

Engineering Momentum – The Lifecycle of a Semiconductor Startup

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Building a semiconductor startup requires navigating a uniquely demanding lifecycle that blends scientific maturity, productization discipline, customer validation, and organizational scaling in precisely the right sequence. Unlike software ventures, semiconductor startups cannot shortcut critical stages of technology readiness and industrialization. Their entire journey is characterized by path dependency, irreversible decisions, long iteration cycles, and capital-intensive milestones, which must be orchestrated with exceptional clarity.

The figure below outlines a template lifecycle for semiconductor companies. This paradigm should not be considered a straitjacket that must be strictly followed; rather, it is a guideline for how to build a venture toward unicorn valuation level.

Our use of the term lifecycle does not correspond to the life and death of a startup. It refers to the period from

Seed to Scale in the evolution of a semiconductor venture — including early technology development, product definition, launch, and early scaling. Throughout this entire timeline, execution must be fast, disciplined, and sequenced, because the consequences of delays are severe. In fact, losing momentum is one of the main reasons semiconductor companies underperform. As it is essential to generate revenue as soon as possible, a company's focus during this period should be on launching a Minimum Viable Product ¹ (MVP) into a carefully selected beachhead market.²

One danger lurking around the corner is competitors who can overtake the technology. Once a company has failed to secure a “socket” (the place where its silicon fits into a “receiving” product), it becomes extremely hard to regain that position because sockets tend to be sticky. Consequently, it will lose credibility with prospective customers, whose enthusiasm to work with the company will fade.

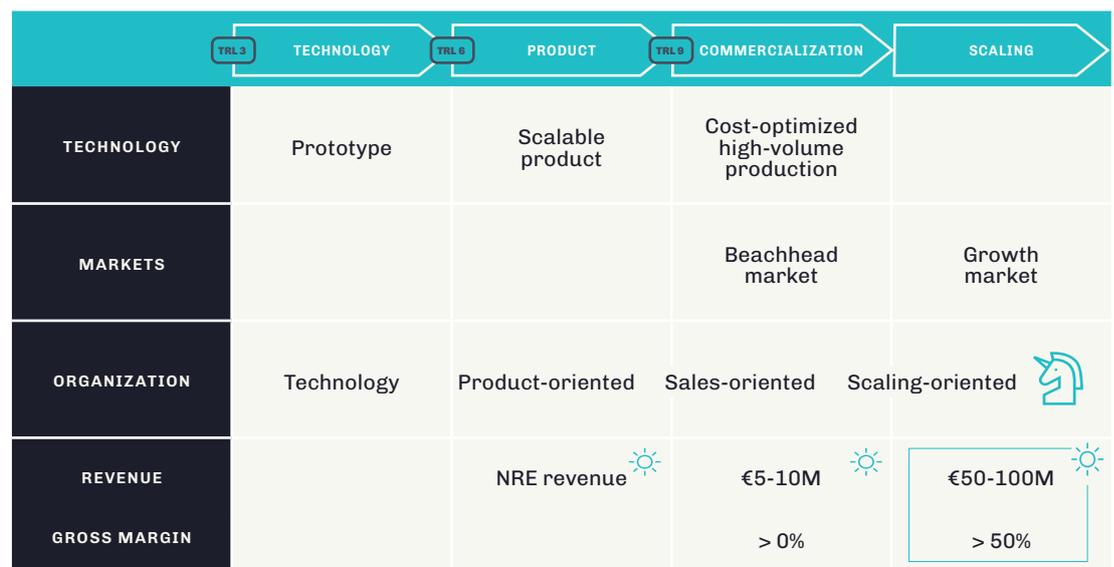


Figure 1 - Lifecycle template for semiconductor companies

Another possible risk is that investors may lose patience. If the company needs new money *before* reaching a major milestone, existing investors will be disappointed, making it more difficult to attract new ones. On top of that, a valuation uptick is hard to achieve, often leading to down rounds or worse. It is extremely hard for a company to recover from such a downward spiral.

In this whitepaper, we identify a yardstick in the **Aerospace Technology Readiness Level (TRL)**³ scale and redefine it for our purposes. We explain why the timeline is so consequential for semiconductor startups, and then map out the five stages defined in the template. We also include a practical example to demonstrate the theory's real-life application.

Conceptually, this lifecycle can be seen as a deeptech startup-centric operationalization of the famous market adoption bell curve popularized by Geoffrey Moore in his 1991 book "Crossing the Chasm."⁴ Our lifecycle framework covers the market entry, first sales to the innovators and early

adopters, while being cognizant of the needs of the early majority. For a comprehensive review of related literature, see Schuh et al.⁵

Figure 2 frames the entire lifecycle as approximately an **eight-year journey**, divided symmetrically into two four-year halves: four years to reach a credible MVP and first revenues, and four years to scale into meaningful commercial traction.

This figure reflects the economics and psychology of semiconductor venture financing. Venture capital aligns naturally with TRL inflection points: Seed capital supports early feasibility; Series A underwrites productization; and Series B and beyond fund growth and scale. Each step reduces a different form of risk: technology risk, product risk, market risk, and last, scaling risk. Ideally, each round should have a new lead investor setting the round's valuation, with the existing investors participating. This will boost confidence in the company and, in controlled steps, lead to higher valuations and finally to unicorn territory.

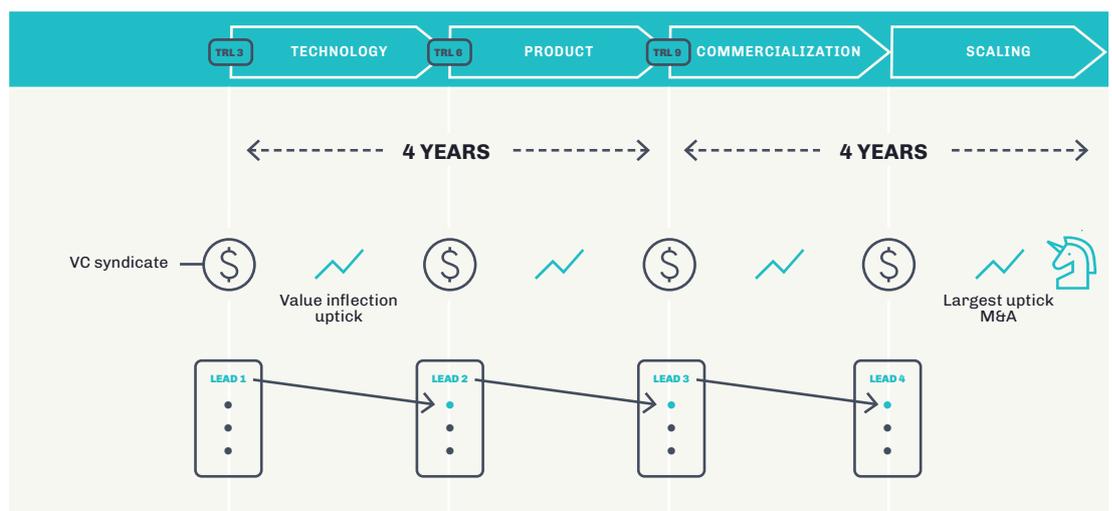


Figure 2 - The semiconductor startup lifecycle

TRL Scale

From Rocket Science to Semiconductors

The yardstick that best fits our needs is the **Aerospace Technology Readiness Level (TRL)** scale. Translating this scale to the world of semiconductor deeptech requires shifting from flight-proven milestones to silicon-proven ones. For semiconductors, the difficulty is not the space environment; it is navigating the intricate interdependencies of the design and fabrication process and the subsequent integration into a final system.

1. Basic principles observed

Theoretical research is conducted, including scientific papers or substantiated hypotheses. This can be at different levels in the value chain: materials, devices, circuit concepts, architectures, and system level concepts. There is no hardware implementation yet.

2. Hardware concept formulated

A hardware concept or architecture is defined. Feasibility is based on theory, simulations, or prior knowledge, but no physical realization exists.

3. Experimental proof of concept developed

Critical functions are demonstrated through bench-level experiments or early test structures. Separate elements may exist, but they are not yet integrated.

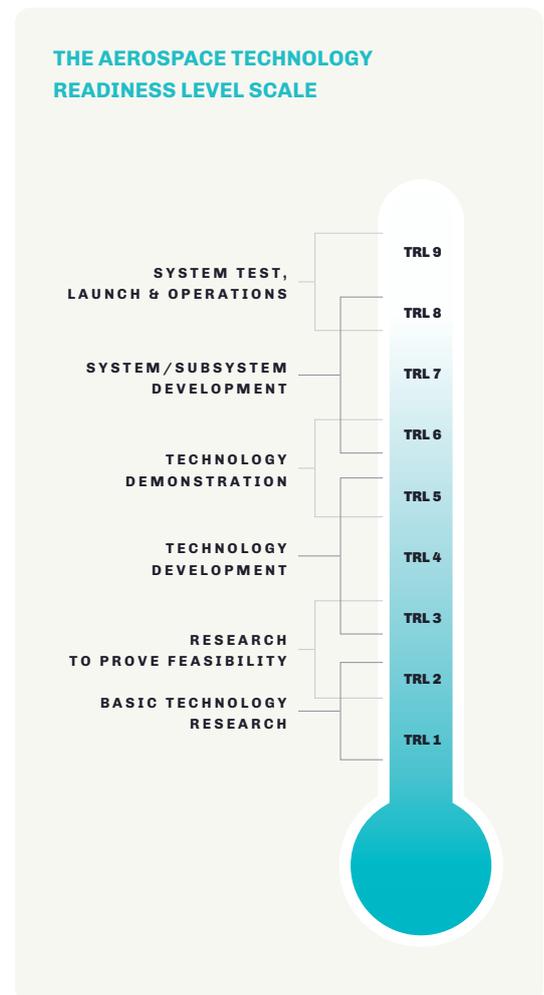


Figure 3 - The Aerospace Technology Readiness Level scale

4. Hardware validated in lab

Key components are fabricated and integrated at lab scale. The hardware operates under controlled laboratory conditions.

5. Hardware validated in relevant environment

The hardware is tested under relevant operating conditions (e.g., temperature, voltage, stress, and throughput). Performance trends and limits are examined.

6. Prototype demonstrated in relevant environment

A representative prototype is built using near-production materials, processes, or form factor. This demonstrates functionality, performance, and reliability in a relevant environment.

7. System prototype demonstrated in operational environment

A fully integrated system prototype

operates in a real operational environment (e.g., a pilot line, field test, or customer setup). Interfaces, packaging, and integration are validated.

8. System qualified

The final hardware design is frozen. Manufacturing, assembly, and test flows are defined and frozen. The system is qualified against standards, specs, and customer requirements.

9. Hardware proven in operational use

The hardware is produced and deployed at scale. Performance, reliability, yield, and lifetime are proven in real operational use.

TRL 1 – 2

Research Phase

The fundamental TRL tiers 1 and 2 are considered a purely academic domain, with timelines and uncertainty levels far beyond the typical venture investor's appetite.

Applied research institutes are fertile breeding grounds for breakthrough semiconductor innovations at this early stage, as they combine the fundamentals of scientific excellence with an industrial partner network and a critical prototyping and testing infrastructure.

In this whitepaper, we focus on the lifecycle following this research phase (at company launch), since this is where the venture part typically begins.

TRL 3 – 6

Technology Phase

The lifecycle of the company usually begins in the **technology phase**, where a new device concept, materials innovation, MEMS structure, sensor architecture, or packaging approach emerges from the research phase and becomes a candidate for commercialization. At this stage, around **TRL 3**, experiments show that the idea can work, but it hasn't yet proven to be repeatable or relevant at the system level. Moving toward TRL 6 is about demonstrating that the innovation is more than an interesting lab result. It needs to hold up across multiple fabrication runs, operate in realistic environments, and show that it can eventually be integrated into a manufacturable flow.

Reaching **TRL 6** represents a significant milestone. The technology is now an engineered prototype that behaves consistently enough to support a product concept. However, many founders misunderstand this stage. TRL 6 does not mean the technology is “done”; it means the technology is finally ready to become the foundation of a real product. In reality, productization work is just beginning. At this stage, the team needs to shift from research mode to product mode, because the assumptions that remained implicit in the lab now need to be validated explicitly, in detail, and often in direct conversation with customers.

Although this is early-stage development, the early definition and validation of the MVP already play an essential role.

Technology innovations can develop in many different directions and combinations, so it is important to focus specifically on the innovations that are essential to the MVP. This helps meet the template's stringent deadlines and avoids wasting time on cycles not relevant to the MVP.

While this early phase can easily consume north of **€10 million**⁶, it is also the time when each invested euro can make the largest difference. Therefore, it is essential to manage funding strategically, mitigating key risks and making vital (founding) team hires, while still urging the team to be conscious of spending.

TRL 6 – 9

Product Phase

The second part of a startup's lifecycle is the **product phase**, a transformation that moves the company from having a promising technology to having a manufacturable, qualifiable device that satisfies customer requirements. This requires reaching **TRL 8**, the point at which a product has been validated in its intended operational environment and is supported by a manufacturing process capable of handling predictable volumes.

In **TRL 9**, which represents the full production operation and market deployment, the company must fully realize its **MVP** in conjunction with a tightly scoped **beachhead market**.

The MVP is not a prototype; it is the first product that will be sold, supported, validated by customers, and produced at a quality level sufficient for initial deployment. It should be the simplest

product that can both demonstrate clear, customer-relevant value and dominate an early market. Semiconductor MVPs cannot be rushed, but they also cannot be allowed to drift. Every month lost because of unnecessary complexity or unfocused engineering extends the time to revenue and increases dilution.

Reaching TRL 9 involves qualification testing, yield learning, packaging development, firmware and system integration work, and intensive customer feedback cycles. Simultaneously, the organization needs to evolve beyond engineering: It should build early supply chain relationships, establish design-for-manufacturing rigor, and begin developing commercial and operational capabilities. This is typically financed through **€10-30 million** in Series A funding.

TRL 9 → MVP Revenue Commercialization Phase

When the product reaches TRL 8 (moving to TRL 9) and the MVP is validated, the company enters the **commercialization phase**. There is absolutely no time to lose at this point, as competitors try to outcompete you, customers need support, and investors expect product revenue. Semiconductor customers never adopt new components lightly. Design-ins and -wins require structured qualification processes, integration pilots, and proof that the supplier can deliver consistent quality and reliable volumes.

The transition from first MVP shipments to recurring revenue is one of the most difficult parts of the entire lifecycle. The company must demonstrate not only that the product works but that it works across customer variants, operational conditions, and the full system in which it will be embedded. Revenues should now move from non-recurring engineering (NRE) agreements to MVP product revenue.

Beyond MVP → Growth Markets Scaling Phase

Once early customers have adopted the MVP and revenue becomes repeatable, the startup enters the **scaling phase**. This is the period when a semiconductor company transitions from selling thousands of units to selling hundreds of thousands or millions, depending on the application. Scaling is about more than simply increasing volume; it is

about transforming the startup into a robust industrial organization. Yield improvement, cost optimization, supply chain reliability, and manufacturing resilience become central strategic priorities.

The company must move beyond the beachhead market and into broader

growth markets. Expansion cannot begin before the company is operationally ready; premature diversification frequently destroys focus and undermines technical progress. Once the foundation is solid, though, entering adjacent segments allows the company to leverage its technology platform, broaden revenue streams, and position itself for strategic partnerships or acquisition.

This stage often requires **another €50-100 million** in growth financing and typically attracts large syndicates, including global VCs and strategic investors. Since both technical and market risks have been substantially reduced by this stage, it is also when the most significant valuation upticks occur.

Key Takeaways

The semiconductor venture lifecycle is shaped by structured, irreversible inflection points. Progression from TRL 3 to TRL 9 includes sequential de-risking of technology, product, market, and scaling dimensions. Each stage demands a different organizational focus and a different type of capital.

Unlike software ventures, semiconductor startups cannot compress or reorder these phases without consequence. The eight-year template — four years to reach a credible MVP and initial revenue, followed by four years to scale — reflects the economic and operational realities of the semiconductor industry. Venture capital aligns naturally with this progression, underwriting successive reductions in risk.

Continuous momentum is required to sustain that alignment. To achieve this and position the company for sustained financing through to profitability, the whole startup team should live and breathe operational excellence during these initial years. An early and well-defined MVP with a corresponding beachhead market will generate a clear focus and facilitate decision-making on the company's resource allocation.

The semiconductor track is among the most value-generative paths in modern venture capital. The lifecycle must be managed with relentless discipline, but when sequenced correctly, the company can reach unicorn-level valuations.

InvenSense

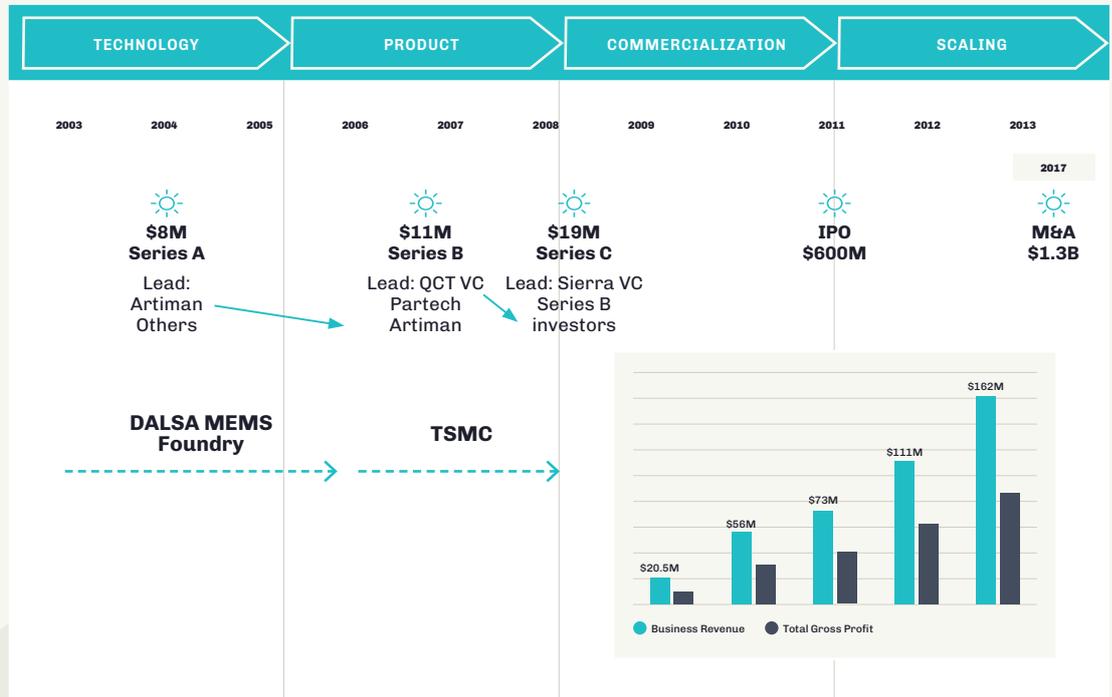


Figure 4 - The Lifecycle of InvenSense

To ground the semiconductor lifecycle in reality, this figure charts the progression arc of [InvenSense](#), a Silicon Valley MEMS sensor startup, from early concept to major acquisition. The company spent its early years (2003-2007) refining its MEMS process at the low-volume manufacturing facility DALSA before moving to TSMC for high-volume manufacturing as its product-market fit solidified. Its revenue increased from \$20M to over \$160M between 2010 and 2013. InvenSense went public at a \$600M valuation and was ultimately acquired for \$1.3B in 2017.

The example illustrates how semiconductor startups progress: early technical risk reduction, disciplined productization, well-timed manufacturing partnerships, first revenue, rapid scaling in a beachhead market, and finally, acquisition or an IPO once the company demonstrates both technology leadership and commercial robustness.

About



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Peter Vanbekbergen is a deeptech investor and technology entrepreneur with extensive experience in semiconductor R&D, venture creation, and early-stage company building.

He has been involved with several deeptech semiconductor startups as a research manager, product development engineer, VP of engineering, CEO, investor, and board member.

As a co-founder of imec.xpand, he focuses on transforming breakthrough research into scalable startups and guiding founders through the complex lifecycle of deeptech commercialization.



imec.xpand

imec.xpand is one of the world's largest independent venture capital funds dedicated to early-stage semiconductor innovation. It targets ambitious startups where the knowledge, expertise and infrastructure of imec, the world-renowned semiconductor and nano-technology R&D center, can play a determining role in their growth.

imec.xpand has an outspoken international mindset towards building disruptive global companies and strongly believes that sufficient funding from the start is key to future success.

References

- 1 The concept of the MVP was first introduced by Frank Robinson in 2001 and later popularized by Steve Blank and Eric Ries. While Ries' primary goal was fast, experimentally validated learning and hypothesis testing, we retain a stricter definition of the MVP as the first *selling* product, catering to the least demanding customers, such as early adopters.
- 2 The concept of the beachhead market is well explained in "Disciplined Entrepreneurship" by Bill Aulet (2013).
- 3 Mankins, John C. "Technology Readiness Levels: A White Paper." NASA, Office of Space Access and Technology, 1995.
- 4 https://en.wikipedia.org/wiki/Crossing_the_Chasm.
- 5 Schuh, Studerus, Hammerle. "Development of a Life Cycle Model for Deep Tech Startups." *Journal of Production Systems and Logistics*, Feb 2022.
- 6 These are indicative figures within a large range of numbers that depend on the characteristics of the venture.

Disclaimer

The investment amounts mentioned for each phase assume a silicon product of medium complexity: imagers, sensors, ASICs, and medium-complexity processors. As soon as you move to more complex integrated systems (servers, complex processors and ASICs, imaging systems, etc.), the investment amounts required often multiply. Founders and investors should be realistic about combining the right level of investment and the right product complexity level. Underestimating the level of investment is often a recipe for underperformance or worse.

