Potter Clarkson

IS AI ABOUT TO REVOLUTIONISE FOODTECH?

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AI AND ML ARE HAVING A DRAMATIC IMPACT ON EVERY ASPECT OF FOOD MANUFACTURE

When foodtech is mentioned, most people will immediately think of the science involved in food production, the proteins, microorganisms, and fermentation processes.

Alternatively, you might jump to production, packaging and delivery processes or the increasing part robotics, drones, and 3D printing now play in the food industry.

The aspects of technology that might not feature in your thinking are Artificial Intelligence (AI) and Machine Learning (ML).

However, AI and ML are having a dramatic impact on every aspect of food manufacture. They help drive efficiencies. They support the formation of new ideas and new recipes. They encourage increased use of automation. They reduce human error which is critical when you are producing products that humans are about to ingest. Most importantly in these difficult times, they reduce waste, reduce the use of chemicals (both pesticides and fertilizers) in the fields and increase productivity and profitability.

In this special report we will examine which areas of food manufacture are benefiting from the introduction of AI and ML and look at the key considerations for maximising the value of the underlying innovation.

WHICH AREAS OF FOOD PRODUCTION CAN BENEFIT FROM AI?

AI innovations are starting to lay the foundations for a better future for the food industry. It has introduced sophisticated data science solutions to tackle some of the key issues the food industry faces including:

› **IMPROVING FOOD SAFETY**

Arguably the most important application of AI in the food industry is in food safety.

There are two potentially ground-breaking uses of AI that are widely tipped to come into widespread use very soon:

1 NEXT GENERATION SEQUENCING (NGS)

NGS could eventually replace DNA in food safety testing. It can capture data and prepare lab samples more quickly and more precisely. It can also be used to highlight potentially dangerous trends and even prevent the outbreak of some diseases.

2 ELECTRIC NOSES

These are electronic chemical sensors that can accurately identify a variety of odours and discern whether the odours they pick up could be signs of pollution or infection.

AI CAN PREVENT MANUFACTURERS FORM ENDING UP WITH A SURPLUS OF GOODS AT ANY STAGE OF THE SUPPLY CHAIN, A SURPLUS THAT WOULD OTHERWISE END UP BEING WASTED.

❯ SUPPLY CHAIN OPTIMISATION

Food manufacture is rightly highly regulated to protect consumers. Part of this responsibility is to make sure the way a food product travels through its supply chain is transparent. AI can play a huge part in this. It can automate the tracking of goods from where they are grown or made all the way to the consumer's table.

However, as well as offering greater transparency in the providence of a foodstuff, AI can also reduce waste. By making more informed decisions on price, inventory and transportation, AI can prevent manufacturers form ending up with a surplus of goods at any stage of the supply chain, a surplus that would otherwise end up being wasted.

❯ IMPROVING PRODUCTION LINE PERFORMANCE

Most food production lines are made up of a series of highly complex machines. It is easy for these to go wrong from time to time. Repair is not only expensive in itself, the resultant delays in production will also be costly. AI can be used to

predict when and where maintenance is needed based on past performance amongst other criteria.

AI can also identify what is/is likely to cause problems so you can act before they become issues to maintain the highest levels of overall equipment effectiveness on your production lines.

These are probably the highest-level applications for AI in food manufacture. However, as we've already said, a lot of food production is science and today, a lot of science is data. The real strength of AI and ML is they can keep you at the cutting edge of data science by using what you know to keep your business moving forward by:

❯ DRIVING THE USE OF NUTRACEUTICALS

The recent pandemic has sharpened our focus on healthy eating. This in turn has sent nutraceuticals back to the top of the food industry's list of priorities, particularly as the benefits of nutraceuticals extend to reducing our susceptibility to allergies, diabetes and disease.

› OPTIMIZING FOR FERMENTATION PROCESSES

If a drink producer or someone looking to develop a dairy or meat alternative wants a specific combination of taste, texture and nutrition, AI can make calculated predictions as to which microbial strains are most likely to work well together.

In the case of fermented dairy products in particular, as they have their own very specific characteristics, AI's predictions will not only inform potential combinations of ingredients but also identify the levels of nutrients the final product will offer. These properties are crucial to the development of products that are genuinely healthy as well as great tasting.

› ACCELERATING THE PRODUCTION OF ALTERNATIVE PROTEINS

Cultured meats and plants are the primary sources of alternative proteins. Advancements in the use of AI in fermentation and molecular biology have empowered manufacturers to find more efficient and more sustainable alternate protein discovery and production solutions.

› GREATER PRECISION

AI has become increasingly important to improving the overall harvest quality and accuracy. AI can assist in detecting disease in plants, pests and nutrition levels in the soil and AI sensors can detect different diseases in agricultural crops and decide which and how much of a particular pesticides or combination of pesticides should be applied.

› OPTIMISING PLANT BREEDING

AI is increasingly being used to shape modern crop breeding.

Improvements in crop phenomics and enviromics (in addition to many other 'omics') is helping researchers understand the complex relationship between genes and agronomic traits. AI injects huge additional computational power and many new tools and strategies that will improve future breeding further still over the coming years.

› WIDENING THE POTENTIAL OF 3D PRINTING

3D food printers are now producing nutritious personalised diets and alternative protein-based meals. Some manufacturers are even experimenting with laser and inkjet food printing and bioprinting methods to develop new food products that meet personal nutrition demands and reduce food waste.

› IMPROVING FOOD-WASTE TRACKING

Far too much of the food produced around the world is still lost or wasted. AI can track food wastage so that trends can be capitalised on to minimise waste in shops, restaurants, hotels, and smart cities and is helping food manufacturers realise their aim of achieving zero waste.

› IMPROVING FOOD SORTING

Historically manufacturers would have to employ a large amount of low skilled workers to sort through fruit and vegetables to separate them for different purposes or to discard them entirely if unsaleable. Today AI can do all of this by size, purpose or even colour.

This doesn't only make the process more efficient and more cost-effective for producers, it also increases food quality and safety for the consumer.

› MATCHING STRATEGY TO CURRENT TASTES

Having data that clearly shows what people like, eat and buy can be invaluable in determining your business' strategy.

It can not only direct your product development, but it can also predict market demand so you can balance your use of resources, your storage requirements and the raw materials and packaging you need to buy. It could also save you from making expensive mistakes by producing the wrong products or marketing certain products in the wrong markets.

› CREATING NEW (AND MORE MARKETABLE) RECIPES

While ways we can combine and the cook ingredients is literally limitless, the fact most recipes are held online means AI can analyse what is most popular where. The resultant data can be used to create new recipes for products designed for specific areas of the world or for specific demographics.

› IMPROVING DELIVERY

Although it is in its infancy, more and more manufactures and retailers (for example 7-Eleven) are now trying to introduce drone and street bots as delivery mechanisms. While there is still work to do to perfect their involvement, it has been recognised that as drones and bots will save companies from having to pay for and manage a human workforce, it is highly likely it is work that will continue apace.

Similarly, Machine Learning is being used to improve delivery routes and logistics strategies to optimise delivery times and costs.

CAN AI HELP US CUT FOOD WASTE?

The United States Department of Agriculture claims that food waste could be as much as 30-40% of the nation's food supply split between retailers and consumers.

In real terms this was approximately 133 billion pounds and $161bn worth of food in 2010. This figure has, you would expect, increased significantly in the following 12 years.

It is a problem that must be tackled immediately and effectively. It is a problem, at least according to industry experts, that AI can play a huge part in resolving. McKinsey believe AI could save as much as $127bn in food waste by 2030 simply by underpinning more regenerative recreational agricultural practices.

MCKINSEY BELIEVE AI COULD SAVE AS MUCH AS $127BN IN FOOD WASTE BY 2030 SIMPLY BY UNDERPINNING REGENERATIVE RECREATIONAL AGRICULTURAL PRACTICES.

AI CAN READ DATA FROM SENSORS, DRONES AND SATELLITES AND GIVE FARMERS WHAT THEY NEED TO MAKE BETTER AND FASTER DECISIONS.

Currently farming methods are not as smart as they could be. The blanket application of synthetic fertilizers and a 'one size fits all' approach to land use is taking its toll. AI can read data from sensors, drones and satellites and give farmers what they need to make better and faster decisions on:

> How to use microbes to increase crop growth without the involvement of synthetic fertilizers

> Which fields to use for which crops to maximise production and minimise cost

> How to improve the ease and efficacy of the food inspection process

> How best to track food through every stage of the supply chain to tackle potential wastage points

> How to improve the journey from producer to consumer

It is highly unlikely one solution or one provider will be able to deliver a solution that can meet all these objectives. This suggests to us that the solutions needed to tackle this most urgent of issues could well be driven by collaboration or even a network of innovators committed to working together to cut food wastage once and for all.

WHAT IS THE FUTURE FOR AI IN THE FOOD INDUSTRY?

The myriad of ways AI is currently being used by the food industry confirms AI has a very bright future in the food industry.

AI's analysis and interpretation of data is already reaping enormous benefits in terms of optimising the performance, safety and waste reduction. This is set to continue apace. The increased level of investment (and interest from investors) is a sure sign of this.

A recent example of the enormous levels of investment being afforded to foodtech innovations is Agrointelli. Denmark-based Agrointellic recently received a €14.5 million investment to scale up production and accelerate the company's international growth plans.

The investment is a collaboration between Nordic Alpha Partners and Vaekstfonden under the umbrella of The Danish Green Future Fund. They are confident that if the company's robotics can realise their potential, it will significantly increase output, efficiency and sustainability of the farms that adopt it.

Swiss-based Gayama recently raised over $3.2 million in funding. Their AI driven invention can detect changes in water, fertilizer, pests, and crop yields and use the data to identify potential threats and alert farmers.

DENMARK-BASED AGROINTELLIC RECENTLY RECEIVED A €14.5 MILLION INVESTMENT TO SCALE UP PRODUCTION AND ACCELERATE THE COMPANY'S INTERNATIONAL GROWTH PLANS.

It is also expected that increasingly sophisticated AI algorithms will provide even greater direction for a broader range of interested parties involved in food provision.

One example of this is the work that has already begun to cross-reference harvesting data with satellite data on the Earth's surface. This will ultimately provide intelligence industry, investors and governments can use to make more informed decisions as to where they need to focus to improve food production levels.

There is also a potential to use AI to preserve our increasingly stretched natural resources. Britain's Institution of Mechanical Engineers believe a shocking 550 billion litres of water are wasted every year during the crop production process. AI has the power to dramatically reduce this number.

However, by the food industry's own admission, while artificial intelligence is having a large impact on the food and beverage industry, there is still huge potential to exploit. Currently the technologies are mainly the preserve of the larger manufacturers but if we follow the trends across the other industries that have embraced AI – digital health for example – the cost of entry will drop as adoption increases and economies of scale kick in.

BRITAIN'S INSTITUTION OF MECHANICAL ENGINEERS BELIEVE A SHOCKING 550 BILLION LITRES OF WATER ARE WASTED EVERY YEAR DURING THE CROP PRODUCTION PROCESS. AI HAS THE POWER TO DRAMATICALLY REDUCE THIS NUMBER.

IF YOU ARE INCORPORATING AI INTO YOUR FOODTECH INNOVATIONS, HOW CAN YOU PROTECT IT?

Formulating an effective strategy for protecting and developing intellectual property (IP) can be critical to the value of your company, regardless of the specific field of technical innovation you are involved in.

IP protection can take many forms. These include patents, copyright, trade secrets, trademarks. It is important you select the optimal type of protection for each of the different types of IP in your portfolio. This is the only way to maximise the commercial value of your innovation and, by extension, your business.

It is also always advisable to consult an IP professional to make sure you have the right and most effective IP protection strategy.

Obtaining patent protection is often seen as the 'gold standard' for protecting technical developments and a granted patent is a very powerful form of IP protection. However, one of the requirements for obtaining patent protection is that the innovation must be disclosed during the patent application process. This will place your innovation in the public domain, regardless of whether the application is successful or not.

Consideration should therefore always be given as to the likelihood of successfully obtaining protection, since an unsuccessful (or a successful but narrow) application may risk placing key details of the innovation in the public domain without gaining any significant benefit.

Artificial intelligence (AI) and machine learning (ML) are powerful tools for manipulating data and, as we've seen, they are being used in an increasing range of applications in the foodtech arena.
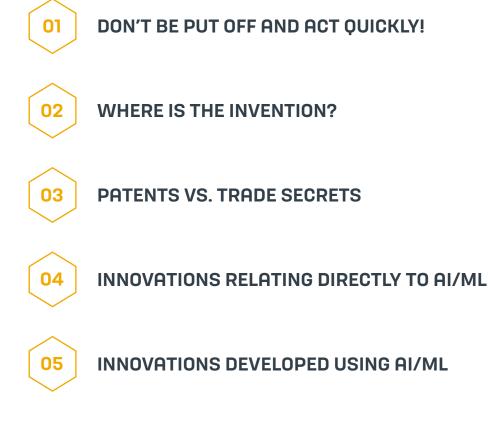
This has inevitably led to interactions between AI, ML and IP; whether through the use of AI and ML in the research and development of IP, or in the generation of IP directly related to the AI and ML techniques being used in foodtech innovations.

However, it is important to remember serious questions surrounding the patentability of AI developed innovations remain unresolved around the world. A number of 'test case' applications have been filed around the world listing an AI program called "DABUS" as the sole inventor. The question as to whether an AI can be listed as an inventor have largely been met with a "no" by courts. This has led to these applications being rejected. However, appeals are ongoing so the situation is unlikely to be finally determined for some time yet.

So, what does this mean for protecting IP relating the use of AI/ML, either in the development process of non-AI related inventions, or in inventions relating to improved AI/ML techniques?

While listing an AI as an inventor for a patent application does not appear to be a good idea (at least for the moment), this does not mean that IP relating to AI/ML cannot be protected. However, care must be taken to ensure that effecting protection can be obtained for the key innovations relating to this subject.

HERE ARE SOME TIPS THAT WILL HELP YOU DEVELOP AN EFFECTIVE STRATEGY FOR PROTECTING IP RELATING TO AI/ML INNOVATIONS

01   DON'T BE PUT OFF AND ACT QUICKLY!

02   WHERE IS THE INVENTION?

03   PATENTS VS. TRADE SECRETS

04   INNOVATIONS RELATING DIRECTLY TO AI/ML

05   INNOVATIONS DEVELOPED USING AI/ML

01

DON'T BE PUT OFF AND ACT QUICKLY!

Although the process of protecting IP relating to AI/ML can be difficult, this does not mean that an effective protection strategy cannot be found!

It is important that a strategy be considered as early as possible in the development process, to ensure that all the key innovations are correctly and effectively protected before any potential disclosures occur.

02

WHERE IS THE INVENTION?

With AI/ML related developments, it is very important to determine what exactly the innovation is.

For example, does the innovation lie in an improvement to the AI/ML itself?

Has the use of known AI/ML techniques facilitated a development of a non-AI/ML related technology?

Does the innovation lie in manipulation of input data that has been used to train AI/ML algorithms?

In each of these cases, a different IP protection strategy (or combination of strategies) may be the most appropriate.

03

PATENTS VS. TRADE SECRETS

Patents and trade secrets each give protection to developed IP, however they do so in very different ways.

Patents require that the innovation be disclosed to the public by way of a patent application, in order for protection to be obtained.

Trade secrets, however, keep the details of the innovation secret. To qualify for trade secret protection, a company must identify the information to be kept secret, and then develop and put in place internal company policies to keep the information private.

This may involve, for example, isolating the secret information in particular development spaces and restricting access to the spaces to certain employees.

04

INNOVATIONS RELATING DIRECTLY TO AI/ML

Innovations that relate to improvements made directly to AI/ML algorithms or training data may be patentable. As such, developments could result in a technical benefit to the execution of the AI/ML algorithms.

In such cases, patent protection may be worth considering as part of the IP protection strategy, although as noted above – the barrier for obtaining patent protection for software innovations in Europe and the UK is particularly high.

Consideration should therefore be given as to the likelihood of successfully obtaining a granted patent, given the public disclosure of the development that would be required during the application process.

It should also be decided exactly where the AI/ML innovations will be implemented by the company.

If the computer code comprising the innovations will be executed exclusively by the company, then simply keeping the code secret, and making use of trade secret protection, may be the best strategy. Alternatively, if the code is to be made available to people external to the company, such that the innovations will be more publicly available, then patent protection may be a more effective strategy.

A final option to consider if the code comprising the innovations is to be provided to people external to the company is the use of code obfuscation, and an agreement in the end user license agreement (EULA) not to attempt to reverse engineer the code. Such a strategy would likely be successful if the end users are a business. Businesses are less likely than private individuals to risk the potential legal consequences of an EULA breach.

05

INNOVATIONS DEVELOPED USING AI/ML

Innovations that are developed using AI/ML, but do not directly involve AI/ML in the actual invention are generally much easier to protect than innovations relating to the AI/ML process in and of itself.

In such cases, the fact that AI/ML has been used in the innovation process is often irrelevant, and so may not need to be considered when pursuing patent protection for the innovation.

If the AI/ML contribution to the innovation has been particularly beneficial, it is generally more advantageous to keep the details of the AI/ML contributions secret, as the AI/ML may lead to further potentially patentable innovations in the future.

An example of such a situation is the use of AI/ML in the development of candidate drugs for use in the treatment of diseases.

The AI/ML may identify many candidate drugs, each of which could lead to the development of a patentable medication.

While it might be possible to obtain patent protection for the AI/ML implementation itself, a better commercial strategy may be to keep the details of the AI/ML secret (for example, by making use of trade secret protection), while obtaining patent protection for each candidate drug/medication identified using the AI/ML.

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