PRODUCT MINDSET IN DEEP TECH VENTURES

THE VALUE OF PRODUCT MINDSET IN DEEP TECH

BOM

The value of product mindset in Deep Tech

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Deep tech startups, the driving force behind technological advancement, are at the forefront of groundbreaking innovations that have the power to revolutionise entire industries. Despite their technological prowess, many of these ventures face a crucial challenge: successfully transforming their technology into a scalable product that resonates with the market.

At Brabant Development Agency (BOM), we stand alongside deep tech entrepreneurs every day. We understand the complexity, long timelines, and capital intensity that characterise these companies. With this publication, we aim to provide concrete guidance for founders, investors, and other stakeholders who want to see deep tech ventures succeed.

While the promise of deep tech is immense, the path to success is fraught with unique and often underestimated challenges. This white paper identifies critical failure modes that repeatedly hinder deep tech ventures. By addressing these issues head-on, this white paper provides a practical framework for founders and investors to navigate the deep tech journey more effectively, from lab scale to market entry.

Contents

"Deep tech ventures demand significant time, capital, and conviction. This whitepaper offers a clear, structured approach to navigating two of their most critical early-stage challenges: customer validation and product realization. An essential resource for founders and investors alike that want to get to market faster and be more capital efficient."

Sander Verbrugge
Partner at Innovation Industries

Summary: What is unique to Deep Tech venturing

Deep tech is defined as novel scientific or engineering breakthroughs making their way into products and companies for the first time [1]. It is characterised by high-complexity hardware-based propositions, above-average resource demands (>10M), and long development timelines for novel technologies (>5 years). Hardware is backed by protectable IP (patents and/or proprietary trade secrets and know-how) and lengthy R&D activities preceding the product definition and venture incorporation itself. According to [2], approximately 40% more capital is required for deep tech startups to reach the market than for traditional Tech Startups. Their capital-intensive nature makes the cost of failure particularly high. Yet, the payoff for success is substantial as returns often rival or even surpass that of SaaS ventures [2]. This is because in deep tech, capital is invested in creating core technological innovation, rather than marketing. This intrinsic value can enable them to outperform SaaS companies [1] and keep their market position for longer. Exits in deep tech typically peak around 6-7 years after first investment, similar to traditional Tech, though timelines can extend longer: beyond 15 years. Such delay not only increases the capital needs and risk of failure further, but it also shifts out the exit horizon and puts pressure on the investment thesis of deep tech VCs, most of which still have a 10-year closed-fund structure.

The challenge is that many deep tech startups get stuck before achieving the product-market fit. The most common failure modes in deep tech are related to the fact that it often employs a technology-push approach without sufficient market validation, resulting in poor product-market fit and wasted resources. A frequently cited cause is the poor identification and validation of problems for the application space that the technology provides: poor problem-solution fit validation. We concur that this is indeed one of the most common causes of failure we have seen in practice. However, there is a second but equally important issue. Even with a compelling technology and a validated concept, converting it into a commercially viable product remains a significant hurdle, especially if the productisation and industrialisation aspects are not considered.

Fortunately, there are strategies to mitigate these risks and challenges. The key lies in adopting a product mindset. This approach involves early understanding and validation of customer needs, with a focus on creating a product that not only meets these needs but can also be produced and maintained at scale. In the early stages, achieving a problem-solution fit is often about demonstrating that a new technology effectively solves a customer's problem in a specific application. However, solving a problem is not the same as building something customers are willing to buy. This is the focus of the next phase in venture development – proving the product-market fit. To make the transition from a technology mindset to a product mindset effectively, the product realisation and validation strategy needs to be well set up, and key roles well represented.
An ideal deep tech team will therefore translate the validated solution into a product that is manufacturable, scalable, and desirable, thereby demonstrating the product-market fit. The implication is that deep tech teams need to evolve from scientific specialists to include talent with expertise in business and product development, such as product managers, system architects, and others who can efficiently navigate the journey from concept to commercialisation without increasing capital needs or stretching timelines further.

In this paper, we focus on the aforementioned aspects of product realisation in deep tech ventures. We stress where failure modes typically occur and how they can be addressed. Furthermore, we outline the image of an ideal deep tech venture and its development lifecycle, with a focus on product development. In our experience, these failure modes are prevalent, and proposed solutions should be on the radar of both founders and investors as the key to managing the described risks in the future. They will help them manage expectations regarding the level of investment required and product maturity per phase or round, as well as anticipate future financial needs and aid in preparing realistic forecasts. This will enable them to grow the right team at the right time and manage these technically intensive risks.

The underlying assumption and starting point of the paper is that:

- Technology is captured in Intellectual Property with a significant hardware component.
- A proper problem-solution fit of the core technology has been found. The startup adheres to the venture capital model: the technology is market-disruptive, providing a substantial competitive advantage in solving a large enough customer problem; there is significant growth potential in terms of market size and value growth rate, as well as impact.
- The last point is critical to note because, in venturing, the capital and time efficiency of the startup are key to the return on investment and the continuous investability of the venture itself.

Our main findings are:

- Deep tech venturing, while capital intensive and following different development characteristics than regular Tech, is lucrative and adds intrinsic value, if done right: with the right team and the right way of working
- The execution of the product development process is at the heart of the venture, playing a pivotal role in both customer discovery and validation, as well as product realisation. These two aspects are the most common failure modes for deep tech ventures, underscoring the need for a focused and attentive approach to product development.
- The timelines and capital requirements of this process are long and high, respectively, and are generally vastly underestimated by the team and investors. Unless specific attention is given to it by both the team and investors, it is often not managed well, and it takes understanding and experience to do so
- Mismanagement of the process can lead to delays of 12 to 36 months and additional investment requirements ranging from approximately € 10M to, in some cases, over € 100M, resulting in increasingly deteriorating exit prospects and, consequently, difficulty in fundraising.
- The product development process is well-known in the industry and must also be rigorously executed for deep-tech startups. There is no real shortcut here.
- The process demands three core roles that cannot be outsourced and must be filled by senior and experienced individuals: product management/business development, system architecting, and project leading.
- There is potential to initially merge these roles with those of the CEO, CTO, and COO, depending on the expertise level, experience, and personal profile of the CxOs.

Common failure modes

The main task of an early-stage deep tech venture is to develop a strategy to get from a proof of concept (PoC) of the core (IP) technology to a finished product, which ideally is based on the following elements:
a) right problem identification
b) product definition that captures a sizeable market volume
c) customer validation
d) product realisation

In reality, many deep tech startups struggle to translate breakthrough and complex technologies into viable commercial products in a timely and capital-efficient way [2].

In reality, many deep tech startups struggle to translate breakthrough and complex technologies into viable commercial products in a timely and capital-efficient way [2]. As it is the inherent nature of deep tech, most deep tech ventures start with a technology discovery and are, by default, technology-centric, meaning the focus is on derisking the technology. However, the fact that the technology solves the problem does not mean that the product gets bought. Likewise, a solution implemented (read: a prototype developed) to demonstrate functionality is not a product.

High failure rates in deep tech can therefore be attributed to two reasons. Firstly, many deep tech cases are technologically driven and have failed to do proper problem validation. Having a poorly defined customer problem early on leads to a lack of product-market fit later on, resulting in the development of the 'wrong' product. Secondly, even if a problem-solution fit has been found, the process that leads to product-market fit is complex and lengthy. It requires having a perspective on a whole value proposition translated into an actionable roadmap, that will turn the technology into a commercial offering that can be reliably produced in volume at the same specs and costs, and can be qualified by a customer.

In our experience the highest risks and pitfalls occur during the product development cycle. Root causes are predominantly a R&D mentality and a lack of productising competencies within the team, failing to establish a solid process for company building in these areas. Long timelines and expensive developments become a problem if they are prolonged or more resource-intensive due to inefficiencies in product development, resulting in lagging venture development.

A R&D mentality leads to extended research and development periods, which delay market entry and increase financial risks for deep tech ventures. Aligning technological solutions with market needs is challenging, and if not properly executed, can result in misaligned product offerings. Consequences are often that the startups are required to pivot. Pivoting in deep tech is notoriously difficult due to the sunk cost and the uncertainty that the technology will provide a superior solution to the newly addressed problem. Pivoting will also require keeping the running costs of the team, adding to the capital need, so this begs the need for "first time right". In addition, scaling itself requires a significant capital investment, and if the foundation is not laid correctly, the costs become even higher.

Furthermore, product maturity is often assessed using the TRL scale to evaluate technology and engineering risks. Initially, the TRL was developed to consistently and uniformly measure and communicate the maturity of various technologies to different stakeholders [3]. However, the TRL scale doesn't provide any information on which commercial steps need to be made to guarantee the success of product introduction to the market. It focuses on the development of core technology to achieve an integrated system with the right performance, but neglects the validation aspects that make a system a product. The characteristic of hardware developments is that the first "real" conversation with customers takes place only once a first demonstrator has been developed, after the (lab-scale) PoC that is used to establish problem-solution fit. Therefore, there is initially no feedback from a customer, and whether the performance meets expectations, beyond merely an expression of 'interest'. To gather feedback on specifications, usability, or to assess performance, a fully functional prototype is typically needed. Likewise, the TRL scale also doesn't address the industrialisation aspects of the product that is required to be sold at volume to satisfy the venture potential of a startup. Industrial customers are often hesitant to adopt new technologies unless they significantly outperform the status quo and have proven to meet specifications, cost requirements, and scalability needs. These customers, therefore, demand evidence of reliable product performance, a credible and mature supply chain, and the ability to deliver products on time and at scale. Deep tech startups frequently underestimate the importance of industrialisation expertise and supply chain management, which are critical to gaining customer trust and ensuring successful product adoption, as well as to arrive at a finished product. Industrialisation expertise should be involved as early as concept design to evaluate the manufacturability of the product and identify the pilot lines needed for the manufacturing of the first commercial Series. Therefore, we call for action to look beyond the limitations of the Technology Readiness scale. Additionally, the founders should foster the value of building partnerships and utilising existing world-class supply chains, such as e.g. those surrounding ASML in the Brainport region.

Finally, we find that venture teams vastly underestimate the required time, resources and planned derisking of product development, and most venture plans assume only a fraction of this period. Firstly, unintentionally, parts of the process get skipped, or the whole process stops once a customer is prepared to pay for a first iteration. Frequently, a venture engages in selling prototypes as an end product because a customer initially accepts and pays for it, even though the product is not yet finished and not all requirements have been satisfied. The consequence is that follow-on sales and series production never follow, and the venture is forced to raise another funding round to finance redevelopment activities. In reality, without realising it, founders engaged in an engineering project business model, selling one-offs. Here, both customer validation and industrialisation are incomplete. Secondly, ventures might be tempted to sell intermediate development deliverables as a strategy to gain early revenues. However, since these are not entirely validated and mass-producible products, the burden of sustaining and servicing them for customers will heavily outweigh the short-term income gain. In this case, ventures should maintain a development focus on products with significant volume potential and implement an applicable funding strategy: aim to raise a larger round.

The solution to efficiently achieving a true product-market fit lies in bringing in a product mindset and focusing on product development and product validation.

From technology to product

The solution to efficiently achieving a true product-market fit lies in bringing in a product mindset and focusing on product development and product validation. A product is and should be central to any deep tech value proposition, which requires a comprehensive productisation plan and process (in some companies referred to as the New Product Introduction (NPI) process). This overarching plan should integrate:

1. Technology derisking plan to address the remaining levels of risk in core technology and methods to mitigate these.
2. Product realisation process, including engineering efforts for the development of an incremental product as well as industrialisation (manufacturing) readiness necessary for scaling, and
3. Commercial strategy outlining the customer engagement process, including gathering the customer and (end-)user requirements as input to product definition, and validation strategy

To aid customer validation and the translation of technology into a product, an early-stage deep tech start-up should define its deep tech product development process, as shown in Figure 1, initially focusing on just one product. The roadmap serves as a guide to navigate the complexities of deep tech innovation, ensuring that technological advancements align with market demands and the go-to-market strategy. It also makes visible which technical developments are undertaken at which point in time, for whom, and for what purpose – from technology derisking through early prototyping to product validation. This approach helps in mitigating risks associated with long R&D&E cycles and enhances the likelihood of a successful market entry.

Example Deep Tech development: the Master plan

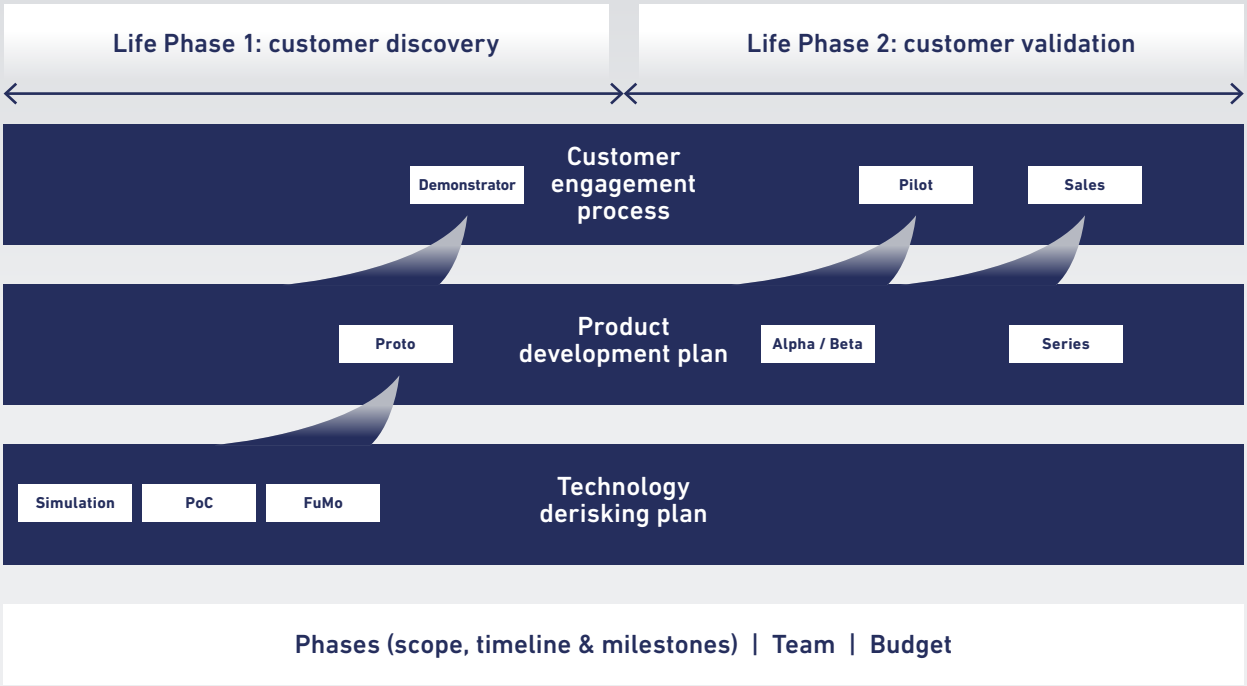

Figure 1. Integrated Deep Tech product development process – deep tech NPI. Simplified representation of the central role product development plays when translating the technology to a commercially viable product.

Deep Tech Life phase model

Before diving deeper into product development and validation, it is essential to understand the venture development context in which they are found and the implications for achieving the challenging product-market fit. An ideal deep tech start-up will develop itself through two main life phases before scaling up – customer discovery and customer validation. It is during these two phases that product development and validation take place. Figure 2 on the next page illustrates the stages of development a venture undergoes, along with the typical proof points associated with deep tech product development and product introduction. The Lifephase model of a venture is based on Steve Blank's ***Four Steps to the Epiphany customer*** development, augmented by a.o. Cooper and Gritd which elaborates on milestones for the two early phases. This has resulted in a popularised version of the life-phase model with six simple milestones.

According to Blank et al. [4], every venture needs to engage in customer discovery to start with, and achieve meaningful commercial milestones in the early phases, whether it is business development, marketing, or sales, are key to defining success. This currently popularised model can be very successfully applied to software and non-deep-tech ventures. Rapid, successive customer interactions using an MVP (Minimum Viable Product) can be iterated quickly to test and learn whether the hypothesised problem is indeed a problem and whether the MVP adequately solves it. The issue, however, is that in deep tech, due to long development times and large resource requirements, the customer validation process is, in practice, quite different. It is often known early what key requirements must be met at a minimum (qualifiers) and which performance items will achieve competitive advantage (differentiators). Deep tech is about accurately identifying and meeting specifications and customer needs, proving it through real-world experimental and scientifically solid data. Deep tech teams are therefore forced to build intermediate demonstrators and datasets they can use to convince first customers to take an interest. These discussion cycles have substantial throughput times because developing the product further and gathering data-driven evidence takes time and resources. Still, the principles of "failing fast and cheaply" apply here (if only relatively speaking), as it is all about learning what the proper solution to the problem is. Principles like rapid prototyping can be valuable tools in a founder's toolkit, as they aim to mimic the MVP process described above [5]. Therefore, product development and customer validation processes are closely intertwined and mutually dependent on each other.

In deep tech, the focus on reaching the "repeatable sales process" milestone must also lie in solidifying the delivery process (and its supply chain) and industrialising a product that is to be repeatedly made and sold.

During customer validation, before one can launch a product into the market, the product needs to reach the full spectrum of requirements, which are typically not only looking at the performance and cost, but at additional requirements such as manufacturability, serviceability, useability in the customer hands, and process integration that need to be concluded positively. Therefore, in deep tech, the focus on reaching the "repeatable sales process" milestone must also lie in solidifying the delivery process (and its supply chain) and industrialising a product that is to be repeatedly made and sold. Understanding this process is crucial for preventing premature scaling in deep tech ventures, as launching a product in the market

(achieving market readiness) has a different meaning than earning a few repeatable sales of an MVP as part of customer validation. This is why we propose to introduce a new 5th milestone for deep tech ventures in the life phase model: "Product delivery and manufacturability" proven.

Finally, we note that the milestone on Business Model Fit as a primary milestone for deep tech is not a priority. It is not that it is impossible to explore and introduce non-standard business models, but our experience is that it is incredibly difficult to change these in the oftentimes conservative deep tech verticals. This means that the majority of cases the business model (including sales channel approach, revenue model, and supply chain delivery) will have to adhere to what customers are used to. It needs mentioning however that exceptions do exist and that incremental improvements on the business model, e.g. by introducing a consumable component on top of a standard equipment sales model, can generate significant value increase for the company. These options should be explored and validated during the first two life phases.

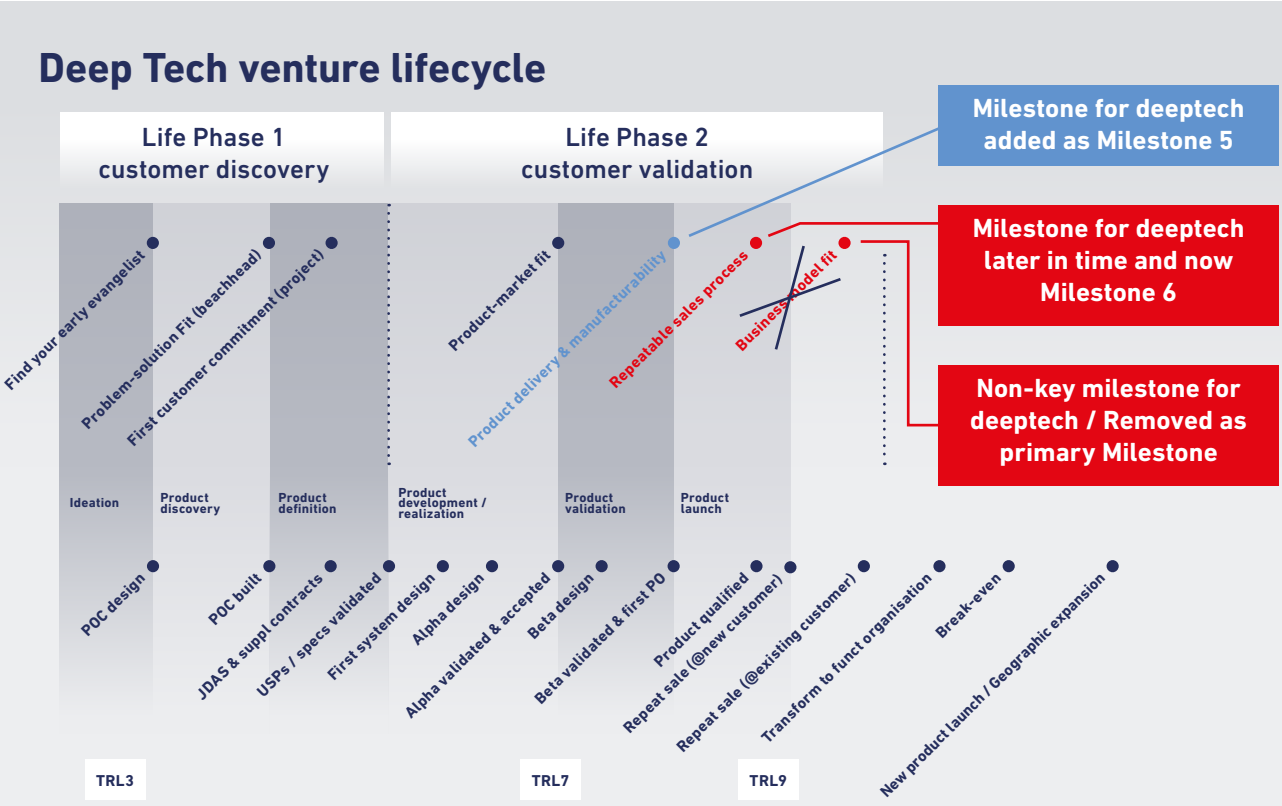

Figure 2. Deep Tech venture lifecycle. Milestones according to Blank, Cooper, Gritd et al are indicated above the development phases, augmented with additional Life phase milestones relevant for deep tech ventures that we described above. Below are the typical proof points for deep tech ventures.

Product development and validation

Strictly speaking, to demonstrate product-market fit (4th milestone) and deliver the product to the market (5th milestone), a deep tech venture team needs to design and develop a product that is aligned with the needs and roadmaps of multiple customers, validate first prototypes, and show satisfactory usage with an MVP. A central product development plan should unite these aspects crucial for derisking the product through technology, engineering and operational activities, and align them with the commercial activities in the deep tech roadmap. As stated above, developing and launching a product in industry often proceeds through a process

called 'new product development/introduction' (NPD/NPI). Following the established NPD/NPI processes can be a powerful tool to help outline and efficiently plan capital-intensive and complex engineering products, preparing them for market entry, as well as aligning all inputs crucial to product definition. A simplified diagram below outlines the process and key activities for deep tech product development in detail. Phases or stage gates are commonly used to derisk technology and market (acceptance) risk, increase development efficiency, and have well-formulated product development deliverables per phase that align with the venture's proof points, as shown earlier. Requirements, budget, plan and product positioning are updated at the end of each phase, with multiple iterations possible between the abovementioned activities.

Deep Tech phases & key activities

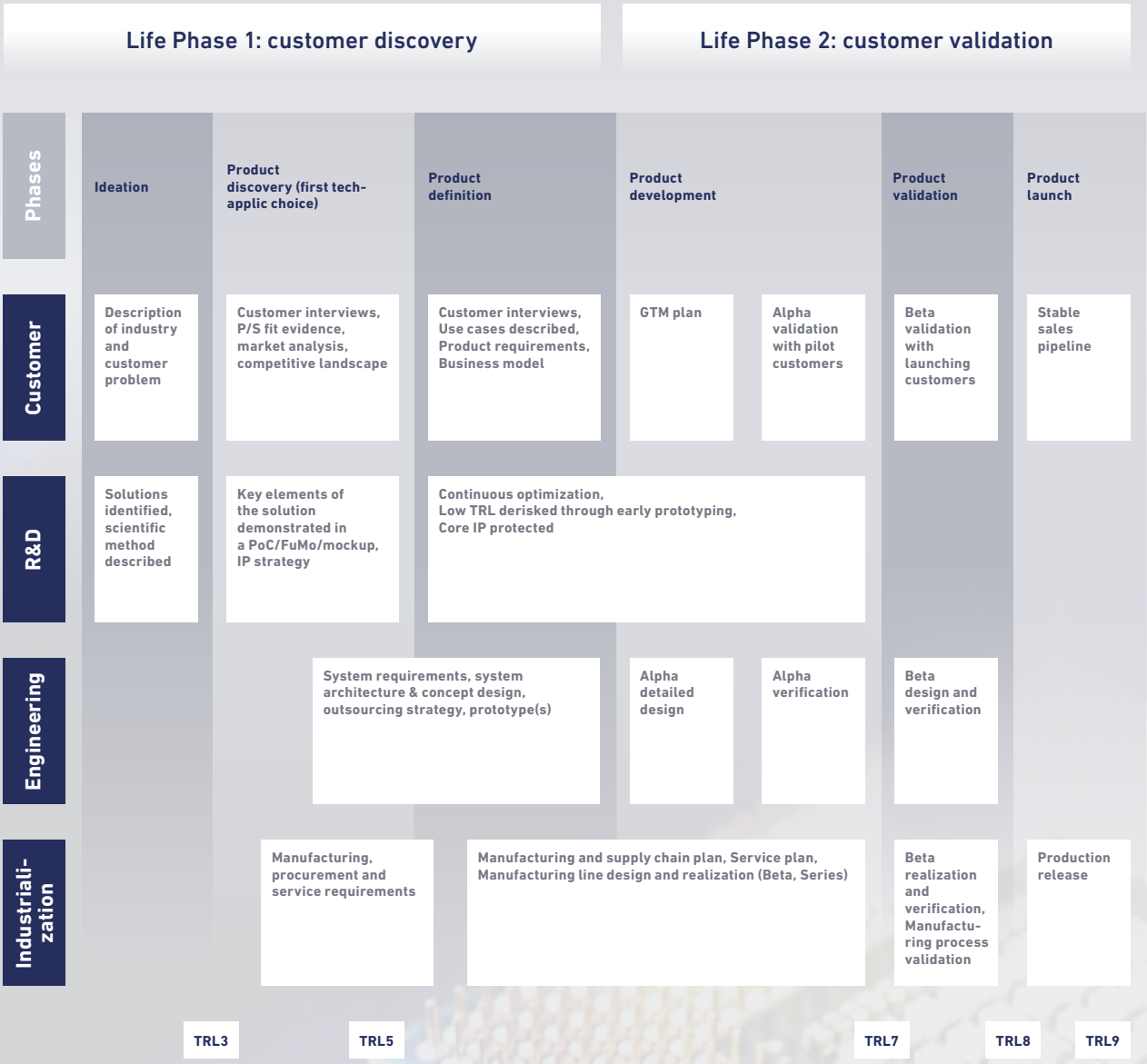

Figure 3. Product development phases & key activities

Starting from TRL 1-2, it typically refers to basic research and concept formalisation in a laboratory environment, while at TRL 3, the concept is proven to work for a specific application. At TRL 4-5, the first demonstrators with only key features are created and serve the purpose of gathering initial experimental data and engaging with customers using tangible hardware. In terms of the Life Phase model, it is essential to note that the problem-solution fit must have been validated with the core technology before TRL 5, using demonstrators and data gathered from the 'earlyvangelists'. This is also the point where the venture should have a thorough understanding of the use cases, customer needs, and requirements for the target application and should be working towards developing product specifications. After the customer requirements are known and validated, they serve as input to the design, taking into consideration all aspects of the product lifecycle (performance, service, manufacturability, pricing, maintainability, End-of-Life).

When the first complete product design has been architected, the company enters Lifephase 2. From a technological perspective, the focus of Lifephase 2 is on integration and testing, specifically addressing engineering risks and preparing for scaled operations. At TRL 6, the first system prototypes are made, and then the following comes into play: a) test system integration (functional submodules operating as one), b) perform system verification (evaluate performance), c) validate the early system with the customer. Based on a), b), and c), the design can still be adjusted, but the concept design itself is frozen, assuming design for excellence (design changes are made based on verification and validation). With this, the technical risk goes down considerably. It is essential to note that product validation and testing are the most crucial steps when translating a technology into a product. Implementing system engineering best practices, such as concurrent engineering or utilising the well-known V-model, helps address testing and integration requirements early, and implement them in the product design, as well as in the validation plan. In addition, implementing design for excellence ('DfX') will help mitigate development risks by collecting all requirements early.

TRL 7 implies a not yet economically viable Alpha design, in which prioritised features that are unique to the basic technology have been realised. From a commercial perspective, the purpose of an Alpha system is to demonstrate the basic functionality to early adopters/customers and to identify any remaining design changes necessary to produce the final product in a controlled and cost-efficient manner. After an Alpha system has been built and tested, the system design can be frozen. In this phase ventures should get a form of customer commitment and proceed to engage in manufacturing line design (industrialisation) in anticipation of volume production, which is piloted[Jv4] in TRL 8 (beta product) and final series production in TRL 9.

Based on the above argument, product-market fit is reached when the Alpha product is created and accepted by customers. This is the point where all customer requirements should have been condensed into the first iteration of the product. The implication is that to arrive at the milestone "repeatable sales process", a deep tech venture has to first launch a product into the market after extensive customer validation, which takes a long time to reach.

In deep tech, the typical throughput time from start to end of 'Product Definition' to 'Product Development' is 18-30 months, and 'Product Validation' takes another 6-12 months, depending on the product type. The latter also requires (on-site) customer support capability to assist the customer in its use and testing. If customer validation work is not done correctly or completed, the time delays it causes can be between 12 and 24 months, as analysis of some 40 deep tech ventures shows.

Proofpoints over venture lifetime

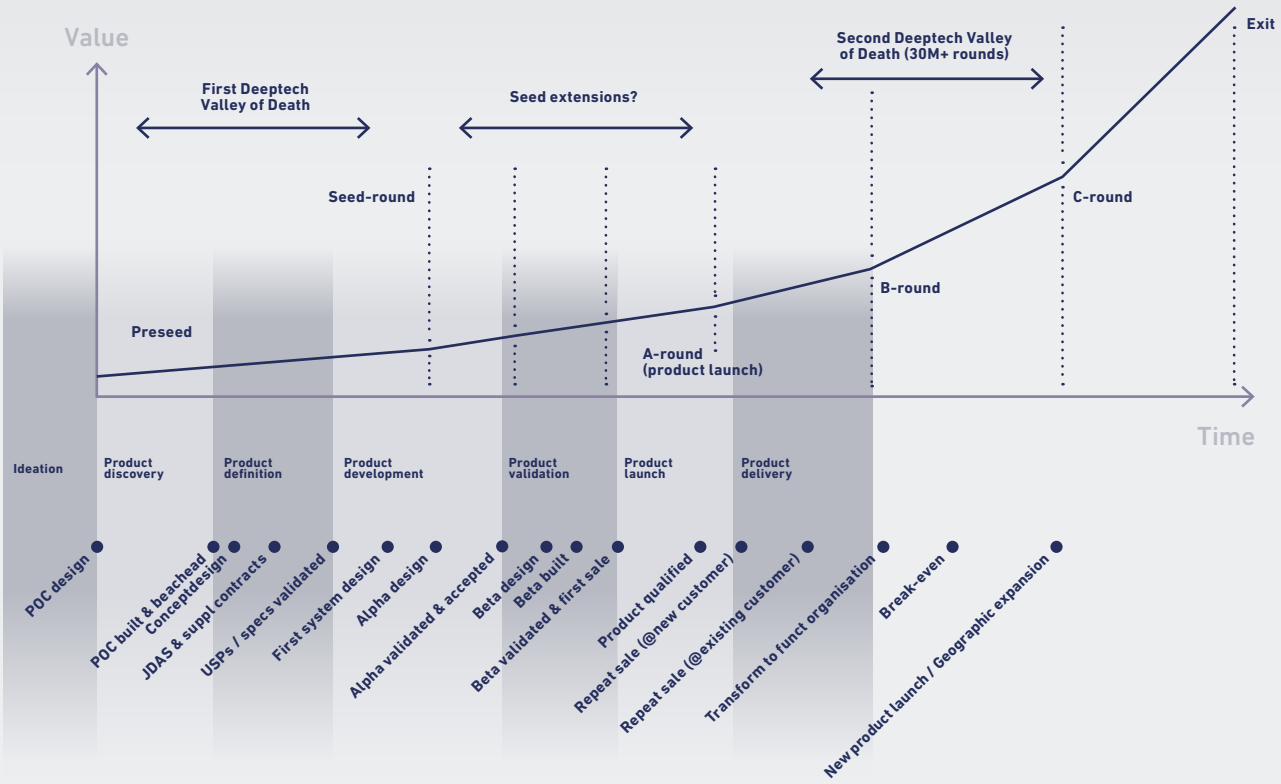

Figure 4. Product development phases with respect to funding rounds.

Team composition

Start-ups are yet to engage in company building and organisational growth and are therefore more agile than existing enterprises. Because hardware and software development and integration require a plethora of different technical competencies, ventures are often initially predominantly composed of large technical teams, with little to no business development expertise. A founding team should demonstrate a strong foundation in both technical expertise and business acumen, which is critical for the success of a deep tech venture. Deep tech founders and teams are a key criterion for an investment by VCs.

An ideal deep tech founding team should include a technically savvy CEO and a CTO with deep domain expertise. The CEO should have the ability to communicate the company's technological "secret sauce" to stakeholders, manage fundraising, and drive business and company growth. The CTO complements this by focusing on technology development, derisking, and managing the IP portfolio, which is essential for maintaining a competitive edge in the deep tech space. Additionally, the team should also include a business developer. For deep tech ventures, however, three competencies are required early on to develop a comprehensive perspective on the entire value proposition that can be translated into an actionable roadmap. We highlight the following functions, which are therefore critical for defining the product vision and achieving product-market fit. Cagan et al [6] refer to this triangle as Product Leadership:

- Product manager/business developer who can identify real customer problems for which the technology can bring a superior solution, and has sufficient business and technology acumen to envision which solution

may prove feasible for the venture. This role ensures a deep understanding of customer needs and market dynamics, which is critical for defining a product based on customer requirements (via e.g., MOSCOW type approach), its market positioning, piloting projects to validate the product and its definition of success

- system architect (oftentimes also referred to as 'product owner') who can conceptualise and design the product, lead the (large) engineering team, and implement existing methodologies such as system engineering practices (Appendix m) to support the much-needed first-time-right design
- a project manager who will make sure that the execution of the (technical) development project proceeds efficiently and that there is alignment between the product development and the commercial roadmap (NPI)

The dynamics between the roles is also of importance. While the product manager defines the product vision, owns the requirements and unit economics of the product, the system architect translates this product vision into a scalable and manufacturable product design, making the trade-offs of what the product needs to do versus what can realistically be produced at acceptable cost. Together, they conduct a cost–benefit analysis and determine the value of a particular requirement. The two roles together own the two aspects critical for the success of a deep tech venture discussed in this paper: product validation and productisation.

A third crucial role is that of a project manager. While the two roles work closely, a project manager is responsible for ensuring that the technical execution aligns with market requirements and that the defined roadmaps and plans are executed effectively. The product development or product leadership 'triangle' facilitates the proper trade-offs between the roles, as each plays its role in defending its interests, allowing for an optimum result to be achieved. This balance between technical and commercial expertise, as well as execution, is a hallmark of a well-rounded team capable of navigating the complexities of deep tech product development. When the company matures, a substantial part of managing the operational process is typically taken over by the COO. The business development and sales role is generally split from the product management role, with the hiring of a CCO, as the product manager focuses on the P&L and lifecycle responsibility. In contrast, the individual development projects remain with the project lead.

Initial Core Deep Tech startup roles

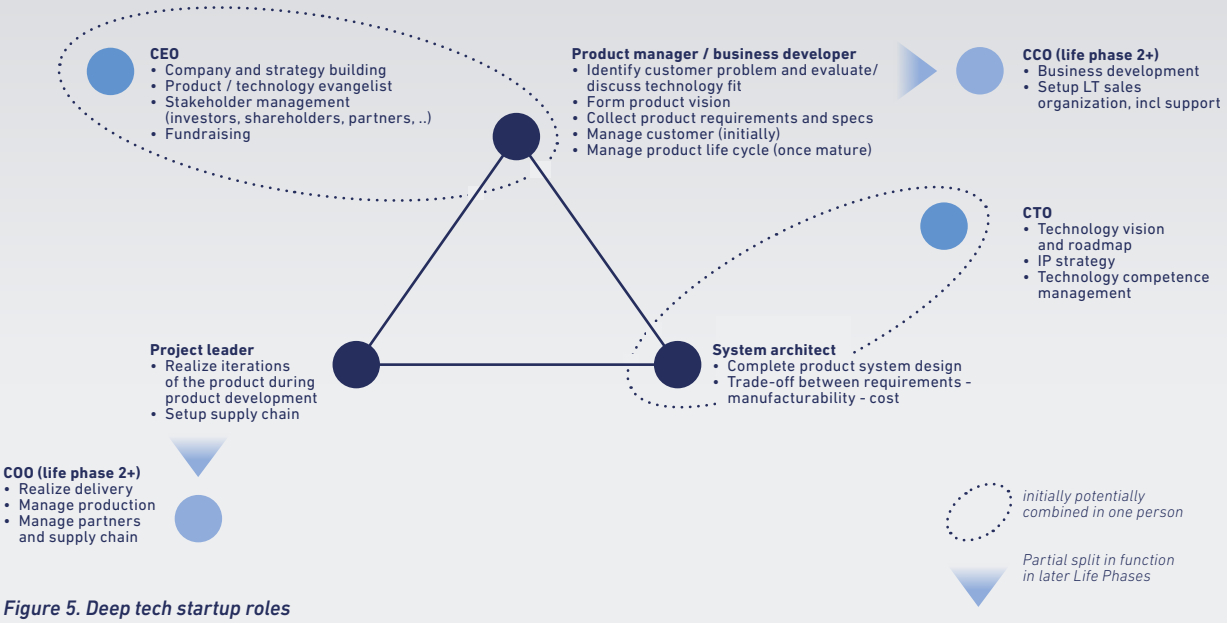

Figure 5. Deep tech startup roles

Especially in the early stages, a single person might occupy two roles. For example, a CEO, who, in addition to setting up the company strategy, building the company, and fundraising, may also be expected to perform business development to identify customer problems and requirements if this CEO has the appropriate profile. Likewise, the role of system architect is often initially filled by the CTO, whose main tasks include technology development, as well as working alongside engineering on product design and realisation. In our experience, the CTO and system architect profiles are substantially different, and it should therefore be considered carefully if this coalescence or division of roles suits the particular founder well. The same is, of course, true for the CEO and product management/business development. In light of the three aspects of product development (technology, engineering, and industrialisation), it is typical for a COO to be hired at a later stage to address the engineering and industrialisation aspects of product development and build out the product delivery organisation, including the supply chain, service, and maintenance.

Dealing with (team) competence gaps

As many teams and investors will attest, finding talent is very challenging, as it is in short supply. It is therefore not easy to form complete teams for founders that have all bases covered. That is, if they even realise their team is incomplete in the first place, which is often not the case. It falls to the deeptech investors to evaluate and assist in filling the gaps as part of their investment thesis.

Core roles need to be filled within the team itself. The first route will always be to hunt for specific resources and, if necessary, acquire them outside of current jobs if the profile is correct. However, it is not always possible to locate or attract the necessary people; yet, we maintain that the core roles must always be filled within the startup itself.

A startup surrounding itself with expert advisors and experienced boards to fill the above gaps is, in principle, a good strategy, provided it is executed at the right time and consciously addresses the gaps made during the early stages of company formation. As much as a strong advisory or supervisory board can complement specific skills, the company still needs to achieve the key performance indicators itself. An experienced board will be most helpful if the company has already identified its beachhead market and application focus, and if the company itself has laid the foundations for the product vision. Founding teams are therefore crucial in the first few years, when identifying the right problem and solution, as well as forming a vision of the ideal product-market fit. A well-selected Supervisory Board that is coaching and supporting is more effective than a non-committal Advisory Board approach.

In addition, deeptech startups often rely on outsourcing engineering, production, or service tasks as a way to complement the gaps. Additionally, this approach can be partially practical if the roles are not core, as previously described. However, founders should be aware of inefficient outsourcing practices as these can lead to delays, increased costs, and quality issues. Common problems include unclear deliverables, changing project scopes, and misaligned workflows between the startup and outsourcing partners. Such inefficiencies can prolong development timelines and increase financial strain, particularly when outsourcing partners lack the necessary expertise or fail to meet expectations. Addressing these challenges requires early involvement of all functions, precise product requirements, and robust project management practices. It is essential to note that outsourcing requires both the startup and the outsourcing partner to align with the key figures who own the development process and deliverables, such as a project manager

and system architect. Likewise, finding the right outsourcing partner with the relevant expertise and skills (e.g., electrical, mechanical, mechatronic, software) will be crucial for the technical progress of the startup.

None of the triangle roles are ever to be outsourced and should be full-time, dedicated; they are too close to the core of the venture, and full ownership by the company must be ensured.

None of the triangle roles are ever to be outsourced and should be full-time, dedicated; they are too close to the core of the venture, and full ownership by the company must be ensured. Ventures sometimes opt to outsource some critical roles, such as the role of a system architect, to a supplier. This should be avoided because it leads to lack of ownership on the performance and delivery of the product at the customer, The supplier does not feel responsible for more than the agreed workpackage, with long delays in the development process as a consequence as the venture struggles to compensate and hopefully not losing their precious launching customer.

Not only is it essential to keep and build these three roles in-house, but for startups, it is also important to hire seniority for these roles: industry veterans with a relevant network and track record. Since a startup is initially entirely dependent on and focused on a single project and structurally under-resourced, it cannot afford a learning curve for inexperienced but smart talent to learn the trade. At the very least, sufficient seniority must be positioned very close by in the venture if it is not present in the triangle. Here is where a division between these roles and the CxOs may be beneficial if the founding team does not yet possess the necessary seniority.

Jurgen and Ivana have used their extensive experience in working with and supporting startups to pinpoint common failure modes and have described a framework that startups should follow to improve outcomes. Their approach lays out a product-operating model for startups, which defines how a venture designs, develops, delivers, and manages products throughout their lifecycle.

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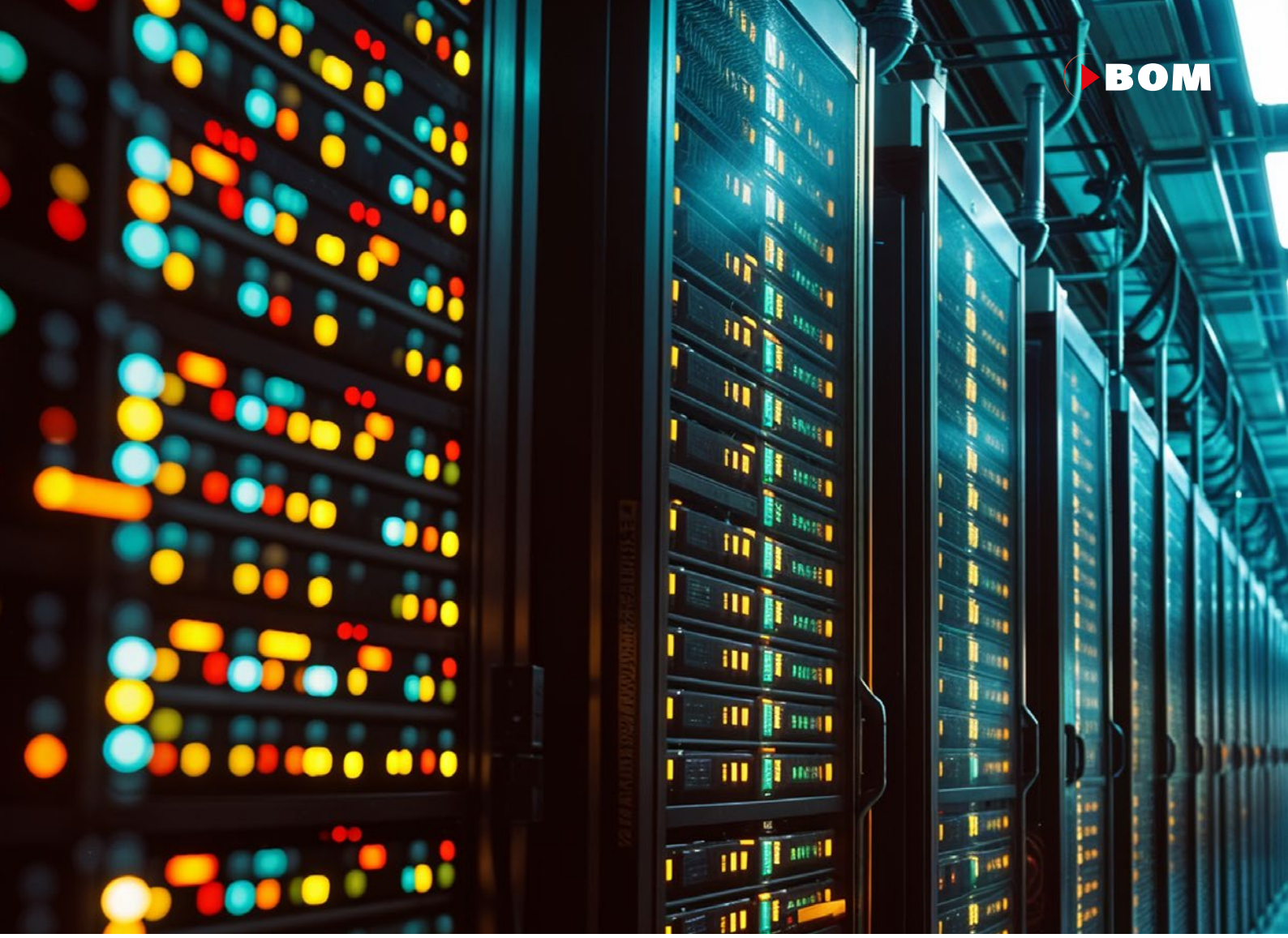

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