the loophole letters

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Welcome to the latest views & perspectives of the future of food

INSIDE

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The Gordian Knot: How AI reduces complexity and compresses technological maturity timespan from centuries into only two decades.

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On our last letter we delt with to sum up this brief "collision with reality's challenges" of Cellular Agriculture and Precision Fermentation. When we deal with scaling up, we are looking at evolving systems, and as any system the cellular agriculture and precision fermentation are made up out of

simple elements, they interact with and grow alongside other elements near them, and as we scale up, it starts to get complicated…

Think of any complex system, some people might think of family or a group of people and their relationships, some might think of neurons and other cells that make up a brain that manages to remember what to buy, solve an equation or write a poem.

Whatever system you might come up with, soon, if not immediately, it is almost impossible to predict how things might develop.

In our discussions, we are looking for a loophole, a way to find a shortcut or a establish a game plan in introducing & fusing the disruptive innovations of the Food-Tech into the global food industry; In this letter we will talk about one of our industry's greatest challenges and a unique tool to solve it.

So, let's start with the simple fact – let us "put it on the table"- **something doesn't work!**

The Food-Tech innovations somehow don't manage to revolutionize the traditional food industry, unlike the other Techs (Fin, Cyber, Med, Bio etc.) and their impact to their respective industries, the promise of the Food-Tech seed is struggling to come true.

How come?

Well, the simplest answer that we managed to come up with is – the tech hasn't matured yet… The complex answer is – we are dealing with Nonlinear Dynamical Systems, which is our way of describing a system that has changes in its components and variables over time, a system that may appear chaotic and unpredictable for most times.

The Food-Tech system has one of the most challenging features in it, that as we scale, we realize that it is counterintuitive, which makes it almost impossible to be diagnosed and analyzed, especially for people that are accustomed to the current global food system.

What we are looking for is an EMERGENCE, which is a fundamental concept in system analysis. It describes how complex behaviors, patterns, or properties arise from interactions among simpler components within a system, often resulting in outcomes that are unpredictable or not directly deducible from the properties of individual components alone.

In other words, an EMERGENCE refers to the phenomenon where the whole system exhibits properties or behaviors that are more than just the sum of its parts.

Let us take for example the Cell based products… basically, with the knowledge we have from biotechnology and tissue engineering, we should be able to produce meat, fish and dairy products from cells (and we do), yet for the last 8 years we haven't seen the leap from lab to industrial production that this accumulates knowledge should have brought; whether in Cell-lines, Media recipes

and productions, Scaffolding, Bioreactors design and Bioprocess standards of procedures, as well as regulation and scaleup capabilities.

Each element is a small Nonlinear dynamical systems on its own, and together, they form a combined complexed one.

It would take us too long, and too much manpower to make it work, it seems too complex, and in any other time in history, we would have to "go blind" and trust technology, but lucky for us, we have a tool to deal with it.

Before we continue, let us remember that tools are tricky things, they can be used for good or for bad, it is the best explained in Nordic mythology, in which Thor describes as owning a hammer. a hammer is a tool, and we can use it to build a house, make an armor or to be use it as a weapon…

So, our tool to solve our challenge is AI. Now, we know that AI is a buzz word, and everyone try to harness it impact, so it become even more abuse, but I reminded of a quate from Herman Melville's Moby Dick: "Ignorance is the parent of fear".

Let's get a bit (I promise) technical. How can AI help us?

By implementing this technology, it can trace the slightest frames of structures in petabytes of data, this tech might put to use its ability to do Time Series Prediction/Forecasting and anomalies detection in Time Series, meaning that for **Bioinformatics and Computational Biology**, we can see, build and manufacture new proteins, starting with Structure Prediction, Protein-Protein Interaction Prediction, Gene Expression Prediction, and much more. We can use it as well in **Chemistry and Molecular Discovery**, modeling Chemical Reaction Prediction, molecular Property Prediction, Reaction Outcome Prediction, and it can be implemented in many other aspects of the food-tech industry**.**

If you are an entrepreneur in the Cellular Agriculture vertical, you should know that the potential is great, but for now it is still just potential.

So, due to the fact that we can't predict the evolution of Nonlinear Dynamical Systems, and AI is still trained as it forge into a real tool, **where lay the confidence that the scaling of this tech is possible?**

I would like to invite you to examine, as a testcase, another system which has evolved over the last two centuries: the STEEL Industry.

The steel industry traces its roots back to the 18th century with the invention of the Bessemer process by British inventor Henry Bessemer in 1856. This process revolutionized steelmaking by **enabling the mass production of steel at lower costs compared to traditional methods**.

Prior to the Bessemer process, steel production was limited and expensive, just like the Food Tech cultured products industry today, it was primarily produced through the labor-intensive and time-consuming process of crucible steelmaking.

The 19th century witnessed rapid advancements in steelmaking technology and the expansion of the steel industry, the Bessemer process was further refined and complemented by the Siemens-Martin process, which allowed for greater control over the composition and quality of steel.

This scale up technology was exactly what industrial giants such as Andrew Carnegie in the United States and Alfred Krupp in Germany were looking for, as they played pivotal roles in the expansion of the steel industry through vertical integration and the establishment of large-scale steel mills, The construction of railways, bridges, skyscrapers, and other infrastructure projects fueled the demand for steel, driving the growth of the industry.

The 20th century marked the maturity of the steel industry, with steel becoming a cornerstone of industrialization and economic development worldwide.

Technological innovations further improved steelmaking efficiency and quality. The steel industry played a crucial role during World War I and World War II, supplying materials for weapons, vehicles, ships, and infrastructure.

The post-war period saw a boom in steel consumption driven by reconstruction efforts, urbanization, and the rise of consumer goods industries; However, the latter half of the 20th century also witnessed challenges for the steel industry, including increased competition from emerging economies, shifting global trade patterns, and technological disruptions.

What we suggest taking as lessons from this example…

1. **The funds and strategy -** the investments that drove the birth of the industry were **huge!** In the US, people like Andrew Carnegie, J. P. Morgan and John D. Rockefeller, as well as other industry leaders in Europe invested fortunes strategically in "steel on the ground" that brought the industry into existence… Today we have these funds available but the investment strategy of investors and profit demands, mixed with savvy founders educated by high-tech accelerating dogma, produced a hyped, well-marketed, trendy investment opportunities in ecosystem that are biting away from funds that should have been put into establishing a new industry.

2. **The standardization** – scale up is dependent on the ability to reach the same results as we grow, and that requires standards of production processes (SOPs in our current lingo) which will allow us to establish the industry. In our testcase, the inspiration for the basic process that started all, the Bessemer process (by British inventor Henry Bessemer in 1856) was already known in China and Japan at least 100 years before, just like Cultivate products today... some companies can make small amounts of cultured products, yet non managed to reached industrial capacities.

3. **The unique business model** - One of Carnegie's most significant contributions was his implementation of vertical integration, where he controlled all aspects of the steel production process, from raw materials to manufacturing to distribution. Carnegie acquired iron ore mines, coal mines, and railway lines to ensure a steady supply of raw materials for his steel mills. He also established his

own shipping fleet to transport steel products to customers. By vertically integrating the vertical founders, investors and companies would be able to achieve cost efficiencies, streamline operations, and maintain a competitive edge in the industry.

4. **Value proposition** - Unlike steel, that had to become a cornerstone of industrialization and economic development worldwide, food is the basis to human existence… the global industry is already exist, it is the technology that needs to become scalable to fuse in and adopt by the existing industry. Unlike the bio-tech and pharmaceutical vertical, that have huge margins from their costumers how pay for the medicine they invented, the food tech will require big investments at first as well, yet it doesn't have the same potential margins, what it does have is a continence need of consumption from every person that live on earth, or that will be born! And that potential profit might become the bases of a new business model as companies scale up.

Many people that read these lines might feel discourage in the face of this monumental task, and we are sad to say that none of us is cut for the job,

So how come we are not telling you all to drop it all and leave it?

We believe that we are at the turn of the tide, since the computer revolution, the information and IT ages demonstrated that knowledge is increasing exponentially, and nowadays in the beginning of the AI age, everything will move faster! Yet, what took, back then, for several committed people to do, will nowadays require a transdisciplinary and global collaboration.

It is no longer science fiction that we can take a technological maturity's timespan from 2 centuries and compress it into 2 decades! And leaders will emerge from this struggle to innovate and become trailblazers for the ones that will follow…

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