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Commentary

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My personal view on investment in chemistry start-ups

As a former employee of one of the largest chemical companies, I had the chance to learn about the true impact and the importance of chemistry in all different aspects of our modern life. I truly believe that chemistry is at least part of the answer to all our global challenges. Climate change, mobility, sustainable construction, sustainable agriculture, health, nutrition and last, but not least, the conversion to a circular economy. All major challenges of the next decades depend on innovative solutions from the chemical value chains (Deloitte and VCI, 2017).

As much as I am convinced, that the importance of real break-through innovation is understood and desired by the chemical industry and its key actors, I have some doubts about the magnitude and the speed of innovation in well-established corporations. I do not perceive the corporates of the chemical industry as worse than other corporates in other industries, but corporate culture ("bureaucracy"), short-term financial targets, and a huge impact of path dependency have proven to be solid roadblocks for real break-through in the past. It might not be considered too pessimistic, if you do not believe the speed and impact of innovation will increase drastically in the next couple of years, especially in a tougher economic environment. Unfortunately, this drastic increase in speed and impact of innovation is necessary.

I do not want to repeat the well-known reasons, why a strong start-up ecosystem will lead to more and more impactful innovation (see e.g. Christensen, 1997). So far, I am not aware of any reasons, why this should not also be true for start-ups in the field of chemistry. However, despite the obvious connections between the need for more break-through innovation in the chemical industry and the fact that a strong start-up ecosystem offers the highest likelihood of delivering break-through innovation, chemistry start-ups have not really been very much in the spotlight.

First, this is a problem of definition: what is a chemistry start-up?

There are so many ways to categorize start-ups and chemistry is quite a broad technology field with many different applications in nearly all industries. At High-Tech Gründerfonds we categorize around 4-5% of all relevant high-tech companies in our deal flow (companies we take a closer look at) as "chemistry or material science start-ups". Each year, we receive between 40 and 70 seed-financing requests from technology companies, which we internally classify as "chemistry or material science start-ups" in a broader sense. These numbers strongly correlate with other sources: e.g., in the public database of the Forum Start-Up Chemie, you will find corresponding numbers[1]. Compared to other fields like biotechnology, especially in drug development, or IT, chemistry start-ups have also never been a focus for venture capital investors.

During the so-called "clean tech boom" between the early 2000s and 2010, a lot of the companies, that were labeled as clean tech, have actually been chemistry or material science start-ups, especially in the field of renewable fuels and materials. Unfortunately, most of these clean tech investments of the past can be considered as a failure and a lot of venture capital investments have been lost in this field (e.g., Eilperin, 2012; Owen, 2019; van Lierop 2021; Temple, 2020). Unfortunately, this history of unsuccessful investments has increased the hurdles for all investors raising money for new venture capital funds in this area – including chemistry or material sciences.

Besides the difficulties in creating specific funds, there are two main reasons why financing chemistry start-ups is still challenging in many cases: building a relevant chemical production facility (world-scale plant) is very expensive and venture capital investors usually do not like investment in

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[1] https://forum-startup-chemie.de/startup.html

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physical assets ("bricks and stones" or here more accurately "steel and processing equipment"). Once you have this huge plant running at full capacity, you need to invest again to build another plant. This takes a lot of time and does not really scale well at least not in the sense of a VC investor.

Based on my own experience working in different roles within the chemical industry as well as searching and evaluating chemistry start-ups as a seed-investor at High-Tech Gründerfonds, I would like to share three aspects, that I perceive as important to consider carefully to improve the likelihood of success for building more chemistry start-ups.

1 Following the "bio-pharma example"

Any bio-pharmaceutical start-up that is pitching to an investor and claims to be able to develop, go through all stages of approval until the patient, to produce and to sell their innovation totally on their own, without any strategic partners from the pharmaceutical industry will have a very hard time to convince most investors.

Why do many founders as well as investors think, this all can be done by a chemistry start-up?

Of course, I am aware of the challenges and costs to go through all stages of approval and registration of a pharmaceutical drug and how this is different to develop e.g., a new polymer for sustainable packaging – but I think the analogy is still valid enough.

So why not copy the successful cooperation model that has been established in the pharmaceutical value chain in the last three decades?

The start-ups should focus on what they can do best: to innovate quickly and to adapt to the market and to develop a new product, that is really needed without being stopped by any kind of established solution or organizational path dependencies.

Once the product development has reached a certain stage (about which stage exactly can be argued - for sure), the product should be moved into an "established production set-up". Of course, I am aware of all limitations and challenges of specific process requirements, raw material availability, regulatory approvals for productions, etc.

There might be requirements for investment, even to enable just a small scale – not yet industrial or commercially viable production. However, at least all additional infrastructure will be available and economies of scale for logistics can be utilized. Negotiating such kind of deal with a strategic partner from the chemical industry will require a certain level of openness and understanding of the start-up ecosystem. Of course, the usual cost allocation mechanisms for costs of general site services and utilities like the site fire department in chemical parks must not be applied here.

Once the final proof of concept is done and the next level of a significant investment into industrial scale production assets is necessary, the potential value of the innovation must be big enough to enable either the set-up of a joint-venture with an established partner or to completely license the technology out directly.

This is usually the point in time when chemistry start-ups get in big trouble to raise huge rounds of several tens of millions of euros, just to build and operate one first industrial scale plant. From an investor's point of view, it is very difficult to justify a reasonable (VC) return on invest (ROI) and usually, it will be very hard for any kind of start-up team to build and operate an industrial scale plant economically.

Here, the cooperation with a partner, who is already running several chemical plants on an established infrastructure with all economies of scale of operations, maintenance, logistics, etc. will save a lot of money and deliver a higher return on investment for all parties involved – the founders, the investors, and the strategic partner.

Once this is done successfully, the same process can be repeated in other parts of the world with the same or other partners as well – creating a lot of additional value via the desired scaling. What might sound too easy here, is for sure very tough to realize.

I think there are three main requirements to open this way of strategic cooperation or licensing for chemistry start-ups:

1. The value of the innovation must be high enough to enable a sufficient margin split. Here again, the question is, how much margin is required by which partner and how much volume can be sold to justify even lower margins per kg?

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2. The intellectual property (IP) must be very comprehensive, global IP and absolutely "tight". The start-up needs to prepare for the partnering option since day one – the same way as all good bio-pharmaceutical start-ups are doing it. The patent portfolio must include a product as well as process patents as well as ideally also some application patents, so enough resources need to be budgeted to ensure this IP can be sufficiently created with the right partners.

3. The preparations for the negotiations with the right partners will require some time, even a few years, I guess. First, the right potential partners need to be identified (more than one, of course), the existing production infrastructure of these partners needs to be understood (at least a basic understanding) and then all these options need to be included in the development of the own process. Of course, this will also create additional complexity and costs, but in the end, all this might be of incredible value once you have reached the level of negotiation with any kind of industry partner.

Again – I know, this is a highly complex topic even in theory and it might not work in most cases. However, I think there are enough chemistry start-ups, that should consider this strategy and discuss it with their investors during the earlies stages already!

And quite recently, I have learned about some interesting examples, where service providers for infrastructure/ chemical production sites are starting to become more active in the start-up ecosystem, either directly as an investor or as a network partner and sponsor of supporting activities.[2]

Hopefully, we will see growing business opportunities for specialized service providers who can help to fill the existing gaps with their knowledge, their services, and their facilities for the chemical value chain in the future. Looking at the highly specialized ecosystem supporting drug-development activities that has developed over the last two or even three decades, I know it will take some time, but just a few contract development and manufacturing organizations in the field of chemistry could really make a huge difference for chemistry start-ups.

2 The business case

When you are pitching as a material science or chemistry start-up to any kind of investor, you will hear a lot of questions like:

- "Can this material be produced at competitive costs/ sold at competitive prices?"
- "Long-term B2B customers will not accept a premium compared to the existing solutions"
- "How do you ensure the raw material costs will be competitive in the future?"

These questions might often be perceived as a kind of "torture" and to be honest, they are also some of my favorite questions.

But to be fair – there are huge limitations to any kind of answer you can give or receive.

Please do not get me wrong here, it is absolutely crucial to understand the potential cost structure of any kind of product that you want to bring into the market in the future and of course, economies of scale, as well as realistic alternatives for own as well as for competing solutions.

However, raw material prices are volatile and sometimes (often?) driven by unexpected developments. I have seen projects being killed because of a high oil price as well as because of a low oil price. And I have seen projects failing that showed a very competitive price during the initial evaluation when they were started but just due to unforeseen developments the product was totally uncompetitive when the product was finally available.

Nowadays, you also need to consider potential CO2 prices, crazy fluctuating energy prices (very recently?), more and more government interference, potential trade policy impacts, etc., so investing in chemistry start-ups might get even more complicated for some investors.
To make a long story short: yes, a very detailed understanding

[2] Two examples of this kind of activities are Brightland Venture Partners in the Netherlands (https://brightlandsventurepartners.com/about-us/) or ChemstarsNRW (https://chemstars.nrw/)

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of raw material costs, the main cost drivers for the production process, economies of scale and the alternative solutions is crucial, but I do not necessarily need a "yes – that is a competitive price already today – all problems solved" business case as a basis to start detailed due diligence.
Looking at the potential benefits, the differentiation potential of the new solution is, for sure, as important to determine the potential value of innovation. Unfortunately, to do so is as complicated as guessing the raw material prices for certain materials in five to ten years from now.

To make this aspect even more complicated, the products of chemistry start-ups can usually be used in more than one application and often in even more than one industry. So, evaluating a potential value leading to a certain price premium compared to currently existing solutions based on additional features, cost savings or customer requests requires a lot of "industry insides".

My past experience has taught me, that it is really important to find at least three (two might not be enough in the long-term) generally desired "features" and not to be caught up too much in very recent trends or specific customer requests, that might end up being unique or depending on a certain individual process or even worse some individual decision makers.

3 Last but not least – stating the obvious: "the team"

As much as this is important for any start-up, this is also important for any chemistry start-up, but of course, with some specific aspects to consider:

All investors want a great and well-balanced team, that has some experience (or at least some prospect) to cover all challenges, that can be foreseen along the way.

However, besides the normal roles and requirements that need to be filled, a chemistry start-up ideally should also cover two more aspects: while there is usually at least one chemist in the team (otherwise who will do the development work in the lab?), I consider chemical process engineering and or manufacturing expertise as equally important.

Other investors might argue that this role is not yet needed at a very early stage, but my personal experience has taught me, that product and process development need to be aligned as early as possible and any process engineer joining later, has much less influence on this super crucial aspect of the company´s key asset.

I know, that adding a great (not just any) chemical engineer will cost more in the beginning, but I am sure, this money as well invested as the company will avoid a lot of expensive mistakes that might also take a lot of time to be solved later.

In case any start-up is considering following a "partnership/ licensing model" as suggested earlier, the process engineer will even be more important as the responsible team member to understand existing production options and their impact on the own development.

The second role to be filled very early (but maybe not as early as the process engineer) is a sales professional, ideally experienced in at least two of the most likely customer industries. Selling chemical products into construction, cosmetics, pharmaceutical, agricultural, automotive, or consumer goods industries requires credibility, deep understanding of the customer industries processes, needs and pricing strategies.

Unfortunately, most start-ups (and or investors) are reluctant to hire a salesperson as long as there is nothing to sell – what a waste of money…

I think, valuable (honest and realistic) customer feedback about requirements, pricing and long-term demand is worth hiring an expert to get this as early as possible. Usually, these experienced experts can easily utilize their network to learn, what others might never find out and as an investor, I also want to know more about "my potential customer" as early as possible.

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Conclusions

As a critical conclusion of my own suggestions, I need to make one important comment: yes, everything I am suggesting here will cost more money in the beginning and might not work out as planned during the later stages.

However, compared to some years ago, financing rounds are growing bigger and bigger, even in the initial seed-phase. I see three main reasons to be optimistic here:

1. There are more and more VC investors willing to look into material science and chemistry cases. Some are driven by sustainability/impact investing, some are really focusing on a certain market segment with a highly specialized team and some others just need to diversify their portfolio.

2. There are some new fonds specifically targeting the financing gap in later stages, when really huge amounts are needed to invest in larger production assets.

3. There are more and more industrial investors looking into the start-up ecosystem, searching for disruptive innovation, new products, new cooperations and new solutions to utilize their assets either directly in production or logistics.

Overall financing a chemistry or material science start-up will always be challenging, but if you have the right vision, the right people and of course the right innovation, the chance of being successful are improving for sure!

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