Proceedings of the 5th NA International Conference on Industrial Engineering and Operations Management

Detroit, Michigan, USA, August 10 - 14, 2020

A Proposed Model for Food Manufacturing in SMEs : Facing Industry 5.0

Wara Widyarini Endah Saptaningtyas

Agency of Industrial Research and Standardization Samarinda,

Ministry of Industry Republic of Indonesia

Samarinda, Indonesia

wara.widyarini@gmail.com

Deasy Kartika Rahayu

Industrial Engineering, Faculty of Engineering, Mulawarman University

Samarinda, Indonesia

deasykartika@ft.unmul.ac.id

Abstract

The world-facing an agile environment and causing disruptive at industrial strategies, from product innovation, process production until product delivery. Prior, industry 4.0 is quite challenging for the food manufacturing industry in a small and medium enterprise (SME) to be adopted in their system. And nowadays, industry 5.0 introduced on a large scale. Moreover, there is a concept of society 5.0 which is adopted by the customers and influences the strategic implementation in industries. Food manufacturing SMEs need guidance to survive in a competitive environment. This paper presents a modified model that emerged from several approaches such as business engineering, industry 4.0, and society 5.0 for SMEs food manufacturing especially in product innovation based on the changing of an industrial environment. For conclusions, it offers the process product innovation model for facing industry 5.0 in food manufacturing SME industries.

Keywords

Business Process Reengineering, Industry 5.0, Society 5.0, Agile Strategy

1. Introduction

Food and beverage small and medium enterprises (SMEs) have a major role in global economic activity. It has a sure growth year by year almost in every country in the world. The customer's needs will be an increase from time to time in quantity and diversity. Customer satisfaction in the food industry focusses on the availability, distribution, and quality of the product (Wedowati, et al., 2014). To fulfilling customer needs, food manufacturing launching new and innovative food products. To design a successful new food product developed organizations must be oriented to

consumer needs (Horvat, et al. 2019). The constantly changing consumer needs made food manufacturing SMEs have a good food product innovation to stay running. Food product innovation not only considers the customer needs, but also the volatility, uncertainty, complexity, and ambiguity environment so the innovation products could adapt to the rapid and unpredictable change. The successful organization largely depends on innovation strategy on the competitive market. The innovation strategy should be planned in detail and in line with the organization strategy through a general framework (Szwacka-mokrzycka, 2010).

The disruption environment in the food market is the effects of the implementation of information technology, global warming, food sustainability, supply chain, and government regulation. Industry 4.0 approach openly offers to increase the effective and efficient business process in food manufacturing. The food manufacturing SMEs as the main player food industry hardly to imply Industry 4.0 because of the lack of resources own by food manufacturing SMEs. Industry 4.0 at some point needed resourceful skill and complex network to apply in the daily business process while with limited resources SMEs almost could not apply this approach. According to (Ostergaard, 2017), the next Industrial Revolution will be necessary according to the consumer's high-demand for individualization in the products that they will be buying

The Japan government initiation Society 5.0 to accommodate communication between the customers, and industry. Society 5.0 could be more approachable for SMEs, it offers a new supply chain in bonding with the digital transaction. Both Industry 4.0 and Society 5.0 is a big change to adopt by the food manufacturing SMEs. This situation needs transformation in a business process in food manufacturing SMEs. (Török, et al., 2019) find that R&D in the food industry has a very low budget. Meanwhile, (Mittal *et al.*, 2017) said that manufacturers should embrace newer strategies to gain competitiveness among other manufacturers across the globe. Adopting a new strategy could be changing the business process. The business process reengineering with the implementation of information technology according to Mukwakungu, et al. (2018) increase customer satisfaction, increase the value chain of a food product through traceability (Cruz and Rosado da Cruz, 2019). With the increase of customer choices, rapid change, and an agile environment, disruption technology for sure is influencing the sustainability of food manufacturing SMEs. The food manufacturing SMEs needed a good strategy to stay in the business, the aim of a competitive strategy is changeable alongside with dynamic environment, and change the value of rules value in the firm (Mutunga and Minja, 2014). In this paper, the authors purposed a model of food product innovation for food manufacturing SMEs based on the characteristics of product innovation, by integrating the business engineering, Industry 5.0, Society 5.0, and agile strategy.

2. Literature Review

2.1. Industry 4.0 and 5.0

Introduced by the German Government in 2011 at Hannover (Rojko, 2017), Industry 4.0 is an integration of all in the value chain of the company from the suppliers to customers, including business and manufacturing processes. The main idea of research and implementation of the Industry 4.0 exploration concepts and technologies of Internet of things (IoT), integration of business and technical processes, application of virtual reality and digital map, and smart factory (Rojko, 2017). Industry 4.0 chasing on efficiency and effectiveness in the manufacturing process.

The focus of Industry 4.0 is the same as the past industrial revolution which is mass production and lack of environmental considerations (Demir, 2019). Furthermore, the world facing massive increases in environmental pollution beginning from the industrial revolution, the manufacturing has to deal with the different aspects of waste generation and management. Having environmental consideration became a competitive edge to the companies. Environment consideration will have, the bigger portion as a success factor for the industry. Industry 5.0 has two visions, the first one is sustainability and the other one is human-robot coworking. According to (Demir, 2019), The focus of industry 5.0 is sustainability. It's supported by (Nahavandi, 2019), the main vision of industry 5.0 is sustainability and waste prevention. The second focus industry 5.0 is a collaboration on the factory floors between humans and machines. The production process will have more creative human touch and robots (Østergaard, 2017).

The main concern in Industry 4.0 is automation while industry 5.0 is a synergy between humans and machines that utilize the human brainpower and creativity to increase process efficiency and effectiveness. The technologies that need to be developed in industry 5.0 is Networked Sensor Data Interoperability, Multiscale Dynamic Modelling, and Simulation: Digital Twins, Shopfloor Trackers, Virtual Training, Advances in Sensing Technologies, and Machine Cognition (Paschek et al., 2019). In the next Industrial Revolution the companies that develop, transition, and transform in digitalization, globalization, agility, customer centricity, and many more business parameters will succeed. Industry 5.0 will change human process integration and daily business due to the velocity of further technological development.

Table 2. Comparison of Industry 4.0, Industry 5.0 and Society 5.0

	Industry 4.0	Industry 5.0	Society 5.0
Motto	Smart Factory	- Bioeconomy - Human-Robot Co-working	Anyone get opportunities anytime, anywhere
Motivation	Mass Production	- Sustainability - Smart Society	Humankind lives in harmony with nature
Power Source	- Electrical power - Fossil based fuel - Renewable power sources	- Electrical power - Renewable power sources	- Electrical power - Renewable power sources
Involved Technologies	- Internet of Things (IoT) - Cloud Computing - Big Data - Robotics and Artificial Intelligence (AI)	- Sustainable Agricultural Production - Bionics - Renewable Resources - Human-Robot Coordination Human-Robot Collaboration	- Internet of Things (IoT) - Cloud Computing - Big Data - Robotics and Artificial Intelligence (AI) - Virtual Reality (AR) - Human-Robot Coordination Human-Robot Collaboration
Involved Research Areas	- Organizational Research - Process Innovation and Improvement - Business Administration	- Agriculture - Biology - Waste Prevention - Organizational Research - Smart Environments - Organizational Research - Process Improvement and Innovation Business Administration	- Smart Environments - Process Improvement and Innovation - Business Administration

*(Demir, 2019)

2.2. Society 5.0

Society 5.0 introduces by Japan Government in 2016 and known to as a smart society. Society 5.0 not only for the manufacturing sector but also to solve a social problem with the help of the integration of physical and virtual spaces. The goal of Society 5.0 is to provide an environment for realizing an individual's potential and achieve the creation of equal opportunities for; not forget to bring economic benefits for individuals in other words human prosperity will be facilitated by this smart society. (Okamoto, 2019) said that Society 5.0 is premised on a "deepening of technological integration" that supports "collaboration, co-creation and human-machine interaction" (Ferreira and Serpa, 2018) Society 5.0 uses advanced IT technologies such as IoT, robots, and artificial intelligence, augmented reality (AR) (Skobelev, 2017) and these technologies, actively used in daily use for the benefit and convenience of each person. The review shows that the growing popularity of the digital economy and human center technology-based is already here. The intellectual systems and personal intellectual resources of each person and to do the habitat attractive to people to live with it in everyday life.

2.3. Business process reengineering

The organizations forced to become innovative and adopt new technologies, methods, tools, and change approaches in the competitive era (Bhaskar, 2016). The fundamental business process reengineering (BPR) is rethinking and radical redesign of business processes to obtain dramatic and sustaining improvements in quality, cost, service, lead time, outcomes, flexibility, and innovation (Dorin, 2019). The enterprise workflow within and between organizations is analyzed and redesign by BPR. BPR method is used through products or services for improving the process to create value for the users (Qu *et al.*, 2018). (Pratiwi and Dachyar, 2020) identifying functional domain and functional needs to aims at removing business limits. Enterprises delivering more value to the customer using BPR start from zero and redesign existing processes (Jha and Brien, 2000). The radical change in manufacturing strategy requires a collaborative and competent human resource (Pratiwi and Dachyar, 2020). Today enterprises want to drive new business value, reducing risk and fraud, enter the new markets more quickly with a higher level of efficacy using data (Jha and Brien, 2000). It means to achieve effective management, information system (IS) is needed (Bhaskar, 2016). BPR manage information system using innovative information technology (IT) to aims at flexible, team-oriented, and cross-functionally coordinated management. Developing skills in computer-aided systems engineering should be encouraged in the information management system (Eisenhardt and Tabrizi, 1995). Enterprise Information Systems (EISs) also allow the level of decentralization in the organization, and balance the transparency and control in the business process (Qu *et al.*, 2018). Another technology in IT big data analysis in business process workflows with a new way of thinking and combining data analytics (Jha and Brien, 2000). Business initiatives support by big data analytics that changes business processes and aligns with the organization's IT infrastructure.

The literature shows that the successful implementation BPR manage data management system enterprise will achieve a higher level efficiency and effective business process. The technologies that use in the literature show is almost the same method using an Industry 4.0, Industry 5.0, and Society 5.0. It shows that BPR plays an important role in successful organization transformation that includes product innovation.

2.4. Agile strategy

Agility is a term of the capability of the organization to respond to marketplace and consumers' requests and in a short time to transform it (Sindhwani and Malhotra, 2017). Agility is the contempary strategy to cope the dynamics and turbulence of market that use by the enterprises (Stachowiak and Szłapka, 2018). According to (Cooper, Cooper and Sommer, 2016), agility is the capability to founding virtual enterprise, to accomplish customer satisfaction, predictive market change, and appreciating humanoid information and services. A business environment that always changing and uncertain, the factor that keeps the organization competitive is agility. The agile strategy made an organization stay competitive, to achieve this state transform an effective and integrated procedure in the business is needed, and made sure to provide satisfy capabilities and driver the agility (Li *et al.*, 2007). These improvements made the good relationship between customer and manufacturer. (Sindhwani and Malhotra, 2017). Nowadays, the customers require the fastest industries to response their personal demand (Kartika *et al.*, 2019)

Agile strategy consist of agile manufacturing, agile product development and innovation, agile supply chain, and agile project management. Agile manufacturing base on the relationship between the organization, customers, and suppliers, an integrated process from product design, manufacturing process, marketing and support serives (Gunasekaran, 1999). Agile manufacturing affect the relationship the role of customer (Timms et al., 2000). Agile manufacturing grow base on The demand of the customer in more difficult to fulfil, that way agile movement such as agile manufacturing. (Timms et al. 2000). According to (Sindhwani and Malhotra, 2017) agile manufacturing meet the current competitive scenario which is fulfilling the customer demand on time. Meanwhile agile product development and innovation, and agile supply chain influenced by changing in organization environment, from disruption product, and technology, customer demand and regulation. Agile product development base on software product development, than apply in manufacturing industry. Agile innovation product usually used in manufacturing product, from mass

production system for general market to specific product for niche market. Agile supply chain is supply chain management that came from constantly changing environment, global marketing, and global warming effect.

2.5. Food product innovation

The typical characteristics of food processing industry is bulky, seasonal and sometime is perishable (Wedowati, et al., 2014). The product requirement of food processing industry is constantly change to fulling customer requirements. This condition made the food manufacturing industry to have to a good supply chain and production process. The food product innovation is a strategy for food manufacturing industry to stay in the business. The definition of product innovation is to produce a new product with the use of new components, features, and technologies or develop it more effectively and more efficiently (Purba *et al.*, 2018). Product innovation is a key factor for an organization to survive in a competitive economy. Product innovation from a creative cognition point of view plan design process, traditionally design method focus on product or technical system (Li *et al.*, 2007). Today's in the disruptive and agile environment encouraging innovation in product design. The major issue in the food system is product innovations (Russo, 2003). Customer requirements have a significant role in product design, especially for food product innovation. The food manufacturing industry has limited resources to do innovation products constantly in fulfilling changing customer's requirements. For efficient and effective food product innovation need information technologies in the product design phase. The proposed integrating cognitive psychology, information technologies, and design theories for the product innovation model (Li *et al.*, 2007). Integrating information technologies in the product innovation model strengthened by others such as implemented in the modular system (Svahn, 2014), real-time, and flexible product design (Eisenhardt and Tabrizi, 1995), real-time behavior, and performance(Lezoche *et al.*, 2020).

Through product innovation, competitive advantage by using information systems such as Cloud Computing, Internet of Things, Big Data, Blockchain, Robotics and Artificial Intelligence (Lezoche *et al.*, 2020) open new opportunities, differentiating its process and variety of goods, and improve the quality, efficient decision-maker and supply chain (Maier, 2018). The food product innovation literature shows that from present knowledge the innovation performance can be derive (Török, et al., 2019) and the implementation information system in the food manufacturing industry plays a big role for them to stay competitive and sustainable.

3. Research Methodology

This research is a theoretical study that will focus on developing a model for product innovation in Food Manufacturing in SMEs. The model will develop the relationship between Industry 5.0, Society 5.0, Agile Strategy, and Business Process Reengineering in food product innovation. The proposed model will be adopted in another section. The initial step in this literature study is to find and collect the articles through the online journal and proceeding according to research topics, including through ScienceDirect, and Google Scholar. Keywords that are used are: food product innovation, Industry 4.0, Industry 5.0, Society 5.0, and Business Process Reengineering. The next step is developing a interaction model of food innovation base on Industry 4.0, Society 5.0 and Business Process Reengineering for food manufacturing SMEs

4. Proposed Model

The agile environment and disruption in business made the organization develop an agile strategy to survive. Food manufacturing especially Small and Medium Enterprises (SMEs) need to face a lot of change rapidly from product demand, the life cycle of the product, customer's need, disruption technology, and high uncertainty environment. Product innovation needs to be launch in faster and faster, but the product characteristics more detail, the market more niche than before. This disruption era is occurring widely, which is why SMEs food manufacturing clear visions develop as well as a clear mind-set for the transformation in product innovation. SMEs with limited resources take strategies by resource-based, knowledge-based, open innovation, networking, and technology buy/make strategies (Chaochotechuang, 2016)

The proposed model is composed in the diagram product innovation for SMEs food manufacturing. The approach presented in this paper, which integrated the business engineering, Society 5.0, agile strategy, and Industry 5.0., is to provide theoretical principles and exploring experience for creating product innovation. The proposed model base on the agile environment in which constant change rapidly almost in everything, every time and everywhere. The organization has to transform. It is a business process by adopting an agile strategy. Agile strategy form by analyzing the database, customer's behavior, regulation, and competitor. Food product innovation is very risky today, influence is weather and global warming that cause the supply of the material, and delivery time became unsustainable.

SMEs must innovate to survive with the appropriate degree of product innovativeness and they need to collaborate and focus on core competencies for efficiency (Cappa *et al.*, 2016). Application of BPR for reinventing and reengineering the organization (Nitha and Sunil, 2017). One potential response to this demand is increasing the changeability of the manufacturing setup, The food-processing industry, like the process industries, operates by mixing, separating, forming or chemical reactions (Bech, Brunoe and Larsen, 2018). In a business environment characterized by technological innovation, the consolidation of industries, deregulation, and demand for consumers in constant evolution, the approaches of the traditional managers can no longer allow for companies to remain profitable (Lezoche *et al.*, 2020). Customer demand can be accommodate through customer feed back and link it to directly in design and production process (Mittal *et al.*, 2017).

The proposed model of food product innovation has 5 (five) stages, it begins with the identified and analyzes their existing business process (old business process). To analyze the current business process using a database could be huge and unstructured. Big data analysis and artificial intelligence are some technologies that can be applied to manage the database, and for analyzing the data could use data science and knowledge management. In the second stage, the organization builds an agile strategy based on analysis results in stage one. The agile strategy considers the change of product demand, regulation, product material, process technology, capital, and human resources with some alternative. The third stage is designed, where customers involve to build product innovation. Customers could be improved from databases, big data, cloud, etc. Product innovation is where the design of the product became the base of product innovation. Product innovation is testing the product design from material to production process engineering. The technology used in this step from data analysis, artificially intelligent, and artificial reality. The last one is a new business model, in this stage, product innovation already made to mass production. In this stage, the organization changing it is a business process to new business processes, to running their product innovation. The synthesized proposed a theoretical model of the study together with the complementary operational model guided us to develop an understanding of the current food industries. Commonly, it can be used in other type of industries. But for the beginning, it would be applied in certain industry which is food sector.

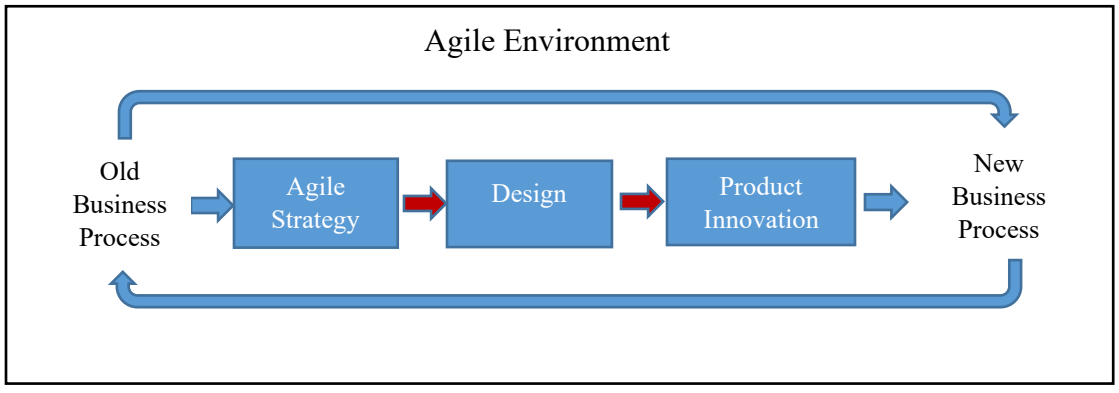

Figure 1. Proposed Model Product Innovation Industry 5.0 for SMEs Food Manufacturing

Burchardt and Maisch (2019) organization needs to change to stay relevant to the market to manifest the new strategy. These proposed model could be the base to develop new strategy in food product innovation in food manufacturing

industry SME. The model develop for facing the upcoming Industry 5.0 where the high quality custom made product is more impotant than the standard mass production product. These model needed is needed because comtemporary innovation is the most important strategy for the enterprises (Szwacka-mokrzycka, 2010).

5. Conclusion and Future Research Direction

This paper introduced a proposed product development model for food manufacturing in SMEs facing Industry 5.0. It also studied that the agile environment made organizations adopt the agile strategy in their business process. The transformation from a traditional organization to an agile organization could be done by implement a business process reengineering to achieve new business value. The paper adds more value by introducing Society 5.0 approach to involve the customers in the design step of product development. As more and more customers are involved in product development and building a good image of the organization and also the products. In summary, what has been presented here is a modified model of food product development to satisfy the customers. As future work, the modified model will be tested in the field with the recommended technology facing Industry 5.0.

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Biography / Biographies

Wara Widyarini Endah Saptaningtyas is a researcher at the Ministry of Industry Republic of Indonesia. She earned Industrial Engineering Undergraduate at Islamic University of Indonesia, Jogjakarta and a master in Industrial and Management Technique from Institute Technology of Bandung, Bandung. She has published journal and conference papers. Ms Saptaningtyas has completed research projects for the Ministry of the Industry Republic of Indonesia and some research project with Faculty of Engineering, Mulawarman University, Indonesia. Her research interests include product development, business strategy, business model, information management architecture, manufacturing, feasibility study and lean.

Deasy Kartika Rahayu Kuncoro is a lecturer and currently is being a Head of Industrial Technology Laboratory in Faculty of Engineering, Mulawarman University. She finished her Industrial Engineering Undergraduate in Islamic University of Indonesia, Jogjakarta and earned Master in Industrial Engineering from University of Indonesia, Depok. Her research interests include innovation, risk, project management, lean, optimization, and entrepreneurship.