



395. Emerging Industries: Small Launch Vehicle Sector (SLVS)

Image Source: NASA



1. Team
2. Project Overview
3. Research Goals
4. Work Stages (map with topics)
5. Data Handling
6. Lit review, State of the art
 - Catapult
 - Articles (IAC website)
 - Visualization
4. Preliminary Findings & Results
5. Visualisation Opportunities
6. Further Work
7. Q&A, Directions of Interest

The Team



Dr. Ken Davidian

Research and Program Manager
| FAA Center of Excellence for
Commercial Space Transportation
| **AST Director**



Dr. Don Platt

Associate Professor
| Extended Studies
Director | Spaceport
Education Center



Anna Wojdecka

PhD Human Centred Design
for Commercial
Human Spaceflight
Innovation Design Engineering with
expertise in Human Centred Design,
Human Spaceflight and Exponential
Technology Application. MA & Msc
Royal College of Art, Imperial College
London, Singularity University GSP
16, International Space University
SSP17



Djalma Batista

**MSc Engineering
Management**
| Department of Mechanical
Engineering and Civil Engineering
Engineer with expertise in Quality
Engineering and Data Management.
Bachelors in Industrial Engineering
18'.
Multidisciplinary approach to problem
solving within multicultural teams
across sectors, including aerospace
and automotive.

Data

	A	B	C	D	E	F	G	H
1		Authd	Compa	Orbit	Date	articles post	Links	References
2	588	Space Fligh		[]	July 28, 2014	Space surveillance craft launched by Delta 4	https://spa	https://spaceflightnow.com/2014
3	586	Space Fligh		[]	October 8, 2014	Galileo launch failure blamed on frozen Freg	https://spa	https://spaceflightnow.com/2014
4	585	Space Fligh		[]	October 12, 2014	Winds sensor opens door for Earth science fr	https://spa	https://spaceflightnow.com/2014
5	584	Space Fligh		[]	October 13, 2014	GPS modernization continues with quick pac	https://spa	https://spaceflightnow.com/2014
6	269	Space Fligh		[]	October 14, 2014	Indian navigation satellite ready for launch	https://spa	https://spaceflightnow.com/2014
7	268	Space Fligh		[]	October 15, 2014	Indian navigation satellite launched by PSLV	https://spa	https://spaceflightnow.com/2014
8	267	Space Fligh		[]	October 25, 2014	Atlas 5 to fly Wednesday, continuing rapid d	https://spa	https://spaceflightnow.com/2014
9	341	Space Fligh		[]	October 27, 2014	Atlas 5/GPS 2F-8 launch timelineOctober 27,	https://spa	https://spaceflightnow.com/2014
10	583	Space Fligh		[]	October 27, 2014	China launches third space mission in a week	https://spa	https://spaceflightnow.com/2014
11	582	Space Fligh		[]	October 28, 2014	Atlas 5 rocket rolled to Cape Canaveral launc	https://spa	https://spaceflightnow.com/2014
12	266	Space Fligh		[]	October 29, 2014	50th Atlas 5 rocket puts up new GPS satellite	https://spa	https://spaceflightnow.com/2014
13	265	Space Fligh		[]	November 7, 2014	U.S. Navy communications satellite shipped	https://spa	https://spaceflightnow.com/2014
14	581	Space Fligh		[]	December 1, 2014	Soyuz rocket deploys upgraded Russian navig	https://spa	https://spaceflightnow.com/2014
15	340	Space Fligh		[]	December 16, 2014	ULA year in reviewDecember 16, 2014Justin	https://spa	https://spaceflightnow.com/2014
16	264	Space Fligh		[]	December 18, 2014	Newest GPS satellite goes activeDecember 18	https://spa	https://spaceflightnow.com/2014
17	263	Space Fligh		[]	December 19, 2014	Third quartet of satellites launched for O3b N	https://spa	https://spaceflightnow.com/2014
18	580	Space Fligh		[]	December 19, 2014	13 launches on manifest for ULA in 2015Dec	https://spa	https://spaceflightnow.com/2014
19	262	Space Fligh		[]	December 29, 2014	O3b Networks plans satellite fleet expansion	https://spa	https://spaceflightnow.com/2014
20	261	Space Fligh		[]	January 7, 2015	Navy satellite to be hoisted atop rocket for Ja	https://spa	https://spaceflightnow.com/2015
21	339	Space Fligh		[]	January 17, 2015	Preview: Navy craft to ride milestone Atlas-C	https://spa	https://spaceflightnow.com/2015
22	260	Space Fligh		[]	January 21, 2015	Recap story: 200th Atlas-Centaur launching c	https://spa	https://spaceflightnow.com/2015
23	259	Space Fligh		[]	January 22, 2015	Did two more Iridium satellites collide with	https://spa	https://spaceflightnow.com/2015
24	257	Space Fligh		[]	February 6, 2015	Galileo satellite deployment campaign to res	https://spa	https://spaceflightnow.com/2015
25	258	Space Fligh		[]	February 6, 2015	New Navy satellite spreads wings, unfurls ant	https://spa	https://spaceflightnow.com/2015
26	256	Space Fligh		[]	February 27, 2015	Four satellites mated to Atlas 5 rocketFebrua	https://spa	https://spaceflightnow.com/2015
27	254	Space Fligh		[]	March 4, 2015	Power system failure likely cause of military s	https://spa	https://spaceflightnow.com/2015
28	255	Space Fligh		[]	March 4, 2015	Liftoff of Indian navigation satellite postpone	https://spa	https://spaceflightnow.com/2015
29	579	Space Fligh		[]	March 8, 2015	Preview: Atlas 5 rocket to launch NASA magn	https://spa	https://spaceflightnow.com/2015
30	338	Space Fligh		[]	March 11, 2015	Atlas 5 rolled to the pad for Thursday night's	https://spa	https://spaceflightnow.com/2015
31	578	Space Fligh		[]	March 15, 2015	Delta/GPS 2F-9 launch timelineMarch 15, 20	https://spa	https://spaceflightnow.com/2015
32	253	Space Fligh		[]	March 21, 2015	Arianespace to launch satellites for Earth ima	https://spa	https://spaceflightnow.com/2015
33	337	Space Fligh		[]	March 22, 2015	Preview: 10 months, 4 launches to finish GPS	https://spa	https://spaceflightnow.com/2015
34	577	Space Fligh		[]	March 24, 2015	Photos: Soyuz rocket transferred to jungle lai	https://spa	https://spaceflightnow.com/2015
35	576	Space Fligh		[]	March 25, 2015	Recap story: New bird flies for GPS navigati	https://spa	https://spaceflightnow.com/2015
36	336	Space Fligh		[]	March 27, 2015	Managers confident ahead of critical launch f	https://spa	https://spaceflightnow.com/2015
37	252	Space Fligh		[]	March 28, 2015	Two new satellites join Europe's fledgling nav	https://spa	https://spaceflightnow.com/2015
38	335	Space Fligh		[]	March 29, 2015	Indian navigation system gets expansion with	https://spa	https://spaceflightnow.com/2015
39	273	Space Fligh		[]	March 30, 2015	Chinese navigation system enters new phase	https://spa	https://spaceflightnow.com/2015

Timeline

January 22

Introduction

- Start of the Semester
- Handover changes

February 22

Project intro

- Handover project
- Kick-off meeting
- Brainstorming
- Tasks Division
- Meeting with Dr. Davidian
- Data inspection
- Literature Review

March 22

Database & Visualization

- Data cleaning
- Querying the data
- Classification
- First testing graphs
- Visualization perspectives
- Crossing database results with industry

April 22

Visualization & Storytelling,

- Visualization ideas
- Starting Storytelling
- Scratch graphs
- Status Presentation
- Scoping Future Research Opportunities

Approach

- Gather and Inspect the Data
- Clean the Data
- Querying the Data
- Classification
- Industry Emergence Characteristics
- Visualization Opportunities
- Visual Storytelling

Q1:

How might we use science, design and visual communication to **facilitate** an **intuitive** overview changes, and an opportunity for early **detection of industry emergence** by 'listening to' the articles' content?



Q3:

How can we **correlate** findings from our own **Database** to current reports provided by the **industry**?

Data



Data - SLV - updates

Event ID	Company Name	Launch Vehicle	Headlines	Month	Year	Author
1	NASA		House subcommittee advances NASA authorization bill		1	2020 Jeff Foust
2	Space Force		U.S. Space Force has lifted off, now the journey begins		1	2020 Sandra Erwin
3	Firefly	Alpha	Firefly suffers anomaly during launch vehicle test		1	2020 Jeff Foust
4	SpaceX	Crew Dragon	SpaceX performs in-flight abort test of Crew Dragon spacecraft		1	2020 Jeff Foust
5	SpinLaunch	Large Mass Accelerator	SpinLaunch raises \$35 million		1	2020 Jeff Foust
6	Arianespace	Ariane 5	Arianespace launches Eutelsat, ISRO satellites on first 2020 mission		1	2020 Caleb Henry
7	The Government of Luxembourg		Luxembourg establishes space industry venture fund		1	2020 Jeff Foust
8	The Commerce Department		Commerce Department seeks big funding boost for Office of Space Commerce		2	2020 Jeff Foust
9	Rocket Lab		Rocket Lab wins contract to launch NASA lunar cubesat mission		2	2020 Jeff Foust
10	Astra	One of Three	Astra emphasizes rapid iteration in its quest for low-cost, rapid launch		2	2020 Jeff Foust
11	Virgin Galactic	SpaceShipTwo	Virgin Galactic's SpaceShipTwo arrives in New Mexico		2	2020 Jeff Foust
12	Blue Origin		Blue Origin opens rocket engine factory		2	2020 Jeff Foust
13	SpaceX		SpaceX launches fifth batch of Starlink satellites, misses booster landing		2	2020 Caleb Henry
14	DARPA		DARPA makes last-minute change to launch competition rules		2	2020 Jeff Foust
15	Space Adventure	Crew Dragon	Space Adventures to fly tourists on Crew Dragon mission		2	2020 Jeff Foust
16	the National Space Council		National Space Council expands membership		2	2020 Jeff Foust
17	NASA		NASA to allow researchers to fly on commercial suborbital vehicles		1	2020 Jeff Foust
18	Expace Technology Co	Kuaizhou-1A	China launches Yinhe-1 commercial low Earth orbit 5G satellite		1	2020 Andrew Jones
19	TriSept	Orbex Prime	TriSept buys Orbex Prime rocket for rideshare flight		1	2020 Debra Werner
20	Orbex	Orbex Prime	Orbex stakes claim to European smallsat launch market		7	2018 Jeff Foust
21	Virgin Galactic	SpaceShipTwo	Virgin Galactic continues work on fleet of SpaceShipTwo vehicles		12	2020 Jeff Foust
22	EU		EU to invest 200 million euros into space industry		1	2020 Jeff Foust
23	Slingshot Aerospace		Slingshot Aerospace gets \$3 million from Air Force, private investors for data analytics technology		3	2020 Sandra Erwin
24	U.S Government		Senate approves coronavirus relief bill with \$10.5 billion for Defense Department		3	2020 Sandra Erwin
25	Northern Sky Research		POWERING SATCOM THROUGH DISTRESSED FINANCIAL MARKETS		3	2020 Gagan Agrawal
26	ITU		ITU Secretary-General Houlin Zhao's statement on the launch of a global platform to help protect space		3	2020 ITU
27	Telstra	TnSS	Telstra touts new satellite to select channel partners		3	2020 Lilia Guan
28	Globalstar		GLOBALSTAR ANNOUNCES 3GPP APPROVAL OF BAND 53 AS A 5G BAND		3	2020 Globalstar
29	Venezuela		Venezuela's flagship communications satellite out of service and tumbling		3	2020 Caleb Henry
30	Rocket Lab	Electron	Rocket Lab kicks off busy year with NRO launch		1	2020 Jeff Foust
31	Dawn Aerospace	Mark 1	Satellite propulsion startup Dawn Aerospace developing small launch vehicle		1	2020 Caleb Henry
32	Astra	Rocket 3.0	Astra unveils plans for frequent, low-cost launches		7	2020 Jeff Foust
33	Rocket Lab	Photon	Rocket Lab turns attention to satellite efforts		5	2020 Jeff Foust

Market Intelligence

Satellite Applications

Catapult was chosen as one of the main resources related to Small Satellite Market Intelligence.



<https://sa.catapult.org.uk/>

**SMALL
SATELLITE
MARKET
INTELLIGENCE
REPORT**

Space Companies Acquired by SPACs

Company	Announced	Offering	SPAC	Ticker Symbol	Valuation*	Merger Closed?
Virgin Galactic	2019	Space tourism	Social Capital Hedosophia	SPCE	\$1.4 billion	Yes
Momentum	2020	In-space transportation and infrastructure	Stable Road Capital	MNTS	\$1.2 billion	No
AST SpaceMobile	2020	Space-based cellular broadband	New Providence	ASTS	\$1.8 billion	Yes
Astra	2021	Launch services	Holicity	ASTR	\$2.1 billion	No
Rocket Lab	2021	Launch services	Vector Acquisition Corporation	RKLB	\$4.1 billion	No
BlackSky	2021	Satellite imagery as a service	Osprey Technology	BKSY	\$1.5 billion	No
Spire	2021	Space-to-cloud data and analytics	NavSight	SPIR	\$1.2 billion	No
Redwire	2021	Space infrastructure technology	Genesis Park Acquisition Corp	GNPK	\$170 million	No

Launch resources

https://www.faa.gov/data_research/commercial_space_data/launches/?type=Licensed



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[Passengers & Cargo](#)

[Research](#)

Licensed Launches



[What's the difference between a Licensed Launch and a Permitted Launch?](#)

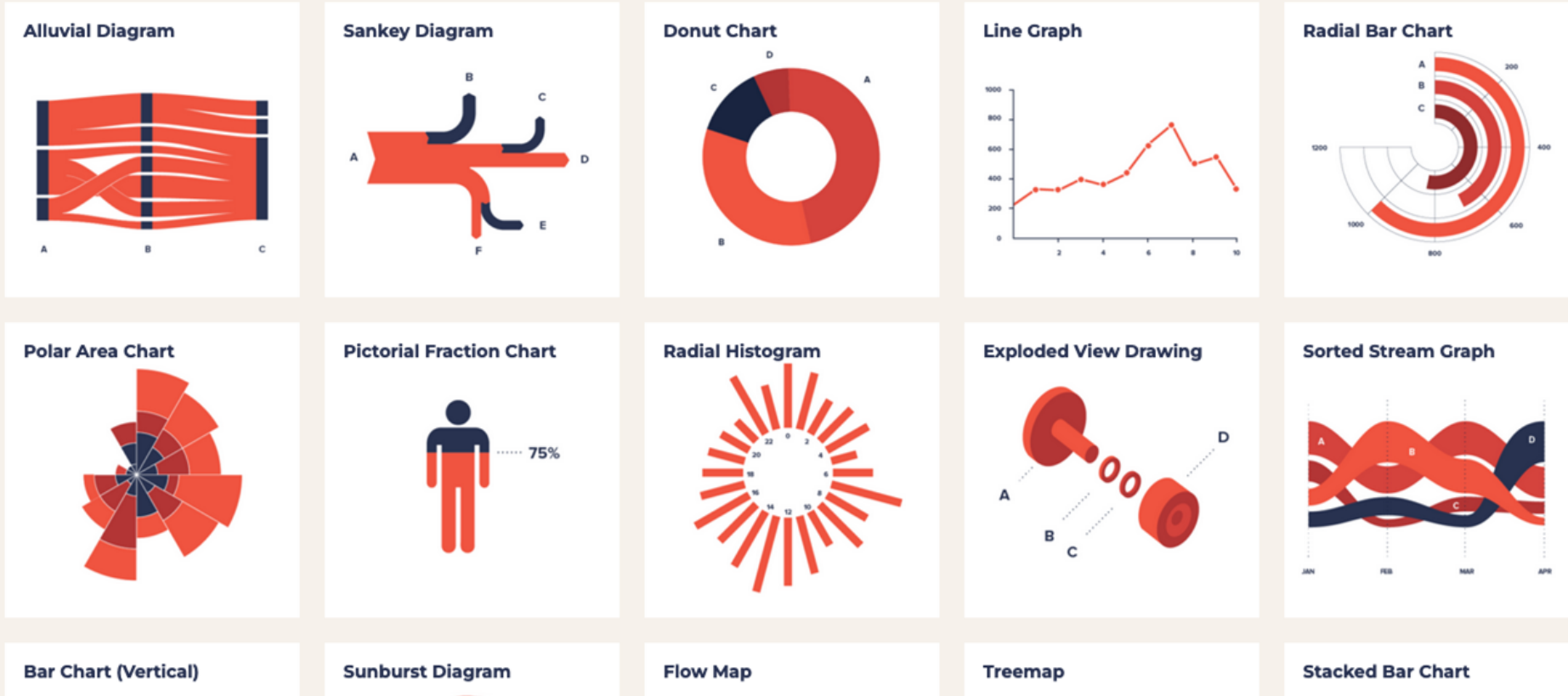
Show entries

Search:

Date	Payload	Vehicle	Company	Site
Apr 2, 2022	FF25 "Without Mission a Beat"	Electron	Rocket Lab Global	NZ 4198
Apr 1, 2022	Transporter-4	Falcon 9	Space Exploration Technologies Corporation	32920 FL
Mar 31, 2022	NS-20/M18	New Shepard	Blue Origin	79855

Visualization Library

<https://datavizproject.com/>



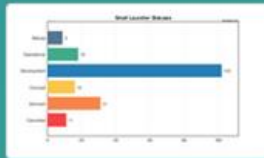


Small Satellite Launchers

Aiming to gather all small launchers (microlaunchers) with up to 1500 kg performance to SSO. Active, planned and cancelled initiatives included.

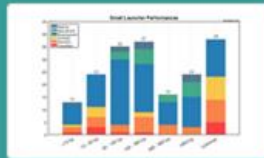
Erik Kulu. "Small Launchers: 2021 Industry Survey and Market Analysis." 72nd International Astronautical Congress (IAC 2021). Oct 29, 2021.

Erik Kulu. "Satellite Constellations - 2021 Industry Survey and Trends." 35th Annual Small Satellite Conference. Aug 10, 2021.



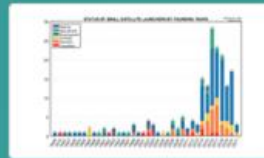
Statuses

large | pdf | svg



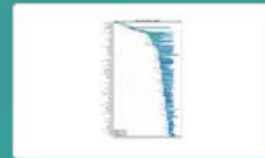
Performances

large | pdf | svg



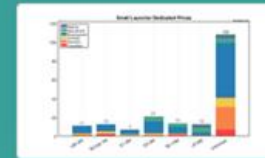
Founded

large | pdf | svg



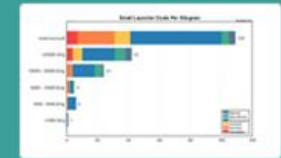
Timelines

large | pdf | svg



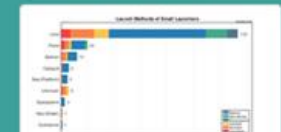
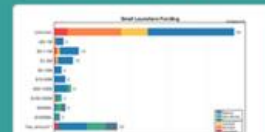
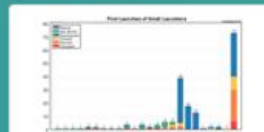
Prices

large | pdf | svg
















Prices per Kg

large | pdf | svg



SLVs

187 launchers in this table.

Organization	Launcher	Founded	Status	First Launch	Launches	Cost	Performance	Price per kg	Funding	Logo	Photo
Northrop Grumman	Pegasus (XL)	1994	Operational	1990	45	\$56M	443 kg	126410 \$/kg	Yes		
MITT	Start-1	1991	Operational	1993	7	-	167 kg	-	Yes		
Northrop Grumman	Minotaur C (Taurus-XL)	1989	Operational	1994	12	\$50M	1054 kg	47440 \$/kg	Yes		
Lockheed Martin	Athena-1	1993	Retired	1995	4	\$17M	794 kg	21410 \$/kg	Yes		
Makeyev OKB	Shtil	1947	Retired	1998	2	-	160 kg	-	Yes		
Lockheed Martin	Athena-2	1993	Retired	1998	3	\$65M	1165 kg	55790 \$/kg	Yes		
Northrop Grumman	Minotaur I	1997	Operational	2000	12	-	331 kg	-	Yes		
CASC	Kaituoze-1 (KT-1)	1998	Retired	2002	2	-	100 kg	-	Yes		
SpaceX	Falcon 1 / Falcon 1e	2002	Retired	2006	5	\$11M	1000 kg	11000 \$/kg	\$1B+		
KARI	Naro (KSLV-1)	2002	Retired	2009	3	-	100 kg	-	\$490M		
AJRD	SPARK / Super Strypi	1942	Retired	2015	1	\$15M	300 kg	50000 \$/kg	Yes		
CALT	Long March 11 (CZ-11, SD-2)	2008	Operational	2015	11	-	350 kg	-	Yes		
CASC	Long March 6	2009	Operational	2015	7	-	1080 kg	-	Yes		
JAXA	SS-520-4	2003	Retired?	2017	2	\$3.5M	4 kg	875000 \$/kg	Yes		
ExPace / CASIC	Kuaizhou-1A (Fei Tian 1)	2016	Operational	2017	14	\$6M	300 kg	20000 \$/kg	Yes		

Types of Innovation



<p>PROFIT MODEL</p> <p>The way in which you make money</p> <p><i>For example, how Netflix turned the video rental industry on its head by implementing a subscription model</i></p>	<p>STRUCTURE</p> <p>Alignment of your talent and assets</p> <p><i>For example, how Whole Foods has built a robust feedback system for internal teams</i></p>	<p>PRODUCT PERFORMANCE</p> <p>Distinguishing features and functionality</p> <p><i>For example, how OXO Good Grips cost a premium but its “universal design” has a loyal following</i></p>	<p>SERVICE</p> <p>Support and enhancements that surround your offerings</p> <p><i>For example, how “Deliver WOW through service” is Zappos’ #1 internal core value</i></p>	<p>BRAND</p> <p>Representation of your offerings and business</p> <p><i>For example, how Virgin extends its brand into sectors ranging from soft drinks to space travel</i></p>
<p>NETWORK</p> <p>Connections with others to create value</p> <p><i>For example, how Target works with renowned external designers to differentiate itself</i></p>	<p>PROCESS</p> <p>Signature or superior methods for doing your work</p> <p><i>For example, how Zara’s “fast fashion” strategy moves its clothing from sketch to shelf in record time</i></p>	<p>PRODUCT SYSTEM</p> <p>Complementary products and services</p> <p><i>For example, how Nike+ parlayed shoes, sensors, apps and devices into a sport lifestyle suite</i></p>	<p>CHANNEL</p> <p>How your offerings are delivered to customers and users</p> <p><i>For example, how Nespresso locks in customers with its useful members only club</i></p>	<p>CUSTOMER ENGAGEMENT</p> <p>Distinctive interactions you foster</p> <p><i>For example, how Wii’s experience draws more from the interactions in the room than on-screen</i></p>

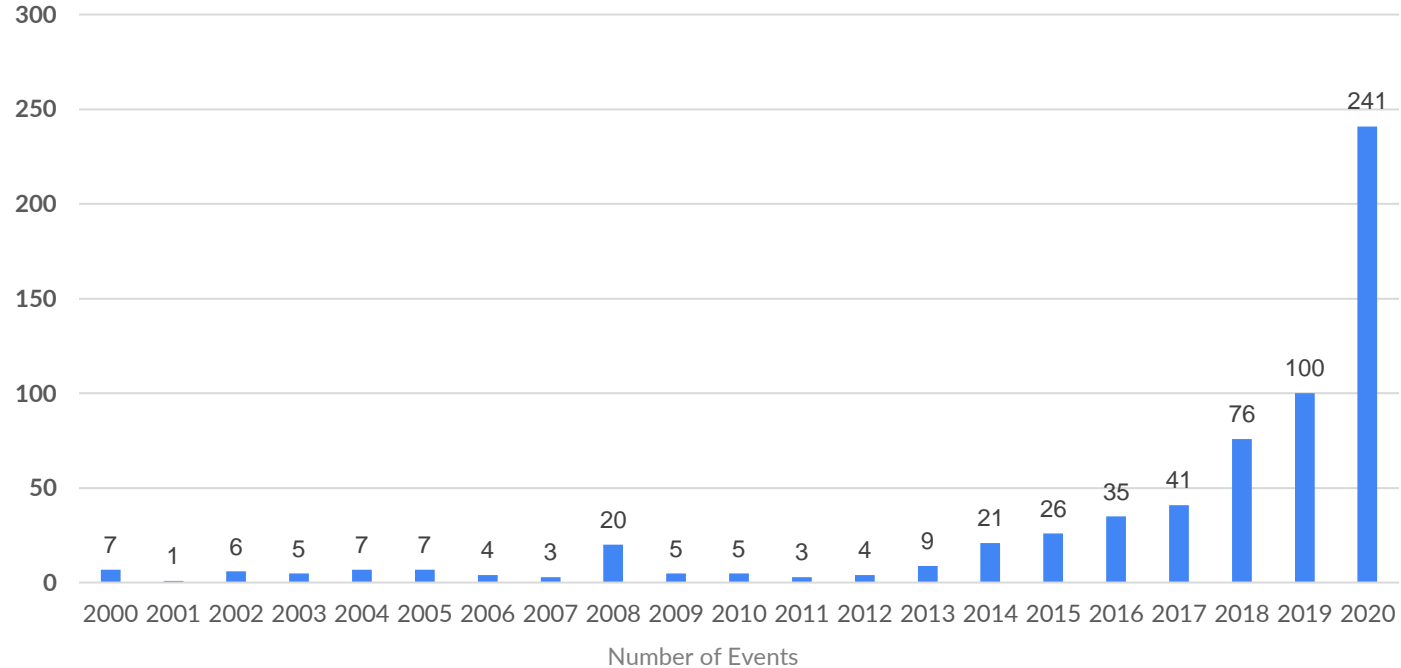
Source: <https://dublin.com/ten-types>

Preliminary Findings



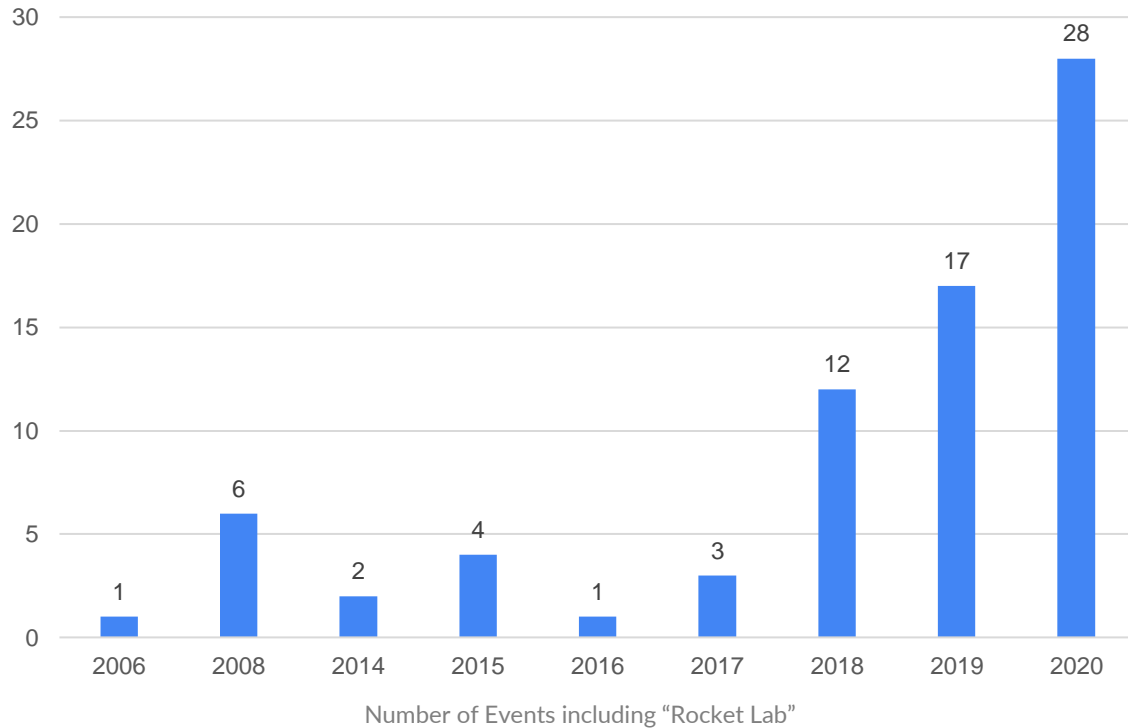
Image Source: NASA

Database – Events vs Time



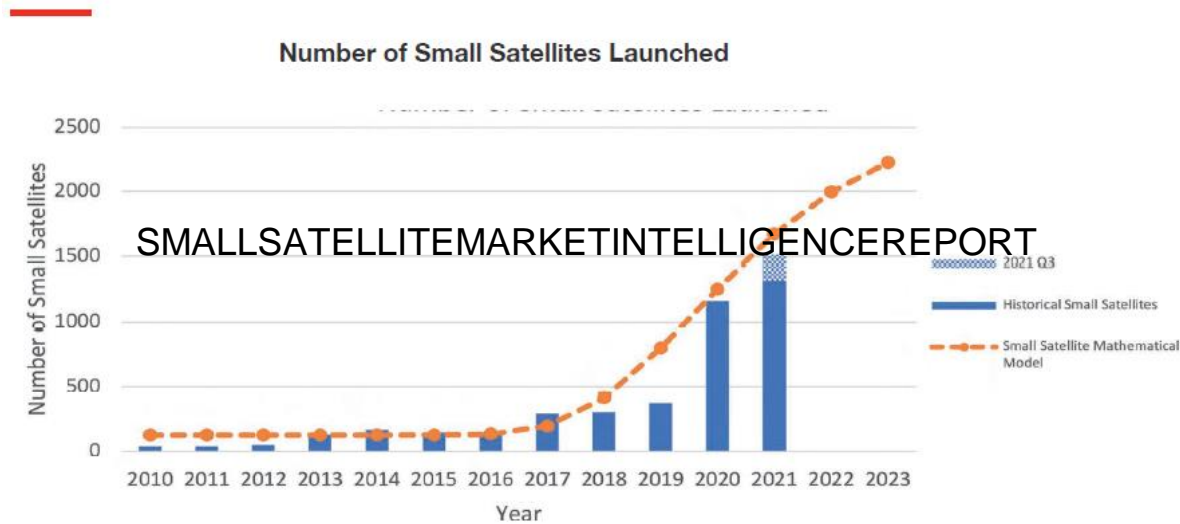
Source: Own Database

Rocket Lab – Events vs Time



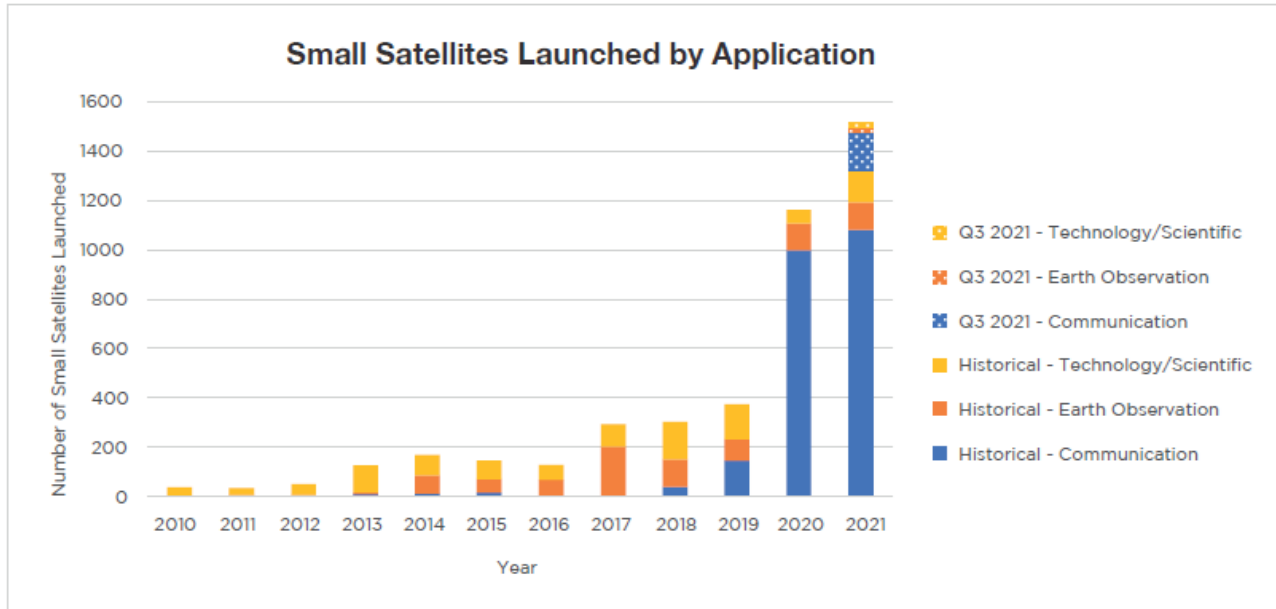
Source: Own Database

Number of Small Satellites Launched



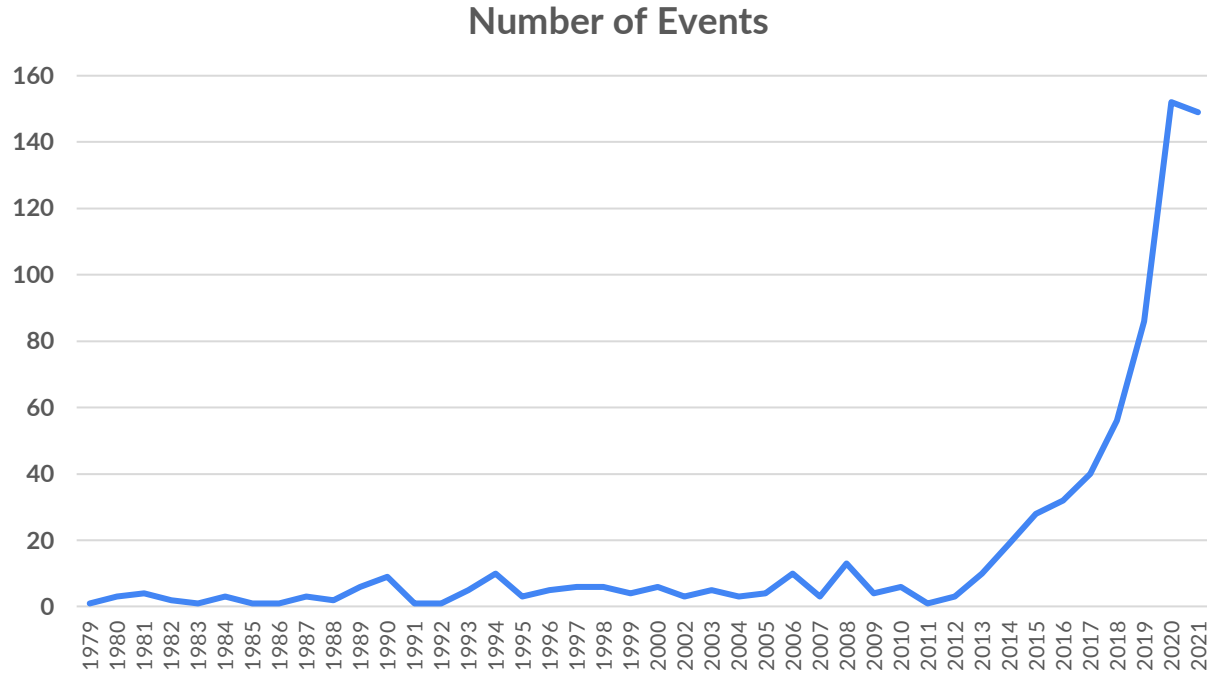
Source: Small Satellite Market Intelligence Report – Q3 2021 / Catapult Satellite Application

Small Satellites by Application



Source: Small Satellite Market Intelligence Report – Q3 2021 / Catapult Satellite Application

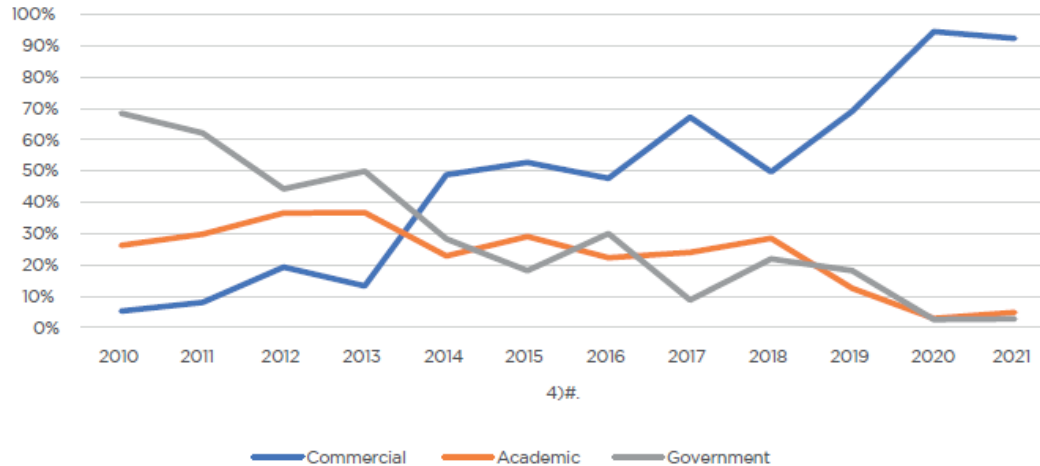
Events - counting



Source: Own Database

Percentage Share

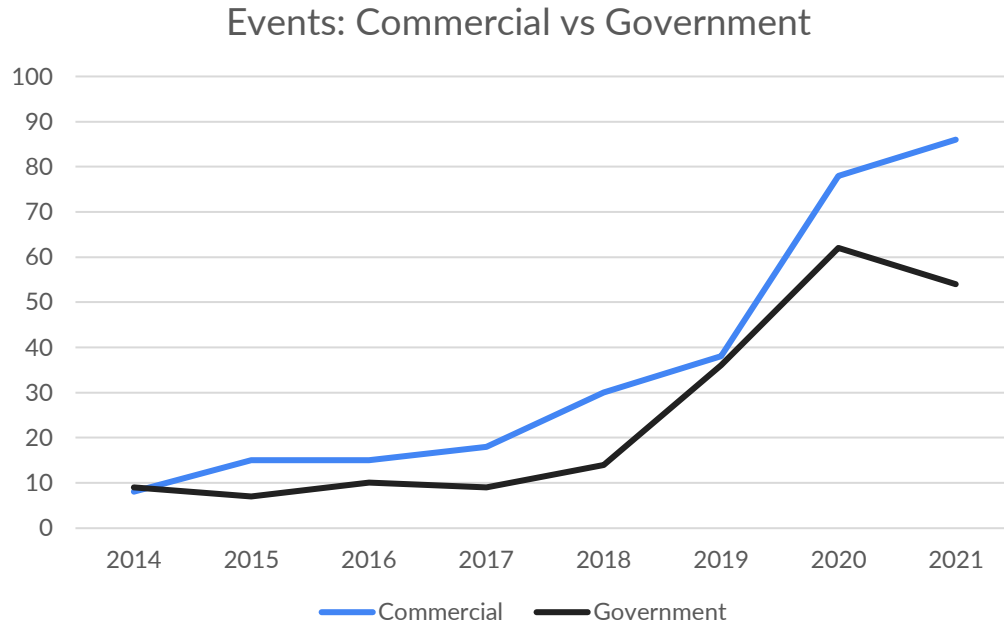
Small Satellites Launched by Organisation



Source: Small Satellite Market Intelligence Report – Q3 2021 /
Catapult Satellite Application

Preliminary Results

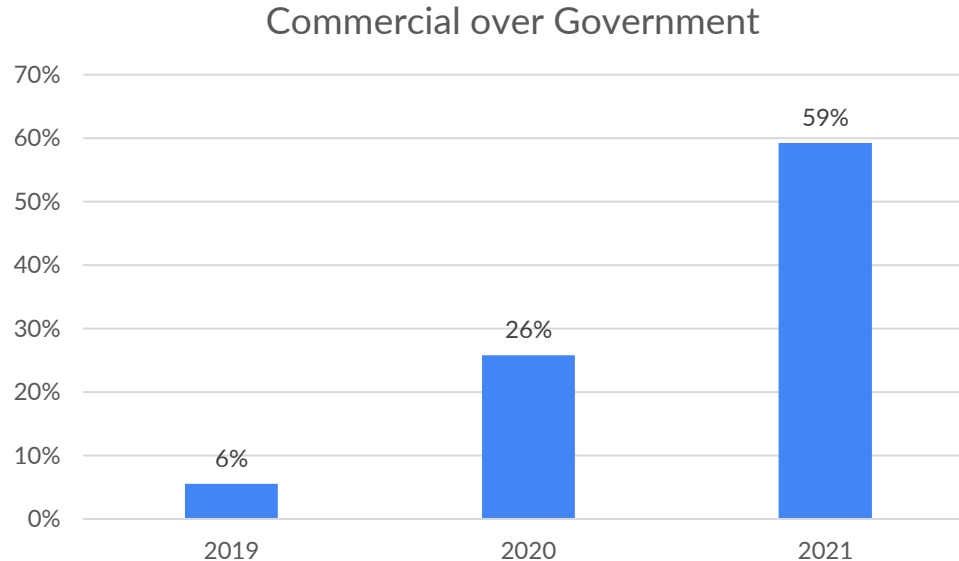
In our data base, we used the search of “Commercial” and “Government” words, the following chart shows the quantitative results for this search.



Source: Own Database

Preliminary Results

In our data base, we used the search of “Commercial” and “Government” words, the following chart shows how much more “Commercial” appears over the presence of “Government”.



Source: Own Database

Constellations Data

July 28, 2014	Space surveillance craft launched by Delta 4	https://spa htt
October 8, 2014	Galileo launch failure blamed on frozen Freg	https://spa htt
October 12, 2014	Winds sensor opens door for Earth science fr	https://spa htt
October 13, 2014	GPS modernization continues with quick pac	https://spa htt
October 14, 2014	Indian navigation satellite ready for launchO	https://spa htt
October 15, 2014	Indian navigation satellite launched by PSLV	https://spa htt
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December 16, 2014	ULA year in reviewDecember 16, 2014Justin	https://spa htt
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March 30, 2015	Chinese navigation system enters new phase	https://spa htt



Image Source: NASA

Keyword Search - Constellations

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Authc	Compa	Orbit	Date	articles post	Links	References	Year	failure	success	launch	invest	acqui	demand	profit	revenue	innovat	
2	588	Space Fligh		July 28, 2014	Space surveillance craft launched by Delta 4	https://spa	https://spaceflightnow.com/2014/07/	2014	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
3	586	Space Fligh		October 8, 2014	Galileo launch failure blamed on frozen Fregr	https://spa	https://spaceflightnow.com/2014/10/	2014	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
4	585	Space Fligh		October 12, 2014	Winds sensor opens door for Earth science fr	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
5	584	Space Fligh		October 13, 2014	GPS modernization continues with quick pac	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
6	269	Space Fligh		October 14, 2014	Indian navigation satellite ready for launchO	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
7	268	Space Fligh		October 15, 2014	Indian navigation satellite launched by PSLVI	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8	267	Space Fligh		October 25, 2014	Atlas 5 to fly Wednesday, continuing rapid d	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
9	341	Space Fligh		October 27, 2014	Atlas 5/GPS 2F-8 launch timelineOctober 27,	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
10	583	Space Fligh		October 27, 2014	China launches third space mission in a week	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
11	582	Space Fligh		October 28, 2014	Atlas 5 rocket rolled to Cape Canaveral launc	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
12	266	Space Fligh		October 29, 2014	50th Atlas 5 rocket puts up new GPS satellite	https://spa	https://spaceflightnow.com/2014/10/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
13	265	Space Fligh		November 7, 2014	U.S. Navy communications satellite shipped	https://spa	https://spaceflightnow.com/2014/11/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
14	581	Space Fligh		December 1, 2014	Soyuz rocket deploys upgraded Russian navig	https://spa	https://spaceflightnow.com/2014/12/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
15	340	Space Fligh		December 16, 2014	ULA year in reviewDecember 16, 2014Justin	https://spa	https://spaceflightnow.com/2014/12/	2014	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
16	264	Space Fligh		December 18, 2014	Newest GPS satellite goes activeDecember 18	https://spa	https://spaceflightnow.com/2014/12/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
17	263	Space Fligh		December 19, 2014	Third quartet of satellites launched for O3b N	https://spa	https://spaceflightnow.com/2015/01/	2014	TRUE	TRUE	TRUE	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	TRUE
18	580	Space Fligh		December 19, 2014	13 launches on manifest for ULA in 2015Dec	https://spa	https://spaceflightnow.com/2014/12/	2014	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
19	262	Space Fligh		December 29, 2014	O3b Networks plans satellite fleet expansion	https://spa	https://spaceflightnow.com/2014/12/	2014	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
20	261	Space Fligh		January 7, 2015	Navy satellite to be hoisted atop rocket for Ja	https://spa	https://spaceflightnow.com/2015/01/	2015	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
21	339	Space Fligh		January 17, 2015	Preview: Navy craft to ride milestone Atlas-C	https://spa	https://spaceflightnow.com/2015/01/	2015	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
22	260	Space Fligh		January 21, 2015	Recap story: 200th Atlas-Centaur launching c	https://spa	https://spaceflightnow.com/2015/01/	2015	FALSE	TRUE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
23	259	Space Fligh		January 22, 2015	Did two more Iridium satellites collide with	https://spa	https://spaceflightnow.com/2015/01/	2015	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
24	257	Space Fligh		February 6, 2015	Galileo satellite deployment campaign to res	https://spa	https://spaceflightnow.com/2015/02/	2015	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
25	258	Space Fligh		February 6, 2015	New Navy satellite spreads wings, unfurls ant	https://spa	https://spaceflightnow.com/2015/02/	2015	FALSE	TRUE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE
26	256	Space Fligh		February 27, 2015	Four satellites mated to Atlas 5 rocketFebru	https://spa	https://spaceflightnow.com/2015/02/	2015	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
27	254	Space Fligh		March 4, 2015	Power system failure likely cause of military	https://spa	https://spaceflightnow.com/2015/03/	2015	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
28	255	Space Fligh		March 4, 2015	Liftoff of Indian navigation satellite postpone	https://spa	https://spaceflightnow.com/2015/03/	2015	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
29	579	Space Fligh		March 8, 2015	Preview: Atlas 5 rocket to launch NASA magn	https://spa	https://spaceflightnow.com/2015/03/	2015	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
30	338	Space Fligh		March 11, 2015	Atlas 5 rolled to the pad for Thursday night's	https://spa	https://spaceflightnow.com/2015/03/	2015	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
31	578	Space Fligh		March 15, 2015	Delta/GPS 2F-9 launch timelineMarch 15, 20	https://spa	https://spaceflightnow.com/2015/03/	2015	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
32	253	Space Fligh		March 21, 2015	Arianespace to launch satellites for Earth ima	https://spa	https://spaceflightnow.com/2015/03/	2015	FALSE	FALSE	TRUE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
33	337	Space Fligh		March 22, 2015	Preview: 10 months, 4 launches to finish GPS	https://spa	https://spaceflightnow.com/2015/03/	2015	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
34	577	Space Fligh		March 24, 2015	Photos: Soyuz rocket transferred to jungle lai	https://spa	https://spaceflightnow.com/2015/03/	2015	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
35	576	Space Fligh		March 25, 2015	Recap story: New bird flies for GPS navigatio	https://spa	https://spaceflightnow.com/2015/03/	2015	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
36	336	Space Fligh		March 27, 2015	Managers confident ahead of critical launch f	https://spa	https://spaceflightnow.com/2015/03/	2015	TRUE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE

Keyword Search - Constellations

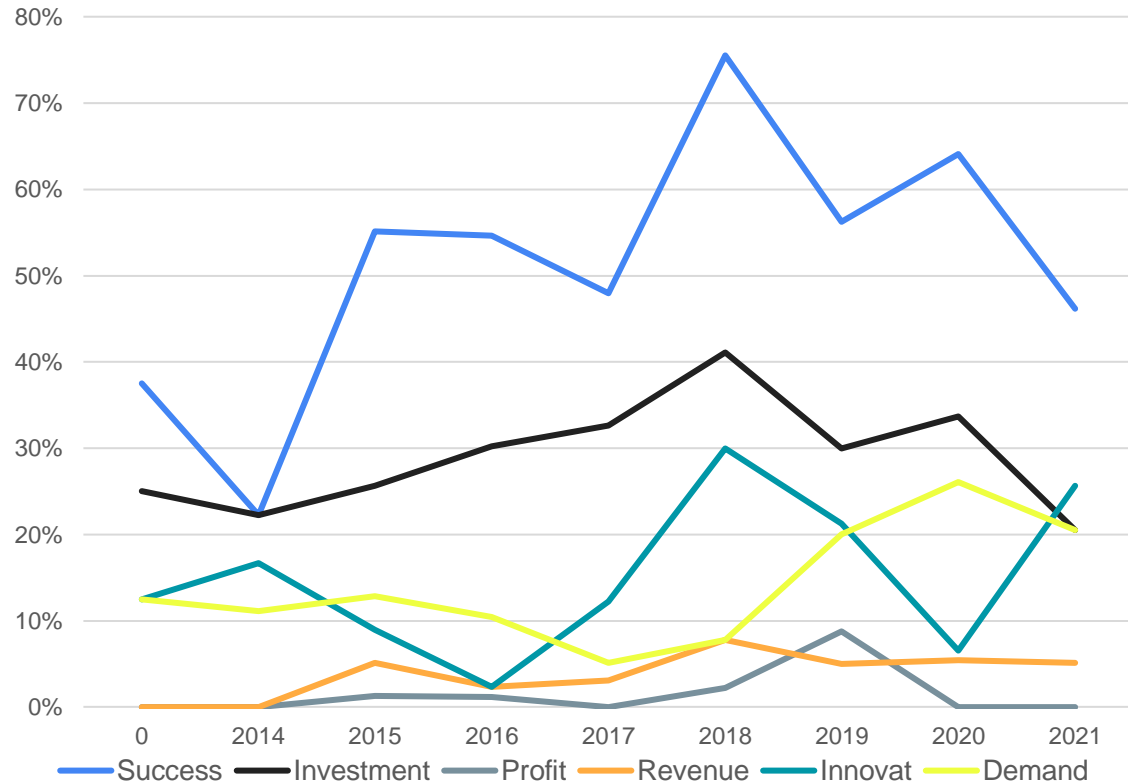
Success
Launch
Failure /fail/

Invest
Demand
Acquire /aqui/

Profit
Revenue
Innovation /innovat/

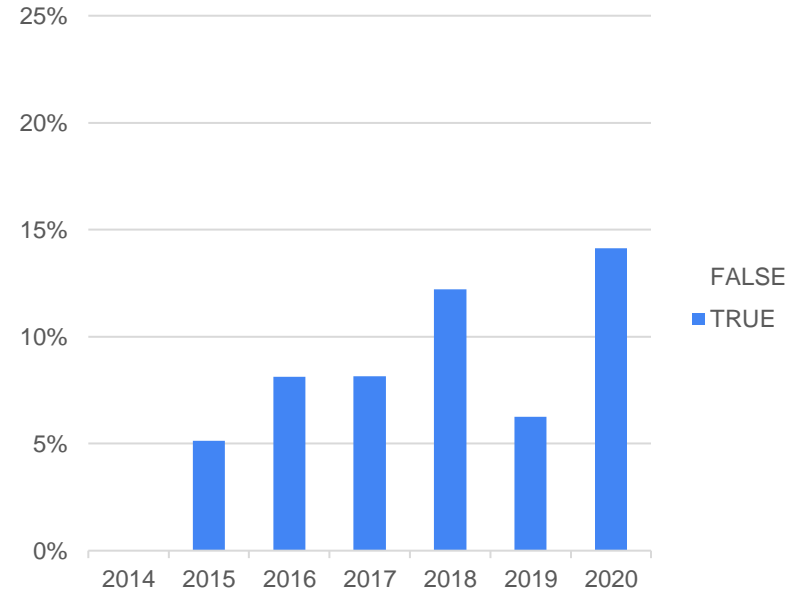
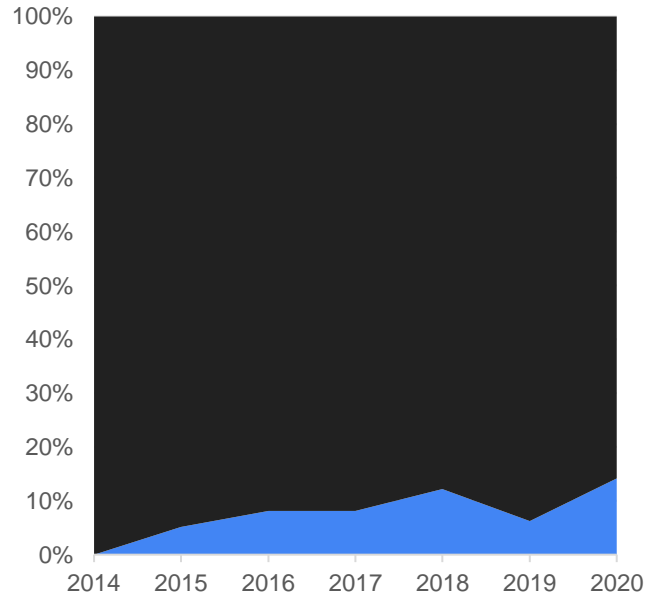
Incidence of Keywords

Incidence of keywords in articles (%)



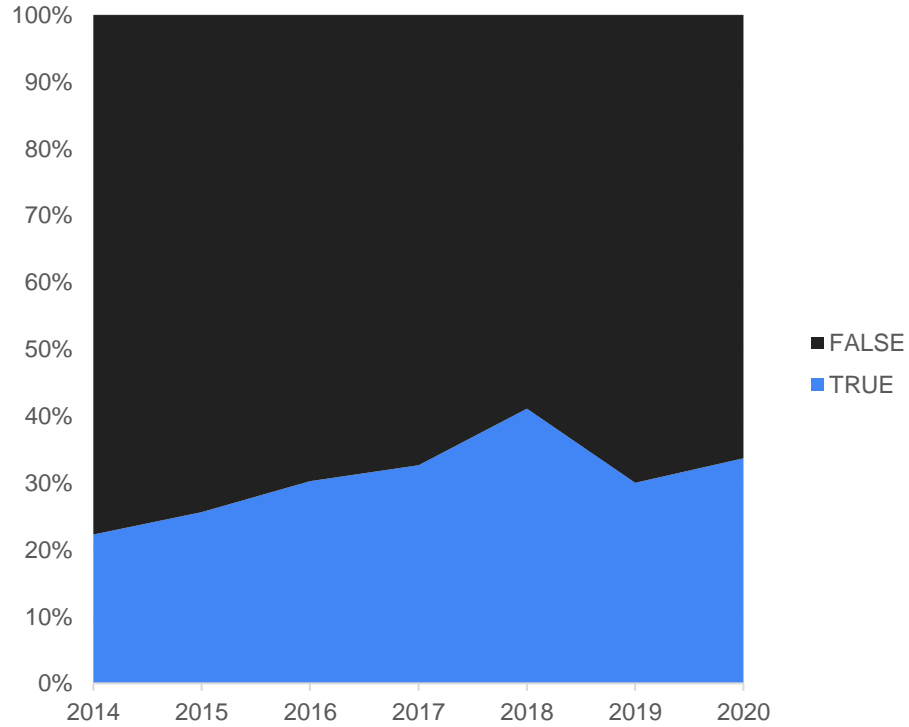
Source: Own Database

Acquisition



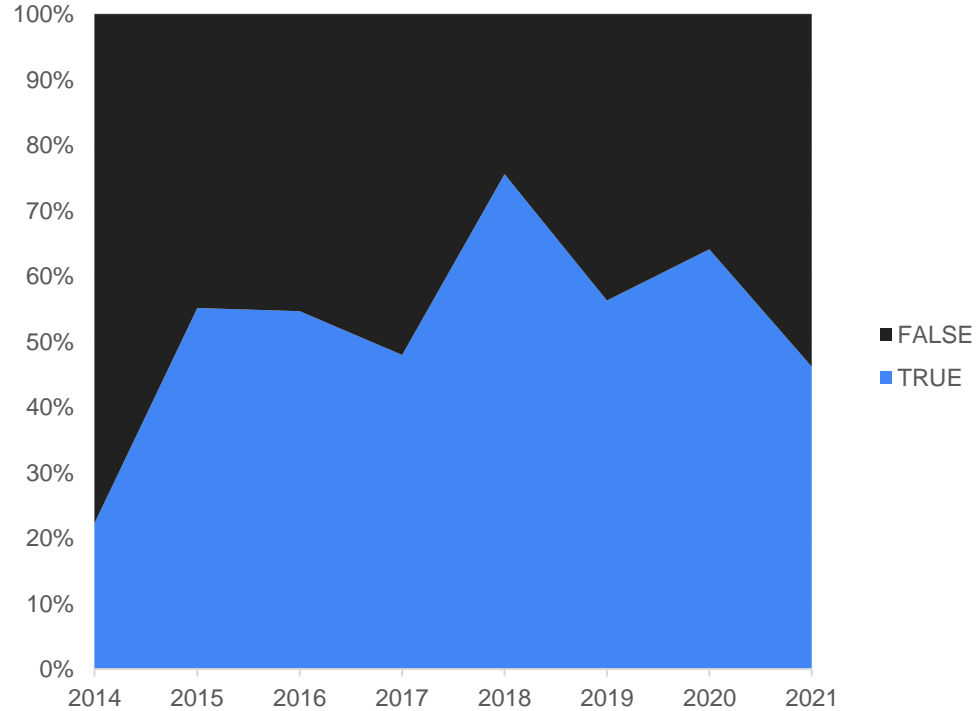
Source: Own Database

Invest



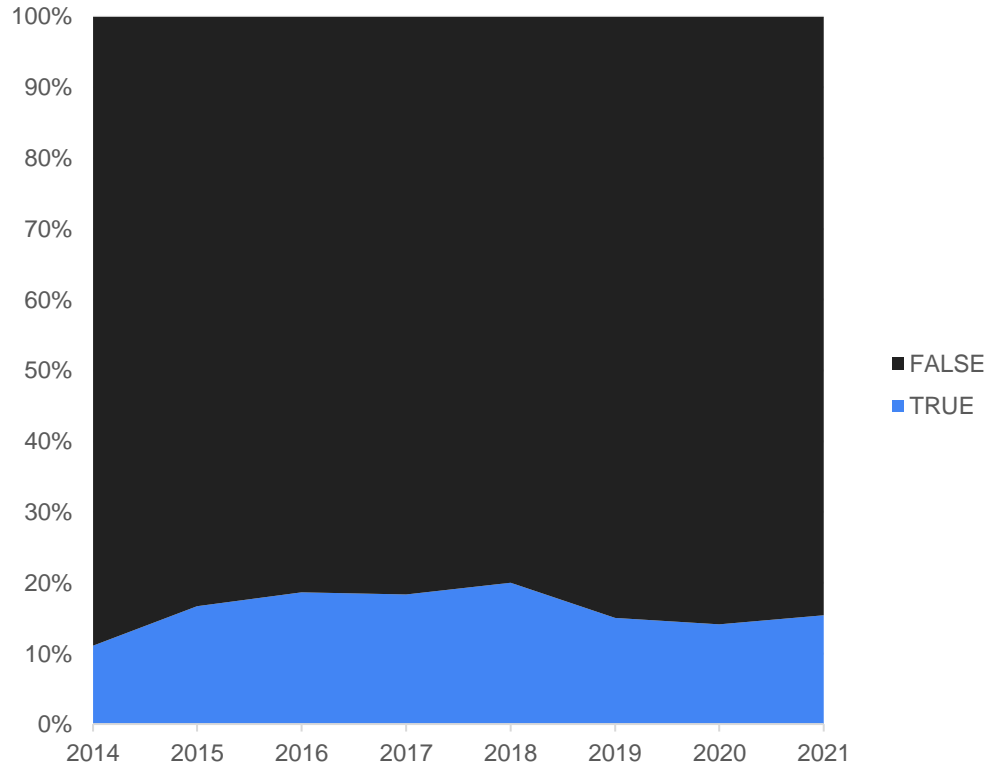
Source: Own Database

Success



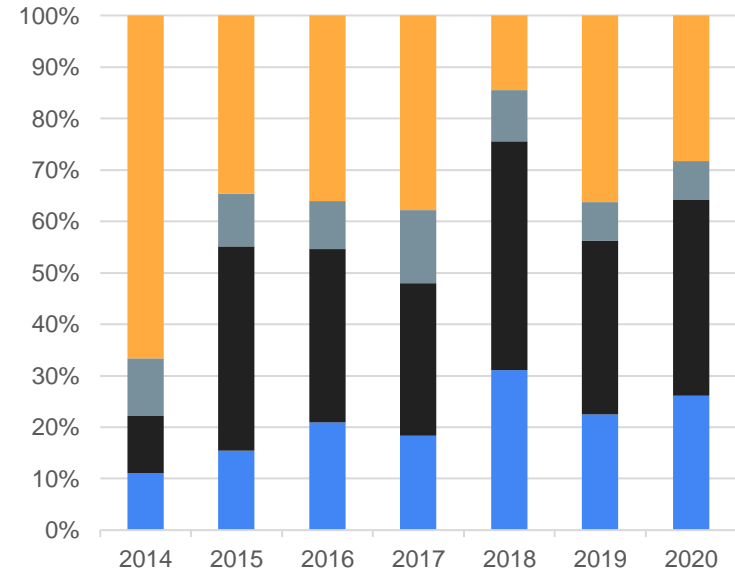
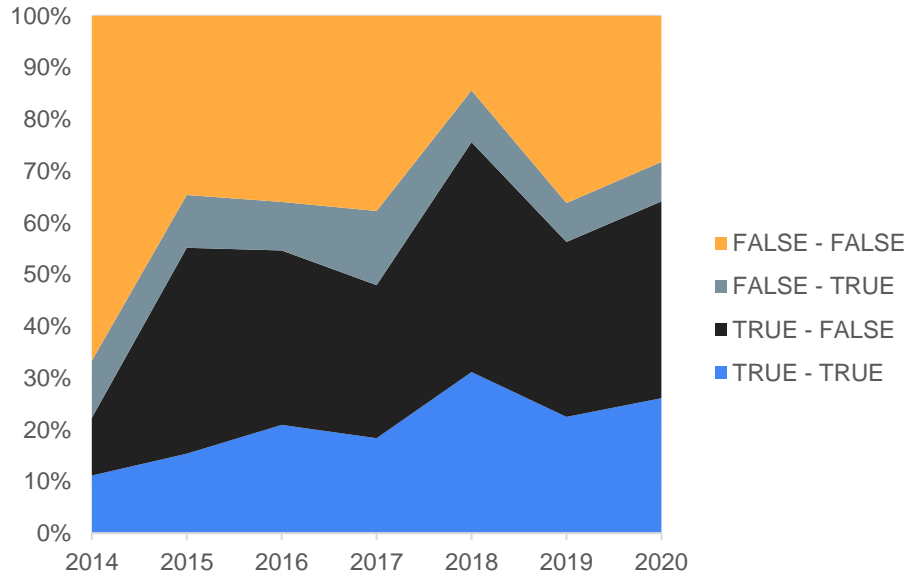
Source: Own Database

Failure



Source: Own Database

Invest & Success - simultaneous word occurrence



Source: Own Database

Launchers



III	Headline	Outcomes	Category	Country	IOR	Y	Q	Y	Q	Y	Q	Y	Q
2.2.8	Ventum C: Astra raises \$90	Funding	Satellite	United States	FALSE	1900	1	1	1900-1				
2.2.8	Ventum C: One of the world's	Funding	Satellite	United States	FALSE	1900	1	1	1900-1				
3.3.6	Non-Gov: Malaysian satellite to	Announcement of	Launch	Russia	FALSE	1900	1	1	1900-1				
1.1.5	Industry R: Australia updates	Creation Event	Launch	Australia	TRUE	2019	8	3	2019-3				
1.1.5	Industry R: Australia to establish	Creation Event	Government	Australia	FALSE	2017	9	3	2017-3				
3.1.3	Testing: Vega's Zefiro 9 Engine	Reveal of Name,	Launch	Italy	FALSE	2020	10	4	2020-4				
3.3.2	Cultural N: Q&A Avio CEO Ranzo	Reveal of Name,	Launch	EU	FALSE	2016	11	4	2016-4				
2.1.1	Gov't Cont: ESA pours \$107 million	Funding	Launch	EU	TRUE	2017	11	4	2017-4				
2.2.4	Equity Inv: Small-rocket builder	Funding	Launch	TRUE	2017	5	2	2017-2					
3.3.3	Government: Axion to fly Crew	Reveal of Name,	Launch	United States	FALSE	1900	1	1	1900-1				
3.3.5	Firm creat: Beijing Interstellar Glory	Creation Event	Launch	China	FALSE	2016	10	4	2016-4				
2.2.4	Equity Inv: Beijing Interstellar Glory	Funding	Launch	China	TRUE	2020	8	3	2020-3				
3.3.5	Firm creat: For Entrepreneur, Fly	Creation Event	Launch	United States	FALSE	1900	1	1	1900-1				
3.3.5	Firm creat: Bigelow Aerospace lays	Expression of	Launch	United States	FALSE	1900	1	1	1900-1				
3.1.1	Manufact: Blue Origin opens	Reveal of Name,	Launch	United States	FALSE	1900	1	1	1900-1				
3.1.3	Testing: Blue Origin's New	Successful	Launch	United States	FALSE	2020	10	4	2020-4				
2.3.2	Recrui: Blue Origin creates	Reveal of Name,	Launch	United States	FALSE	2020	12	4	2020-4				
2.2.7	Common S: Betos Casting in \$3.1	Funding	Launch	United States	FALSE	2020	11	4	2020-4				
3.1.3	Testing: Startup tests hybrid	Successful	Launch	United States	FALSE	2021	1	1	2021-1				
3.3.5	Firm creat: One Small Step for	Creation Event	Launch	United States	FALSE	2014	1	1	2014-1				
2.2.2	Gov't Cont: One Small Step for	Funding	Launch	United States	FALSE	2014	1	1	2014-1				
3.1.1	Manufact: Boeing Studying Air-	Reveal of Name,	Launch	United States	FALSE	1900	1	1	1900-1				
3.1.1	Manufact: Business Digest	Reveal of Name,	Launch	United States	FALSE	1900	1	1	1900-1				
3.1.3	Testing: Boeing to fly second	Announcement of	Launch	United States	FALSE	1900	1	1	1900-1				
3.3.1	Marketing: Boeing launches	Creation Event	Launch	United States	FALSE	1900	1	1	1900-1				
1.1.5	Industry R: BRAZIL: TO SIGN	Creation Event	Government	United States	FALSE	1900	1	1	1900-1				
1.1.3	Launch Lic: Brazilian Space Agency	Receipt of	Launch	Brazil	TRUE	2020	12	4	2020-4				
3.3.5	Firm creat: Brazil Plans Launch of	Creation Event	Launch	Brazil	TRUE	2020	10	4	2020-4				
2.2.5	Industry-V: Brazilian Space Sector	Creation Event	Government	Brazil	TRUE	2020	9	3	2020-3				
Gov't Programs	Quitting the space race	Creation Event	Government	EU	FALSE	1900	1	1	1900-1				
2.2.6	Gov't Prog: KINGDOM:	Funding	Launch	EU	FALSE	1900	1	1	1900-1				
2.2.4	Equity Inv: British government and	Creation Event	Satellite	EU	FALSE	1900	1	1	1900-1				
2.2.5	Industry-V: Startup financing	Funding	Launch	United States	FALSE	1900	1	1	1900-1				
3.2.4	Partnersh: Spaceport America and	Reveal of Name,	Spaceport	United States	TRUE	2020	10	4	2020-4				
3.3.6	Non-Gov: Cancom Announces	Reveal of Name,	Satellite	United States	FALSE	1900	1	1	1900-1				
2.2.7	Common S: Cancom announces sale	Funding	Satellite	United States	FALSE	1900	1	1	1900-1				
2.2.7	Common S: Cancom Sells Shares in	Other	Satellite	Canada	FALSE	1900	1	1	1900-1				
3.3.2	Cultural N: How many small launch	Expression of	Launch	United States	FALSE	1900	1	1	1900-1				
3.1.1	Manufact: Chinese rocket	Launch	China	FALSE	2020	9	3	2020-3					
3.1.3	Testing: Launch of China's new	Expression of	Launch	China	FALSE	1900	1	1	1900-1				
3.3.3	Government: Long March launches	Successful	Launch	China	FALSE	1900	1	1	1900-1				
3.3.6	Non-Gov: China launches third	Creation Event	Launch	China	FALSE	1900	1	1	1900-1				
3.3.6	Non-Gov: China resumes space	Successful	Launch	United States	FALSE	1900	1	1	1900-1				
	China Launches New	Successful	Launch	China	FALSE	2013	9	3	2013-3				
3.1.1	Manufact: Kuaizhou (Fast Vessel)	Creation Event	Launch	China	FALSE	2009	1	1	2009-1				
3.1.3	Testing: Kuaizhou first test	Successful	Launch	China	FALSE	2012	3	1	2012-1				
3.2.2	Merger: Kuaizhou (Fast Vessel)	Reorganization	Launch	China	TRUE	2011	1	1	2011-1				
3.3.3	Government: China Launches Two	Reveal of Name,	Launch	China	FALSE	2014	11	4	2014-4				
3.3.6	Non-Gov: Chinese Kuaizhou 1A	Expression of	Launch	China	FALSE	2020	9	3	2020-3				
3.3.6	Non-Gov: Chinese commercial	Creation Event	Launch	China	FALSE	2020	4	2	2020-2				
2.2.2	Gov't Cont: China successfully	Funding	Launch	United States	FALSE	2012	11	4	2012-4				
3.1.3	Testing: Chinese new-	Creation Event	Launch	United States	FALSE	1900	1	1	1900-1				
3.3.6	Non-Gov: Celcom develops	Creation Event	Satellite	United States	FALSE	1900	1	1	1900-1				
2.2.9	Gov't Gran: Celesta UK to develop	Reveal of Name,	Satellite	EU	FALSE	1900	1	1	1900-1				
3.3.4	Consumer: New launch complex for	Reveal of Name,	Spaceport	China	FALSE	2021	2	1	2021-1				
3.3.6	Non-Gov: Long March 11	Successful	Launch	China	FALSE	2020	12	4	2020-4				
3.3.6	Non-Gov: First launch of Chinese	Expression of	Launch	China	FALSE	2020	7	3	2020-3				
3.3.3	Government: China to construct	Reveal of Name,	Launch	China	FALSE	2021	3	1	2021-1				
3.3.3	Government: Successful launch takes	Successful	Satellite	United States	FALSE	1900	1	1	1900-1				
3.3.3	Government: China launches Shiyan-	Creation Event	Launch	China	FALSE	1900	1	1	1900-1				
3.3.6	Non-Gov: China to continue world-	Other	Launch	China	FALSE	1900	1	1	1900-1				
3.1.3	Testing: Long March 3B carrying	Launch Failed	Launch	China	FALSE	1900	1	1	1900-1				
3.3.6	Non-Gov: Chinese Long March 6	Successful	Launch	China	FALSE	2020	11	4	2020-4				
3.3.6	Non-Gov: Chinese Long March 11	Successful	Launch	China	FALSE	2020	9	3	2020-3				
3.2.4	Partnersh: E-Town Capital invests	Creation Event	Launch	China	TRUE	2016	11	4	2016-4				
3.3.5	Firm creat: E-Town Capital invests	Creation Event	Launch	China	FALSE	2016	11	4	2016-4				
3.3.6	Non-Gov: China's commercial	Creation Event	Launch	China	FALSE	2019	8	3	2019-3				
3.1.1	Manufact: China moving to	Creation Event	Launch	China	FALSE	1900	1	1	1900-1				
1.2.2	Regulation: Guiding Opinions of the	Passage of Law	Government	China	TRUE	2014	11	4	2014-4				
3.3.3	Cultural N: Space industry annou-	Expression of	Government	United States	FALSE	1900	1	1	1900-1				

Launchers

Inclusion for SVLS

vehicle	TOT
Electron	190
LauncherOne	
vega	
vega C	
Vega	
Vega C	
Alpha	
Alpha 1	

Rocket Lab's Electron - (list of all launches)

Virgin Orbit's LauncherOne - (list of launches)

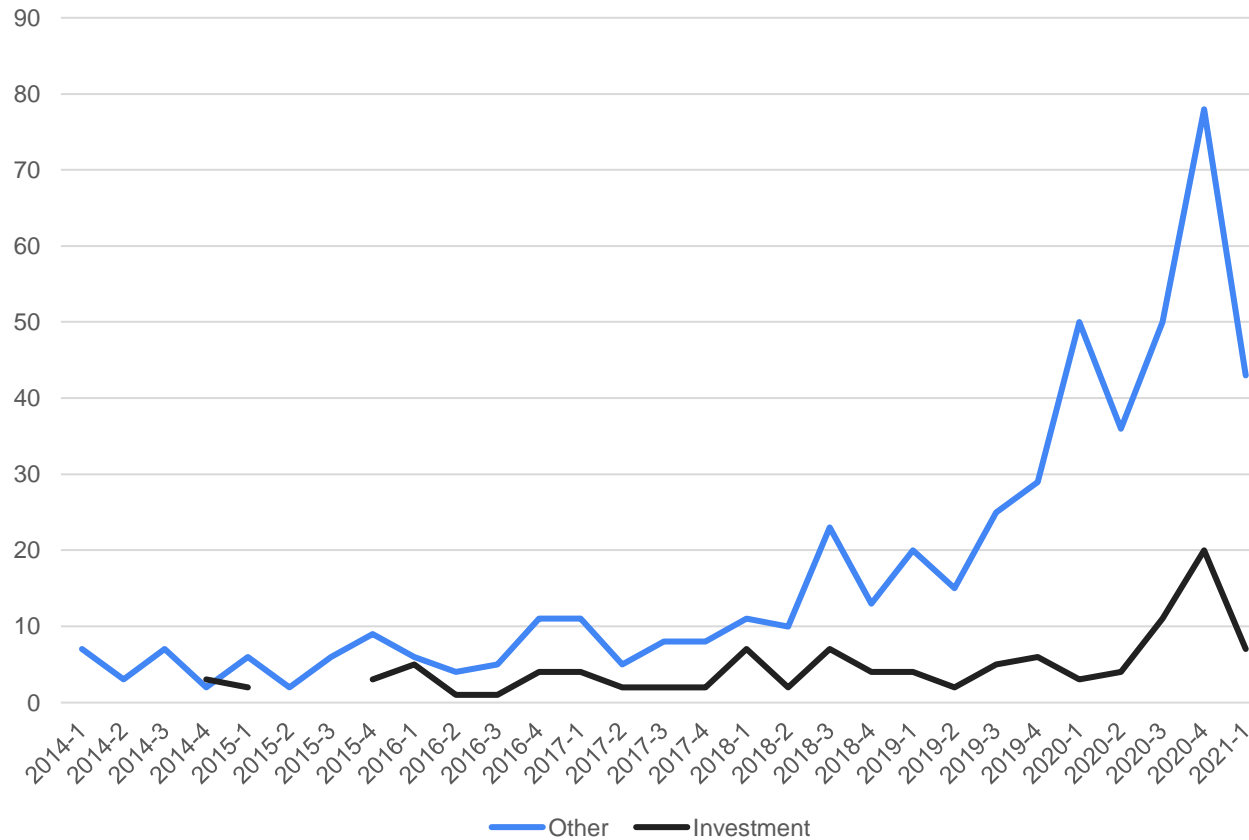
Astra's Rocket - (list of launches)

(not in the xcl data currently)

Firefly's Alpha - (list of launches)

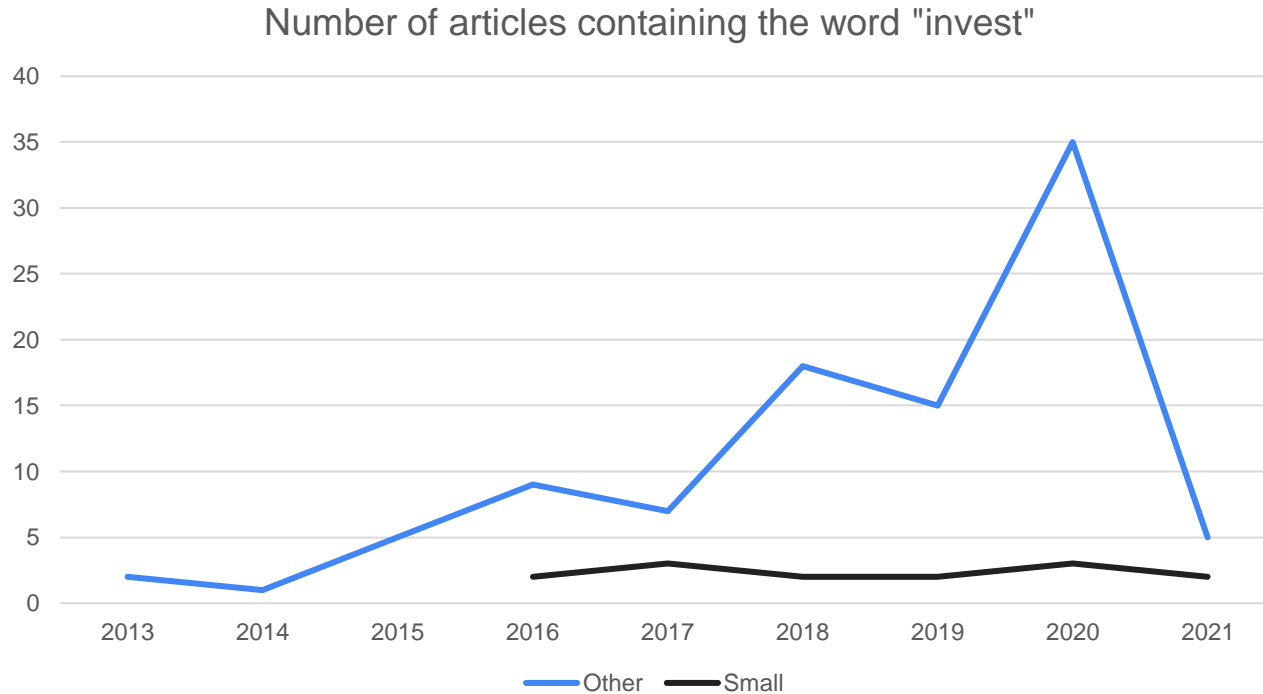
Vega - (list of launches)

Articles with 'Investment' and without



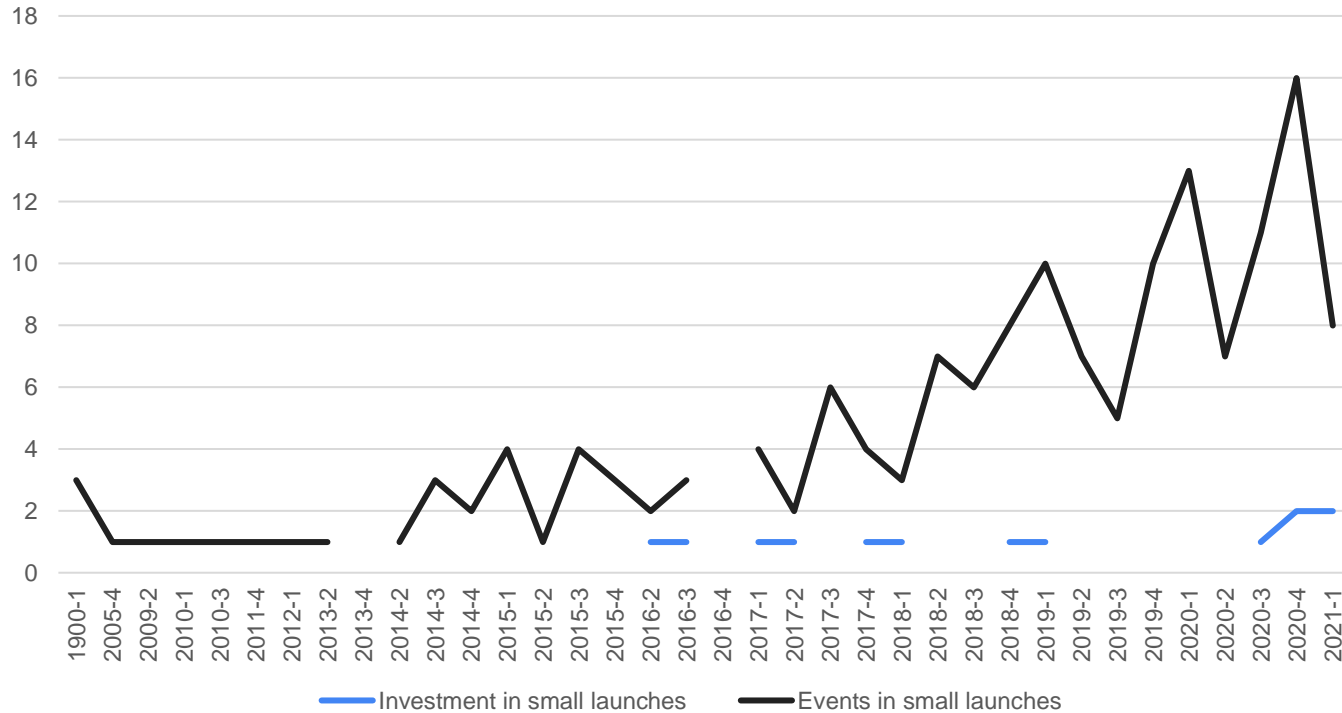
Source: Own Database

Investment in SVLa and other



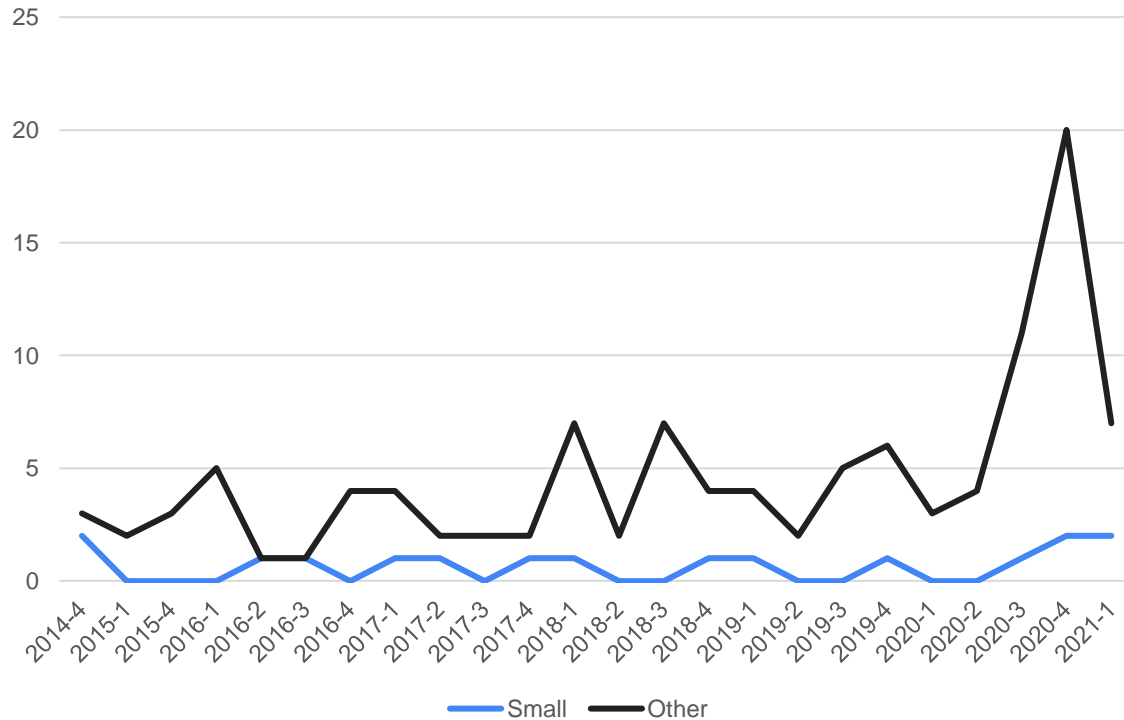
Source: Own Database

Investment and Events in Small Launchers



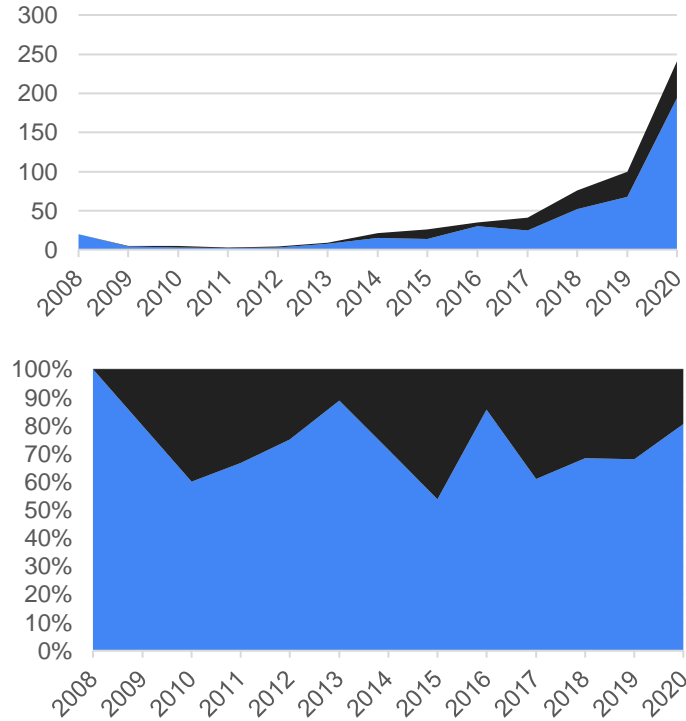
Source: Own Database

Investment in small launchers and non-small

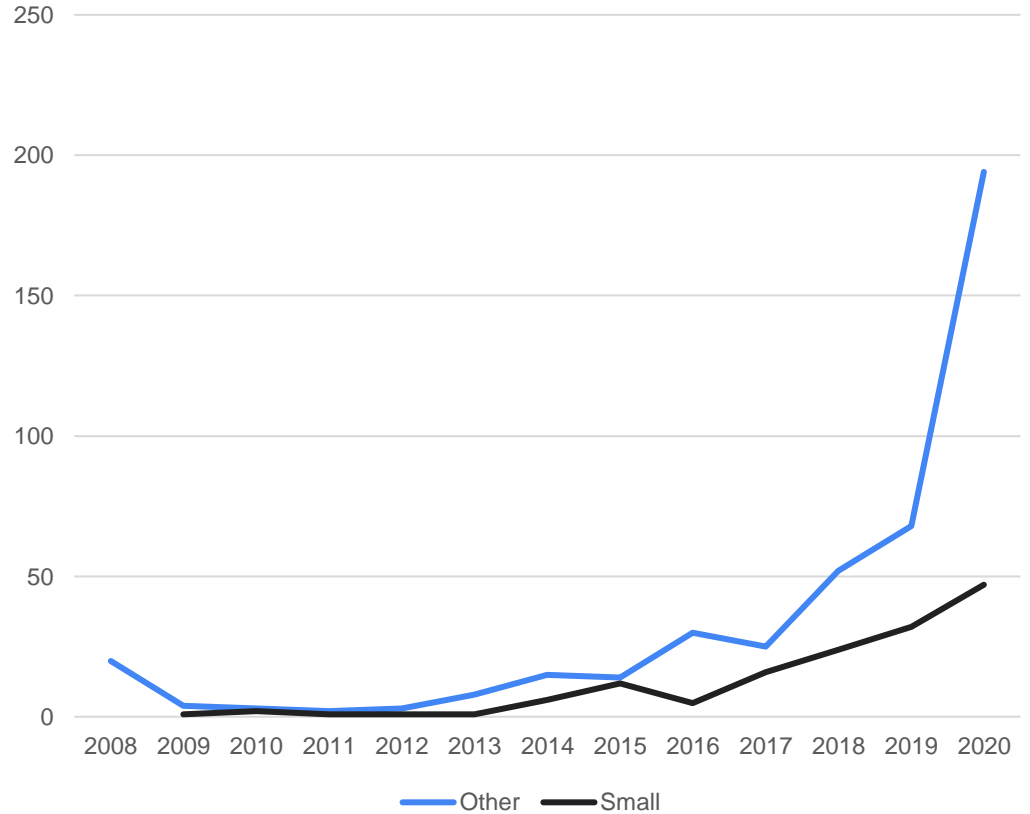


Source: Own Database

Events - Launchers



Number of events by year and launcher size



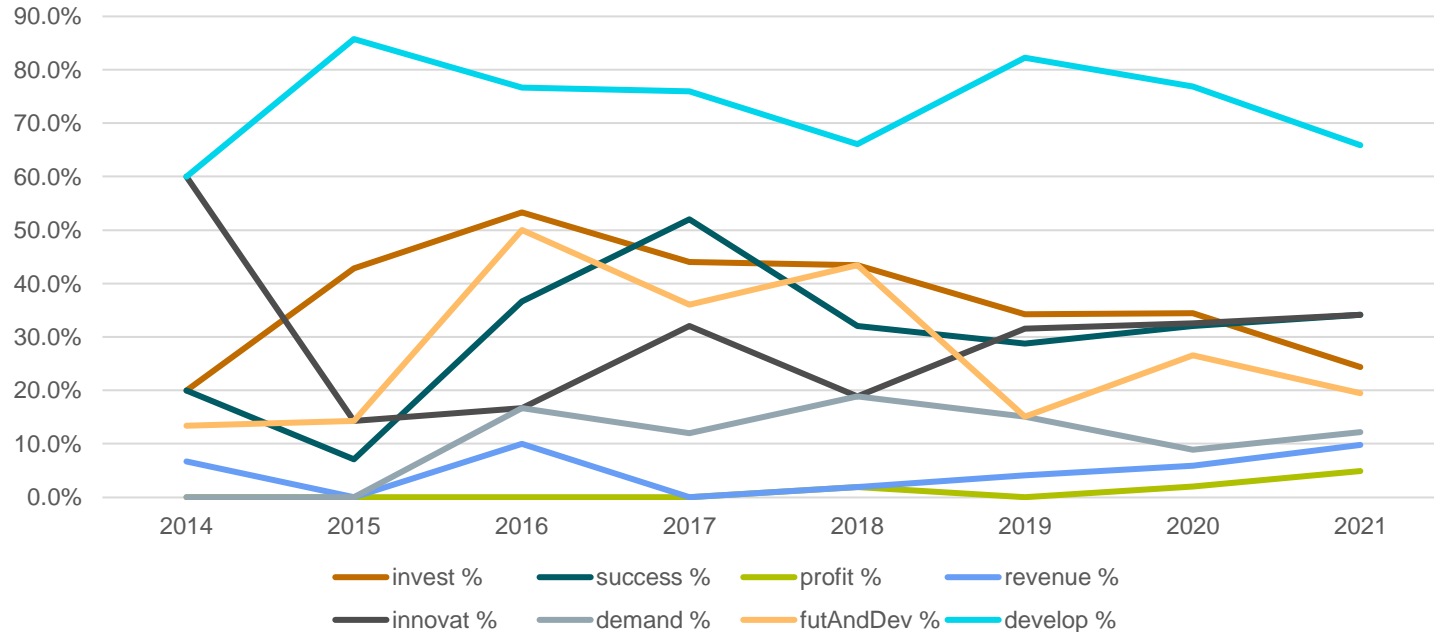
Source: Own Database

Launchers - Keyword Search

A	B	C	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP
KD's	IE	Headline	Outcomes	Category	Country	IDR	year	mon	quart	year-quart	small-launch	invest	success	profit	revenue	innovat	demand	future	develop	futAndDev	commercial	government
2.2.8.	Venture Capital	Astranis raises \$90 million	unding Received	Satellite	United States	FALSE	1900	1	1	1900-1	FALSE	1	0	0	0	0	0	0	0	0	0	0
2.2.8.	Venture Capital	One of the world's largest	unding Received	Satellite	United States	FALSE	1900	1	1	1900-1	FALSE	1	0	0	0	1	0	0	0	0	0	0
3.3.6.	Non-Gov't	Malaysian satellite to be launched	ouncement of	Launch	Russia	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	1	0	0
1.1.5.	Industry Re	Australia updates	ation Event	Launch	Australia	TRUE	2019	8	3	2019-3	FALSE	0	0	0	0	1	0	0	0	0	0	1
1.1.5.	Industry Re	Australia to establish	ation Event	Government	Australia	FALSE	2017	9	3	2017-3	FALSE	0	0	0	0	1	0	0	0	1	0	0
3.1.3.	Testing	Vega's Zefiro 9 Engine	real of Name,	Launch	Italy	FALSE	2020	10	4	2020-4	TRUE	1	1	0	0	1	0	0	1	1	0	0
3.3.2.	Cultural No Q&A	Avio CEO Ranzo	real of Name,	Launch	EU	FALSE	2016	11	4	2016-4	TRUE	0	1	0	0	0	0	0	1	0	0	0
2.1.1.	Gov't Contr	ESA pours \$107 million	unding Received	Launch	EU	TRUE	2017	11	4	2017-4	TRUE	0	1	0	0	0	0	0	1	1	0	0
2.2.4.	Equity Inve	Small-rocket-builder	unding Received	Launch	United States	TRUE	2017	5	2	2017-2	TRUE	1	1	0	1	0	1	0	1	0	0	1
3.3.3.	Governem	Axiom to fly Crew	real of Name,	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	1	0	0
3.3.5.	Firm creati	Beijing Interstellar	ation Event	Launch	China	FALSE	2016	10	4	2016-4	FALSE	0	0	0	0	0	0	0	0	1	0	0
2.2.4.	Equity Inve	Beijing Interstellar	unding Received	Launch	China	TRUE	2020	8	3	2020-3	FALSE	1	1	0	0	0	0	0	1	1	1	0
3.3.5.	Firm creati	For Entrepreneur, Fly	ation Event	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	0	1	0	0	0	0	0	0	1	0	0
3.3.5.	Firm creati	Bigelow Aerospace lays	ression of	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	0	0	1
3.1.1.	Manufactur	Blue Origin opens rocket	real of Name,	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	0	1	0	0	0	0	0	0	1	0	0
3.1.3.	Testing	Blue Origin's New	ccessful Launch	Launch	United States	FALSE	2020	10	4	2020-4	FALSE	0	1	0	0	0	0	0	1	1	1	0
2.3.2.	Recruitmen	Blue Origin creates	real of Name,	Launch	United States	FALSE	2020	12	4	2020-4	FALSE	0	0	0	0	0	0	0	0	1	0	0
2.2.7.	Common SI	Bezos Cashing in \$3.1	unding Received	Launch	United States	FALSE	2020	11	4	2020-4	FALSE	0	0	0	0	0	0	0	0	0	0	0
3.1.3.	Testing	Startup tests hybrid	ccessful Launch	Launch	United States	FALSE	2021	1	1	2021-1	FALSE	0	1	1	0	0	0	0	1	1	1	0
3.3.5.	Firm creati	One Small Step for Main	ation Event	Launch	United States	FALSE	2014	1	1	2014-1	FALSE	0	0	0	0	1	0	0	0	1	0	0
2.2.2.	Gov't Contr	One Small Step for Main	unding Received	Launch	United States	FALSE	2014	1	1	2014-1	FALSE	0	0	0	0	1	0	0	0	1	0	0
3.1.1.	Manufactur	Boeing Studying Air-	real of Name,	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	1	0	0
3.1.1.	Manufactur	Business Digest	real of Name,	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	1	0	0
3.1.3.	Testing	Boeing to fly second	ouncement of	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	1	1	0	0	0	0	0	0	0	0	1
3.1.1.	Marketing	Boeing; Lockheed Martin	ation Event	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	1	0	0
1.1.5.	Industry Re	BRAZIL TO SIGN TREATY	ation Event	Government	United States	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	0	0	1
1.1.3.	Launch Lic	Brazilian Space Agency	ceipt of	Launch	Brazil	TRUE	2020	12	4	2020-4	FALSE	0	0	0	0	0	0	0	0	1	0	0
3.3.5.	Firm creati	Brazil Plans Launch of	ation Event	Launch	Brazil	TRUE	2020	10	4	2020-4	FALSE	0	0	0	0	0	0	0	0	0	0	0
2.2.5.	Industry-W	Brazilian Space Sector	ation Event	Government	Brazil	TRUE	2020	9	3	2020-3	FALSE	1	0	0	0	1	1	0	1	0	0	1
Gov't Programs	Quitting the space race		ation Event	Government	EU	FALSE	1900	1	1	1900-1	FALSE	1	0	0	0	1	0	0	1	1	1	1
2.2.6.	Gov't Progr	UNITED KINGDOM:	unding Received	Launch	EU	FALSE	1900	1	1	1900-1	FALSE	0	1	0	0	0	1	0	0	1	0	1
2.2.4.	Equity Inve	British government and	ation Event	Satellite	EU	FALSE	1900	1	1	1900-1	FALSE	1	0	0	1	1	0	0	1	1	1	1
2.2.5.	Industry-W	Startup financing	unding Received	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	1	0	0	1	0	0	0	0	1	0	0
3.2.4.	Partnership	Spaceport America and	real of Name,	Spaceport	United States	TRUE	2020	10	4	2020-4	FALSE	0	0	0	0	1	0	0	0	1	0	0
3.3.6.	Non-Gov't	Cancom Announces Star	real of Name,	Satellite	United States	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	0	0	0
2.2.7.	Common SI	Cancom announces sale	unding Received	Satellite	United States	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	0	0	0
2.2.7.	Common SI	Cancom Sells Shares in	er	Satellite	Canada	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	0	0	0
3.3.2.	Cultural No	How many small launch	ression of	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	1	0	0	0	0	0	0	1	0	0	1
3.1.1.	Manufactur	Chinese rocket	ation Event	Launch	China	FALSE	2020	9	3	2020-3	FALSE	0	0	0	0	1	0	0	0	1	0	1
3.1.3.	Testing	Launch of China's new	ression of	Launch	China	FALSE	1900	1	1	1900-1	FALSE	1	1	0	0	0	0	0	0	1	0	0
3.3.3.	Governem	Long March launches	ccessful Launch	Launch	China	FALSE	1900	1	1	1900-1	FALSE	0	0	0	0	0	0	0	0	0	0	0
3.3.6.	Non-Gov't	China launches third	ation Event	Launch	China	FALSE	1900	1	1	1900-1	FALSE	0	1	0	0	0	0	0	0	1	0	0
3.3.6.	Non-Gov't	China resumes space	ccessful Launch	Launch	United States	FALSE	1900	1	1	1900-1	FALSE	0	1	0	0	0	0	0	0	0	0	0
China Launches New			ccessful Launch	Launch	China	FALSE	2013	9	3	2013-3	FALSE	0	1	0	0	0	0	0	0	1	0	0
3.1.1.	Manufactur	Kuai Zhou (Fast Vessel)	ation Event	Launch	China	FALSE	2009	1	1	2009-1	FALSE	0	1	0	0	0	0	0	0	0	0	1
3.1.3.	Testing	Kuai Zhou first test launch	ccessful Launch	Launch	China	FALSE	2012	3	1	2012-1	FALSE	0	0	0	0	0	0	0	0	0	0	0
3.2.2.	Merger	Kuai Zhou (Fast Vessel)	rganization	Launch	China	TRUE	2011	1	1	2011-1	FALSE	0	1	0	0	0	0	0	0	1	0	1

Launchers - Keyword Search - sentiment

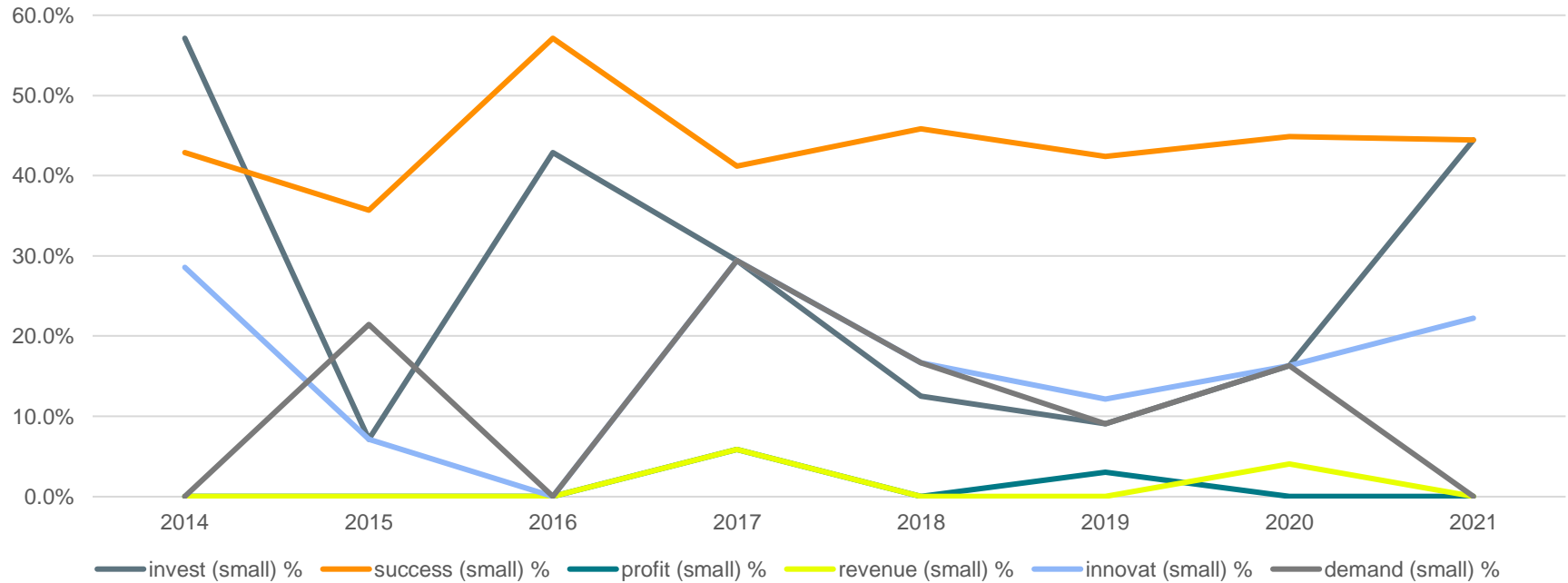
Incidence of keywords - all launcher articles



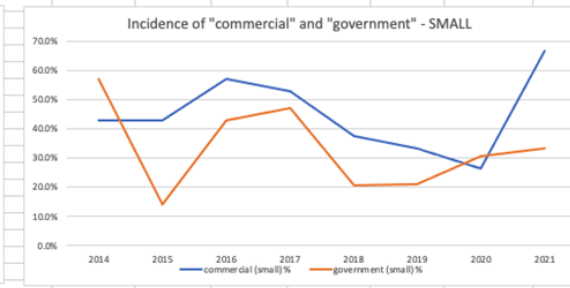
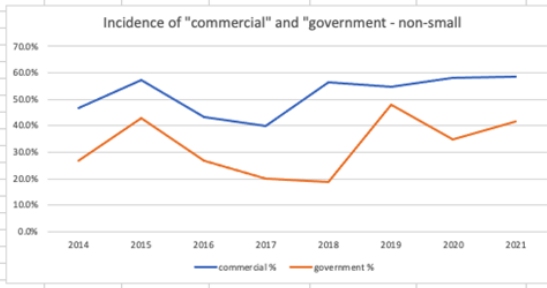
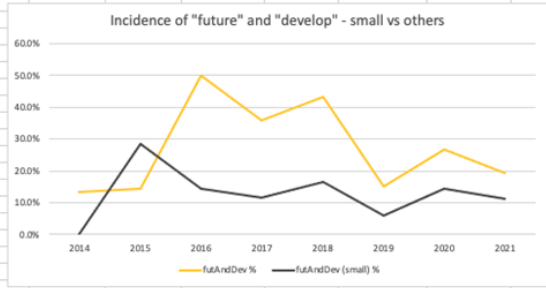
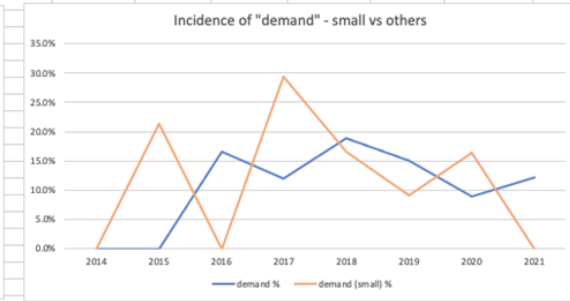
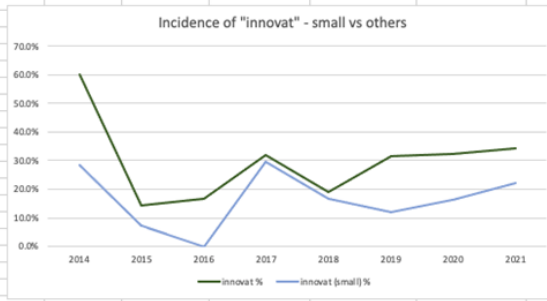
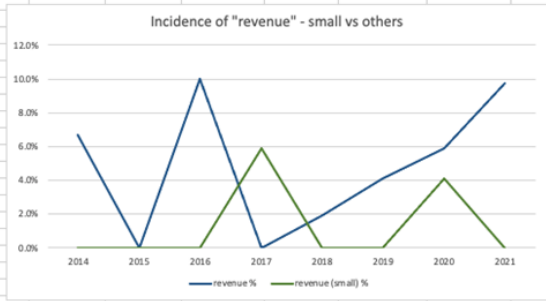
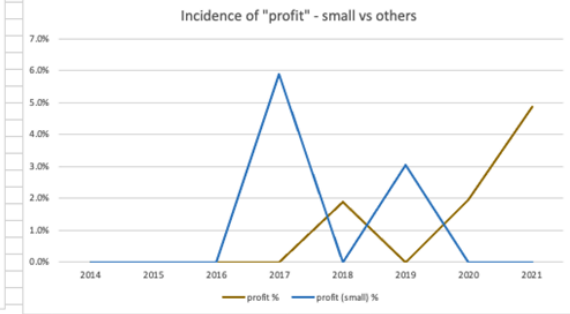
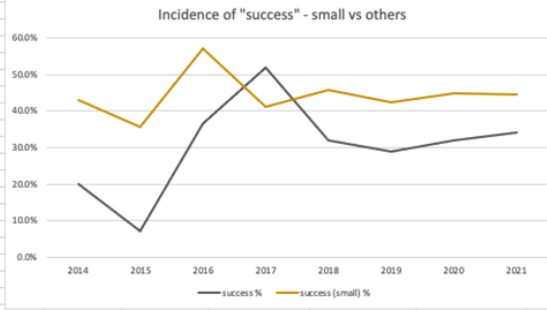
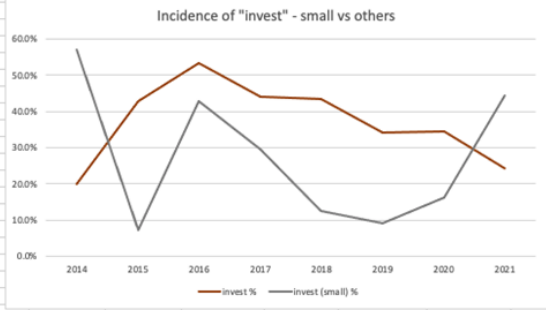
Source: Own Database

Keyword Search - SLVs

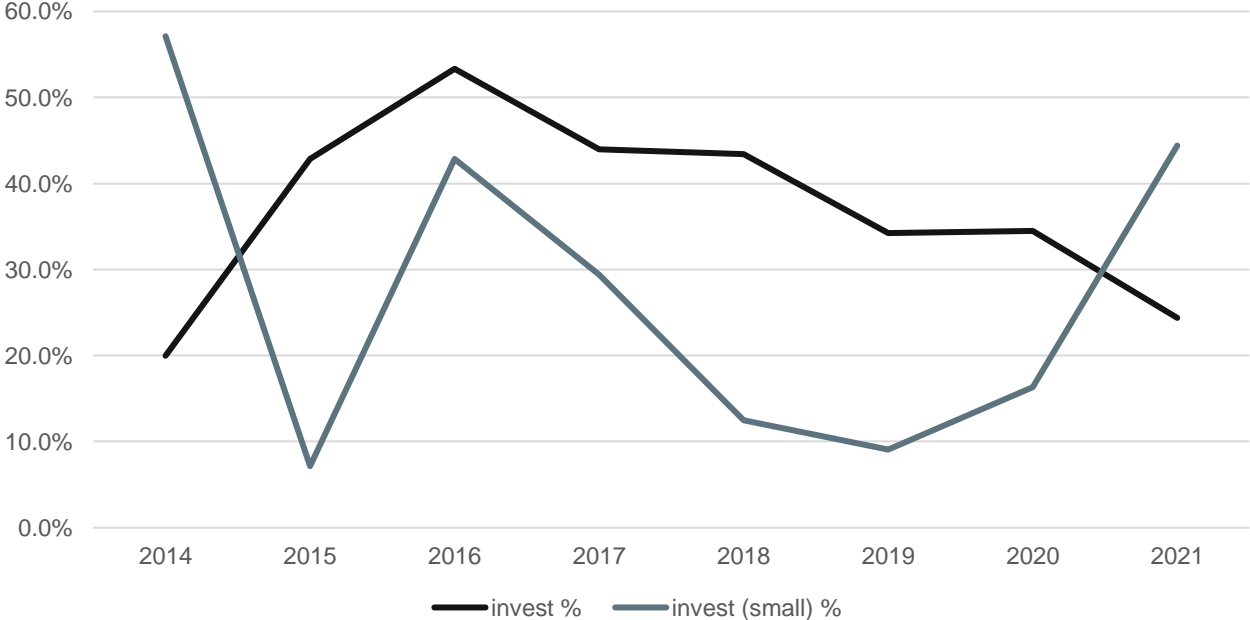
Incidence of keywords - small launchers only



Source: Own Database

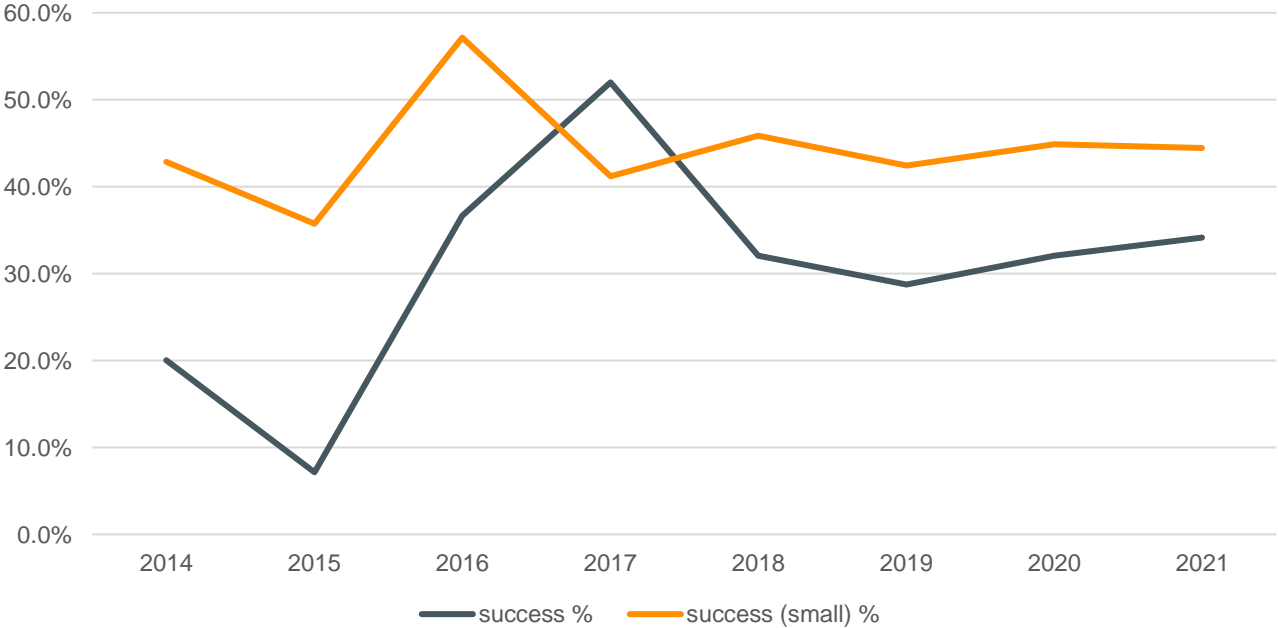


Incidence of "invest" - small vs others



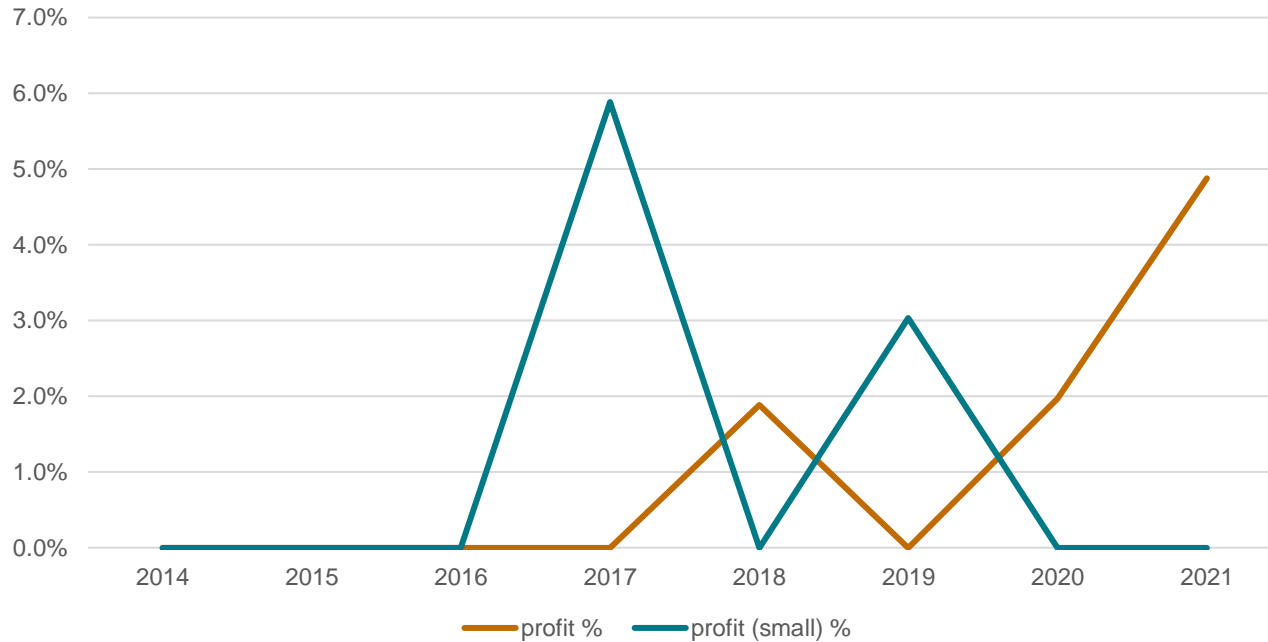
Source: Own Database

Incidence of "success" - small vs others



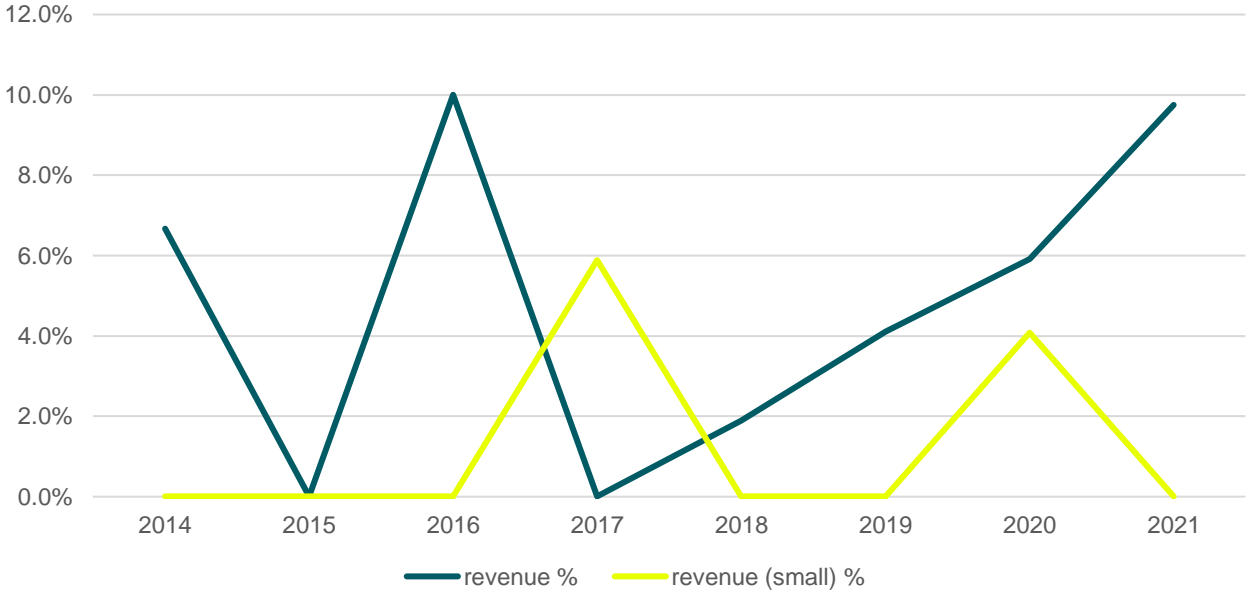
Source: Own Database

Incidence of "profit" - small vs others



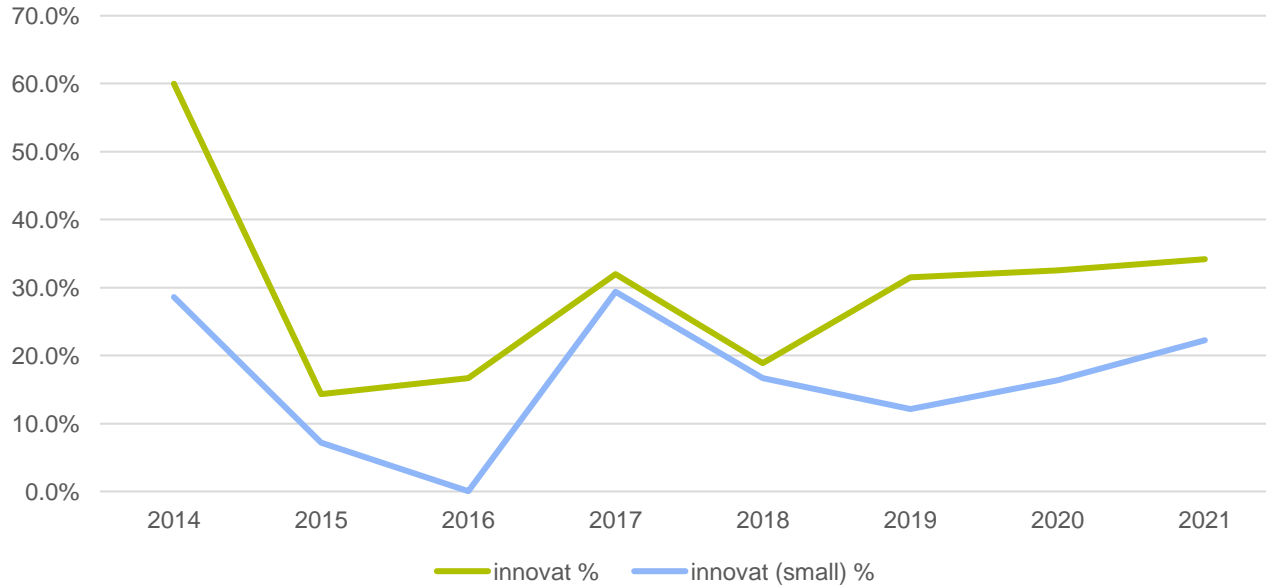
Source: Own Database

Incidence of "revenue" - small vs others



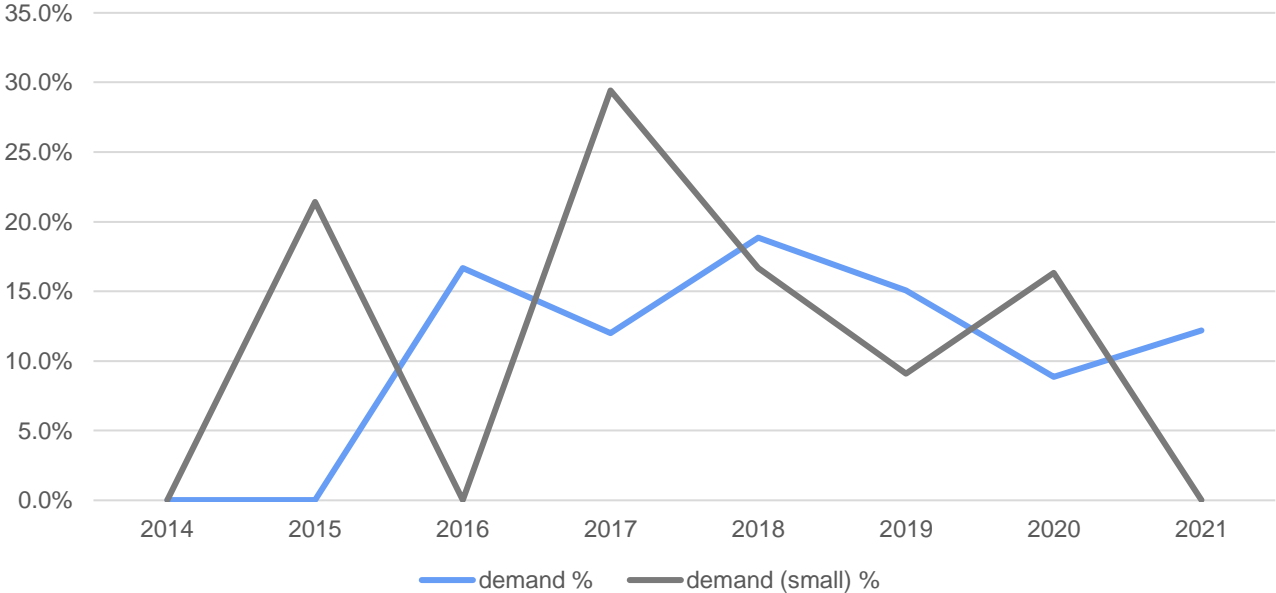
Source: Own Database

Incidence of "innovat" - small vs others



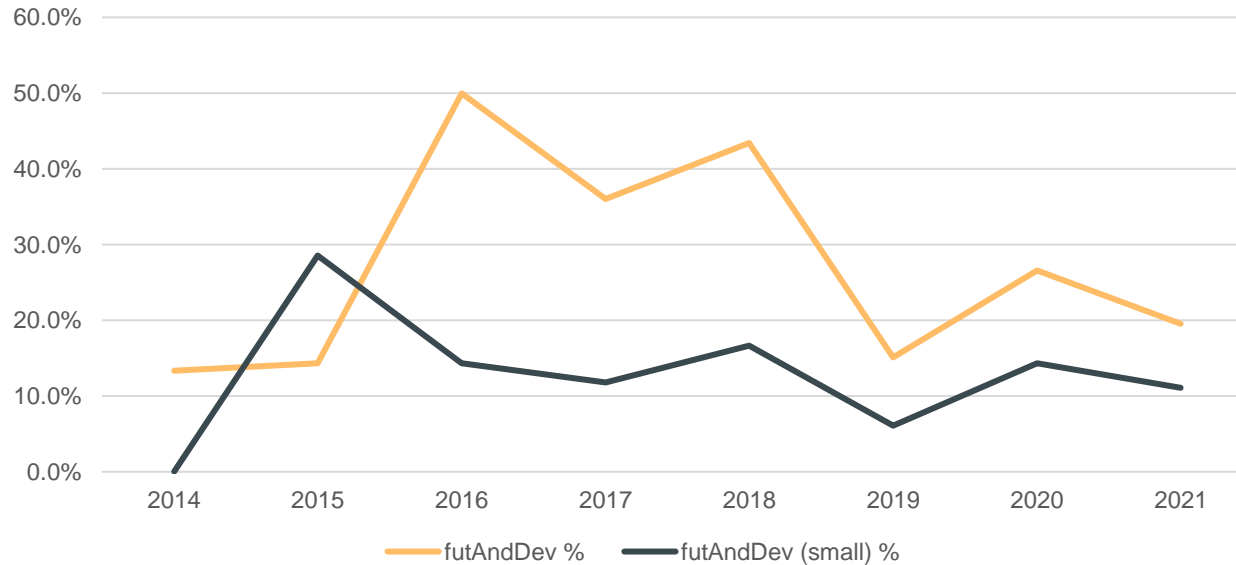
Source: Own Database

Incidence of "demand" - small vs others



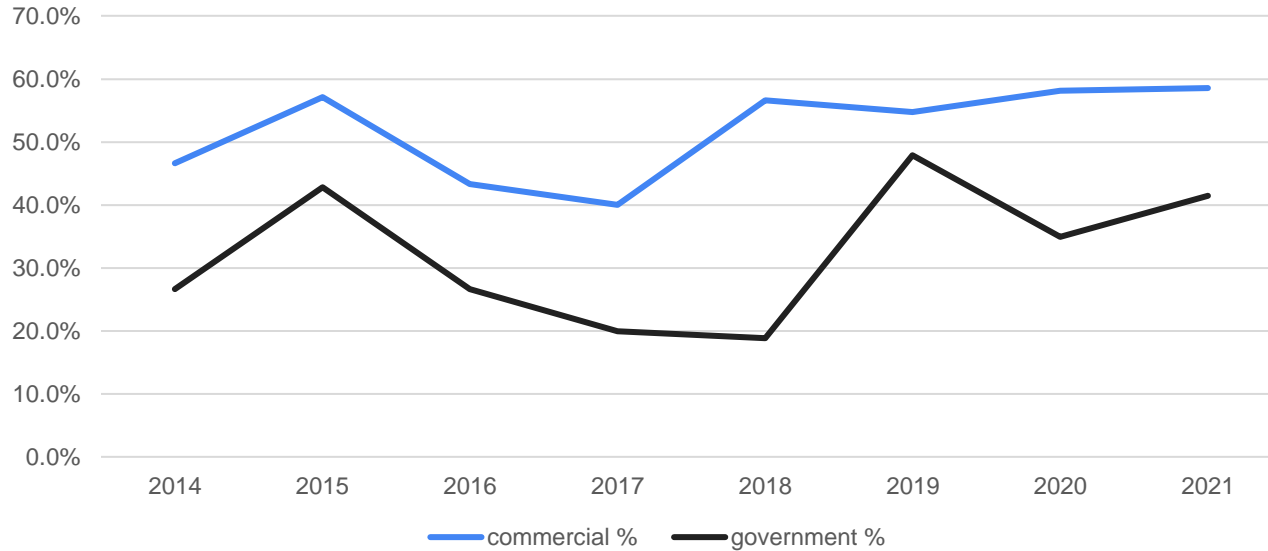
Source: Own Database

Incidence of "future" and "develop" - small vs others



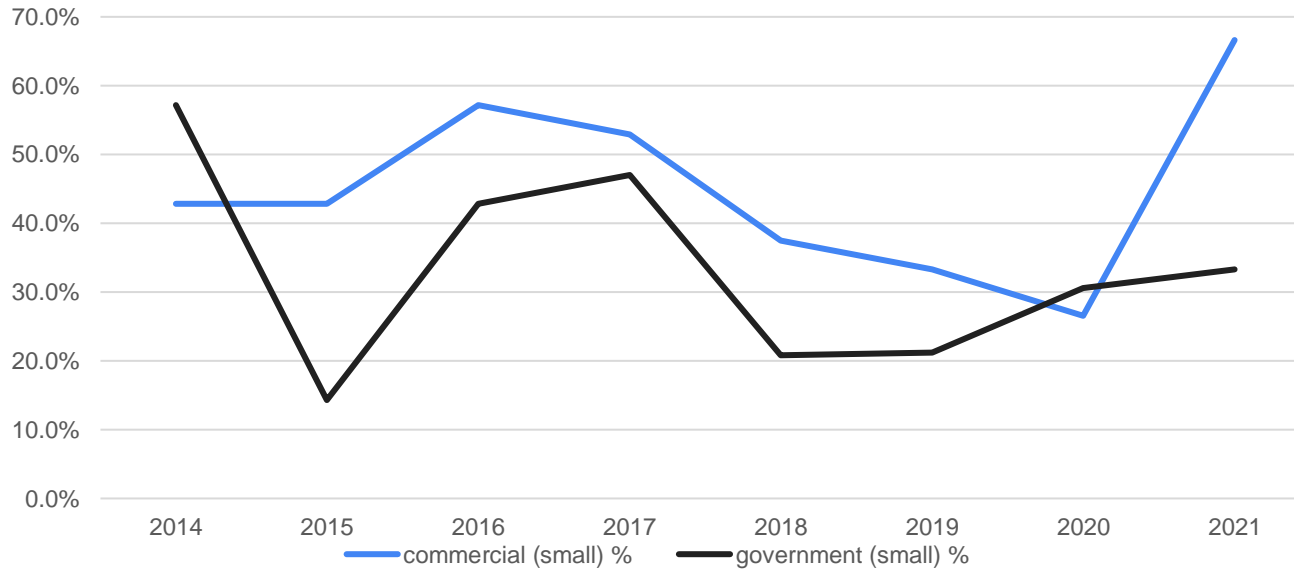
Source: Own Database

Incidence of "commercial" and "government - non-small"



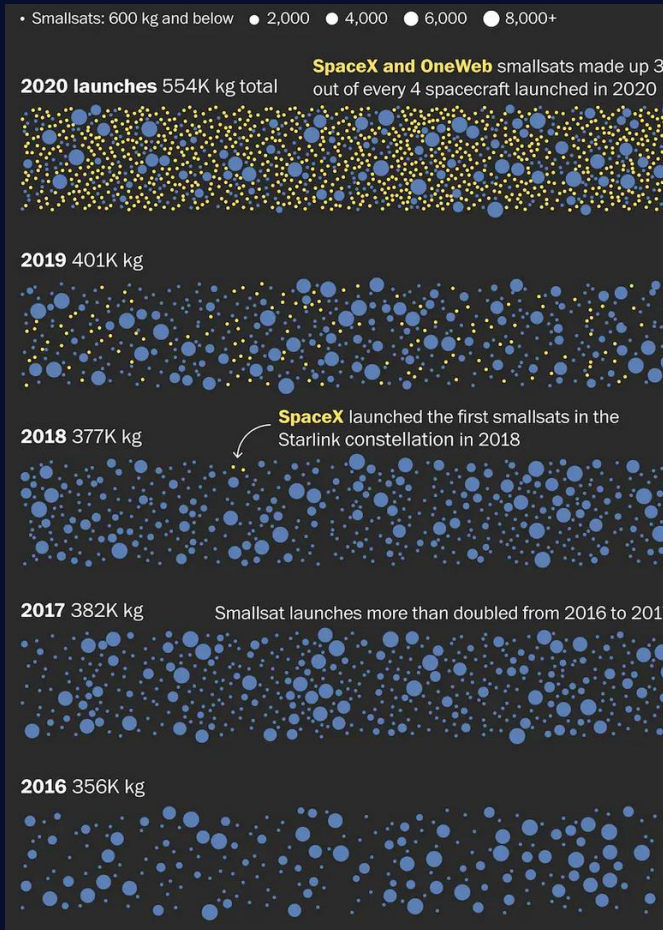
Source: Own Database

Incidence of "commercial" and "government" - SMALL



Source: Own Database

Emergence Visualization



Source: Bryce Tech

ROCKET

STAGE 1 Electric Pump
THRUST [vac] ~154 kN

STAGE 2 Pressure Fed
THRUST [vac] 2.9 kN

500 km
SSO \$\$\$



ELECTRON

STAGE 1 Electric Pump
THRUST [vac] ~247 kN

STAGE 2 Electric Pump
THRUST [vac] 25.7 kN

PHOTON KICK STAGE

500 km
SSO \$\$\$

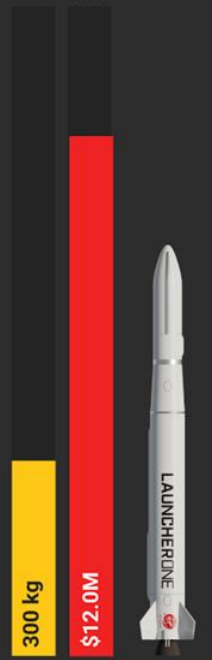


LAUNCHERONE

STAGE 1 Open Cycle
THRUST [vac] 327 kN

STAGE 2 Open Cycle
THRUST [vac] 22.2 kN

500 km
SSO \$\$\$



RS-1

STAGE 1 Open Cycle
THRUST [vac] 485 kN

STAGE 2 Open Cycle
THRUST [vac] 57.8 kN

500 km
SSO \$\$\$



ALPHA

STAGE 1 Tap Off Cycle
THRUST [vac] 736 kN

STAGE 2 Tap Off Cycle
THRUST [vac] 70 kN

500 km
SSO \$\$\$



TERRAN-1

STAGE 1 Open Cycle
THRUST [vac] 1016 kN

STAGE 2 Open Cycle
THRUST [vac] 132 kN

500 km
SSO \$\$\$



FALCON 1

STAGE 1 Open Cycle
THRUST [vac] 451 kN

STAGE 2 Pressure Fed
THRUST [vac] 31 kN

[ADJUSTED FOR INFLATION]

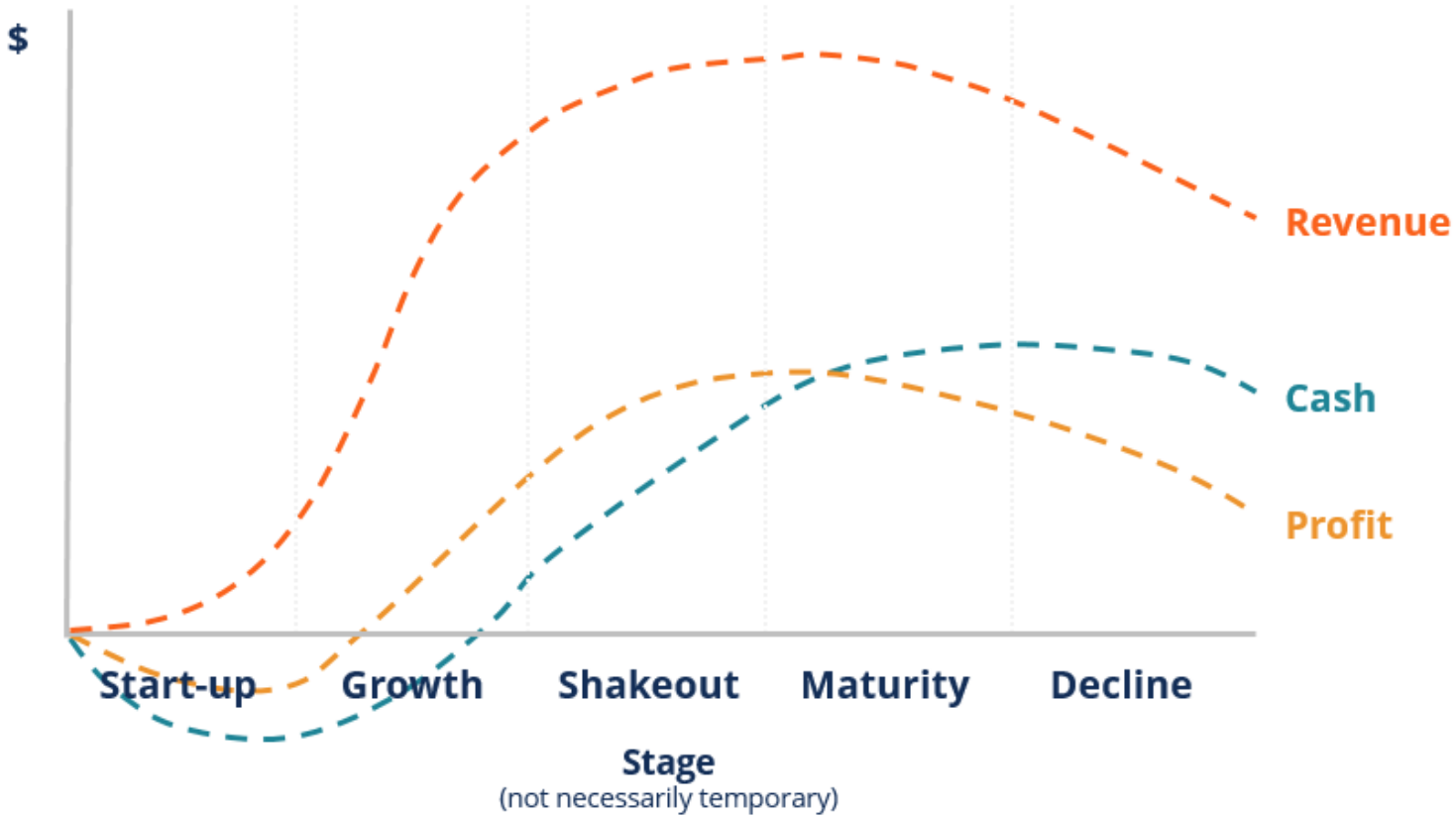
500 km
SSO \$\$\$



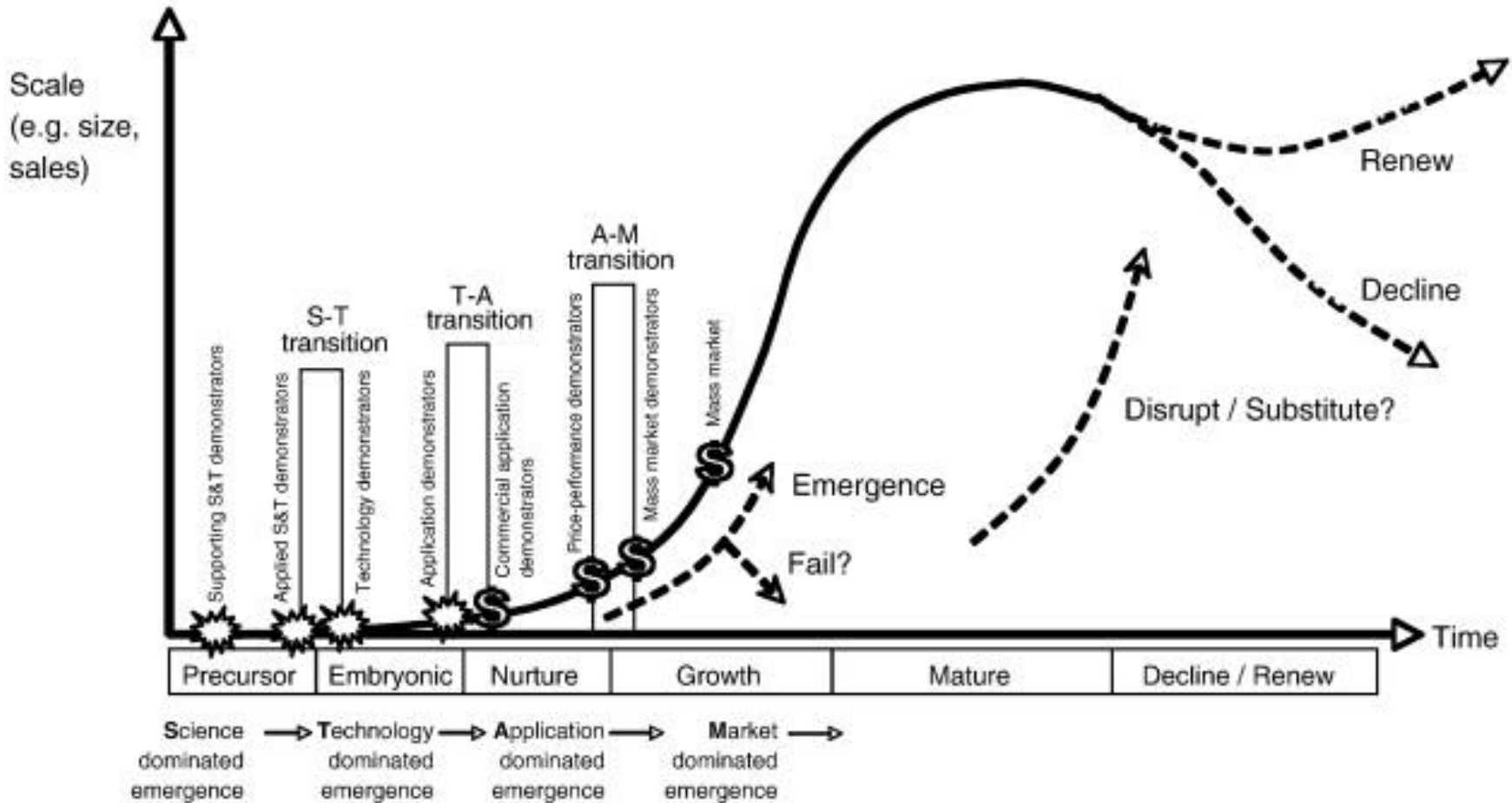
Visualization

Acquisitions and Investment



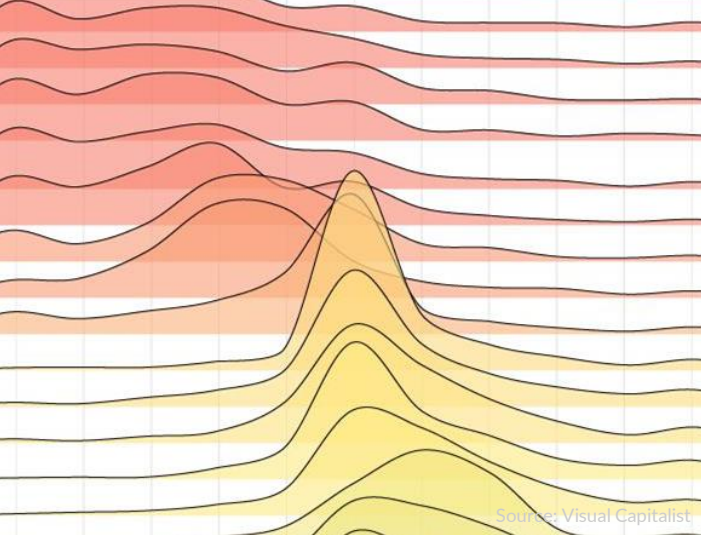


Source: <https://doblin.com>

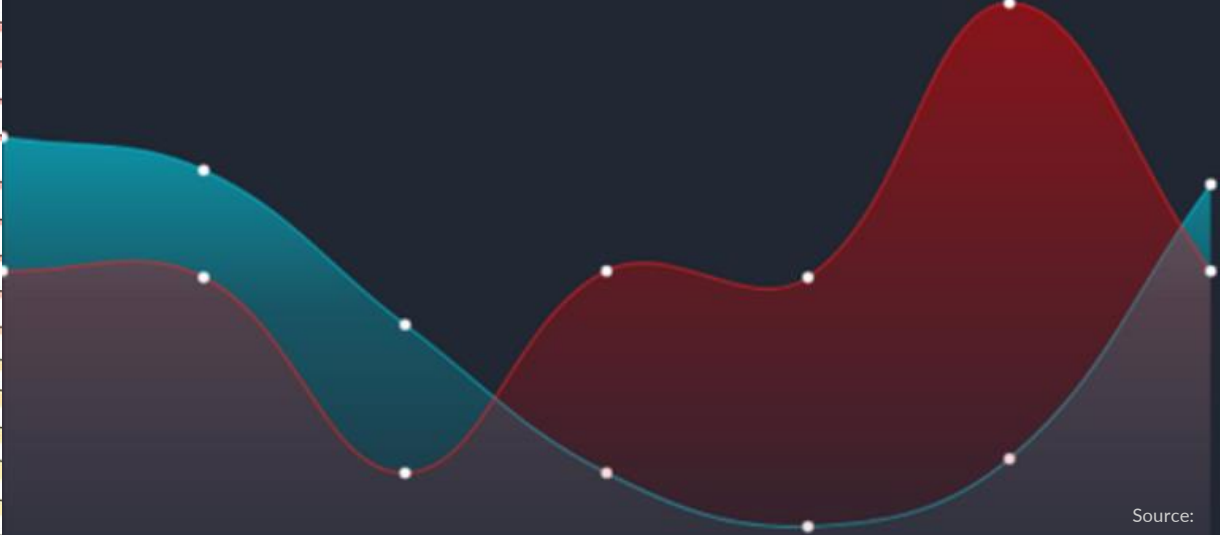


Source: (Phaal, 2011)

Visualization of Sentiment & Emergence



Source: Visual Capitalist



Source:

February 22

Project intro

- Handover project
- Kick-off meeting
- Brainstorming
- Tasks Division
- Meeting with Dr. Davidian
- Data inspection
- Literature Review

March 22

Database & Visualization

- Data cleaning
- Querying the data
- Classification
- First testing graphs
- Visualization perspectives
- Crossing database results with industry

April 22

Visualization & Storytelling

- Visualization ideas
- Starting Storytelling
- Scratch graphs
- Status Presentation
- Scoping Future Research Opportunities

Summer 22 +

Visualization & Prototyping

- Visualization prototyping
- Storytelling & Visual Narrative
- Research Application of New Technologies & Visualization to support ML

Questions & Brainstorming

1. Which aspects of visual storytelling suit best the expected outcomes from the research?
2. Which types of visualizations would be the most appropriate to demonstrate the Small Launch Vehicle Emerging Industry?
3. What else can be exploit from our own Database?
4. How can we predict the future trends from this industry using our current Database?

Image Source: NASA

References

Davidian, K. (2021). *What makes space activities commercial?* *Acta Astronautica*, 182, 547-558.

Davidian, K. J. (2020). *Small Satellite Market Research Methods*. In J. N. Pelton (Ed.), *Handbook of Small Satellites: Technology, Design, Manufacture, Applications, Economics and Regulation* (pp. 1–12). Springer International Publishing. https://doi.org/10.1007/978-3-030-20707-6_106-2

Phaal, R., O'Sullivan, E., Routley, M., Ford, S., & Probert, D. (2011). *A framework for mapping industrial emergence*. *Technological forecasting and social change*, 78(2), 217-230.

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Catapult Sate. *Small Satellite Market Intelligence Report*. Q3, 2021.