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Dear Reader,

What follows is a brief case study of one entrepreneur's experience. Sherif Soliman founded Matregenix and, as of this writing, has brought the company to cash flow positive. This is a record of the choices he made and his path to a critical moment in the life of any company.

I wrote this case study with Sherif's assistance in the hopes that future entrepreneurs can learn from Sherif's experience.

Most sincerely,

Rana K Gupta
Director, Faculty Entrepreneurship
Managing Director, Business Innovation Center (BIC)

November 28, 2021
Sherif Soliman
CEO, Matregenix

**Case Study on Entrepreneurial Finance:
Starting and growing a company from a pure technology without equity investment**

We met in the fall of 2018 when Sherif was attending BU's Exec MBA Program and working on his idea. At that point, he had only a pitch deck.

Background

One founder

Married with one child in fall 2018. Now three children!

Exec MBA (EMBA) at BU, completed spring 2019, 25% paid by employer and 75% paid by Sherif (employer had agreed to pay 50% but reneged on half that). PhD from University of Rome Tor Vergata in 2009 in Material Science.

Worked full time for Biostage until 2018 and then quit to work full time for Matregenix, the company he founded. Sherif was the original founding scientist for Biostage's Cellspan technology for organ regeneration. When asked why he did not have equity in Biostage, despite being the founding scientist, Sherif replied, "I had no idea what equity meant at the time. I never asked and never cared. I basically was very happy to find a real job at the time after doing two postdocs at MIT and Princeton University."

Objective then and now

Sherif's objective changed over time as he became provider for his family, so finances became more important.

His goal was always to commercialize his nanofiber technology, an innovation about which he has been most passionate.

Why was he so passionate? His was a raw technology with commercial potential.

The tech – nanofibers - is well established but it was "trapped in academic labs." Although this was a well-known technology, Sherif was astonished to learn it was (still) not 'on the street.' He felt frustrated; he recognized its commercial potential. Sherif's PhD topic was on electrospinning. Sherif's challenge was to commercialize a raw technology. (Note: he did not have to license IP from a university. See Appendix B for Sherif's explanation of the technology's origins and the value of IP as he created and tried to raise funds for Matregenix.)

Getting started – first product concept

Sherif wanted a product focused on a medical application to address unmet clinical needs. What makes his product unique is the ability to make scaffolding material to regenerate organs: highly porous, with a microstructure that mimics native tissue. This makes it the perfect tech to make tissue-engineered scaffolding.

Chronology

He had a dental application when we met in 2018 while finishing an Exec MBA.

He was on a trajectory to develop a barrier dental membrane for guided bone regeneration. While in Boston, he advanced the technology to a pre-clinical stage (animal studies). Sherif's family then moved from Boston to Irvine, CA, where his wife is from.

While still in Boston, Sherif sold his house and withdrew 401(k) savings. He used that money to rent a lab at BU and buy materials. But the equipment he needed was expensive (>\$100,000). To gain access to a machine he needed to continue development, Sherif contacted "every single electrospinning machine supplier" (all of whom happened to be in

Europe). While he engaged in discussions with all of them, one supplier was more interested than the others in Sherif's talents and services (see Appendix A for a letter to a supplier written to engage in a business relationship). He offered two services: 1) to give the manufacturer feedback on how to design its machines better – free consulting and 2) to talk with their clients. The company used Sherif to communicate with US customers. Sherif initially asked to borrow the machine, but the manufacturer donated it after establishing a relationship with Matregenix.

To start the company, Sherif used resources at BU, within Boston and beyond (see Appendix C for a concise list). He undertook R&D at the Photonics Center (rented lab space). Matregenix used the Build Lab as office space. Matregenix was able to enlist free interns from the Mass Life Science (MLSC) internship program. The MLSC program permits for the hiring of two fully paid interns and then reimburse the payments. The interns also used BU's EPIC facility to make accessories for the machine to create prototypes for Matregenix. Sherif used the law clinic at BU "extensively during the first year where I received free services to form the legal entity, issue stock, register trademarks, etc." Sherif wrote a draft of the patents and then hired an attorney, who agreed to a deferred payment plan. Sherif found the patent attorney in Chicago via his wife's cousin.

Sherif also had two EMBA classmates who were "extremely helpful...as part of the team. They both dedicated a lot of time helping me out." Initially Sherif's EMBA classmates helped because they wanted the experience during their EMBA entrepreneurship. Later, Sherif enlisted their help as needed. They've received no compensation to date and thus far have never discussed it. Sherif says since moving to California, "we have been meeting once a week over zoom for about one hour. I certainly plan to give them equity and compensate them retroactively for their time."

While in Massachusetts, Sherif established a collaboration with a professor at the University of Michigan, who helped perform animal studies. Sherif was familiar with the professor's work through his published work; he is considered a pioneer in barrier dental membranes (Matregenix's first product). Sherif emailed him to float the idea of a collaboration, and he was excited about the project. Sherif visited him in Michigan, where they discussed their mutual interests. The professor sought clinical data to publish; Sherif wanted the data for a product. So, the professor did the bench testing and animal studies at no cost beyond his regular lab funding). There were no IP issues with the professor as all patents had been filed by Sherif. To collaborate with the professor, Matregenix signed a simple material transfer agreement with the university. Fast forward and the two parties recently collaborated on two SBIR grant applications. The company is the sponsor, and the academic lab is a collaborator. Matregenix owns the IP.

"We need his lab to evaluate our product safety and efficacy," Sherif said. "What the professor really cares about is publishing results that would help him getting more grant money."

Sherif's wife, who was pregnant at the time, moved to California ahead of her husband. There she stayed with her family. The two months that Sherif was supposed to remain in Boston became five months. Their twins were born without Sherif present.

Sherif moved to California in December of 2019, once he had achieved the milestone of procuring pre-clinical data. "We should now be able to raise funds based on what we learned in the MBA program," Sherif thought. The reality was that while he started talking with Angel investors, none were forthcoming with funding. Two months of pavement pounding ensued. Meanwhile, he continued consulting to pay for living expenses. The European-based company donated its machine to the Boston-based lab and shipped a new one to Sherif in California. Before he had left Boston, Sherif had offered R&D services to potential customers that the European-based machine maker had connected him with to prove the machine's capabilities. One offered to pay Sherif to perform outsourced services. Upon moving to California, that same customer increased Sherif's compensation in return for more services. Sherif discovered there

are many companies, even big companies, who are interested in nanofibers but did not want to make a capital investment. So, outsourcing the work to Sherif became an easy decision. After moving west, he added an additional four paying customers. Three of the five are still clients.

Lab space cost 5 times more in California than the lab at the Photonics Center. Sherif, his wife, and their three children lived with his in-laws for four months. Only once his consulting services started bringing in cash could he afford to rent a house.

Although he was making money as a consultant, he had no investors. His confidence that he could secure funding was low. His efforts elicited no money but lots of criticism from potential investors. He questioned his communication skills. Was his pitch not clear?

Enter Covid

One of his paying corporate customers was working on a water treatment technology. They were impressed with Sherif's work, which produced good results. When Covid hit, that company decided to enter the mask market. Matregenix repurposed the machines to make filter media that is inserted as a middle layer of their masks. Both Sherif and the client realized they needed to buy more machines to scale up production. "I will develop the product" Sherif told the customer.

Before Covid, China was the sole supplier for this middle layer filter media. In the early days of the pandemic, the supply from China stopped and manufacturers in the U.S. could not source the filter media. Nanofiber is known to be an efficient filter media but was not viewed as ready for mass production. "We thought we can scale it up," Sherif said. The customer invested in more machines and placed an order with the European company. In March of 2020, Sherif came to an agreement with the customer: Sherif would develop the product if they invested in the machines and kept them with Matregenix. In effect, it was a transaction that exchanged product development for machines. Sherif initially agreed to give the corporate customer an exclusive license to use Matregenix's proprietary technology, limited to making and marketing filter media specific to the field of masks. The plan was for the corporate customer to buy more machines. In exchange, Matregenix would train its people.

The license agreement was exclusive with the following terms:

- Matregenix trains the customer's personnel in using machines to make mask filter material
- The company retains rights to patents specific to the field of use for medical masks and N95 respirators and pays Matregenix an up-front \$4 million** in exchange for IP rights
- Matregenix retains machine ownership.

***The \$4 million was based on the company's projections that they would earn more than \$300 million in revenue per year on mask filter material. "Then you won't mind giving away \$4 million in a lump sum," Sherif told his client company*

The corporate customer had big plans. But their implementation took longer than expected. They needed to raise money to execute those plans. They needed growth capital that did not materialize. The exclusive license agreement was never executed and so the \$4M was not capitalized.

After five months the two parties, the corporate customer and Matregenix, returned to the table to renegotiate. At that point, they made the license non-exclusive so Matregenix could make and sell the filter material to others.

Now Matregenix is the sole supplier of this mask material, which generates revenue of \$35,000 per month. They are at capacity. Customers find them, generating passive sales. They offer other services, but those revenues are variable. Matregenix has five people working full time on the manufacturing of mask material and R&D for other biomedical applications.

Epilogue

I asked Sherif two last questions:

What were the important and difficult decisions?

- Selling 401K and house and taking full risk while having a family to support financially
- There's an ongoing debate in Sherif's mind about whether to continue boot strapping or go after investment dollars. Bootstrapping has not been easy: running out of cash, high overhead. Services and sales sustain the business but there's no time remaining to engage in R&D to expand resources
- Pivoting into new area where they had NO experience from biomaterial implants to mask filter material. Should we pivot when the client asked?

What were people telling you to do?

Investors wanted a bigger opportunity. We are a platform company initially focused on this \$200 million niche dental market with the idea of leading us into other markets. Investors hated that. Go do something more exciting, they said. Something disruptive in a bigger market. But I first had to convince myself that the tech would work for this application. My plan was to start simple as a proof of concept. I was drawn to dentistry devices because the barrier to entry there is significantly lower than in other medical areas. Then I would move into other areas. That vision was not shared by people with money. This was the biggest gap that made us fail at fundraising.

End Note: I interviewed Sherif in the fall of 2021 for this case study. Upon sharing my notes, Sherif wrote "The document captured the story in a coherent way. Thank you very much as this interview gave me the chance to reflect for the first time and it actually served as a motivation at a time, I think I needed it."

Appendix A: Sheriff's letter to an electrospinning company to engage in a mutually beneficial business relationship

Dear XX

Thank you for taking time in explaining your electrospinning machine capabilities. You and your team have done a great job and the effort and time needed to develop these cutting-edge machines will pay off.

My company, Matregenix, would welcome the opportunity to work with you and your company for our mutual benefit.

As you know, we are an early-stage start-up business made up of a diverse group of health care, business and legal professionals and advisors. We are, however, in the process of conducting a round one capital raise. It would not be prudent to commit this initial capital funds and pledges on the purchase or long-term lease of machinery.

Also, I understand your need to build your business with new customers in the US.

At this time in our development, I would like to propose a relationship that could be very fruitful for both of our companies.

From our end, we would like to offer [your company] physical space in our chemical laboratory at Boston University where you could set up your electrospinning machine. You would be able to showcase it for any prospective customers in a working environment at your own schedule. Space could also be made available for your cool SEM benchtop demo unit.

For this, [your company] would agree to allow Matregenix to use the equipment for an agreed period. I would hope we could secure use of the equipment under this agreement at least for 6 months, with possibility to extend under mutual agreement.

In addition, I can personally offer my help to your business development plans based on my relationships in this space. Specifically, I could:

1. Showcase the machine for your potential clients when you or your staff is unavailable
2. Access the key industry personnel in the US through my connections. I am currently leading an ASTM working group that writes standards for electrospun construct characterization. This will help me connect you to many potential customers in the US
3. Assist you with SBIR grant submission since you already have established a corporate presence in the US; and
4. I can potentially help expand your company offerings to contract research services and, eventually, to a contract manufacturing services in the US

I am looking forward to discussing this very exciting offer with you and your team tomorrow. Let me know if you want me to send a zoom invitation to do video conference with your teammates.

Thank you for your consideration.

Sincerely,

Appendix B: In this side note, Sherif addresses the status of the technology, its IP and the importance of IP as Sherif grew the company and tried to raise funds from investors

The original concept of electrospinning (the process of drawing nanofibers from polymers with the aid of electric field) is a rather ancient concept and is considered public knowledge in the IP world, where nobody can claim IP rights for it, however, there is still a lot of room to claim IP using the electrospinning process. For instance, most of our filed patents are focused on the composition of matter (the formulation and the chemistry) of the polymers we use with this process. We also have claims for improving the process of electrospinning to achieve high throughput production. We also have “combination claims”, where we suggest utilizing the process in a certain way for specific applications that may not be considered “obvious” under the IP laws.

The process of electrospinning is “messy”. It is not a kind of “plug and play” process (like 3D printing) where manufactures can quickly adapt, but it requires some deep scientific expertise to control. Also, there is a high customization factor that need continuous development of new chemical formulations that requires long R&D commitment. Although we have a very strong patent portfolio now, I do believe that our differentiator lies in the “know-how” and deep understanding of the process and not really the patents.

If you ask my honest opinion, I think the know-how is a lot more valuable than patents in this space, however, the investors we talked to seem to care much more about actual filed patents, and I have yet to speak to an investor who can come back with specific questions on the claims we made in the filed patents. Having experienced this my conclusion is that patents are a myth and may or may not have real value, but it seems like an essential step to be able to raise funds from investors!

Appendix C: Resources Sherif used to start Matregenix

Personal

Selling house
401(k) savings

BU

BUild Lab: office space
Law clinic
EMBA classmates
Business Innovation Center (BIC) lab space
Engineering Product Innovation Center (EPIC): made accessories for electrospinning machines

External

Mass Life Sciences Center (MLSC) internship program
Patent attorney
Professor at University of Michigan seeking laboratory data

Customer

Donated machine