



Restaurants can utilize AI to assist patrons in selecting their meals. Interactive digital menus can provide real-time information about ingredients, nutritional values, and allergen warnings. Additionally, these virtual assistants can entertain or survey customers while they wait for their orders. This approach would free up the waitstaff's time and help marketers gather valuable customer insights.

Photo: IMAGO/NurPhoto

Disruptive omnichannel transformation

How AI is driving efficiency in food product development

The food industry is witnessing a shift as companies increasingly integrate AI technologies into their operations. From enhancing digital marketing to accelerating product development, AI-driven tools offer numerous advantages. Established brands and startups alike are leveraging lifelike virtual avatars to engage consumers and mining vast data to identify emerging taste and flavor trends. As companies explore the potential of AI, the technology is becoming a critical asset in maintaining competitiveness in a dynamic market.

By Henk Hoogenkamp

Food shopping has become increasingly multichannel, with online sales revenues growing rapidly. Both legacy and startup companies are investing in greater digital marketing initiatives, such as using artificial intelligence (AI) and

lifelike virtual avatars that can instantly respond to consumers' questions. AI plays an important role in optimizing food product development, nutritional profiles, and processing efficiency. By mining millions of consumer preference data points, companies can identify emerging trends in taste and flavor, while AI also enables higher ecologically sustainable food system achievements.

Because of AI, technology now allows company executives, marketing, and R&D teams to have their own "digital assistants" who can replace a sizable portion of the daily office workload, such as memo writing, emails, annual reports, presentations, and even partly replace human resources and legal representation.

AI-powered ingredient innovation platforms will dramatically reduce development timelines and costs, as well as enable R&D and

manufacturing teams to gain competitive advantages. Especially (plant) protein and mycelium-based ingredient innovation using biotechnology systems such as precision fermentation and molecular agriculture will benefit from AI-enhanced efficiency and speed-to-market introduction.

AI-driven creation platforms, based on machine-learning-powered (ML) technologies, can swiftly and accurately test hundreds of potential product combinations simultaneously, including organoleptic, nutritive, cost, and sustainability parameters. As such, AI and ML will become invaluable tools for purchasing ingredients, speeding up R&D trajectories, and improving efficiency, as well as consumer marketing, without the usual internal pain points.

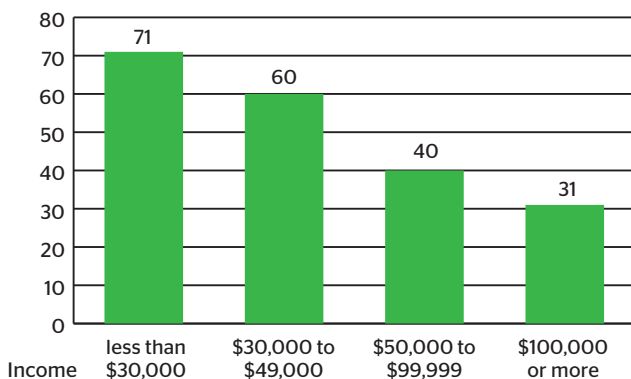
Traditional R&D is mainly driven by trial and error and can be expensive and time-consuming. AI imple-

mentation allows many of the traditional R&D inefficiencies to be sidelined because of its more accurate outcome and optimization predictions. The main advantages of AI are the data-driven decision-making tools, such as algorithms that can analyze data and identify patterns that humans find hard to detect, thus significantly enhancing product quality and consumer satisfaction.

In terms of AI, it can be argued that advances in computer technology have been major drivers of social and economic inequality. AI will go far beyond making low-skilled work obsolete and will especially penetrate and capture the work of high-paid professionals like medical doctors and lawyers. AI should help society instead of hurting it. After all, AI are computer-driven tools that are not consumers and, therefore, do not create income to purchase goods and services.

Disruptive omnichannel transformation

Respondents viewing fast food as a luxury (in percent)



FLEISCHWIRTSCHAFT International 2_2025

Using fast food as an affordable option to stretch your budget is a thing of the past. Nowadays, most U.S. consumers believe it's more likely to strain your finances rather than save money. In other words, fast food has become a luxury.

Source: LendingTree survey of 2,025 U.S. consumers, conducted in April 2024

Inflationary disrupting forces

With more employers embracing hybrid work models, daily dietary eating routines are also changing, particularly "heat-and-eat" breakfast and lunch options, as well as snacking options, leveraging multiple product formats. The Covid scare continues to be a prime example of how quickly society forgets hardship and switches from one extreme to another. In 2025, Americans started to eat out more as the Covid home cooking boom began to fade.

Food brands have adapted their business strategies and branched out of traditional platforms to maintain consumer engagement. Especially during times of inflationary pressure, food prices are crucial to the consumer's overall value experience.

A spike in post-pandemic inflation has created a situation where many Americans can no longer afford fast food menu items like Big Macs. Customer traffic to legacy US fast food restaurants like McDonald's and Burger King has slowed down, especially among lower-income households earning \$45,000 a year or less, causing a significant drop in restaurant visits.

Clearly, there is a limit to how much fast-food companies can raise prices to increase their outlet operating margins. However, the reality is that the cost of food relative to where it has been in the past will likely be higher as ingredient manufacturers and protein supply chains seek to sustain their much-needed margins.

Online and mobile

Prepared ready-to-eat food brands will be able to capitalize on the growing home delivery market by using smart delivery technologies, ranging from apps and autonomous vehicles to robots and drones. To see what the future has in store, consider the two-legged humanoid robots at Amazon warehouses stocking shelves, which are ultimately programmed to work in hotels for guest relations and hospitals for routine patient care.

In a relatively short period of time, digital ordering services have become "a must-have" rather than just "nice to have." It is expected that food delivery services will continue to grow, particularly in non-traditional delivery outlets. For the food service industry, including casual dining restaurants, the challenge is to figure out how to increase revenue without physically expanding the business.

People are ordering more food through apps on their smartphones or by calling in. These app options are changing the conventional restaurant industry as we know it today. Restaurants will need to modify their menus and select ingredients that maintain quality expectations between the time of food preparation and delivery to the home or office. The reason is obvious: food delivered to a restaurant table tastes quite different than when it has been in a box for 60 minutes or longer.

For food consumers, there has never been an easier time to get

what they want and how they want it – delivered quickly at the click of a smartphone app. "Fingertip" orders will be the future of food delivery services in the highly competitive arena. The revolutionary change will first be seen in megacities, where most people live too busy lifestyles and do not want to worry about meal preparation.

Apps and delivery services are not only rapidly transforming consumer attitudes but also providing instant access that attracts tech-savvy consumers of the younger generation, who think outside traditional legacy retailers and restaurants. This younger age segment is looking for more convenience in terms of both speed of delivery and dietary preferences. An example is McDonald's teaming up with UberEats to capture the rapidly developing market for ready-to-eat home delivery.

Grocery e-commerce in the US has one in four people shopping for food online and is forecasted to capture about 10 percent of the

market in 2025. The rapid growth of digital ordering translates to affluent consumers turning more frequently toward food delivery. This shift comes at a time when the US and EU restaurant industries are experiencing flat or declining sales for table service.

Exponential growth

The critical component is the software, including artificial intelligence, which will be the core instrument in disrupting many traditional industries. An illustrative example is Uber, a platform that does not own any cars but is still the biggest "taxi" company in the world. Similarly, AirBnB is now the largest "hotel" company in the world, although they don't own any property. Even AI in legal affairs is becoming exponentially superior, with much higher accuracy than human lawyers.

The same pathway is true for traditional car companies that continue to try the evolutionary approach, while AI allows compa-

Advertisement

niroflex

CHAINMAIL BOLERO

- No unprotected gaps between sleeve/shoulder and body.
- Chainmail versions:
Body – 4.2 or 7.0 chainmail;
with 1 or 2 arm(s) – 4.2 chainmail
- Detectable
- If pointed knives are used,
type 4.2 is highly recommended
- Additional protection for the
upper part of the body
- Good fit and high comfort are
insured by weight distribution
in the neck and shoulder region
- Available in different sizes

Visit us:

IFFA 2025
03. – 08.05.2025
hall 9.0 – C10

Friedrich Münch GmbH + Co KG

In den Waldäckern 10
75417 Mühlacker
Phone: +49 7041 95440
Fax: +49 7041 9544-55
Mail: info@niroflex.de
www.niroflex.de

nies like Google and Tesla to follow the revolutionary approach and build computers on wheels. Typical car insurance policies for future car owners are likely to disappear because, in theory, there won't be accidents caused by computer-driven electric cars.

As with all exponential technologies, it can be expected that the food business model will change, disappear, or become completely modified in the next 10 to 20 years. The road to the 4th Industrial Revolution will bring disruptions in areas such as artificial intelligence, education, 3D printing, and agriculture, including cellular biotechnology and vertical or aeroponic indoor farming. The latter is a soil-less technology using horizontal-layered plant beds, yielding an average of 8 times the crop yield of a conventional farm. Vertical indoor farming uses about 95 percent less water, approximately 50 percent fewer fertilizers, and no herbicides or pesticides.

In countries like urbanized Singapore and the Netherlands, where land commands a premium, a buffer is needed against disruption in the food supply chain. One solution is to allow farmers to develop high-tech systems to improve food security by significantly boosting production levels. Vertical-layered chicken, fish, and vegetable farming not only secures great output productivity gains but also reduces the carbon footprint. However, animal cruelty activists object to these developments and force companies to install systems that allow a natural environment to outgrow animals like chickens. Perhaps making animals live in a high-rise building for the meat and fish supply chain is a bridge too far.

The acquisition game

Some of the largest food and beverage brands seem too slow to innovate and are struggling to sell their products to a new generation of shoppers living in affluent societies. Consumers aged 30 and below are social media savvy and prefer personalized food choices with many gradations of preferences – be it ecologically sustainable, natural, organic, or dietary-modulated.

Sales across the various legacy food brands show a steady downward slide. The sometimes-seismic shift in market dynamics can be



An automated feeding system can significantly reduce the work load of farmers, resulting in greater flexibility in their working hours while increasing accurate herd feeding. Photo: IMAGO/Depositphotos

explained by the new generation of consumers who are actively seeking out unique and authentic brands that meet personal preferences like "green and clean," rather than just responding to classic advertising tactics.

During the pre-social media and pre-Amazon era, it was very difficult and expensive for upstart entrepreneurial food companies to get noticed in the crowded market sphere. For many decades, the legacy consumer-packaged food companies were hardly challenged by competition from upstarts. As a result, the legacy companies did little to innovate simply because consumers were accustomed to seeing the same products on the food store shelf time after time. With little incentive to innovate and the path to innovation being risky, the R&D and brand managers based their priorities on short-term sales and targets to meet the quarterly numbers, if only to secure their fat bonus checks. Subsequently, the mindset of some legacy food brands has always been to spend much effort promoting and selling existing products rather than risking their future bonus checks.

Now, the tide has changed, and legacy food companies are acquiring upstarts because of their own lack of management and R&D vision. Snatching up or taking a financial interest in entrepreneurial-driven food start-ups is now

frequently seen. The main problem that legacy food companies need to solve is how to preserve the uniqueness and authenticity of their newly acquired products. If the legacy brands do not adhere to these basic principles, they will often find themselves right back where they started only a short time later.

Women drive change

When developing a new food product, it is no longer sufficient to understand ordinary demographics like age, gender, and income. Probably apart from sports nutrition, women are driving most of the new food product sales across all categories. Marketers must now be aware of lifestyles, attitudes, and even household compositions of targeted customers. Consumers want food transparency, accountability, sustainability, affordability, and convenience. These desires can sometimes conflict with revenue growth and short-term profitability.

Sustainability and green environmental issues are on the minds of consumers, although the impact is less than what it seems. Perhaps consumers have subconsciously relegated certain environmental issues by blocking certain thoughts from their minds and considering these less important than social factors and personal well-being. When it comes to food, many consumers are rather self-centered and egotistical.

Mass exodus

Sociological, economic, and demographic changes will impact the quality of our lives. The world population will continue to grow at unprecedented levels, of which approximately five billion will be affluent, urban-based consumers. The issues of population growth and possibly global shortages of fresh water and food are overpowered by the number of developed countries and affluent societies confronted by a "greying society" and a declining birth rate.

These demographic trends will influence not only domestic and international policies but also the means to support aging populations with managed healthcare systems and two-tiered food programs: affordable nutrition for people in economically depressed countries and the availability of premium lifestyle foods for those living in affluent societies. Both demographic and socio-economic changes make it difficult for the food industry to predict the long-term behavioral attitudes of its customer base. Childbirth in affluent countries is much lower than in developing countries. Affluent societies serve as a magnet for legal and illegal immigrants in search of a better life. Thus, multicultural communities will continually develop and prompt changes in country-specific food and dietary choices. Mass immigration, like the exodus from war-torn Ukraine,



Self-driving food trucks could be the future of food delivery.

Photo: IMAGO / CFOTO

Syria, Afghanistan, and some African countries, can become the norm rather than the exception, which could destabilize socio-political infrastructures in the host countries.

Nutrition literacy

The food industry has largely been responsible for the creation of hedonistic foods, which combine superior organoleptic properties using sugar, fat, and salt with the sole objective of triggering compulsive eating. These triggers are boosted by a mechanism whereby the dopamine neurotransmitter – a pleasure hormone – is released, causing a behavioral condition that keeps the consumer coming back for more.

It is a rather strange phenomenon that large numbers of consumers are both obese and malnourished. For example, about one in six Americans is food insecure, and many of these people frequently opt for inexpensive food choices that are low in nutritional value. In other words, hunger or malnutrition is not always a shortage of calories but often a shortage of essential nutrients like protein. A long-term diet of excessively calorie-loaded but nutrient-deficient foods, combined with compulsive eating, eventually causes obesity and degenerative diseases. People living on food stamps or receiving "Food Bank" food should be restricted from purchasing or receiving unhealthy foods.

The recession of 2008 impacted many people's ability to deal with basic issues, such as purchasing affordable and nutritious food. One should distinguish between the various interpretations of hunger and malnutrition. There are certainly fewer hungry people in the US and EU than in Africa. It goes without saying that countries truly deficient in food should be supported by affluent countries whenever possible. However, rapidly changing world demographics are also bringing inadequate food availability closer to home for what are considered affluent societies. Empty US supermarket shelves during the peak of the COVID-19 pandemic in 2021 illustrate this point.

The situation of inadequate nutrition is not much different in the EU and the US. They have become examples of modern and affluent societies with a huge number of entitlements. Once people get used to food and other entitlements, it is difficult to untangle the political landscape and make freebies a thing of the past. For example, in the US, food insecurity increased with more than 17 million households lacking adequate nutrition in 2022, up from 13.5 million the year prior. For households living below the poverty line, it is an increasing struggle to purchase fresh foods at affordable prices.

Changing habits

Eating and diet habits change over time due to evolving cultural and socio-economic factors. For example, the dogmatic attitude of some American fast-food companies to sell 100 percent pure beef hamburger-

ers to the masses will ultimately be unsustainable. For varied reasons, consumers living in developing countries or economically depressed regions have not only demanded change but also forced food companies to loosen their formulaic guidelines and adapt to local and regional flavors. In the future, food service will be largely unrecognizable compared to its current business model. Product innovations, new flavor preferences, and continuing demands for affordability, healthy choices, and made-to-order 24/7 conveniences will drive these changes.

Plant-based meat and hybrid meat blends made into burgers or chicken patties are good ways to increase sustainability and affordability. From an environmental perspective, replacing a portion of the meat with plant protein ingredients will significantly reduce carbon emissions. Food products made from blends of plant and meat can be positioned as hybrid products that will interest flexitarians, who do not reject meat but are moving toward a positive "feel good eating" experience. The food service industry has come to realize that "health" does not necessarily sell – at least for now. Many fast-food customers do not want to know what is in their food but just want to enjoy it without the burden of guilt.

Food service may be a leader in setting culinary trends, but its nutritional correctness often lags retail. This is largely due to the absence of nutritional labeling on food service products, supported by the mindset of many consumers who seem to have a double standard when it comes to purchasing

— Advertisement

NO SMOKE WITHOUT FIRE SMOKY INGREDIENTS FOR HEARTY FLAVORS

Smoking as a method to enhance the flavor of food is equally popular among chefs and consumers. Rely on our smoke solutions to achieve the best results. With our expertise in developing flavors and smoked foods, we offer you a diverse range and outstanding taste with great flexibility.

When it comes to EU regulations, our regulatory know-how ensures that you are always on the safe side.

Visit us at IFFA from May 3rd to May 8th, 2025, in Frankfurt, Hall 11.1, Booth C68.

www.thgeyer.com

TH.GEYER
SUPPLYING YOUR IDEAS



food at a grocery store versus eating out. Fast food customers say they want to eat healthily, but when decision time comes, they often end up choosing food that does not align with their initial intentions.

The success of virtually any food product is driven by three main components: taste, taste, and taste. Everything else takes second place. There are endless opportunities for creating new and exciting foods and beverages, but the secret to their ultimate success is great taste. It is a no-brainer that great taste is the equivalent of great repeat business. It is as simple as that!

Demographic changes

Demographic changes are influencing food trends but in different ways around the world. In developed countries and affluent societies, there is an aging population that is more health-conscious, with more discretionary money to spend. At the same time, segments of society are trapped at either end of the economic spectrum – the age of both prosperity and austerity. These separate segments will drive out average-price quality and force food marketers to position foods at either end of the spectrum. Special "Dollar Menus" are perfect examples to illustrate this. These "low-end foods" increase much-needed traffic for supermarkets and restaurants to maintain business and retain important demographic segments.

Consumers are increasingly prioritizing health, which will carry over into the ready-meal sector, where customization will become of major importance for time-pressed people. Traditional sit-down family meals are disappearing. Instead, people often eat "ready meals" solo without the pleasures of relaxation and dinner table conversation. The availability of ready-to-eat or grab-and-go meals, as well as a well-stocked refrigerator with "heat & eat" food choices, has created a society wherein consumers expect instant fulfillment while the smartphone or tablet is always within reach.

Women in the workforce

Higher education will gather speed, with more women becoming the primary breadwinners. As a result, the purchasing power of women in affluent societies has never been greater, and the choices have never

been harder. This is especially true for women who prefer to take on the traditional role of childcare.

In 2025, about 65 percent of US working-age women will be employed. This number is low compared to most other affluent societies like Canada, Australia, Sweden, and Germany. In the US, women falling out of the workforce generally reduce the economic status of a family.

Part of the reason why fewer women contribute to boosting the national economy and family income is the high cost of childcare. Childcare in the US eats up a disproportionate part of the income, as infant care is oftentimes more expensive than college tuition. To increase women's participation in the workforce, it is imperative for mothers to receive government-mandated paid maternity leave, as well as equal access to preschool care.

The looming anthropological question is how gender will affect society. It is safe to say that life in the current modern global economy might be more stressful for women who are working long hours while being responsible for the "traditional" role of caring for their children. These developments will greatly impact their relationship to food, convenience adjustments in the speed of food preparation, and ease of instant availability for busy working women with no time to prepare homemade meals the way their mothers did. Single parents who are busy balancing lifestyles with small children might have different priorities and adapt to an "eat-as-you-please" lifestyle.

Snacks replace meals

No one is the same. Thus, dietary advice should not apply universally to all individuals. Responses to food, exercise, and medicine differ from person to person, largely depending on genetics and lifestyle.

Diet, lifestyle, genetics, and work-related calorie expenditure all play important roles in the lifestyle puzzle. Over the last 50 years, physically active work has decreased significantly in both affluent and developed countries. In 1960, one out of two Americans had a job that was physically active. Fast forward to 2025, and only one in eight jobs can be considered physically active. Subsequently, it can be concluded that the type of work and

its environment are partly to blame for the obesity epidemic.

Eating weird is the new normal. Specifically, students do not eat meals but rather snack at very strange hours of the day. "Eating what we want, when we want" is the new mantra of the younger generation. Traditional eating hours with three meals a day have increasingly become a thing of the past and may eventually become extinct. Single diners and on-the-go young parents and their kids increasingly view better-for-you snacks as meal replacements.

Increased communication via social media has changed the way people relate to food. For a large part, social media will also replace traditional parent-child interactions in cooking skills and planning meals. It is expected that "digital food" will carve out a greater role in planning meals as a partial replacement for visual and rational decision-making. This can ultimately grow into an emotional connection with digital food that influences actual purchases and enjoyment of eating.

Basic food sales on the center shelves of the grocery store are facing stagnant growth with time-impaired consumers turning to snacks and ready-to-eat foods instead of home-cooked meals. Although there are many cultural differences in meal composition throughout the world when compared to globally branded sweet or savory snacks, eating habits are much more similar among countries than meal preferences.

A new health definition

Consumers are impressed by the term "free-from" – something they consider healthier than foods without those claims. The same is true for the growing availability of natural and organic foods. Less processed and close to nature in a setting of natural formulations is the new mantra for people who take food seriously. Along with all these subtle changes in consumer behavior, it seems that there is much less emphasis on the fat content of foods. As a matter of fact, it is expected that global dietary fat intake will account for about 30 percent of calorie intake by 2030, up from 25 percent in 2015. It is hard to believe, but the "low-fat" craze has lost momentum. Even the phobia of animal fats shows signs

of weakening. All these changes indicate that a rethinking of nutritional guidelines is needed to reflect a new reality.

Going forward, education will be more technology-driven through online learning, effectively reducing or even eliminating mid-level colleges and universities. It is also noteworthy that skilled labor, like electricians, is becoming more valuable than a college degree. Regarding healthcare, robotics will replace much of the frontline diagnostics done by medical doctors. A relative decline in income can already be seen for college-educated people, with most incomes stagnating since 2000. The bottom line is that sustained growth cannot be harmonized with declining middle-class income. To put it differently, a minority of the college-degreed workforce cannot uphold a healthy economy.

Highly developed countries like Germany and Japan are sitting on a ticking demographic time bomb where the aging Baby Boomer population begins to drag down economic growth. A possible answer to avoid economic decline is to implement the use of robots that can replace activities requiring labor. The overriding question in such a scenario is how far robotics will eliminate jobs in outsourced manufacturing in developing countries.

Automation and robotics are here to stay and will make life a lot easier. On the other hand, robots are not consumers. Moreover, the pressure on the middle class to spend available income will dramatically change the landscape of long-term earning potential. As such, people will have to face new realities, knowing that change is happening at a faster speed than they will emotionally and psychologically admit or be able to accept as the new reality.



Henk Hoogenkamp
works as an author and
Protein Application Specialist.

Contact
Hoogenkamp1@gmail.com