

EXECUTIVE SUMMARY

The Digital Transformation of the Food Industry

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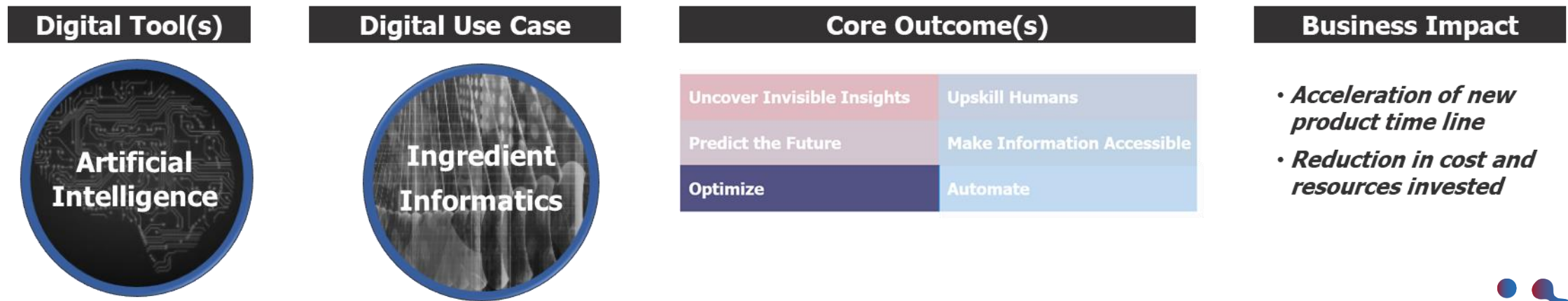
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Executive Summary

This report is based on the digital framework created by Lux, in which we have identified six core outcomes of digital transformation – uncover invisible insights, predict the future, optimize, upskill humans, make information accessible, and automate – and focuses specifically on the application and unique challenges of adoption in the food industry.

We highlight eight use case examples of digital in the food value chain, including ingredient informatics, cold chain monitoring, automated food quality inspection, and food traceability and transparency, and illustrate how to apply the digital framework to achieve successful digital tool use and avoid dangerous (but easy-to-make) pitfalls.

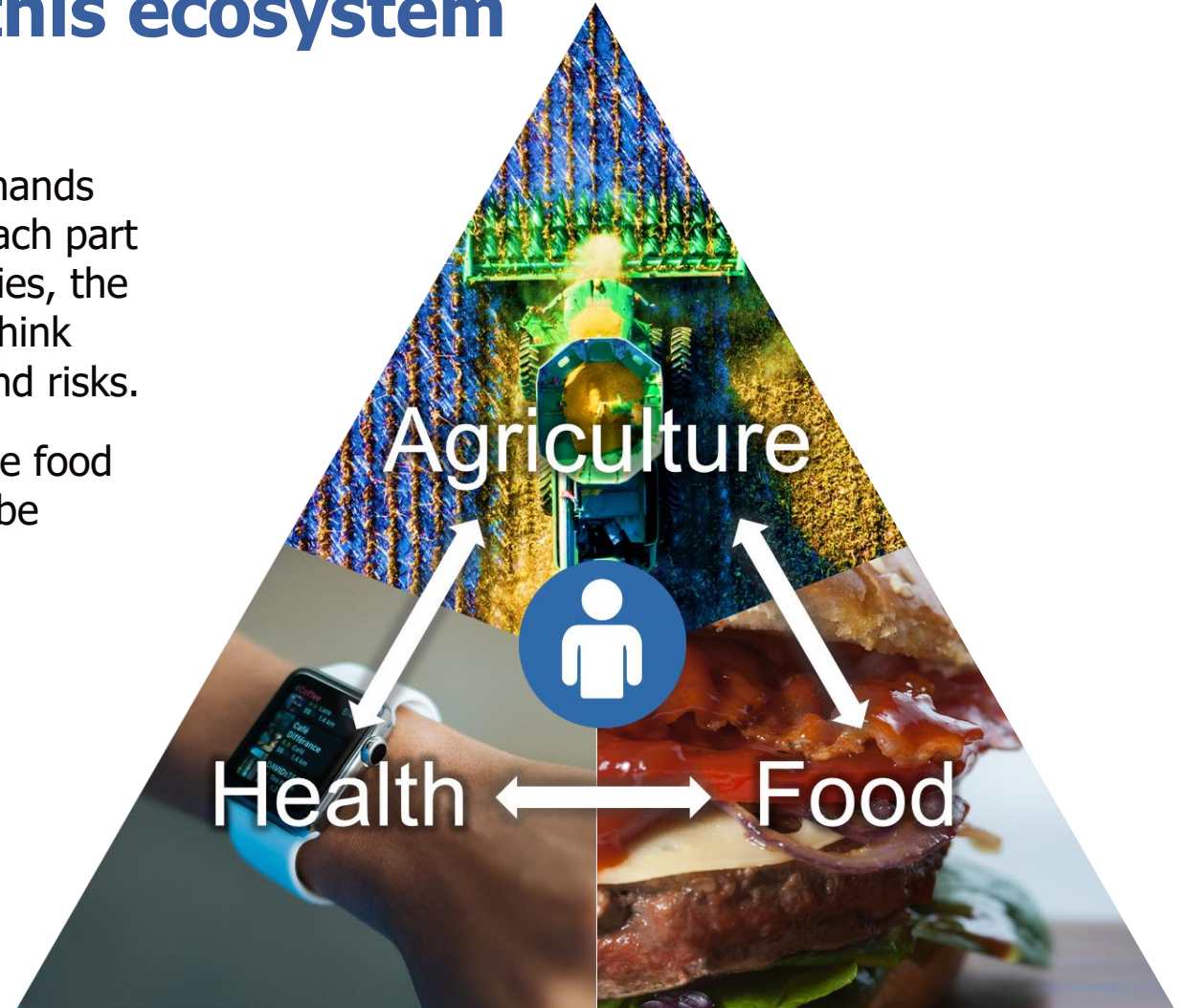
As companies in the food industry are trying to embrace digital transformation, this report is a critical resource to uncover the true potential of digital technologies applied to the right use cases and to assess the near-term and long-term impacts of digitalization in tackling external drivers changing the dynamic food landscape.



Agriculture, food, and health are deeply interconnected, with consumers at the center of this ecosystem

The consumer is in the center because consumers' demands frequently drive changes across the ecosystem – but each part exerts influence on the others. More than other industries, the agrifood and health ecosystem requires companies to think beyond their four walls to identify both opportunities and risks.

As an integral part of the interconnected ecosystem, the food industry is going through a massive change which can be attributed to a number of key external drivers.



Digital transformation of the food system can help address key challenges

Digital technologies will be playing a key role in addressing the present and future challenges faced by the food industry, but implementing them successfully is nontrivial, and finding a suitable business impact is even harder. Although companies in the food industry recognize the impact of digital technologies, compared to some other physical industries, such as aerospace and automotive, the food industry is lagging in embracing digital transformation.

In this report, we address the following important aspects of digitization of the food industry.

- What are some key use cases of digital innovation that are applicable to the food industry?
- How can digital technologies enable core outcomes and add value to a product or process in the food industry?
- How will digital transformation impact the future of the food industry across different parts of the food value chain?



We deconstruct digital transformation into the ways it adds value

Digital transformation adds value across every function of a business by enabling six core outcomes:

Uncover Invisible Insights	Find an insight by analyzing a signal or set of signals that humans can't easily interpret
Predict the Future	Determine the most likely outcome of a future situation – a particular type of invisible insight
Optimize	Find optimal setpoints given a set of constraints – a particular type of invisible insight
Upskill Humans	Grant humans a skill they didn't have before
Make Information Accessible	Make information visible and apparent
Automate	Eliminate or reduce human involvement in a process, task, or decision

These six outcomes represent the building blocks of the universe of goals for digital transformation projects; **any digital transformation technology or implementation will aim to achieve one or more of these outcomes, which build toward specific business impacts.**

The six outcomes are the building blocks of digital transformation

Although we talk about digital transformation as a single concept, it is not a monolithic solution to an industry's problems – **digital transformation is realized through the bit-by-bit application of diverse digital tools to uncover invisible insights, predict the future, optimize, upskill humans, make information accessible, or automate.**

Each application of digital tools forms a use case, which aims to achieve one or a combination of these six core outcomes as building blocks to the business impact of the project.

DIGITAL TOOL(S)



CORE OUTCOMES

Uncover Invisible Insights	Upskill Humans
Predict the Future	Make Information Accessible
Optimize	Automate



BUSINESS IMPACT

We examine eight digital use case examples and map their relevance to the food industry

To illustrate the broad reach and diverse use cases that define the digital transformation of the food industry, we highlight eight examples of digital use cases relevant to the food industry in the full report. We organize these use cases by where the case study fits in the business value chain, with four sections: **planning & design**, **manufacturing**, **operations**, and **customer engagement**.

For each use case, we describe:

1. The meaning of the use case, which core outcomes it achieves, with some examples in the agrifood sector
2. A case study of one example of the use case in the food industry, explaining the technologies used, business impact, and the extent to which it helps address food industry challenges, characterized as high, moderate, or low.

High: A use case without which food industry players can't keep up with changing consumer needs

Moderate: A use case that supports changing consumer needs but isn't a critical element

Low: A use case that is not related to meeting changing consumer needs (even though it's a useful application of digital)

USE CASE	EXAMPLE
<i>Planning & Design</i>	
Design optimization	Ingredient Informatics
Forecasting	Demand forecasting using automated food tracking
<i>Manufacturing</i>	
Process Automation	Automated food quality inspection
Predictive Maintenance	PdM in food manufacturing and processing
<i>Operations</i>	
Asset Monitoring	Cold chain monitoring
End-to-end visibility	Food traceability and transparency
<i>Customer Engagement</i>	
Personalization	Personalized nutrition
	Tracking consumer preferences

DIGITAL USE CASE

Design Optimization

WHAT IT IS

Use of optimization tools in the design stage of a project, achieving feasible designs that maximize performance or minimize cost.

WHAT IT ACHIEVES

Uncover Invisible Insights	Upskill Humans
Predict the Future	Make Information Accessible
Optimize	Automate

EXAMPLES IN THE AGRIFOOD INDUSTRY



[McCormick conceptualized a line of seasonings](#) using IBM's AI platform, drawing from McCormick's wealth of proprietary sensory data as well as consumer preference data.



[Carlsberg recently unveiled "beer fingerprinting,"](#) which incorporates sensor data and artificial intelligence (AI) algorithms to expedite product development, with 30% reduction in time required for new product development (with goals similar to materials informatics).



Mackmyra is looking to [leverage machine learning algorithms](#) together with Microsoft's Azure cloud platform for new product design.

CASE STUDY

Ingredient informatics

WHAT IT IS

The concept of ingredient informatics involves designing novel food ingredients and products, using data, analysis, and artificial intelligence (AI) to reduce costs, improve outcomes, and accelerate development of new food and beverage products.

UNDERLYING DIGITAL TECHNOLOGIES

Ingredient informatics relies most fundamentally on machine learning; for new food ingredient or product development, it combines genomics and evolutionary algorithms for effective data mining and modeling, as in the case of developers like NotCo and Nuritas.

EXAMPLE DEVELOPERS



Business Impact:

- Acceleration of new product time line
- Reduction in cost and resources invested

Extent to which the case study helps address key food industry drivers



Although it is still an emerging space in the food industry with only a handful of players, clients should view ingredient informatics as an efficient strategy to rapidly accelerate the development timeline for new product launches, thus enabling companies to address challenges around changing consumer preferences.

Summary: The use cases of digital transformation in the food industry reveal near- and long-term impact enabled by the digital technologies in tackling key external drivers in the food industry

USE CASE EXAMPLES	CORE OUTCOMES ENABLED BY DIGITAL TRANSFORMATION						EXTENT TO WHICH THE DIGITAL USE CASE ADDRESSES DYNAMIC FOOD INDUSTRY CHALLENGES
	Uncover Invisible Insights	Predict the Future	Optimize	Upskill Humans	Automate	Make Information Accessible	
Planning & Design							
Ingredient Informatics							Moderate
Demand forecasting using automated food tracking							High
Manufacturing							
Automated food quality testing							Low
PdM in food manufacturing and processing							Low
Operations							
Cold chain monitoring							High
Food transparency and traceability							High
Customer Engagement							
Personalized nutrition							Moderate
Tracking consumer preferences							High

10 Note: Use cases involving upskilling humans are not well developed in the food industry today and thus haven't been explored in this report.

The digital transformation of the food industry will impact at multiple points across the food value chain

FOOD PRODUCTION

Driven by changing consumer preferences, a number of ingredient and CPG companies in the food industry will be under even more pressure to revamp their products to resonate better with consumers. This is a [tedious process, especially when approached without a data-driven strategy](#). Incumbents that do not embrace a digitalized product development strategy will fall behind the rest, as more and more vertically integrated companies with digital approaches look to enter the landscape.

Integrating ingredient informatics with synthetic biology and fermentation-based approaches for future food production will be a transformational step in the food industry, and companies should invest now to reap future rewards.

SUPPLY CHAIN

The food industry supply chain will benefit the most from digital transformation both in the near and long term. In the longer run, as the food industry looks to invert production and distribution in the supply chain to become closer to consumers, digital tools like soft robotics and digitally driven applications like last-mile transportation will play an important role.

As the food industry heads toward a more transparent future, a number of industry players will look to adopt “end-to-end” traceability solutions by coupling blockchain with IoT sensors. Digital solutions like [AI-enabled sensors](#), for instance, [IBM's next-generation Crypto Anchor Verifier](#), will play a crucial role in tackling food safety challenges along the supply chain. Stakeholders in the food value chain who do not adopt digital solutions for food safety and transparency will be left behind.

RETAIL

The food retail and e-commerce landscape is rapidly evolving by incorporating more digital platforms, exemplified by recent developments from players like Amazon and Alibaba. Given these omnichannel offerings, digitization of food retail will create an entirely new way for companies to interact with consumers.

Not just restricted to retailers, digital will be an important part of CPGs’ toolset as they look to develop “digital-first” strategies to enter this dynamic food e-commerce landscape.



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