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PHYSEC:
Venture Biography

Content

Disclaimer

The document presents a story of the start-up PHYSEC GmbH prepared through desk research and interviews with the two founders. The biography has been approved for publication by the founders and can be used for further research by citing it accordingly (see below).

Suggested citation:

1 ID Card

Name of the start-up	PHYSEC GmbH
Which ecosystem?	The Ruhr
Founding date	Idea 2013, founding 2016
Sector	Cybersecurity
No. of employees	65
Male / female founder	Two male founders
Timeslots of start-up phases	
idea generation	2013 to 2016 (Phd and commercialization of results)
incubation	2016 to 2021
consolidation	2021-onwards
Funding / financial support	BMBF-EXIST, strategic investor

2 Founder(s)' Background and Motivation

Christian, the first founder, completed his BSc and a double master's degree in electrical engineering (communications engineering) and computer science (cryptography) in a major German city and the USA before he moved to the Ruhr to conduct his PhD at a cybersecurity institute. He was introduced to his later PhD supervisor by the dean of his old university (as his PhD supervisor happened to be an alumnus of his old university), as the dean saw Christian's scientific competencies. Christian planned to become an engineer and was initially not interested in research. His professors have repeatedly shown him that he is very good at his scientific work and that he has the skills. His later PhD supervisor convinced him to participate in a research project in the Ruhr during his MSc, and following his stay in the USA, where he completed his MSc, he moved to Bochum to conduct his PhD. The results of his PhD research formed the foundation of the new venture, PHYSEC.

Heiko, the second founder, has a background in economics and conducted his PhD in business administration at the same university, where Christian did his PhD. Heiko and Christian first met at a matchmaking event for founding teams that the faculties of engineering and economics conducted to bring entrepreneurial persons with business and technical backgrounds together.

3 Business Modell

The company's key technologies bring cryptographic approaches and hardware devices together to allow the secure operation of sensors in insecure environments. The technology represents the current research frontier and was developed in a cybersecurity institute in the Ruhr. Hence, PHYSEC represents a clear deep-tech start-up. The technology is beneficial for operators of critical infrastructure in gas, water, heat, and electricity. Because of its novelty, PHYSEC has also developed more conventional

security solutions for IoT devices (that only need software) to reach business success. Currently, PHYSEC has three key business areas:

- The novel crypto hardware-software device for the secure operation of sensors in unsecured environments. This technology is offered as a product as a service.
- A (cryptographically) safe software platform to run IoT devices.
- Project development with and for partner companies.

In addition, the company participates in several third-party funded research projects. The first founder also holds a professorship at a university in the Ruhr and is engaged in university research and teaching.

4 Start-up development

The development of PHYSEC is interlinked with the research at the cybersecurity institute and represents one of several cybersecurity spin-offs from the institute. Christian's PhD supervisor is not only a leading cybersecurity professor but also founded and sold successful ventures and acts as a local business angel. He also invested in PHYSEC and other cybersecurity ventures.

4.1 Idea-Generation

Christian started his PhD at the cybersecurity institute in 2013. The technology combines cryptographic and telecommunication aspects to extend security verification from data to physical objects, such as the physical integrity of sensors. With such a combination, so the idea, it would be possible to detect if someone manipulates a sensor, for example, by opening a smart meter box to manipulate the metering. Existing theories describe how radio technology could conduct such physical object surveillance, but the approach was not applied in practice and required yet-to-be-developed specific computer chips. Christian developed a different approach and combined existing computer chips to implement an efficient system that works. Together with students, who are now employees of PHYSEC, Christian implemented a running system and tested several combinations of chips, hardware, and software. It turned out that they had created a very efficient implementation to run the surveillance task that works with existing computer chips.

"Following the first positive results of the PhD work, his PhD supervisor asked Christian to have a conversation and told him, that "*as a graduate, you don't necessarily have to go to Bosch or another corporate, you can also set up your own venture*", as he himself had experience in founding a company and has already done it once or twice. Following this advice, Christian started searching about start-ups and participated in several events. One event was called **"fit for foundation**" held by the universities' faculties of engineering and economics. One key aspect of this event was a kind of speed dating with the intention that potential founding teams could find each other. There, Christian met Heiko. Several people with economic backgrounds were interested in joining Christian's team. However, Heiko asked the most intelligent questions, and they decided to join forces. "*So, we started to philosophize a bit about what we could do. We then identified the EXIST research transfer as one of the best funding options*."

Over Christmas 2014, Heiko and Christian wrote the business plan and applied for EXIST. **EXIST Research Transfer** is a German start-up support programme to support university spin-offs and the commercialization of research results. The grant consists of two phases. In the first phase, the university receives the funding, and the founding team is hired and can employ other people to further develop the technology for commercialisation. If successful, the venture will formally be founded and receive

the first project funding from the grant. Phase 1 can last 18 up to 36 months with up to four persons funded (plus additional costs). Phase 2 can last up to 18 months with 180 000 € of funding[1].

"Christian and Heiko connected their entrepreneurial ambition to the application's success: *We made ourselves more or less dependent on whether we got EXIST. We had said that if we didn't get it, we would try the NRW equivalent, which was less well-funded. But if both did not work, that is it*. EXIST involved a competitive application process, including pitches, etc. They were eventually successful and started to work on developing PHYSEC with the funding they gained in August 2015.

Then, the commercialization of the technology started, which was a difficult process for the founders and their team. The first idea was to target the mass market of smart home products, for this purpose the team developed an adaptation of the technology for ultra-low power and low budget. However, it turned out that security was (and still is) not a pressing concern for most smart home users. More problematic, their technology was far ahead of current standards and, hence, was not compatible with regulatory requirements besides its technological superiority. As Christian put it: "*There was always an approval hook missing, and then we said, yes, if you want standard cryptography, we can do that too. We can even do it quite well, and hence, we developed the software as the first MVP [minimum viable product]*". In this way, they managed to get their first minimum viable product, the cryptographically safe software platform for IoT devices. At the same time, they continued to develop their novel technology and focused on new use cases that did not yet exist (to avoid problems with existing regulations)."

4.2 Incubation / Founding

In line with the EXIST Research Transfer programme, PHYSEC GmbH (limited company) was established in 2016. At this time, the venture had about 10 employees who worked on different research and consulting projects. However, a minimum viable product was not ready:" We *already had our first customers*", with whom we mainly had, let's say, consulting and familiarization projects. Developing a product takes a few years and is never finished. It's a very ongoing process. Having the first MVP also took several years. However, we could still gain experience and earn money quickly through consulting in the cybersecurity sector, which we were happy to do."

Heiko reflected on the challenge of gaining first clients: "*The first challenge is to acquire the first customers; nobody wants to be the first user of such a new product. The next challenge is to have a customer you can reference because then the client naturally must reveal the topics they are working on. We had to find the right wording; we came from a university and explained to customers what we offer in far too abstract ways. It was a learning process for us to describe the problem in such a way that the customer realised that the problem was actually their problem. If you do not see the risk on the customer side, there is no willingness to pay.*"

Third-party funded research projects were a relevant revenue stream for the young venture at the beginning. They were successful in research application because the company's advanced technology was unique (not many other were able to do similar things). Gaining early revenues from consulting and research projects, besides the EXIST grant, allowed PHYSEC to develop its product without much external funding.

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[1]https://www.exist.de/EXIST/Navigation/DE/Gruendungsfoerderung/EXIST-Forschungstransfer/existforschungstransfer.html

Still, founding a limited company in Germany requires 25,000 €. Two **business angels**, the PhD supervisor and his business partner, invested in the new venture and received five percent of the company each. Besides this initial private equity funding, the company received no external investment in the founding phase. Instead, Christian and Heiko managed to build and grow the business from revenue and had sufficient income to pay their own share of third-party funded research projects and the EXIST funding.

In the beginning, the company was located in the **university's technology centre**. As Christian outlined: "*The technology centre was more or less for spin-offs or companies from the university, and we had there the opportunity to grow relatively dynamically. If we needed more space, they did a really good job and managed it well; they always looked at what the start-ups needed in which phase. They kept rooms free for them instead of allocating them directly, etc. And that was really good; that's what I mean by infrastructure. To have something like that, where you can continue to grow dynamically, and you don't know beforehand how quickly you will grow, that is crucial.*"

Following its foundation, PHYSEC participated in several business plan **competitions** and pitches and won many of them, including the Internet AWARD, the German IT-Security Price, and the German Digital Start-up of the year award. To the founders, business plan competitions are of particular interest because you must reconsider your business model, and it is worth participating in several quality competitions over time because once on, business is also changing. Other prices are of interest for their high recognition, and you get very well-known through such competitions. Finally, the financial aspect is of interest: "*There are some competitions that really have an extremely high reputation, like the German IT Security Award, which is a hundred thousand euros, or the Digitalisation Award with 60,000 € or Digital Start-up of the Year 50,000 €, these are prizes where there is real money behind. Especially at the beginning also 5,000 € is a lot of money in the first year of your venture, of course*". At the same time, Christian warns against unsuitable competitions and fraudulent offers: "*I'd say we've taken part in 10 percent of the prizes or competitions for which we were asked for. In other words, you get many requests of all kinds. We've never done anything you have to pay money for; there's a lot of bullshit out there, that you can just completely throw into the bin.*"

With the combination of consulting and research projects, the establishment of the first minimum viable product that eventually attracts regular customers (reference clients) and some income from prices and competitions, the company entered a dynamic revenue-funded growth phase.

4.3 Scaling-up / Consolidation

Scaling PHYSEC gained momentum when a large **strategic investor** from the energy and water sector joined the venture. The investor was one major project partner and customer of PHYSEC and took over 20 percent of the company in 2021. As Heiko put it, "*We were not necessarily looking for new equity capital but growth organically with our growing revenue to about 40 employees. However, at some point, we had a highly standardized platform and good processes. With more capital, we were able to develop new sales channels and enter other sectors, etc.*" The strategic alignment with the investor was an excellent fit to accelerate the business because it accelerated contacts with many potential clients besides the financial investment.

In January 2023, Christian and Heiko introduced a middle management. Before this, Christian oversaw technology, and Heiko managed the commercial aspects. Now, Christian is in charge of strategy, and Heiko supervises the operations. This was necessary because with a certain maturation of the products,

technological and commercial aspects belonged together much more, and the middle management team allowed splitting operations into different areas, respectively, product groups.

At the time of interviewing in November 2023, PHYSEC had 65 employees and just moved to a large office building in a new technology district in the Ruhr area. Christian reflects on the scaling process: *"All these transformation and growth steps, there are certain frictions and issues, and they still exist today. There is always something I'm worried about. I say 95% is going pretty well, but there are always a few things that aren't going so well, and when the team gets so big, you don't have such an overview of everything."* The company made money with the software platform and just rolled out a new iteration of their novel crypto hardware-software device on a product-as-a-service base. Besides this, Christian is still, and has always been, active in university research. He supervises several PhD students and has just published a paper in a major journal which is very well-recognized beyond his discipline.

5 Reflection and Conclusion

Reflecting on the challenges of setting up a deep-tech venture, Christian explained the difficulties of handling intellectual property (IP). If key technological aspects are developed at the university or research organization, which is usual for deep-tech spin-offs, the university, as the employer of the later founders, has the right to claim revenues from any patents generated. In North Rhine-Westphalia, this is managed by an external agency. The problem arises because the external agency, to Christian's perception, tends to charge fair to high claims for transferring the patent from universities to the young venture. One workaround is not to apply a patent for the technology in the first place, which implies the risk that competing teams may patent the technology. Another workaround is to publish the technology so that no one can patent it. However, this solution would disclose the competitive advantage that a young venture may have from the technology. Hence, Christian calls for more deep-tech start-up-friendly IP commercialization so that start-ups can afford their patents and that contracts do not thwart the investment readiness of the new ventures.

PHYSEC used a lot of entrepreneurial support from the emerging Ruhr entrepreneurial ecosystem of its time. The "fit for foundation"-matchmaking, the business angels, the EXIST fund, the technology centre and plenty of local, national, and international competitions and pitches to gain recognition. Still, Christian would like to have more useful support at the beginning: *"The most important thing is that you can talk to people who have started their own business. […] Regardless of whether they failed or were successful. But persons who have spent four or five years trying to build a company […], they know where the devil is in the details, and I would have liked to see a little more of that. There were a few in the ecosystem that we could ask. So that was quite good, but in retrospect, I think it would have been even better to talk a bit more to get different views and average them. Because one person says this, the other says that, the third says this and that you don't just have one opinion, where you say afterwards, he doesn't have a clue, and in the end, you realize that he does have a bit of an idea. But that still wouldn't have been the best thing for us, and it would have been good to be able to talk to two or three other entrepreneurs."*

Against this background, Christian critically reflects on the many entrepreneurship support organizations currently operating in the Ruhr: *"It's great to talk to some people who work in some entrepreneurship centre and try to explain to you something. That's totally sweet and all good, but it's worth a million times more to talk to people who have done [a start-up] by themselves."* He also criticized the fragmented entrepreneurship support landscape: *"The problem is, that every university has its own entrepreneurship brand or programme, and how many do we have in our city? And then,*

every university has a three-quarter position for a semi-skilled counsellor who, without me taking it badly or personally, would really be better if bundled. If all these human resources were somehow bundled in one place and if the strengths of each individual person were strengthened, it would be better. Then, the advisor travels to the different campuses or meets teams online. But in this way, and this is also an issue, most of the founders are not out of their minds, which means that when they see how inefficient such a system is, they ask themselves how much they would like to be advised by such persons."

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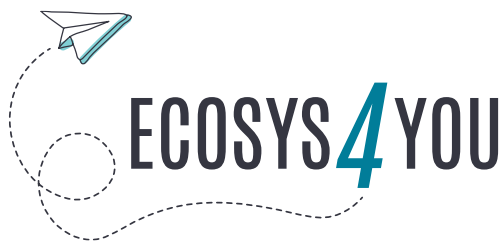
Ecosys4you – Engaging Entrepreneurial Ecosystems for the Youth (2023-2026) strives to bridge the entrepreneurial ecosystems of the Ruhr, Germany, Varna, Bulgaria and Slovenia by connecting young founders, start-ups, HEIs and other ecosystem actors.

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