

The Role of Disruptive Technologies in Health and Sustainability

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Abstract: The Fourth Industrial Revolution has brought about significant change in the way the world operates and industries perform. These so-called “disruptive technologies” have fundamentally altered the digital landscape and can pave the way forward for new innovations. The rise of technologies such as cloud computing, the Internet of Things, artificial intelligence, and blockchain has the potential to revolutionize the functioning of every single industry known to man and promote sustainable and healthy practices worldwide. One of the potential industries that these technologies can have a significant impact upon is the food and agriculture industry. Now more than ever people are more conscious of what they put on their table. Ensuring that everyone has access to safe and high quality nutrition is the goal of many companies and governments. This paper focuses on the implications that these technologies can have on the food and agriculture industry.

CURRENT CHALLENGES OF THE FOOD AND AGRICULTURE INDUSTRY

The food sector faces several key challenges that some of these new disruptive technologies can address namely the issue of food safety, food loss, and food waste. Loss happens in the supply chain through improper management of the produce. Additionally, as a result of the COVID-19 crisis many farmers are losing food due to lack of logistical support and transportation. Therefore, all of their produce is just sitting in their farms and perishes as they are not able to sell them. Even without the current crisis, there are still other logistical challenges that the food and agriculture sector faces such as delays in transportation or a lack of temperature and humidity control. Consequently, bad logistical support can cause perfectly healthy produce to go bad by the time it gets to the consumer’s table, thereby resulting in the loss of food. From a sustainability perspective, loss of food is detrimental as it takes emissions of greenhouse gases in order to produce and transport the food. Preventing food loss ensures that there is no wastage of energy and emissions so that all resources are used effectively. In addition to the environmental aspect of sustainability, there is also an economic aspect. Those who can afford to lose and/or waste food are those who are more financially secure and of a higher socioeconomic status. By losing food, that food is being taken away from those who cannot afford it and further exacerbating the inequality between the rich and the poor in terms of food eaten. Finally there is the social perspective as it relates to health. Higher quality nutrition is key to a healthy lifestyle. By wasting food, others are placed at a social disadvantage which can worsen health outcomes. Food plays an important aspect in the social

determinants of health framework that many governments have adopted in order to improve health outcomes. Currently, food is lost through the supply chain as there is not sufficient transportation, logistics, or storage facilities. These problems are especially exacerbated during the current crisis. The producer may be producing high quality produce but by the time the produce reaches the retailers, the food may be bad as the people involved in the supply chain may not take care of produce as well as the producer. Studies show that producers want to supply high-quality produce but their job is done after producing the product as they are not concerned about and not responsible for the logistical or retail aspect of it. Retailers themselves have to maintain a high standard of quality so that consumers will buy from them. They may use various chemicals and techniques to maintain the produce’s appearance; but when a consumer purchases it, there is no guarantee that the food is what it claims to be. For example, the food could claim to be non-GMO/GMO free or organic. It may also have been claimed to be produced in a certain environment. Some of it may be true, but that does not mean the food is fresh and not spoiled or contaminated by the time it reaches the hands of the consumer.

Technological Applications

It is in this capacity that there is a role for new technologies and computational systems. For example, using available technologies a QR code can be assigned to a specific item. The consumer can look at QR code of produce and by scanning that they can see the entire path of the product. For example they can see where it came from, how long it has traveled, the conditions in which it travelled, whether or not it was produced organically and maybe even some videos documenting its journey.

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All this information can be stored in the cloud and the Internet of Things can be used to collect all of these various data points and store it on a blockchain-based ledger technology. Industries can do data analytics using cloud computing platforms to understand consumer preferences and judge producer capabilities. Retailers can monitor customer preferences and make sure they are always stocked with those items. In fact, these processes can be automated through the IoT. With the food that consumers want being automatically stored and stocked there can be huge reductions in food waste and loss as retailers will be able to specifically cater to customer needs and not have excess produce.¹ At the end of the day, Traceability provides transparency. It results in supply chain optimization, a reduction in food loss, an increase in revenue, and the verification of sourcing claims.

Everyone in the industry is well-intentioned. However, the transportation company may be lacking in the scientific aspects of food transportation (ie temperature, humidity, and other environmental factors). Retailers may pay attention to some of these factors and might not to others. In order to ensure that the produce is of the highest quality and ensure minimal food loss, all of this management needs to be coordinated. For example, if the temperature and humidity are tracked during transportation then the farmer and retailer will know and can alert the transportation company to fix any issues that may arise. This system allows for minimization of supply-side losses. Many people all over the world die or get sick because of food poisoning or lack of priority being placed on food safety. This kind of technological based surveillance and monitoring can go a long way to promote the health of people. Additionally, food safety is important to preventing pandemics. Outbreaks of swine flu and avian flu occur because of improperly prepared meat and a lack of safety. The coronavirus also highlights the importance of food safety as many people believe that it originated due to contaminated produce in a market in Wuhan. Various companies and startups are already experimenting with and practically implementing many of these technologies by many companies and various startups. Nestle has come up with a collaboration with AWS to monitor the coffee bean that they produce to keep track of the laborers who are involved in it and the quality of the coffee beans. IBM has developed its IBM Food Trust where it engages with food and agriculture firms on a blockchain-based traceability system. It has

¹ Nagarajan S. (2020). Nagarajan S. (2020, June 2). *Revolution of Food Supply Chain with IoT*. Infosys. <https://www.infosys.com/insights/iot/revolutionizing-the-food-supply-chain-with-iot.html>.

partnered with companies such as Dole, Driscoll's, Golden State Foods, Kroger, McCormick and Company, McLane Company, Nestle, Tyson Foods, Unilever N.V. and Wal-Mart². These are some big name companies that are involved in various aspects of the supply chain. A company in Vietnam and a partner of the Food and Agriculture Organization of the United Nations, TE-FOOD, developed a blockchain-based farm-to-table solution that tracks 10,000 pigs daily³.

Product and Process Standards:

Standardization of Standards

Along with tracking and monitoring the product along the supply chain to ensure quality, there are other standards that products generally need to conform to ensure quality namely product and process standards. Product standards refer to the quality of the product itself. For example, a shirt product standard would involve the feel and comfort of the shirt and whether or not it has the materials it claims to have. On the other hand, process standards refer to how an item was made. Consumers want to know whether their produce was produced along with or contaminated by other foods. Vegetarians and vegans want to know if their food was contaminated by meats or other animal products. Those with peanut and other nut allergies need to ensure that the food they are eating was not produced in an environment with those allergens. Muslims and Jews need to ensure that their food is halal and kosher, respectively. Being able to track production allows the consumer to have all of this information at their fingertips. Storing this information on a blockchain-based ledger ensures transparency and allows individuals to be able to securely and safely practice their religious beliefs⁴. Additionally, monitoring can be used to ensure the ethical treatment of workers and that products are

² World Economic Forum. (2019). *Innovation with a Purpose : Improving Traceability in Food Value Chains through Technology Innovation*. System Initiative on Shaping the Future of Food. http://www3.weforum.org/docs/WEF_Traceability_in_food_value_chains_Digital.pdf.

³ Lin, C-F., & Liu, H-W. (2018). *Disruptive Technologies and Sustainable Development: Implications for Southeast Asia*. International Centre for Trade and Sustainable Development (ICTSD). <https://www.ictsd.org/themes/development-and-ldcs/research/disruptive-technologies-and-sustainable-development>.

⁴ Chandra G.R., Liaqat I.A., and Sharma B. (2019). *Blockchain Redefining: The Halal Food Sector*. *Amity International Conference on Artificial Intelligence (AICAI)*, Dubai, United Arab Emirates, pp. 349-354, doi: 10.1109/AICAI.2019.8701321.

not produced in sweatshops. Currently, there are inspector institutions who implement various process standards and they generally do a good job of enforcing quality standards. However, it is still extremely difficult to implement standards every time due to the sheer volume of industries involved. For example, a factory can “cheat” their way through an inspection if they know it is going to occur beforehand. Industries that employ child labor or have lax labor standards in general can just be more careful during times of inspection but then go back to using these forbidden practices at other times. Standardization agencies can only go so far to help solve these issues. Their role can be easier and more scientific with some of these new technologies that can be used to track the entire supply chain. If there is a device that is constantly tracking and monitoring what is happening in this factory then high standards have to be constantly enforced and not just simply during times of inspection. Process standards are incredibly important for sustainability. Conscientious people will want to know how the goods they are consuming are produced. The Alta Garcia Apparel company’s claim to fame is that it produces its products in sweatshop free environments. Consumers then buy their apparel for this reason. However, rather than relying on a company guarantee consumers can instead rely on the data embedded into the QR code for the product. If consumers are able to keep track of what is happening through the supply chain such as labor, then they will be more empowered and well-informed and can make a data-backed choice. A consumer can know that the produce in their hands is organic by looking at the entire supply chain rather than having to have a third-party guarantee. They can be confident in their decision-making. Consumers will be empowered so more and more people can follow these sustainability friendly consumption patterns, thereby promoting sustainability and health at a larger scale. Consumers already make these choices in the textile industry today.

CONCLUSION

To conclude, these disruptive technologies can play an important role in ensuring healthy and sustainable practices especially when it comes to ensuring food safety and preventing food loss, and food waste. These technologies can be used to implement and enforce product and process standards in a variety of industries. Governments can incentivize companies to adopt these technologies and conduct analytics with regards to behaviors of consumers in order to promote health and sustainability. These technologies can be incorporated into the current system to foster better practices that lead to a better-fed world.

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