

Fortunes of High-Tech

Citation for published version (APA):

van Duijn, J. (2019). *Fortunes of High-Tech: A history of innovation at ASM International, 1958-2008*. Wilco. <https://doi.org/10.26481/dis.20191122jv>

Document status and date:

Published: 01/01/2019

DOI:

[10.26481/dis.20191122jv](https://doi.org/10.26481/dis.20191122jv)

Document Version:

Publisher's PDF, also known as Version of record

Please check the document version of this publication:

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Valorization

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Rallying solutions to problems

Nearly a thousand pages of intellectual expositions, subtle differentiations, and complex story lines require some sort of a shortcut. I am fully aware that most professionals in big corporations, start-ups and government lack time to distill relevant lessons of this expansive study. To meet this demand in this valorization, I will answer a burning question: What are the benefits of this study?

The answer could be given in many ways, but I think it is helpful to follow one particular theme from this history of innovation, which aligns to the omnipresent realities of current high-tech industries. One of the benefits of this studies is that it shows how an high-tech enterprise survived over fifty years. A remarkable accomplishment. To that end, the company – ASM International – had to be resilient or robust enough to weather change. Below, I will elaborate upon this characteristic, the robustness to endure change.

Some conditions to overcome anxiety in high-tech innovation

Getting an understanding of change is most relevant for society as a whole. To enforce this argument, I quote the virtuoso of popular history, Stephen Fry:

‘Change, transformation, mutation, cultural evolution, these are our weather systems. Our historical and future landscapes were and are shaped by these processes. Just as our geographical landscapes are shaped by the action of water and weather. To believe that we could or should hold them, or to waste time mourning the existential alterations to our ways of living, is to put it crudely, to piss into the wind.’¹

High tech is the forefront of change. In many ways, high-tech industries pioneered new technologies, business practices and social dynamics. This study has tried

¹ Stephen Fry, ‘A Faustian Pact’, Podcast series: *Stephen Fry’s Great Leap Years – The stories behind inventions* (16-4-2018 by SamFry Limited), fragment at 46.14.

to come to terms with the dynamics of high-tech innovation, and by doing so offering some sort of grip upon our historical and future landscapes.

Getting a grip on change is priceless. Especially, within the context of high-tech innovation, in which uncertainty about a successful conclusion of the endeavor often seems endemic. Consider some of the most talked-about technological projects in the Netherlands. One prime example is the protracted effort to industrialize extreme ultra-violet lithography by ASML, taking almost twenty years, requiring a radical overhaul of the company and billion euro's in investments. Another is the courageous, astonishing yet unfortunate effort by Mapper to commercialize their unique parallel e-beam lithography machine, taking also twenty years and over 200 million euro in investments. Or take into account the advanced and still open-ended projects like the Delft Hyperloop or the quantum technology of QuTech. The ambiguity embedded in these examples stirred anxiety among the involved entrepreneurs, engineers, public officials, and investors.

After all, the time required to commercialize an invention makes high-tech innovation vulnerable to dramatic and unexpected changes. In this process, the biggest risk is that the pursued market-need does not materialize. Would all the efforts put in the innovation ever yield a profit? And would the enterprise succeed in sustaining the financial backing for the endeavor? These concerns were and are not without cause. In fact, on top of the list for reasons why start-ups fail stands 'no-market need', followed by 'ran out of cash'.² Both of these phenomena are of particular relevance to high-tech enterprises, as their products command advanced technological competences and require significant financial resources.

In respect to this common feature of high-tech innovation, this study shows that ASM International regularly engaged in innovation projects characterized by rapidly changing circumstances and market-needs.³ In all these examples, the time-to-market or final application proved more volatile than expected. This even accounts for some of the processes developed in the proven product lines like epitaxy, vertical furnaces and plasma enhanced chemical vapor deposition. So, how did ASM International sustain its innovation processes, and overcame uncertainties about the market-need?

² Data follows from a qualitative post-mortem analysis of 101 failed start-ups, executed by business intelligence agency CB Insights. – CB Insights, 'The Top 20 Reasons Startups Fail', *cbinsights.com* (2-2-2018) <https://www.cbinsights.com/research/startup-failure-reasons-top/> (viewed: 24-9-2019).

³ This observation accounts for aluminum chemical vapor deposition (1981-1992), the initial lithography machines of ASML (1983-1989), the A600 cluster reactor (1987-1999), atomic layer deposition (1999-2007), plasma enhanced atomic layer deposition (2001-2011), Nanophotonics' integrated metrology (1999-2008), and NuTool's (2001-2006).

A short answer to this question involves the art of securing time and money. To sustain exploration of new technologies, Arthur del Prado – the founder and chief executive officer of ASM International – leveraged both internal and external assets. Here, I will elaborate a bit further upon two groups of assets.

Internal leveraged pertained to harnessing the benefits of diversification of products and motivation among staff. ASM International had been a diversified company from its early beginnings, and this organizational structure was a clear asset. Through the strategy of diversification earnings of yet commercialized products were staked in the development of new ones. It was a strategy that gained prominence through the works of management scholar Clayton Christensen in his book *The Innovation Dilemma in 1997*.⁴ Yet it had been a strategy observed by Del Prado since the 1970s. Back then, Del Prado invested the earnings of his sales agency – profits made by selling products with a clear market-need – in the development of new innovations. Furthermore, over the course of its history, ASM learned that to sustain ‘moonshot innovation schemes’ cash was truly king. Seeing high-tech innovations through required an internal source for cash. Proven products generated that cash.

Internal leverage also involved empowering the staff members. The absence, or volatility, of market-need cultivated ingenuity, creativity, perseverance, and inventiveness. To this end, ASM consisted of various small divisions. Each of these subsidiaries were granted significant autonomy to pursue their successes through their own innovations. Whether in ASM Lithography, ASM Europe, ASM America or ASM Microchemistry, engineers and managers were all in it together to prove the viability of their technology. The intrinsic ingenuity, curiosity and strive among engineers were a crucial asset in the effort of seeing an innovation through.

Leveraging external assets concerned external funding, customer support and benevolent industry dynamics. The most obvious way to see a project of high-tech innovation through was to secure financial backing from investors. This could be done through venture capital, public offerings, and loans. In the case of ASM, the company employed loans and public offerings for the benefit of its innovations.

Throughout the history of ASM International in which the company engaged too many ambitious innovation projects simultaneously, this way of external leverage proved to be problematic. Most of these funds required some loss of control; selling shares, offering a position in the board, etc. Whenever anxiety or

⁴ Clayton Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Harvard Business Review Press, Boston, 1997); In his second book, Christensen elaborated on the same theme: Clayton Christensen and Michael Raynor, *The Innovator's Solution: Creating and Sustaining Successful Growth* (Harvard Business Review Press, Boston, 2003); Bower and Christensen, ‘Disruptive Technologies’.

concern about the feasibility of the business and innovations seized the investors, the continuation of the innovation process got endangered.

Another method of external leverage was to get customers involved in the project. Almost in every case, ASM tried to attract the interest or commitment of customers for its new products as soon as possible. Most often, this was done through joint-development programs, in which ASM developed new technologies together with a customer. The more a customer was invested in ASM's technologies, the better the chance for commercial success. Such interaction resulted in quick harmonization between supply and demand. Yet, ASM also selected the technologically leaders to cooperate with, since that cooperation might result in spill-over effects to lagging customers elsewhere.

In case of ASM, a third external leverage was of significance, and that was the company's adherence to benevolent industry dynamics. In particular, this involved the famous Moore's Law – stipulating the doubling of transistors, and thus computing power, every 18 months. As long as ASM's innovations enabled the production of smaller dimensions on a computer chip, its uncertain endeavors might attract some interest of the industry eventually. Smaller was always better. The obedience of ASM's innovations to Moore's Law took away anxiety about its innovations; it showed the relevancy of the complex technological projects to a wider audience.

Moreover, in the study I argue that the famous and often misinterpreted Moore's Law was part of a wider process of industrial maturation. The past fifteen years, fewer suppliers and manufacturers in the semiconductor industry command the knowledge and resources to continue miniaturization of transistors in line with Moore's Law. Within these circumstances, securing market interest for new innovations became increasingly difficult. Only the technological leaders remained, thus reinforcing the benefit of concentrating cooperation to the technological leaders.

To conclude this valorization addendum and offering the professional reader some practical advice, I will reduce these insights into two major points, which may sound trivial but they proved key to the fate of ASM. The first is to generate cash as quick as you can. Cash is king and with these funds you can extend your activities towards more ambitious ones, step by step. The second is to be aware of the industrial dynamics from the start. Competing an already mature industry is tougher than an uphill battle, even for established companies let alone for start-ups. If you think, these statements are laboring obvious points and can easily be followed, I cordially invite you to read the rest of the manuscript and wallow in the wonderful stories, nuanced insights and strategic lessons.