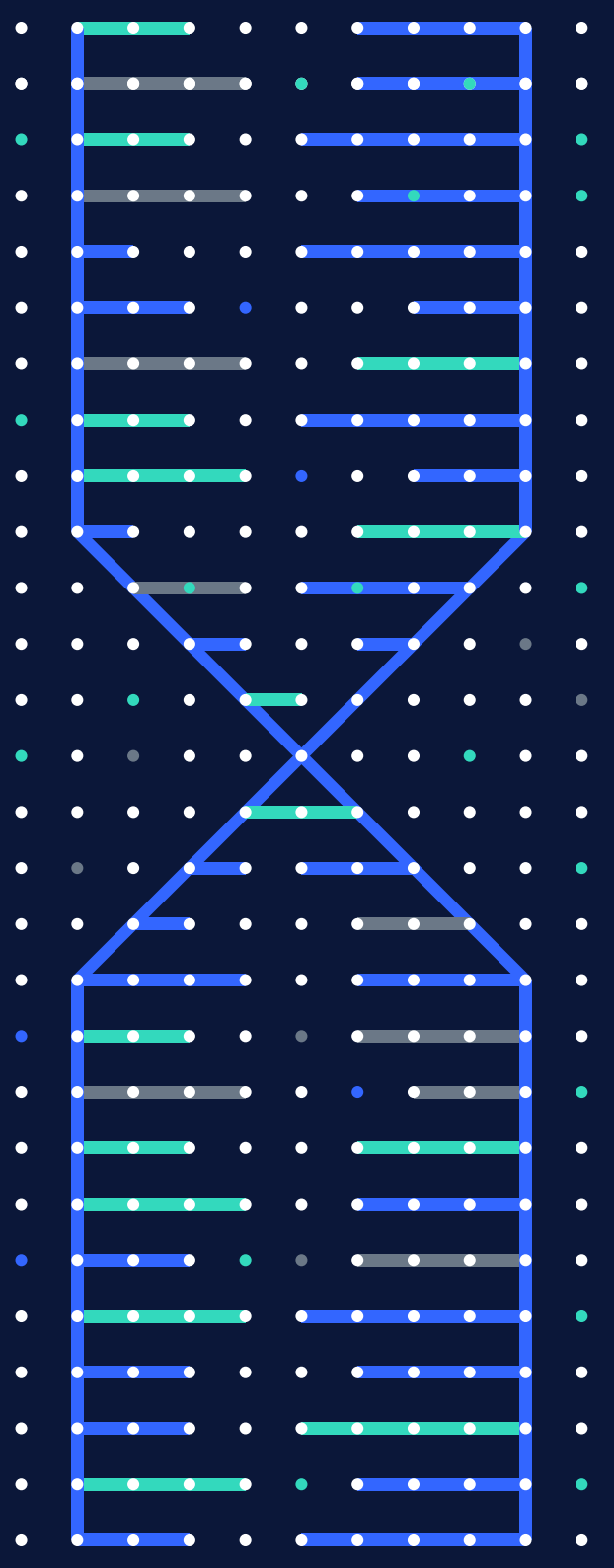
Creme Global

Overview of Creme Global Microbiome Expertise



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Modelling the Microbiome

Creme Global has developed significant expertise in bioinformatics, data analysis, machine learning and predictive modelling in the microbiome space.
Our approach can be summarised in three steps.

1. Determining the composition and status of the microbiome
2. Understanding the factors that influence and change the microbiome
3. Predicting how the microbiome influences its host or immediate environment

Factors that change the microbiome

Microbiome

Impact on the host or environment

The underlying principle and technologies that are used to analyse the microbiome are the same, whether it is the microbiome of a product, a factory, a hospital environment or the gut. Measuring the microbiome involves taking a swab from the environment or a sample of a product, extracting the DNA and using Next Generation Sequencing (NGS) to detect each individual bacteria.

This collection of bacteria is the microbiome. When this is combined with additional information such as where the sample was taken, what were the conditions at the time, what were the conditions beforehand and afterwards and any other relevant information, this is the sample metadata. Machine learning analysis can then be conducted on these multiple sources and types of information, correlations, trends, risks and insights can be gained.

Essentially the process converts biological data to digital data. This enables interrogation and modelling of the data to determine the behaviours of living organisms at a very detailed level. The insights available from using data on the levels of several species together are far greater than those available from using traditional growth models. This can be done from both first principles of microbiology and also from big data analysis using machine learning and mathematical modelling to determine the key factors influencing the microbiome. Creme Global has in-house scientists, mathematical modelling expertise and computing technology to do both.

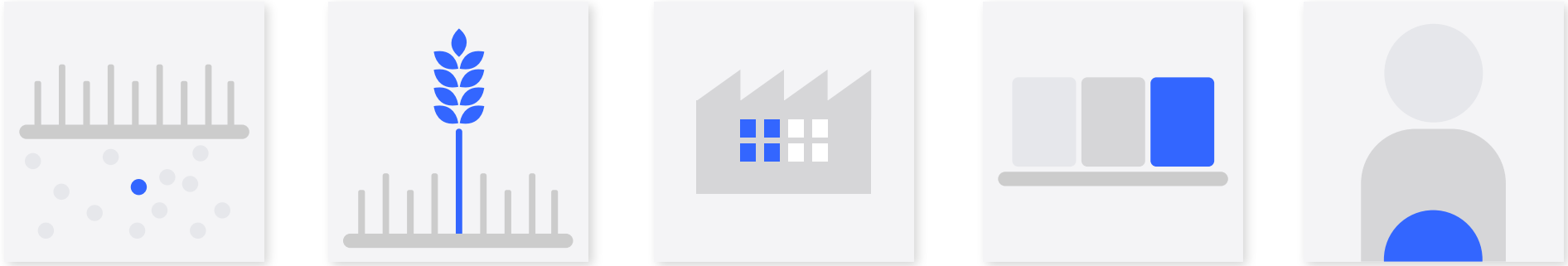
In this manner, the microbiome can be analysed for a wide range of scenarios. For example, the microbiome of products as they move through the supply chain can be examined to understand changes in and between each step. In particular, the types and relative quantities of bacteria present in each sample, whether they are a spoiler or pathogenic or otherwise.

Samples can have >1,000 distinct bacteria

Traditional techniques can detect <10%

NGS can detect all

Locations on the supply chain where the microbiome can be analysed



In brief, it has been shown that the microbiome of the soil at the time of crop planting can have a significant impact on the prevalence of pathogens. Tomato growers from east coast USA were having an issue with Salmonella. The root cause was identified as being related to the presence of Salmonella in the soil. (See case study). There have been many recent recalls on romaine lettuce, this was traced back to contaminated irrigation water. There is also an increase in the frequency of contaminated floodwater due to climate change. Animal bourne fertiliser also harbours many pathogens, there are many studies ongoing to better understand how pathogens are circulating in the food chain.

Creme Global has deep expertise in mapping the microbiome of factories. The underlying technology was developed in partnership with the University College Dublin-Center for Food Safety (UCD-CFS) www.ucd.ie/cfs/ following an extensive 'first in the world' study of five large scale food manufacturing plants. NGS was used to determine the full microbiome (>1,000 bacteria) of the built environments over a three-year period. Critically, this analysis includes both culturable and non-culturable bacteria. It has enabled the ability to assess a description of the complete bacterial microbiome of an environment. The key insight was to understand the interrelationship between these bacteria and how this might play a role in persistence. This unique insight is what has enabled the possibility to develop a model and technology solution to predict the likelihood of occurrence of bacteria into the future (see case study).

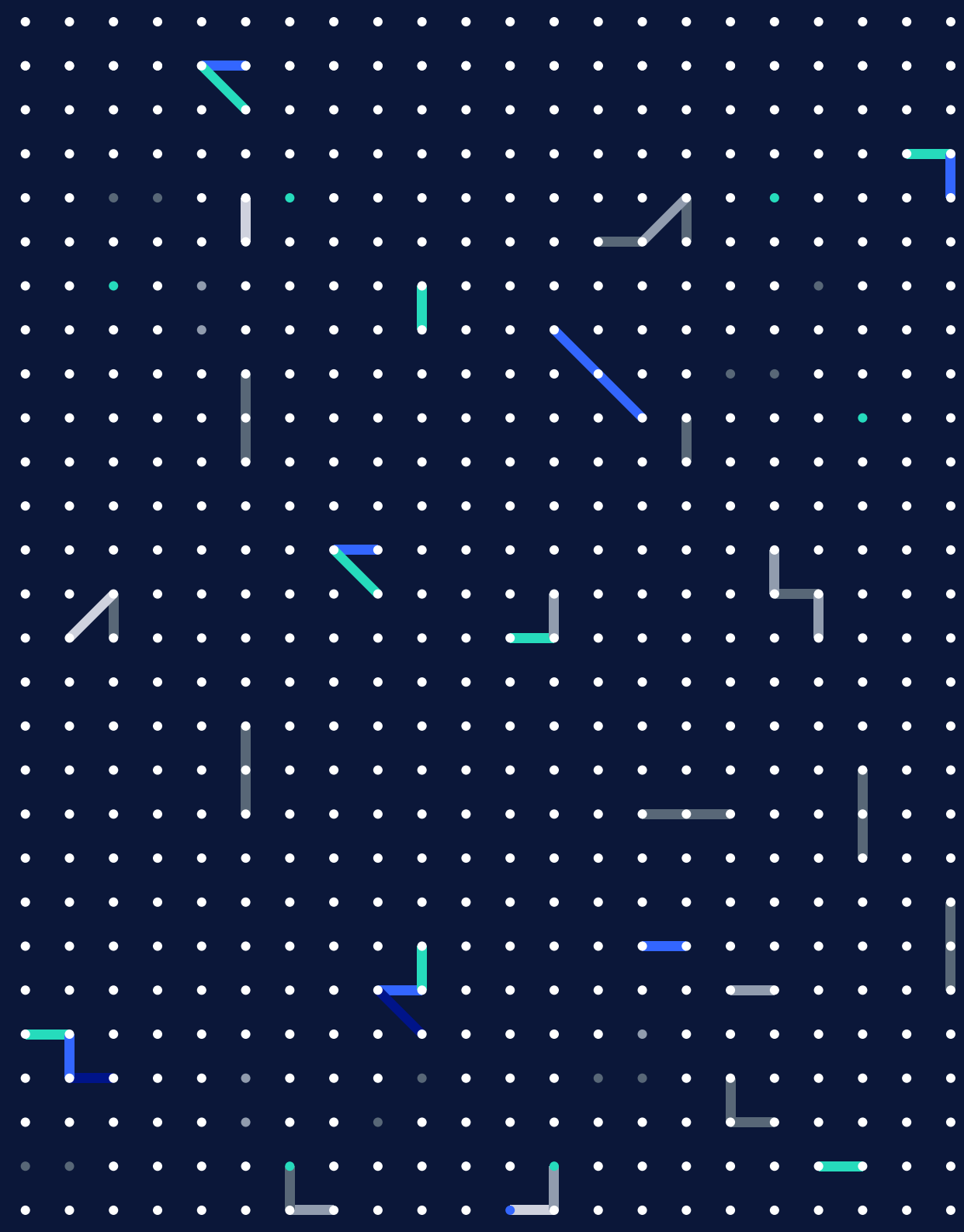
Creme Global is building a partnership with entities such as The Institute for Food Safety and Health (IFSH) https://www.ifsh.iit.edu/ in the USA and Campden BRI https://www.campdenbri.co.uk/ in the UK. Campden BRI has 2,500 member companies in 80 countries and provides practical scientific, technical, regulatory and information support.

In a similar vein, Creme Global uses data analytics and machine learning to model and map the changes in the microbiome to gain the insight needed to understand which particular bacteria are increasing or decreasing product shelf life, and to identify the associated correlating factors that are causing these changes. This insight enables the implementation of process control measures to promote or inhibit such bacteria in an efficient, effective and highly controlled manner.

And again with the gut microbiome, factors that influence the gut microbiome could include the dietary habits of the individual. It has been seen however that an individuals microbiome stabilises in childhood and then is remarkably resilient to remain as this into adulthood. Various elements can have an impact on the overall health, wellbeing and fitness on how foods are processed in the gut as a person consumes nutrition from fortified and biofortified foods, supplements, etc. The impact of consuming contaminated or pathogenic food can be very severe and can cause chronic illness and disease. A key area of research for globally leading research centres such as the Alimentary Pharmabotic Centre (APC) in Ireland http://apc.ucc.ie/ and the Quadram Institue in the UK https://quadram.ac.uk/

In summary, whether the interest is looking at how the microbiome of soil affects the crops growing in it, or the microbiome of a factory floor or piece of equipment affects the likelihood of the presence of pathogens, or the microbiome of a final product affects the shelflife (spoilers) or indeed the health of the consumer (pathogens) - the technology platform, bioinformatics and machine learning is the same. The only thing that change is the metadata.

Creme Global has deep expertise in this process and has developed partnerships with many globally leading research centres and domain expertise. The techniques and expertise have been developed to provide real value to the industry in this space.



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