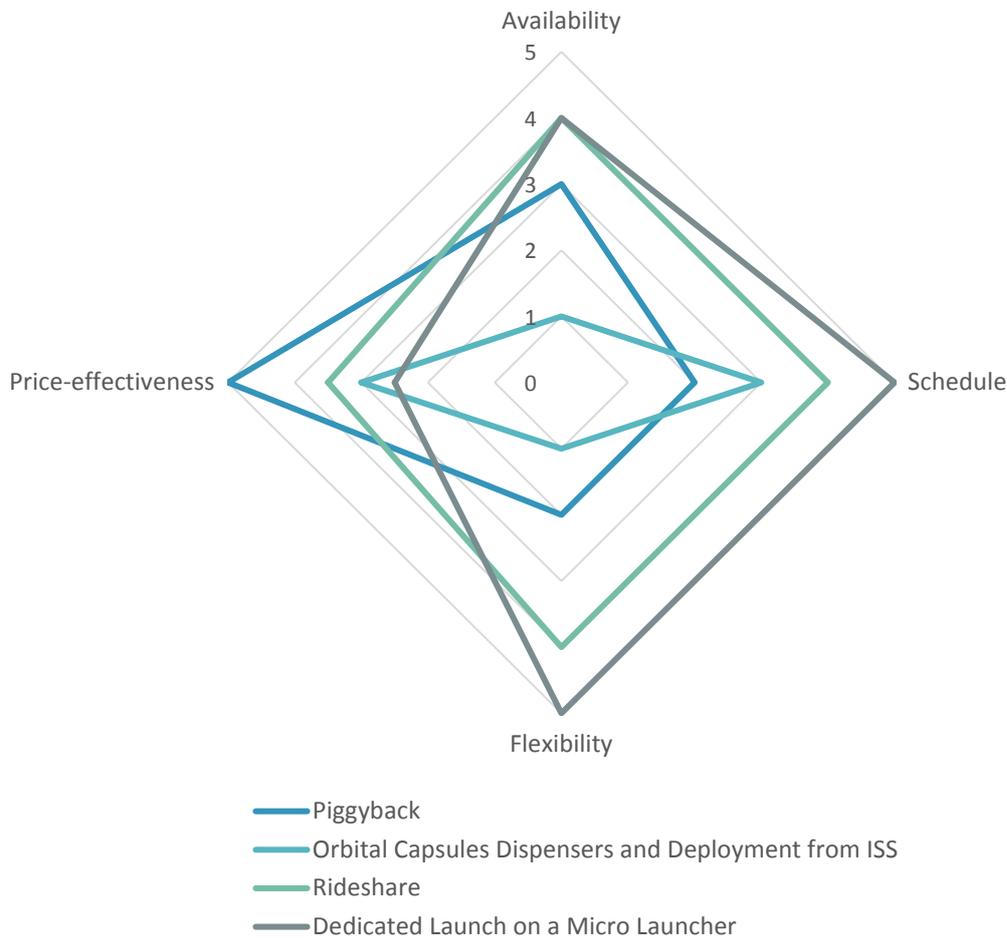


Figure 2: Benchmark across small satellites launch strategies.

In fact, the high cost of accessing space is perhaps the main blocking factor for emerging smallsat commercial companies. Yet timely access to space could also become a make-or-break element for those companies, particularly start-ups, to quickly start generating revenue and ultimately survive in an increasingly competitive market. In this regard, micro launchers might be favoured by customers who cannot afford delays in their launch schedule (provided that these companies can reach their ambitious launch rate targets) and/or need to go into specific orbits not usually serviced by traditional launchers in order to provide their services and fulfil their mission.

This, indeed, could well be the case for defence-oriented spacecraft, in addition to commercial ones. While for spacecraft involving military-grade technology, the launcher would necessarily have to undergo specific certifications and fulfil strict requirements, thanks to the ability to achieve quick and responsive access to space, micro launchers clearly continue to attract a significant interest from the defence sector.

Regarding technology demonstration spacecraft, unless the specific mission has to be performed in particular orbits to accomplish its objective, traditional launch options – from opportunity or rideshares – would ultimately prove more affordable, regardless of the initial customer. A similar argument can be made for small-scale scientific missions, and even more so for university and education projects.

Here perhaps lies the conundrum for micro launchers: the customers who would benefit most from the added value offered by micro launchers (and with pockets deep enough to bear the typically higher price per Kg to orbit) are those who do not need to launch as often as would be required to achieve the very high launch frequency anticipated in typical micro launcher business cases – considerations of future elasticity of the market, set aside.

In this regard, Figure 3 describes some of the identified known and unknown factors around the business cases of micro launcher companies, with a specific regard to the European context.

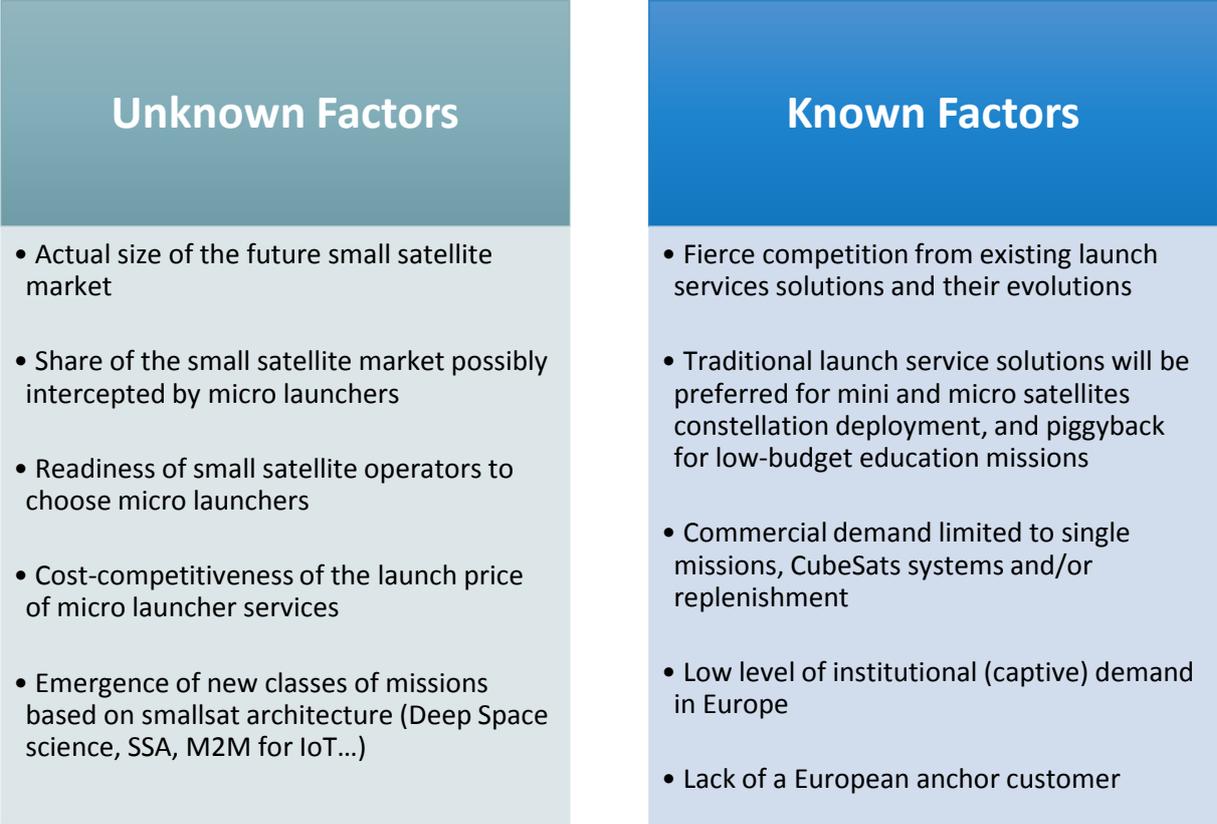


Figure 3: Outstanding issues in the business case of European micro launcher companies.

Stakes for Micro Launchers Companies

As has emerged from the research, while the market for micro launchers is currently unclear, a few considerations can be identified. Following the analysis conducted on the micro launchers offer's price structure in terms of both absolute value and price per kilogram, and bearing in mind individual value propositions as well as the current and evolving offers of established launch service providers and their small-to-large vehicles, it is safe to argue that:

- Commercial customers will likely opt for rideshare solutions for the deployment of large-scale constellations (in particular for remote sensing and satcom, i.e. in the 150 Kg to 500 Kg class of satellites), and in the longer term might consider dedicated launch of a micro launcher vehicle for replenishment of smallsats in the mini/micro class segment.
- Institutional operational missions (in particular defence) could favour micro launchers for single spacecraft with very specific orbital and schedule requirements. When launching single payloads with less stringent mission requirements (such as technology demonstrators, R&D, science), a rideshare or piggyback approach may offer the best value-for-money.
- CubeSats from universities, small scale science, as well as amateur or educational projects, will certainly continue to favour opportunity rideshare or deployment from the ISS despite long manifest waiting times and limited choice on mission parameters, since those will continue to represent the most affordable options.

Figure 4 outlines the stakes for micro launcher companies across the identified small satellites market segments, as has emerged from the research.



Figure 4: Stakes for micro launcher companies across small satellite market segments.

Institutional Support for Micro Launchers in the European Context

With the aim of conducting an assessment on the rationales of, and stakes for, a micro launcher in the European context, the research investigates demand and supply conditions for this specific market segment in Europe. The study demonstrates that the value of a European micro launcher vehicle emerges when combining both commercial and institutional drivers in a long-term perspective. Building on this, the research reflects whether there is room for some form of institutional support for micro launchers initiatives. In this regard, the report first describes some boundary conditions and potential issues associated with a direct form of support; i.e. envisioning a micro launcher as an institutional programme along the lines of Ariane 6 and Vega-C programmes.

The report then thoroughly discusses indirect types of support from European institutions aimed at facilitating the emergence of European micro launchers and sustaining their business case. This support would take the shape of policy measures supporting the ecosystem around micro launcher initiatives, and is categorised under four broad kinds of actions, which could be implemented at a coordinated national and/or pan-European level in order to increase ability and readiness of Europe in the micro launcher segment. These policy considerations, further elaborated in the report, are graphically captured in Figure 5.



Figure 5: Policy considerations for indirect support to a European ecosystem around micro launcher vehicles.

Conclusions

Following a comprehensive assessment of the structure and dynamics of the small satellite market, a competitive analysis of small satellites launch options, and elaboration of policy considerations in the European context, the main conclusions of this research are as follows:

- **Uncertainties around the future structure of the small satellite market, and even more so around the business case for micro launchers, persist.** However, while the CubeSats and nanosatellite segments are in the process of being structured (one of the reasons being the now-widely adopted standard of CubeSats), and covered by a number of already available launch options, the upper segment of mini and micro satellites is seemingly more open to competition for accessing space and for micro launchers in particular.
- **There is not one single predominant business case for micro launcher vehicles,** but a rather plethora basket, which includes satellites of different classes of mass, mission types and customer origin, as and micro launchers themselves come in a variety of sizes and performances. Therefore, companies will necessarily need to aggregate a very heterogeneous demand to ensure successful exploitation.
- In the European Strategy on Space, autonomous access to space is identified among Europe's strategic priorities. The question arises as to whether this would extend also to the segment represented by micro launchers. However, the fact that these vehicles do not constitute a critical means for accessing space (despite their potential value offer), coupled with European demand (institutional first, then commercial) that so far is very limited, suggests that **micro launchers do not constitute a compelling strategic requirement for ensuring Europe's independent access to space.** At the same time, when looking at worldwide developments and future trends, it can be argued that institutions should be ready to adjust their stance in this regard, either through direct or indirect means as outlined above.
- Low historic demand and so-far limited domestic markets for small satellites in Europe suggest the **need for a thorough assessment of the projections, potential and evolution of the European small satellites market,** particularly in light of the skyrocketing capabilities that are today being exploited by commercial companies, but could be equally relevant for institutional actors in years to come. In this regard, identifying or encouraging the establishment of a European small satellite "anchor customer" would be strongly beneficial for the long-term sustainability of any European micro launcher initiative.
- Indeed, **a more comprehensive and encompassing European small satellite policy** (in terms of technological standards and components development, strategic goals, regulatory frameworks, R&D support etc.) **should precede any strong institutional involvement in micro launcher development.** This comprehensive policy should furthermore include continental spaceports in its scope.
- **Direct involvement of European institutions in micro launchers to be then exploited on the global market needs to be thoroughly assessed, also from a governance and legal perspective.** On the former point, consideration should be given to the optimal framework for the commercialization of a possible micro launcher vehicle within the European setting: it remains to be seen whether possible micro launcher development would include or exclude Arianespace as a potential dealer on the commercial market. On the latter, consideration should be paid to the risk of being challenged for unfair competition by purely privately funded competitors on the global market.



European Access to Space: Business and Policy Perspectives on Micro Launchers

Authors: **Tugnoli**, Matteo, **Sarret**, Martin, **Aliberti**, Marco

Available for purchase online:

<https://www.springer.com/us/book/9783319789590>

Publisher	Springer International Publishing
DOI	10.1007/978-3-319-78960-6
eBook ISBN	978-3-319-78960-6
Softcover ISBN	978-3-319-78959-0

Executive summary available for download from the ESPI website:

www.espi.or.at

Title: Business and Policy Perspectives on Micro Launchers – Executive Summary
Published in: May 2018

Editor and publisher:
European Space Policy Institute, ESPI
Schwarzenbergplatz 6 • A-1030 Vienna • Austria
Tel: +43 1 718 11 18 -0 / Fax: -99
Email: office@espi.or.at

Mission Statement of ESPI - The European Space Policy Institute (ESPI) provides decision-makers with an informed view on mid- to long-term issues relevant to Europe's space activities. In this context, ESPI acts as an independent platform for developing positions and strategies.