

The AI Productivity Game in Pharma

Oct. 5, 2020 by Amandeep Singh

The pharmaceutical business is one of the riskiest industries to venture into. Drug discovery is an artisanal process where a carefully designed drug takes about 10 years and approximately 2.5 billion dollars to be approved and launched into the market. The complexity of biological systems places the odds at a ridiculous failure rate of 90%. In recent years, the declining efficiency of the R&D efforts has put the pharma industry on its toes.

In the past decade, Artificial Intelligence (AI) has already revolutionized several industries, including automotive, entertainment and fintech. AI dictates routes and ETA on google maps, executes multiple stock exchange transactions, enables facial recognition, and powers the voice assistants Siri and Alexa. However, the adoption of AI in pharma has been restricted due to limited data available about what works (the successful 10%) and the innate complexity of the process of drug discovery.

The sudden hype of AI in pharma

The pharma industry has been using elements of machine learning (a type of AI algorithm) in drug discovery R&D for at least 2 decades now. The most common software used by medicinal chemists, Schrodinger's suite, has been offering regression analysis for quite some time now. So, what's new?

However, the recent widespread interest has been fueled by the breakthrough made in neural networks, beginning with 'AlexNet' in 2012. AlexNet, a convolution neural network, augmented with supervised learning, could classify images with outstanding precision. It was not too late that these algorithms found its way in chemistry to classify drug molecules. Subsequent publishing of Generative Adversarial Networks (GANs) or often referred to as 'creative AI' in 2014, combined with reinforcement learning that could be used to generate novel molecule entities with a desired set of pharmacological properties.

By 2018, Natural Language Processing (NLP) and computer vision algorithms, which can generate insights by crawling through millions of papers, patents, grant, clinical trials data etc., made significant

progress and allowed making sense of vast amount of fragmented data. Simultaneously, advances in -omics and other high through put techniques generating the big data allowed pharma to use to AI efficiently.

These advanced methods could be efficiently trained to predict/generate novel chemical structures with desired pharmacological properties, learn systems biology to identify new targets/biomarkers, predicting toxicity, and many other applications in drug discovery and development.

The conundrum of data sharing

Citing the promise as real, numerous pharma companies have since forayed into AI by partnering with 'AI-specialized start-ups' to explore the process. The big pharma companies, having deep pockets, have also started investing heavily in developing their internal AI capabilities for long term, rather than completely outsourcing it the numerous specialized start-ups. This trend is rather opposite of what we have observed with contract research organisation (CRO) industry, that has grown by building the scales for the services that pharma cos and biotech's wanted to outsource. And we need to understand why?

AI works as well as the data it is fed, and the pharma companies own that data.

It is extremely important to integrate a vast variety of datasets and create structured data lakes from sanitized data, such that you can reasonably apply deep learning and make sense out of it. And it can be a daunting and transformational task, especially for pharma industry which deals with a gargantuan amount of diverse data ranging from billions of molecules to large omics datasets, from in vitro and animal testing data to clinical trial data.

"It took us about 18 months only to integrate data across 11 different data systems to actually build the databank to actually then start applying the artificial intelligence...We were so focused on the endpoint, in terms of the FDA or the EMA, that we never collected the 80% of the data that could be pulled out from

CROs, like imaging datasets, biomarker data etc.”, says Vas Narasimhan, CEO of Novartis.

There is a rising sentiment about organizing data in a structured manner and sharing with the community to improve the overall process of drug discovery, while still protecting the IP. COVID-19 got the pharma industry sharing data and coordinating at unprecedented levels to get treatments or vaccines out to market as early as possible. It would be interesting to observe, whether this trend will survive or wither away just like the leaves of autumn.

“Our philosophy is truly that all boats rise with the tide.., we think that there's other ways that you can create competitive differentiation around your algorithm, quality of the data, the analysts, the companies you partner with”, says Lee Lehman-Becker, Senior Director for Digital and Personalized Health Care Partnering at Roche.

The conundrum is, without exclusive data pharma companies might face unnecessary external competition and risk the expected upside of the process. While it is difficult to ascertain whether data sharing will become a common practice or pharma what would be cautious, will ascertain the future of a lot of 'niche' AI drug discovery start-ups. It is likely that only the AI start-ups who distinguish themselves with robust algorithms along with clean and therapeutically valuable datasets will see the light of day.

AI productivity in pharma

A recent study, 'The upside of being a digital pharma player' compares 21 big pharma companies by their internal as well as external AI projects, publications and patents mentioning AI, investments in AI start-ups and consortiums and alliances between 2014 and 2018. Many companies are showing early and clear signs of leadership in digitalization. For example, Novartis has shown leadership in adopting AI with a patient centric approach and Astrazeneca has published very impressive results in generative chemistry.

The study also cited peers in the industry who are doing less than expected when categorized the state of AI and total revenues. “A lack of coordinated strategy in many companies have made the AI adoption look as a re-branding exercise and not yielded the desired results”, says Dr. Alex Zhavoronkov, co-founder, and CEO of Insilico Medicine – one of the top 10 companies leading the way in the applications of AI to drug discovery. One of the authors of the study, Alexander Schuhmacher, adds in an interview with Dr.

Zhavoronkov that “AI is still not a part of core strategies for some of the leading companies”.

Structuring and sanitization of data is obvious to begin with, but importantly it is imperative to understand the uniqueness and robustness of algorithms/models developed to solve these increasingly complex problems.

Not all AI are created equal. It takes a delicate interplay between the chemists, biologists, and data scientists to come with algorithms that work effectively. “Most AI conversations with pharma begin with questions like ‘How is your platform distinct from others?’, even by some heads of digital/AI departments”, continues Dr. Zhavoronkov.

Different AI models may be needed for the diverse type of applications within a small function. For example, optimizing a lead molecule in drug discovery requires to optimize selectivity, toxicity, blood brain barrier and much more parameters. Having a robust AI model that allows multi-parameterization simultaneously is a feat only a few groups in big pharma and a few start-ups have achieved.

The progress in the big pharma has been much slower than the academia or start up space in terms of developing robust machine or deep learning algorithms, however the big pharma are slowly catching up. It is likely that only the AI start-ups who distinguish themselves with robust algorithms along with clean and therapeutically valuable datasets will see the light of day.

Other very important factors that affect AI productivity are the leadership and culture. Pharma companies are traditionally accustomed to slow turnaround cycles, taking 5-10 years to launch 1 drug and multiple years to even finish a clinical trial. In the world of digital, you must act as tech companies and be more comfortable with rapid cycle innovation and rapid failure.

The transformation drive has to take a top down approach where the leadership understands what benefits AI can provide in each of the verticals and create a new AI unit that can cross talk with each of these vertical. “When you data science efforts primarily led by business leadership, it certainly adds to the data science efficiency. It is essential to find leadership that has a domain expertise in multiple domains and can adapt to data science domain fairly quickly to construct an economically viable model” says Dr. Bülent Kiziltan, an accomplished AI executive working in a stealth mode AI start-up.

Since the big pharma companies will not be able to accomplish such transformational changes in the short term, they might continue to partner or acquire or invest into start-ups as they do not want to miss the opportunity. In contrast, small biotech’s/pharma, with much less data and relatively high flexibility,

may be able to bend their strategies to incorporate AI tools across the value chain by just partnering with the right start-ups. Whatever the size of your company, AI is likely to impact at least one vertical of your value chain. It is imperative to begin your AI journey as early as possible.