I. INTRODUCTION

1.1. Background

Technology and knowledge are exponentially evolving. A real example of the results of the development of science and technology is Big Data. Big Data is a collection of data that is very large and complex. Research and case studies regarding the use of Big Data in various fields have been widely published, such as its application in the automotive field (Kuo & Kusiak, 2019; Pero et al., 2010; Yu & Yang, 2016), beverages (Irfan & Wang, 2019; Jagtap & Duong, 2019; Schemmann et al., 2016; Singh-Ackbarali & Maharaj, 2014), education (Salicrú & Civit, 2014), electronic (Amato et al., 2019; Archak et al., 2011; Elghannam et al., 2019; Xing et al., 2010; Zhan et al., 2018), and marketplace (Eldesouky et al., 2015; Grover et al., 2018; Jin et al., 2016; Kwong et al., 2009). Besides, Big Data has been discussed in various fields for the product development process (Choi et al., 2020; Jin et al., 2016; Li & Wang, 2017; Pero et al., 2010; Redzepovic & Peristeris, 2015; Salicrú & Civit, 2014; Sun & Liu, 2021; Yu & Yang, 2016), product design determination (Grover et al., 2018; Ma & Kim, 2014; Srinivasan et al., 2012), customer needs and behavior prediction, or even trend prediction (Kumar et al., 2020; Kuo & Kusiak, 2019; Nikolay et al., 2011). Big Data Analytics is still a trending topic because there are so many studies about Big Data Analytics that have been published in 2011-2021. As an illustration, when searching using the keyword "Big Data Analytics", there are 371.000 articles found via Google Scholar on June 1, 2021 at 21:26 (WIB).

Big Data is a massive volume of accessible, scalable, and accurate data of various types (structured to unstructured) that can be used for many benefits (Almeida, 2017). Big Data has been used nowadays to replace empirical data, particularly that cannot be obtained due to pandemic situations. In addition to saving costs, the information presented can be obtained more widely and varied. As mentioned previously, review articles on the use of Big Data in some fields have been widely published. However, to the best of my knowledge, there is no review yet on the

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applications of Big Data Analytics for the new food product development process in the food industry.

The growth of new companies as competitors will increase from time to time. Every company will try to produce products that are superior to its competitors. Product innovation is carried out by a company in order to produce creative products that are more in demand by consumers. A well-produced new product can be an injection of new growth for a company that existing products cannot do (Hallstedt et al., 2020). Hence, new product development plays an important role in the company's future because new products are the key to the industry's sustainability and development. Therefore, this study will review the application of Big Data Analytics for the new food product development process. This review can be used as a portrayal of how the food industries should implement Big Data Analytics in the process of developing new food products.

1.2. Theoretical Overview

1.2.1. New Food Product Development

Product development is the key to the sustainability of an industry. The development or innovation of a new product is responsible for the future of the company. A new food product is either a product that has never been manufactured or distributed by the company or a product that has been established but introduced into a new market target/ function/ package/ size/ form/ label by the company (Fuller, 2016).

New food products have some different characteristic descriptions that are classified in Table 1.

Table 1. Types of New Food Products (Fuller, 2016)

Types of new food products	Description and examples
Line extensions	Extensions of an established line of product in the

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	form of variants. For example, new flavors for wine or potato chips or bread-crumb coating.
Repositioned existing product	Repositions of an established product into new markets. For example, products containing oatmeal positioned as products that can help lower cholesterol, products containing soy positioned as products that can help to combat cancer, and soft drinks are positioned as a companion to the main meal.
New form or size of existing product	Modifies an established product into a new form to add its convenience or even its value. For example, pre-peeled or sectioned oranges or grapefruit, changes of margarine or butter that can be spreadable at the room to refrigerator temperatures, instant teas, and coffees with flavor.
Reformulation of existing product	Improvement/ reformulation of an established product to improve characteristics of the product, replace unavailable materials with remain price of materials, improve production process with higher quality product and lower cost, cheaper selling price to compete with competitors, increase the safety of all ingredients that are used, create a new market in the form of lower sodium content, fewer calories, more fiber, and others. For example, low sodium (reduced sodium), lower-calorie (reduced fat/ sugar), and high-fiber products, lactose-free (non-lactose content) milk products, greener products, and organic products.
Repackaging of existing product	Changes the packaging of an established product into smaller and more convenient packages. For example, yogurt with single-serving size, snack food with

	pillow packs size, products with the packaging of squeeze bottles to a thin container.
Innovative products	Inventions of unique products from ideas integration. For example, frozen dinners such as frozen vegetables and pastry, dinner kit that consists of dry spaghetti pasta, sauce spices, can of tomato sauce, and grated cheese.
Creative products	Create a new product that is rare and has never been on market. For example, discovered extruded products, reformed meat products, surimi, and products contained short-chain fatty acid.

According to Rini (2013), product development is a new product innovation and new technology modification to the product as a form of marketing strategy. Product development can also mean a process of finding ideas to modify some of the characteristics of an existing product or product modification with the improvement in terms of characteristics, quality, and style to increase sales (Rini, 2013). The goals of product development are to increase sales, fulfillment of goods and better new businesses need to be done to improve existing businesses and also carry out various research, engineering, and product design activities (Rini, 2013). The development process aims to create a product that the market wants with the highest probability of success and the lowest uncertainty factor (Fuller, 2016).

Product innovation always adapts to the product characteristics that customers want but also involves company objectives to be suitable and effective for both parties. In the product development process, the product's characteristics that the customer demanded will be turned into product design parameters that can be measured and can determine the quality of the product (Grujić & Grujić, 2012). New food product development must be designed to meet consumer demands and sensory characteristics, use seasonal and local

ingredients, need to be safely manufactured and traceable from raw materials to the final food products, ensure manufactured at a large scale, and minimize the environmental impact (Azanedo et al., 2020).

New product development stages consist of identifying customer demands, developing product concepts, developing design, testing, and commercialization (Kazimierska & Grębosz-Krawczyk, 2017). According to Kotler (2000), the new product development process involves 8 stages, namely finding ideas by identifying products and markets, selecting good ideas, developing and testing product concepts, developing marketing strategies, analyzing business by evaluating forecasts or initial sales and products, development products by making products physically, market testing to study market acceptance and consumer reactions, as well as commercialization to better introduce products to the market openly. Determining the timing of product launches, geographic strategies, and marketing strategies also need to be considered when launching a new product (Kotler, 2000). On the contrary, based on Schroeder (2000), the product development process model based on the operational side includes concept development, product design, initial process design, product production testing, and final process design.

According to Fuller (2016), product development is a process from product ideas to product concepts with clear characteristics requirements, market testing, and final evaluation. Company goals are the starting point of new product development then followed by identification of how to get the goals. After the plan of management's goals is clear, consumer needs can be identified through market research by the marketing department. Ideas then were selected based on the most can be developed successfully using three screening criteria (feasibility of idea within the requested time frame and available skills, suitability of idea to customer needs, and management goals of financial aspect). Benchtop prototypes then were developed to match the

product statement using research information by the research and development department. Examples of benchtop prototype developments are making standard ingredients, process, equipment, packaging, and reformulation. Afterward, production can be done followed by consumer trials, then test market or even directly to be launched regionally. Finally, the launching and competition in the market needed to be evaluated.

A successful new product will also adjust the expenses and this process needs talented workers, comprehensive investigation, convenient facilities, and funds (Fuller, 2016). Fundamentals of successful product development need effective collaboration between some areas such as R&D, production, marketing, and other departments in each of the product development stages (Kazimierska & Grębosz-Krawczyk, 2017). Management must know the allocated of money that will have the best benefit, the marketing department will prioritize products that are suitable with what the customer wants and consider the sales to smaller the risk, the finance department will direct investment in the product development or market expansion that contribute better profit, manufacture department will accentuate effective production of products such as better facilities, lower cost, lower energy cost, smaller emissions/ carbon footprint, and more profit for the company (Fuller, 2016).

Product innovation is the key to a food company that involves many departments in the process of the long steps. Apart from being based on good quality, these innovations must be based on the needs and desires of target consumers. Competitive strategies such as shortening product preparation time, reducing innovation costs must be developed to anticipate market changes and be successful in facing market competition. Knowledge information is the basis of all decisions made. Of course, the results of science and technology development like Big Data must be very useful for more effective processes and better profits.

1.2.2. Big Data Analytics

Big Data is a large and complex unit of data science and information technology. Volume, variety, and velocity are the three primary characteristics of Big Data and are commonly referred to as 3 V of Big Data (Piramuthu & Zhou, 2016). Variety indicates data types, ranging from structured data, semi-structured data (XML, RSS), and unstructured data (video, text, images, audio, geospatial) (Piramuthu & Zhou, 2016). Velocity indicates the frequency of data generation and data transmission speed, while volume indicates large amounts of data storage (Piramuthu & Zhou, 2016). The faster data dissemination speed and more types of data variations (semi-structured and unstructured) are examples of the advantages of Big Data over traditional data sources (Su, 2014). Examples of Big Data sources are web data (based on reviews, number of visitors, searchers, readers, buyers), text data (based on email, news, Facebook, documents, etc), location and time data (based on GPS from electronic devices, Wi-Fi connection), social network data (based on online applications such as Facebook, LinkedIn, Instagram) (Su, 2014).

According to Gartner Glossary (2021), Big Data is an information asset of high volume, speed, and variety that demands cost-effective and innovative forms of information processing and can be utilized for insight enhancement, decision making, and process automation. The core use of Big Data is to increase insights, help make decisions based on the insights gained, and automate the process of decisions taken. Also, Big Data can be applied to improve product/service quality, improve relationships with consumers, streamline decision making, reduce costs (Piramuthu & Zhou, 2016); predicting behavior and knowing consumer segmentation, predicting consumer loyalty to maintain it, knowing how to market and its recommendation system, analyzing consumer sentiment, analyzing the operation process (Su, 2014).

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Despite its various benefits and advantages, analysis using Big Data still has weaknesses. Due to the amount of raw data accumulated, data acquisition is the primary weakness in Big Data analysis (Labrinidis & Jagadish, 2012). There is a lot of unsuitable data in Big Data, so a filter with good settings is needed while analyzing Big Data so that beneficial data is not missed. The next most significant challenge is the struggle of observing structured information that describes the recorded data, its origin, and measurement. The data that has been gathered is not in a ready-to-analysis form. Data extraction is required to collect the necessary information in a structured form and can be examined. Because of the huge volume and a wide variety of data types, Big Data analysis requires specialized skills and suitable tools.

1.3. Research Questions

The research questions that can be identified are:

- What techniques and types of Big Data Analytics are used in the new food product development process?
- How is the application of Big Data in the new food product development process?

1.4. Objectives

This study aims to review the application of Big Data Analytics for new food product development processes covering the implementation, techniques, and types of Big Data Analytics used in new food product development processes.