PMF-101

The PMF Field Guide

Diagnosing Product-Market Fit in the Space Economy

A practitioner's toolkit for founders, strategists, and investors

by Patrick Connolly

What This Guide Is For

This is not a summary of PMF theory. It is a set of diagnostic instruments — frameworks, questions, and checklists you can use in a startup war room, a board meeting, or a VC pitching session to evaluate whether a space venture has genuinely found product-market fit, is mistaking something else for PMF, or is building toward PMF without realising it hasn't arrived yet.

The frameworks here draw on the best PMF thinking from consumer tech (Sean Ellis, Andrew Chen, Rahul Vohra at Superhuman) and adapt it for the specific characteristics of the space economy: long development cycles, government-influenced demand, hardware manufacturing constraints, and the near-impossibility of iterating fast.

Use it alongside real cases: test each framework against a space venture you know well.

What PMF Actually Is

And what it isn't — especially in space

The Definition

Product-market fit exists when a significant number of customers are getting enough value from your product that they would be genuinely disappointed if it went away — and their behaviour proves it.

The key word is behaviour. Not intent. Not aspiration. Not survey response. Behaviour.

Marc Andreessen's Original Definition (2007)

"Product/market fit means being in a good market with a product that can satisfy that market."

This is useful but incomplete. It tells you what PMF is. It doesn't tell you how to recognise it, how to measure it, or how to know when you've lost it.

The Behavioural Test

Sean Ellis, who popularised the 40% test at Dropbox and LogMeIn, distilled PMF into a single survey question:

"How would you feel if you could no longer use [Product]?"

If 40% or more of respondents answer 'Very Disappointed', you have PMF. Below 40%: you don't. This is a useful threshold, not an absolute law. But it operationalizes something important: PMF is about disappointment at loss, not satisfaction at use.

Why This Is Hard in Space

The Ellis test works best with B2C and B2B SaaS products that have large user bases and rapid feedback loops. It is difficult or impossible to apply directly to:

- A company with 3 government customers
- A hardware product in development that no customer has used yet
- A platform that serves other businesses' operations (customers can't imagine losing it because they've never had it)

This doesn't mean PMF doesn't apply. It means you need adapted diagnostics — which is what the rest of this guide provides.

What PMF Is Not — Common Confusions

This is NOT PMF	Why Not
Interest / Demand signals	Letters of intent, conferences attendees asking questions, press coverage — these measure aspiration, not demand. Virgin Galactic had 800 ticket reservations. That is not PMF.
Contract wins	A signed government contract is not PMF. It may be the precondition for PMF (revenue to continue building) or an early PMF signal (if it demonstrates pull), but procurement is often supply-push, not demand-pull. OneWeb had offtake agreements and still went bankrupt.
Technology readiness	A working satellite, a successful launch, a technical milestone — none of these are PMF. Iridium's constellation worked perfectly. Orbex was on the cusp of its first test flights. Neither had PMF in the commercial sense.
Market size	TAM analysis tells you the theoretical size of a market, not whether customers will choose your specific product at your specific price point. OneWeb's TAM — global broadband connectivity — was genuinely enormous. Their PMF was insufficient to support their capital structure.
Revenue	Early revenue, especially from friendly early adopters or government grants, can mask the absence of real PMF. The question is not 'are customers paying?' but 'are customers paying enough, with low enough churn, at a low enough acquisition cost, to generate a sustainable business?'

The Four Diagnostic Frameworks

Tools adapted for the space economy

Framework 1: The Retention Curve

The most reliable PMF signal is not a survey — it is a retention curve. If you plot cohort retention (percentage of customers who are still active) over time, a PMF product shows a curve that flattens above zero. A non-PMF product shows a curve that trends toward zero.

For consumer products, 'active' means daily or weekly engagement. For space B2B products, 'active' might mean contract renewal, continued data consumption, payload uptime, or re-purchase.

✓ PMF Retention Signature

Cohort retention flattens above 0 after initial drop. Some customers become permanent. Retained customers increase usage over time. Expansion revenue (upsell) occurs without outbound sales.

× No PMF Retention Signature

Cohort retention trends toward 0. Customers churn after first use or first contract period. Renewals require heavy sales effort. No expansion revenue without active selling.

Space-Specific Application

For pre-revenue space companies (most of your portfolio), you cannot measure retention on customers because you don't have customers. Instead, measure retention proxies:

- Pilot programme to second contract conversion rate
- Data reorder rate from early EO imagery customers
- Re-engagement rate after beta partnerships
- Customer reference willingness (will they go on record?)
- Customer-initiated feature requests (pull, not push)

Framework 2: The Pull vs Push Test

Fundamentally, PMF is about pull — customers seeking you out, renewing without prompting, referring without incentive. The absence of PMF manifests as push — needing to sell hard, to educate extensively, to discount heavily, to lobby for policy support.

This distinction matters especially in the space economy, where almost all companies are in push mode by default. The market is not yet mature enough to generate spontaneous pull for most products. The diagnostic question is not 'are we pushing?' but 'what would pull look like for our specific product, and are there any early signals of it?'

Pull Signal	What to Look For
Inbound leads	Are potential customers finding you, or are you finding them? Inbound from unexpected geographies or segments is a strong signal.
Sales cycle length	Is your sales cycle getting shorter over time, or longer? Shortening = pull emerging. Lengthening = product-market misalignment.
Customer referrals	Are existing customers introducing you to new customers without being asked? Unprompted referrals are among the strongest PMF signals.
Procurement speed	Are customers moving through procurement faster than the typical government or enterprise timeline? Urgency is a pull signal.
Feature pull	Are customers asking for more, or asking for something different? 'More' = pull. 'Something different' = may indicate insufficient PMF in current form.
Price resistance	Can you raise prices without losing customers? Willingness to pay premium = high perceived value = PMF signal.

Framework 3: The Superhuman PMF Engine (Adapted for Space)

Rahul Vohra at Superhuman email client developed a more sophisticated PMF engine than the simple Ellis test. Rather than just asking 'how disappointed would you be?', the Superhuman approach also asks: who are the 'very disappointed' users, and what do they love? Then product development focuses on making more people like the 'very disappointed' segment.

Applied to space B2B, this becomes a segmentation exercise:

1. Among your current customers or pilots, identify the ones who would be 'very disappointed' to lose your product. Even if this is 1 or 2 customers, they are your PMF beachhead.
2. What specifically about your product creates that 'very disappointed' response? Is it a technical capability, a cost advantage, a procurement relationship, a specific data type?
3. Are there other customers who share the same characteristics as your 'very disappointed' customers? This is your true addressable market.
4. For customers who would NOT be very disappointed, what is the gap? Is it a product gap (solve this and they'd be very disappointed), a fit gap (they're the wrong customer), or a value communication gap?

The Beachhead Logic

For space companies, PMF almost never starts as a broad market. It starts as an intense, validated fit with a specific customer type in a specific use case.

SpaceX's PMF beachhead: commercial satellite operators needing dedicated medium-lift launch.
Rocket Lab's PMF beachhead: small satellite operators needing dedicated small-lift launch.

Albedo's PMF beachhead (discovered): defense/intelligence operators needing flight-proven VLEO bus platforms.

The question for any space startup: have you identified your beachhead? And is your beachhead large enough to sustain the business while you expand?

Framework 4: The Space PMF Matrix

This framework is purpose-built for the space economy. It evaluates PMF across three dimensions simultaneously: market pull, capital sustainability, and competitive durability.

Dimension	Strong Signal	Weak Signal / Risk
Market Pull	Customers seek you out. Inbound from unexpected segments. Renewals without prompting. Price increases absorbed. Customer-initiated referrals.	You win only through heavy sales effort. Customers need educating before they recognise the need. Deals stall on procurement. No inbound leads.
Capital Sustainability	Revenue growth rate exceeds capital consumption rate. Gross margins support path to profitability. Customer LTV justifiably exceeds CAC. Strategic investors provide non-dilutive capital.	Each revenue dollar requires disproportionate capital spend. No path to positive unit economics at realistic scale. Dependent on government grants with uncertain renewal. Cash burn accelerating.
Competitive Durability	Your cost structure, technical capability, or customer relationships create switching costs. No current competitor can replicate your core advantage within 3 years. Your PMF is defensible at scale.	A better-funded competitor is pursuing the same market. Your advantage is time-based (first mover) without structural moat. Customer relationships are thin and procurement-based, not mission-critical.

A company with strong signals on all three dimensions has found PMF. A company with strong market pull but weak capital sustainability may have PMF but the wrong business model. A company with strong capital sustainability but weak market pull may have a cash-burning sales machine, not a PMF business.

The 30-Minute PMF Audit

Run this on any space venture in a pitch, a board meeting, or a war room

Use this audit to evaluate whether a space venture has found PMF, is on a credible path to PMF, or is building something for which PMF evidence is absent. Score each item. The pattern of scores matters more than any individual answer.

SECTION A: CUSTOMER EVIDENCE

SCORE	Question	What to look for
✓ ? ✗	**Real customers vs. pilots**	Paying customers (even small payments) > unpaid pilots > LOIs > survey interest > nothing
✓ ? ✗	**Renewal/repeat behaviour**	Did any customer renew, expand, or re-order without a sales push? Even one is a signal.
✓ ? ✗	**Customer specificity**	Can you name your PMF customer precisely? 'Government defence' is not specific. 'NRO imagery analysts requiring sub-30cm resolution in contested airspace' is specific.
✓ ? ✗	**Referral behaviour**	Has any customer introduced you to another customer without being asked? This is one of the strongest PMF signals available.
✓ ? ✗	**Churn and reason**	What is your churn rate? What are the stated reasons? 'Budget constraints' may mask PMF absence. 'We switched to a competitor' confirms PMF exists — in someone else's product.

SECTION B: BUSINESS MODEL EVIDENCE

SCORE	Question	What to look for
✓ ? ✗	**Unit economics trajectory**	Are gross margins improving as you scale? Even in hardware, margins should improve as production volumes increase. Flat or declining margins at scale = structural PMF risk.
✓ ? ✗	**Capital efficiency**	How much capital has been consumed per dollar of ARR? For space hardware, efficiency ratios are inherently worse than software. But 'worse' should be bounded, not infinite.
✓ ? ✗	**Willingness to pay**	Have you tested price elasticity? Can you raise prices without losing customers? If the answer is 'we've never tried to raise prices', that is a red flag.
✓ ? ✗	**Revenue diversification**	Is >50% of revenue from a single customer? Single-customer dependence is a common space company fragility. Not necessarily fatal (government anchor customers are

		legitimate), but it requires scenario planning.
✓ ? ✗	**Capital structure match**	Does the capital structure (investor return expectations, loan covenants, grant conditions) match the development and commercialisation timeline? Orbex had government loans requiring conversion to equity — incompatible with a commercial PMF that took 11+ years to reach test flights.

SECTION C: COMPETITIVE ENVIRONMENT

SCORE	Question	What to look for
✓ ? ✗	**Structural cost advantage**	Does your business model allow you to serve customers at a cost structure that incumbents cannot match without cannibalizing their own margins? SpaceX vs. Arianespace. Rocket Lab vs. rideshare.
✓ ? ✗	**PMF durability horizon**	Will the market conditions that make your PMF possible still exist in 5 years? Iridium's PMF thesis was valid in 1991 and invalid by 1998. What changes in the next 5 years could erode your PMF?
✓ ? ✗	**Cross-subsidy exposure**	Is a well-capitalised competitor cross-subsidizing their entry into your market? This was OneWeb's fatal problem — Starlink was funded by SpaceX launch economics. If yes: can you survive, and at what cost?
✓ ? ✗	**Customer stickiness**	How hard is it for your customers to switch? Data continuity, platform integration, security clearances, and mission-critical dependency all create switching costs. Pure commodity services have none.

SECTION D: MARKET TIMING

SCORE	Question	What to look for
✓ ? ✗	**Market readiness now**	Is the market ready for your product today? Or is it a market that will exist in 3-5 years, which requires you to survive until it matures?
✓ ? ✗	**Assumption age**	When were your original market assumptions formed? Have they been stress-tested against what has changed since? Iridium's assumptions were 7 years old by launch. Are yours aging?
✓ ? ✗	**Technology enabler timing**	Does your PMF depend on enabling technologies (launch cost, sensor maturity, AI processing, spectrum allocation) that are on a trajectory to meet your product timeline?
✓ ? ✗	**Regulatory pathway**	Is there a clear regulatory pathway to commercial operation, and does it fit your capital runway? Regulatory delay is a common PMF-killer in space — it extends the time to revenue without reducing costs.

INTERPRETING YOUR AUDIT

Score Pattern	Interpretation
All or mostly ✓	Strong PMF evidence. The question is execution: can you scale into the PMF you've found without losing the characteristics that created it?
Mix of ✓ and ?	Partial PMF or PMF in a specific segment. Go deeper on the '?' items — they may reveal the constraints on your growth or the conditions under which PMF will solidify.
Mostly ?	Early PMF signals without confirmation. You may be pre-PMF and moving toward it, or you may be optimising around a misaligned product. The key question: what experiment would resolve the '?' into '✓' or '×' fastest?
Several ×	Absence of PMF evidence. This does not mean PMF is impossible — it may mean the product is too early, the customer is wrong, or the price point is misaligned. But it should trigger a structured reassessment, not additional execution.
Mixed ✓ and × with pattern	Look for which sections the × cluster in. A pattern of × in Section A (customer evidence) suggests a fundamental product-market misalignment. A pattern of × in Section B (business model) may suggest the PMF exists but the monetization model is wrong.

PMF Myths in the Space Economy

The beliefs that kill space startups

Myth 1: 'The technology is the PMF'

A technically superior product does not have PMF unless customers will pay for the technical superiority at a price that generates a sustainable business. Iridium's constellation was a marvel of engineering. It did not have PMF. The market had evolved past the problem the technology solved.

The correct question

"What specifically about this technology makes customers willing to pay more than alternatives, and will that differential persist long enough to build a business?"

Myth 2: 'We have a government contract, so we have PMF'

Government contracts provide revenue, validation of technical capability, and sometimes market-making. They are not PMF in the commercial sense. Government procurement is driven by programme requirements, political priorities, and budget cycles — not by product pull. A company that exists only on government contracts has not validated commercial PMF, and is exposed to programme cancellation, policy change, and budget reallocation.

The correct question

"If this government programme were cancelled tomorrow, could we survive on commercial revenue, and if not, what does our business actually look like?"

Myth 3: 'We just need to get to orbit, then we'll find PMF'

This is perhaps the most dangerous myth in new space. The implicit assumption is that once the technical capability is demonstrated, customers will arrive. But Orbex had commercial launch commitments before it collapsed. Having a working vehicle and having customers who will pay for it in sufficient volume, at sufficient margin, to generate a business — are completely separate questions that must be answered independently.

The correct question

"Have we validated our first commercial customer at the price point our business model requires, and does that validation hold regardless of whether we have flown yet?"

Myth 4: 'The space market is different from other markets'

Space does have genuine structural differences: longer development cycles, higher capital requirements, government-influenced demand, hardware manufacturing constraints, dual-use considerations. But the PMF principle — that customers must want your product enough to demonstrate it through their behaviour — is universal. The frameworks require adaptation, not abandonment.

The correct question

"Which aspects of standard PMF thinking apply to our business unchanged, which require adaptation, and which genuinely do not apply — and can we justify each answer?"

Myth 5: 'If we build the constellation, the customers will come'

Field of Dreams syndrome is uniquely virulent in the space economy, because constellations do require upfront capital commitment before the service can be provided. But this sequencing constraint does not mean customer validation should wait. OneWeb committed to a full constellation business model before validating unit economics at any price point. The solution is not to avoid investment — it is to separate technical investment decisions from market validation decisions and to run the latter as cheaply and quickly as possible.

The correct question

"What is the minimum viable service we can provide to prove that customers will pay our required price, before we commit to the capital required to provide full service?"

Myth 6: 'The 'fail-fast' methodology justifies any failure'

The fail-fast philosophy has genuine merit — especially in an industry with a history of billion-dollar programmes that spent years confirming what early testing would have revealed. But it has been absorbed by the new space community in a way that sometimes normalises PMF failure as simply 'learning.' SpaceX's Starship failures are fail-fast learning. Virgin Galactic's twenty-year failure to find a sustainable business model is a PMF failure, not a productive iteration.

The correct question

"Is this failure teaching us something that improves our probability of finding PMF, or is it revealing that the PMF hypothesis was incorrect — and if the latter, when do we update the hypothesis?"

The Decision Framework

Scale, Pivot, or Kill — and when to do each

Once you have run the PMF audit, you face a decision. The three options — scale into the PMF you've found, pivot to a better PMF, or exit the current path — require different conditions and carry different risks. This framework helps distinguish them.

When to Scale

Scaling is appropriate when: retention curves have flattened above zero; customers are expanding their use or spend without heavy selling; your cost structure improves as you scale; and the competitive environment is not about to change in ways that erode your PMF.

The scaling trap: scaling a product that has partial PMF — strong in one segment, weak in others — amplifies the partial-PMF characteristics. Revenue grows but unit economics don't improve, because the non-PMF customer segments drag down overall efficiency. Diagnose before you scale.

When to Pivot

Pivoting is appropriate when: your audit reveals strong signals in one dimension but weak signals in others; a specific customer segment shows intense PMF while others show none; your technology has proven value in a different application than originally designed; or a better-capitalised competitor has made your original market thesis untenable.

The Albedo pivot is the exemplar: they didn't pivot because their original thesis failed — they pivoted because a better thesis revealed itself. The best pivots are opportunity-driven, not desperation-driven. By the time desperation forces a pivot, the options are narrower and the execution capital is depleted.

The Pivot Test

Before pivoting, answer three questions:

1. Is there evidence of stronger market pull in the new direction than the current one — not just weaker push?
2. Does the pivot preserve the core asset (technology, team, customer relationship) that created value in the original thesis?
3. Does the pivot give you enough runway to reach the next PMF validation milestone?

When to Kill

The hardest decision in entrepreneurship — and the one most rarely made correctly — is recognising when neither the current path nor any credible pivot leads to genuine PMF within the available capital.

The killing decision is appropriate when: the PMF audit consistently returns × across all sections with no improving trajectory; the market that the product was designed for no longer exists or has been captured by a competitor with structural advantages; the capital required to reach the next validation milestone exceeds what is reasonably available; or the founding team has lost conviction that the problem is solvable with the resources available.

In the space economy, this decision is complicated by sunk costs (the satellite is already built), political considerations (government funding creates accountability), and founder ego (the vision is compelling). None of these considerations change the underlying economics.

The Hardest PMF Question

"If we were starting this company today, with the current market information, current competitive landscape, and current capital environment — would we start it?"

If the honest answer is no, the conversation about kill or pivot must happen immediately, not after the next milestone.