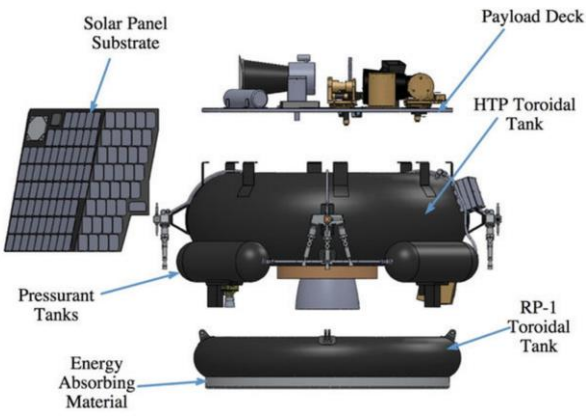
# August 2016
# Satellite & Space Monthly Review

**Chris Quilty**
cquilty@quiltyanalytics.com
+1 (727)-828-7085

**August 3, 2016: Moon Express gets go-ahead for moon landing.** In the first example of what could become a more regular phenomenon, **Moon Express** announced on August 3rd that it "…has become the first private company approved to literally go out of this world as a pioneer of commercial space missions beyond Earth orbit," after the US Government granted approval to land its MX-1 lander on the moon by the end of 2017.

On a similar note, **SpaceX** announced earlier this year that it will send its robotic "Red Dragon" lander to Mars in 2018 and **Deep Space Industries** announced on August 8th that it will launch a spacecraft (Prospector-1) to an asteroid in 2020 to investigate the object for potential resource exploitation. Galactic Federation approval is still pending.

**Moon Express MX-1 Lander**




Source: Moon Express.

**Conclusion: Space 2.0 becoming legit?** In recent years, more than a dozen ambitious startups have announced plans to establish novel space-based business models, ranging from floating space hotels (**Bigelow Aerospace**) to asteroid mining (**Deep Space Industries**, **Planetary Resources**), satellite servicing (**Effective Space**), space tourism (**Virgin Galactic**, **Blue Origin**), and pharmaceutical microgravity research (**SpacePharma**).

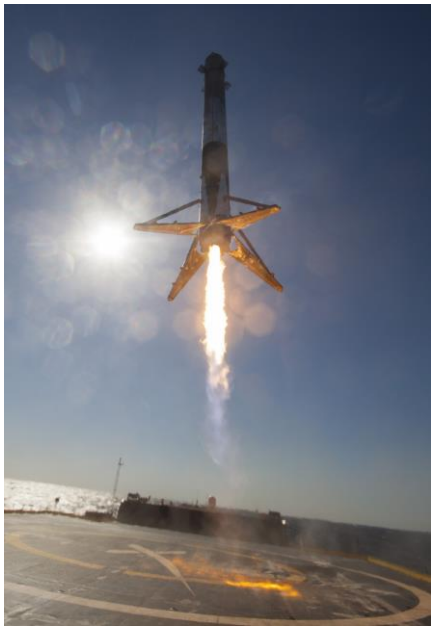
Notably, the above list does not include literally dozens of startups focused on "more-traditional" space activities such as launch, small satellite manufacturing, SATCOM, and remote sensing. Why the flurry of startup activity? While a variety of factors come to mind, two are particularly notable:

- **Launch access:** Even as the industry awaits the (potential) introduction of more than two dozen new launch vehicles, legacy launch providers have become much more accommodating to "rideshare" opportunities. This trend has been aided, in part, by the efforts of third-party launch brokers such as **Spaceflight Industries**.
- **Money access**: Historically dependent on the largess of defense/aerospace benefactors, the space industry has experienced a flood of new financing sources over the past decade, including venture/angel investors and billionaire space enthusiasts such as Elon Musk, Jeff Bezos, and Richard Branson.

While noteworthy, the Moon Express milestone also offers a cautionary note. Due to vague language within the Outer Space Treaty of 1967, Moon Express was forced to navigate a byzantine path to regulatory approval that included input from White House Office of Science and Technology Policy, the FAA, the FCC, the Department of Transportation, and the Department of State. It would not be surprising in landing on the move proved easier than obtaining official regulatory approval to pursue resource extraction.

**August 30, 2016: SES orders GEO launch on used Falcon 9**. In a widely-anticipated move, **SES** announced that it will use a "flight-proven" **SpaceX** Falcon 9 rocket to launch a GEO communications satellite (SES-10) during 4Q16. The rocket in question was previously flown and recovered (via barge) on April 8th for NASA's CRS-8 mission.

**CRS-8 Recovery at Sea**



Source: SpaceX.

**SES** had long-expressed a desire to be the first customer for a "previously-owned" rocket, although SES' Chief Technology Officer, Martin Halliwell had publicly argued that a 50% discount would be more appropriate than the 30% discount cited by SpaceX's Gwynne Shotwell. Actual pricing was not announced.

**Conclusion. Let the era of reusability begin?** SpaceX publicly-announced plans to develop a reusable Falcon 9 rocket in the fall of 2011 after a mere two successful launches. Over the ensuing five years, SpaceX has gradually advanced its ability to recover an orbital launch vehicle, using paid customer launches and a test vehicle ("Grasshopper") to tweak hardware, software, and landing techniques.

While SpaceX has largely proven the ability to recover a rocket (2 of 2 for land recoveries and 4 of the last 5 sea landing attempts), the company must still demonstrate the ability to relaunch on a timely, reliable, and profitable basis. Can it be done? Some factors to keep in mind:

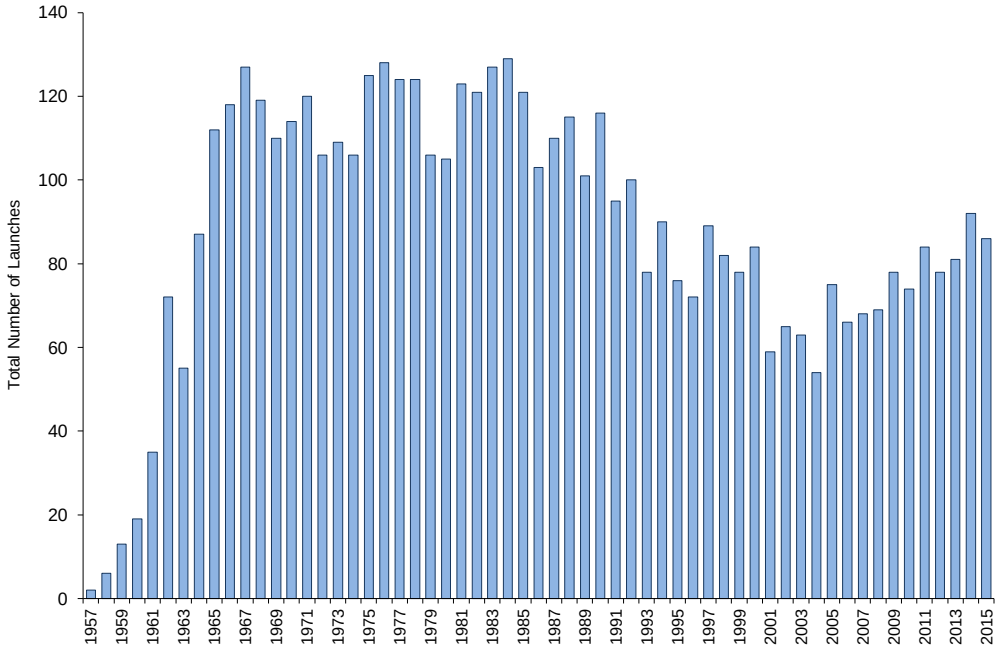
- **Lessons learned:** Prior to December 22, 2015, every successful launch event in history resulted in a destroyed rocket, thus robbing designers and engineers of the opportunity to inspect, test and iterate upon their designs. Over the past year, SpaceX has recovered, inspected, and tested six rocket cores, providing the company with invaluable data that can be used to improve reliability and lower costs.

- **Refurbishment time/cost:** While generally willing to cede the *technical* feasibility of recovering a launch vehicle, SpaceX's competitors have historically cited "refurbishment costs" as the primary rationale for *not* aggressively pursuing a reusability strategy (Note: **Arianespace** and **ULA** have grudgingly announced plans to introduce partially-reusability in the mid-2020s). According to CEO Elon Musk, SpaceX expects to recover 75-80% of LEO first stages and 50-60% GEOs, with the goal of achieving "airline-like" re-launch times measured in "single digit hours." Time will tell.

- **Factory loading:** SpaceX carried out seven orbital launches in 2015 and eight YTD in 2016, but the company's long-term goal is to produce 40 rocket cores per year to support a mix of both Falcon 9 and Falcon Heavy launches. Should SpaceX's reusability efforts prove effective, however, factory production of new rocket cores (absent a massive expansion in launch demand) would likely dwindle to 5-10 per year (depending on the rate of re-use), thus negatively impacting factory loading and manufacturing costs.

- **Market demand:** Global launch activity has been on a modest uptrend over the past decade, averaging just under 80 launches per year (vs. 100-130 per year during the Cold War-era), with ~30% of these launches commercially-competed. If reusability results in dramatically lower launch costs, will demand rise sufficiently to offset price erosion? Elasticity of demand is an unproven concept in the launch industry, but may soon be put to the test.

**Global Orbital Launch Activity (Commercial/Military/Civil)**




Source: FAA, Quilty Analytics, Inc.

- **Insurance premium:** What's the insurance premium on a used rocket? Believe it or not, our industry sources indicate that the SES-10 launch premium was largely in-line with the Falcon 9's current insurance rate of ~5%. Give the marketing department a bonus for coming up with the "flight proven" branding concept.

  Assuming SES was able to negotiate a 40% launch discount (i.e. "split the difference"), the company stands to save approximately $26 million on the SES-10 mission, or ~10% of the mission cost.

| **Est. SES-10 Launch Price** | |
|---|---|
| Falcon 9 list price | $62.0 |
| (-) Discount @ 40% | $24.8 |
| (=) Launch cost | $37.2 |

| **SES Cost Savings** | **Used** | **New** |
|---|---|---|
| Satellite cost | $180 | $180 |
| (+) Launch cost | $37 | $62 |
| (=) Insured value | $217 | $242 |
| | | |
| (+) Insurance @ 5% | $11 | $12 |
| (=) Total cost | $228 | $254 |
| | | |
| Total Savings | $26 | (10%) |

Source: Quilty Analytics.

As a private company, SpaceX does not publicly report revenue/profit metrics, but management has nonetheless dropped enough clues over the years to enable an informed guesstimate of relaunch profitability. Key elements in the cost equation include:

- **Launch costs/profitability:** How much profit does SpaceX make on a launch? Industry benchmarking doesn't necessarily provide much help. Orbital ATK (selling near-exclusively to the USG) has historically generated a high single-digit EBIT margin. ULA (aided by a $1 B annual USG subsidy) makes a ~10% margin. Arianespace typically operates at loss (excluding ESA support payments). For purposes of our analysis, we will assume a SpaceX gross margin ranging between 30-50%
- **First stage cost**: Elon Musk has publicly stated that the first stage comprises about 75% of the Falcon 9's cost.
- **Second stage**: Although SpaceX hopes to eventually re-use the Falcon 9's second stage, the company must currently supply a new second stage for each relaunch attempt.
- **Fuel**: ~$200,000 to refuel the first stage with kerosene.
- **Operations and range costs**: In the absence of better information, we will assume a $5 million cost to refurbish/test a "flight-proven" stage and cover any transportation and range costs.

| | Falcon 9 Gross Margin | | |
|---|---|---|---|
| **Falcon 9 Cost** | **30%** | **40%** | **50%** |
| Falcon 9 list price | 62.0 | 62.0 | 62.0 |
| (-) Gross profit | 18.6 | 24.8 | 31.0 |
| (=) Falcon 9 cost | $43.4 | $37.2 | $31.0 |
| | | | |
| **Stage Costs** | | | |
| First stage @75% | $32.6 | $27.9 | $23.3 |
| Second stage @25% | $10.9 | $9.3 | $7.8 |
| Total cost | $43.4 | $37.2 | $31.0 |
| | | | |
| **Relaunch Profit** | | | |
| Price @ 40% discount | 37.2 | 37.2 | 37.2 |
| (-) Second stage | 10.9 | 9.3 | 7.8 |
| (-) Keosene | 0.2 | 0.2 | 0.2 |
| (-) Ops & range | 5.0 | 5.0 | 5.0 |
| (=) Relaunch profit | $21.2 | $22.7 | $24.3 |

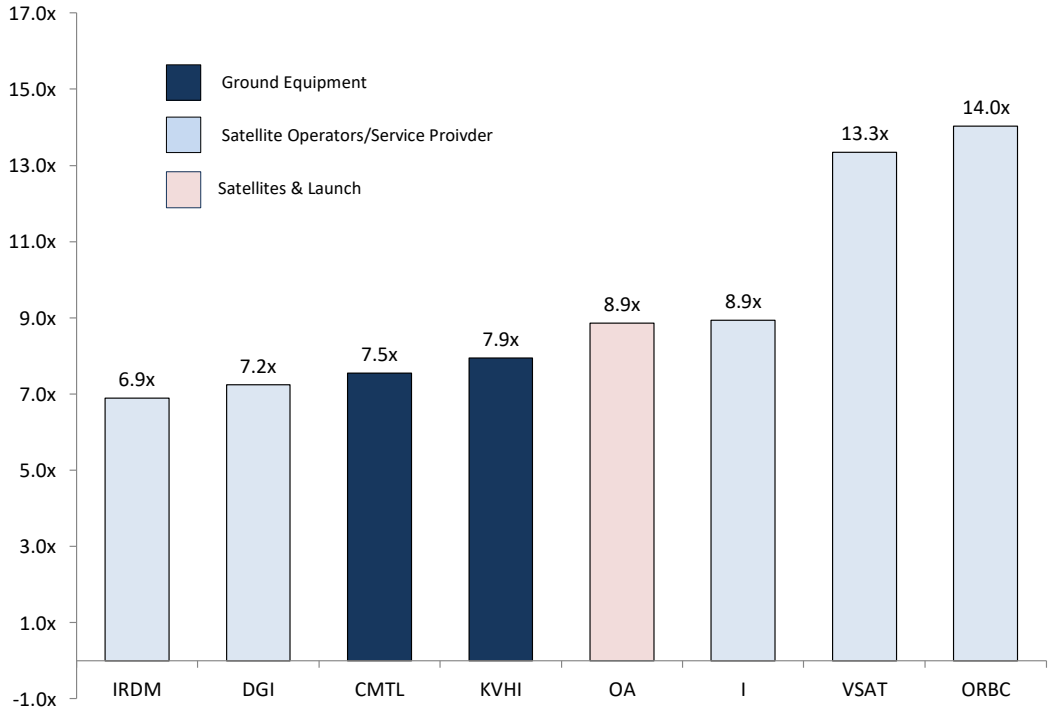
Source: Quilty Analytics.

Net-net, it appears that the gross profit generated by a relaunch could actually be greater than that of a "primary" launch, depending on the underlying gross margin assumption and other factors (i.e. assuming a 30% gross margin, a relaunch generates $2.6 mm more gross profit than a primary launch).

Likewise, the above analysis also highlights the fact that refurbishment, operational, and range costs represent a much larger percentage of the profit equation for a reused rocket. This fact may partially explain the rationale behind SpaceX's decision earlier this year to conduct its static fire test with the payload already mounted on the rocket. This condensed pre-launch procedure likely saved SpaceX two to three days of processing time and $2-3 million of operational costs, but subsequently proved to be a fatal decision (i.e. the Amos-6) pad explosion.

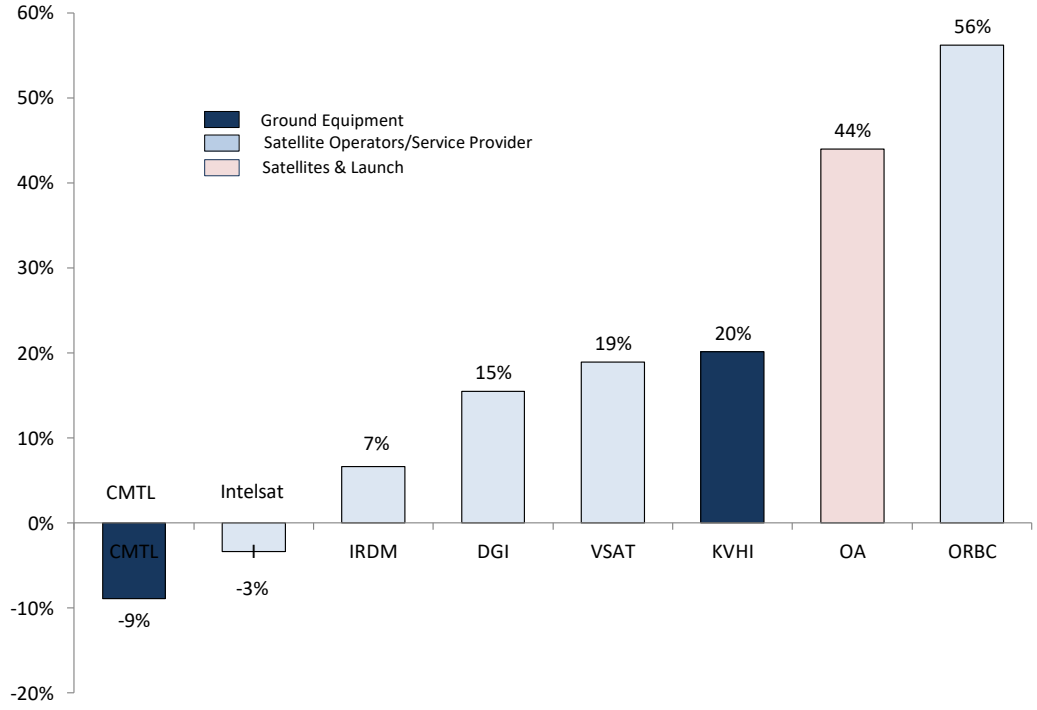
## Industry Growth, Valuation, and Stock Performance

**EV/EBITDA Multiples (2017)**



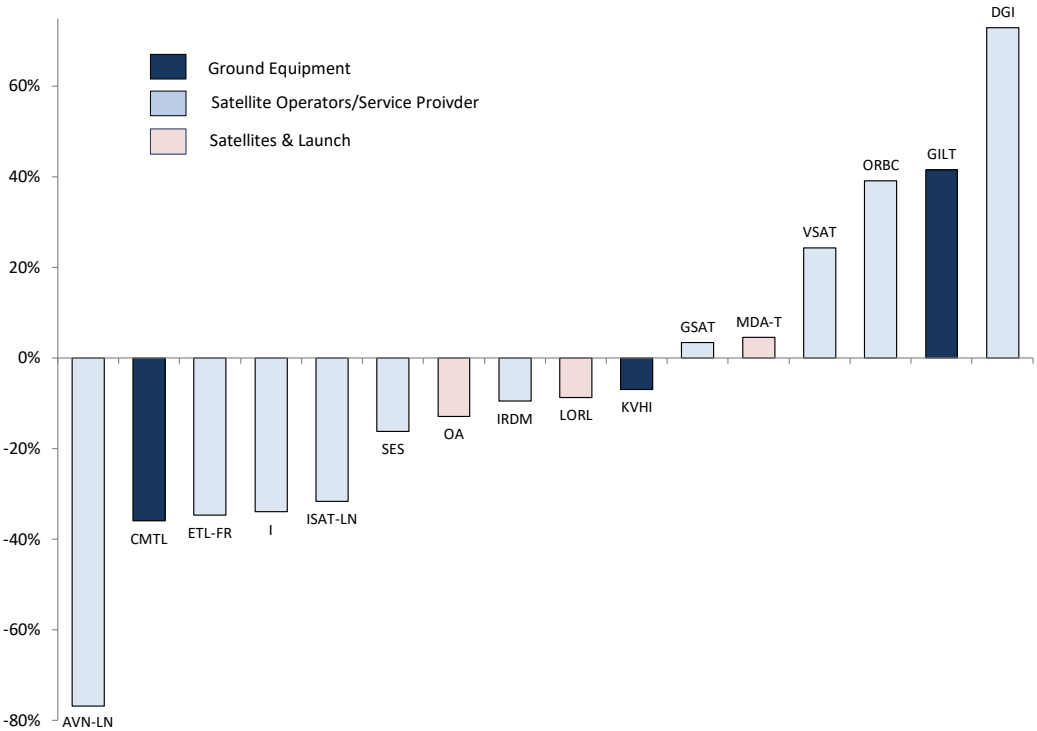

Source: Sentieo.

**2001-2006 EBITDA CAGR**




Source: Sentieo.

**Year-to-Date Satellite & Space Stock Performance**




Source: Sentieo.