DESIGN FOR MASS CUSTOMIZATION IN FOOD INDUSTRY: LITERATURE REVIEW AND RESEARCH AGENDA

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ABSTRACT

Increasing customer's wants and needs for food products drive companies to prepare product varieties. One way to satisfy product varieties is applying concept of mass customization (MC) in food industry. However, with the distinctive characteristics of the food industry, it will be more complex to implement MC for the food industry. The distinct characteristics of food industry ranging from raw materials, production processes, as well as the end products, therefore it is necessary to develop the appropriate design of production system. The problems that arise due to the increase of this product variation among due to the customer's wants and needs in the appropriate products design. Furthermore, how to select and determine the appropriate process design in order to meet and make products according to the customer's wants and needs. Moreover, when coupled with the nature of the raw materials that are perisable and seasonal, which will certainly have an impact on the process characteristics and typical properties of the product as well, which is different from the characteristics of the processes and products of other manufacturing industries. This paper aims to review the previous papers related to the food industry, the concept of mass customization, design for mass customization (DFMC), application of MC to the food industry, and propose a research agenda related to DFMC in the food industry.

Keywords: design, mass customization, food industry, literature review

1. INTRODUCTION

Consumer's wants and needs tend to change and more varied at any time. One way to meet consumer's wants and needs is applying mass customization concept. The concept of mass customization (MC) was introduced in the late 1980s by Davis (1987) and followed up with the increased flexibility and optimization of costs and quality elements (Silveira, Borenstein, & Fogliatto, 2001). To apply the MC concept in an industry need to be developed design for mass customization (DFMC) (Tseng & Jiao, 1996). Design for mass customization is used to consider the economics of scope and economics of scale at the early stages of the product development process (Tseng & Jiao, 2001).

Food industry has unique characteristics when compared to other manufacturing industries. According to McIntosh, Matthews, Mullineux, & Medland (2010), there are several factors that differentiate food industry with other manufacturing industries, among them the chemical change, maturing cycles/delay and food product decay. Besides that the raw materials in the food industry has unique characteristics as well, namely seasonality, perishability and variability (Austin, 1983). Given these unique characteristics, the production system in the food industry also has different characteristics. With the typical characteristic of this, the DFMC that will be developed will also have a distinctive design as well.

Mass customization can be done in an effective manner through product customization (Jiao & Tseng, 2004). Customizability can be reviewed by three (3) aspects, namely: (1) design customizability: design based on the intrinsic properties of the product, which enables easy customization of both the customer and the manufacturer, (2) process customizability: the economic value of the variation process to meet product customization, and (3) the value of customization that is perceived by customers.

In general, companies face the problem of how to understand customer's needs, and interpret those needs into a product configuration that can meet the customer the maximum at minimum cost (Gangurde & Akarte, 2013). Design of product configuration can be used to realize the variety of products efficiently and effectively. Configuring the product has been recognized as an effective way to meet customer's needs individually in mass customization (Zhou et al., 2008 in Gangurde & Akarte, 2013). Product configuration optimization aims to produce customized products at the lowest cost level but is able to provide maximum customer satisfaction.

This paper aims to conduct a review of literature related to mass customization, design of mass customization, and propose a research agenda related DFMC especially in the food industry. The application of the concept of mass customization in an industry, particularly in food industry that have distinct characteristics, ranging from raw materials, production processes, as well as the end products.

2. METHOD

First step in this literature review is to find and collect the articles through the online journal according to research topics, including through ScienceDirect, Emerald, Tandfonline, ebooks and Google Scholar. Keywords that are used are: food industry, mass customization, and design for mass customization. At this stage there are 34 articles, which includes 5 books, 22 journals and 7 proceeding articles. List of books, journals and proceedings of this literature search results are shown in Table 1.

Table 1. List of books, journals and proceedings, frequency of appearance

No. 1	Name of Publications 2	Frequency 3
1.	Addison-Wesley Publishing Company, Inc.	1
2.	Applied Soft Computing Journal	1
3.	Benchmarking: An International Journal	1
4.	British Food Journal	2
5.	CIRP Annals – Manufacturing Technology	2
6.	Computer Aided Design	1
7.	Computers & Industrial Engineering	1
8.	Decision Sciences	1
9.	Expert Systems With Applications	1
10.	Food Chemistry	2
11.	Food Quality and Preference	3
12.	Harvard Business Review	1
13.	Innovation: Management, Policy & Practice	1
14.	International Journal of Production Economics	1
15.	International Journal of Production Research	1
16.	John Wiley & Sons, Inc.	1
17.	Journal of Business & Economics Research	1
18.	Journal of the Science of Food and Agriculture	1
19.	Managing Service Quality	1
20.	Procedia CIRP	3
21.	Proceedings of the Sixth International Conference on Machine Learning and Cybernetics	1
22.	System Engineering Procedia 2	1
23.	System Engineering Procedia 3	1
24.	Technovation	1
25.	The International Journal of Flexible Manufacturing System	1
26.	The Johns Hopkins University Press	1
27.	Springer	1

Articles that have been collected are sorted by topic and its method of use. Topics are sorted by using the term, namely: food industry, mass customization, mass customization in food industry, and design for mass customization. While the methods used are sorted by types, namely: modeling, experiments, survey, case study, and conceptual/literature review. The sorting results as shown in Table 2.

Table 2. Sorting articles result by topic areas and methods used

Method	Topic Area			
	Food Industry	Mass Customization	MC in Food Industry	Design of MC
1	2	3	4	5
Modeling	-	4	1	3
Experiment	3	-	-	-
Survey	4	-	-	-
Case Study	2	-	1	3
Conceptual/Literature Review	1	6	3	3

3. CONCEPT OF MASS CUSTOMIZATION

Production systems are driven by changes in the environment in which it operates manufacturing process, change character and grow in a pattern at all times, as shown in Figure 1. The most commonly used production systems are Craft Productions, American Production, Mass Production, Lean Production, Mass Customization and Global Manufacturing. Most of all this paradigm is still operated in various industrial sectors. However, related research topics, today's focus on strategies and methods for dealing with the development of products, processes, and production systems to support lean production, mass customization and product personalization systems (Mourtzis & Doukas, 2014).

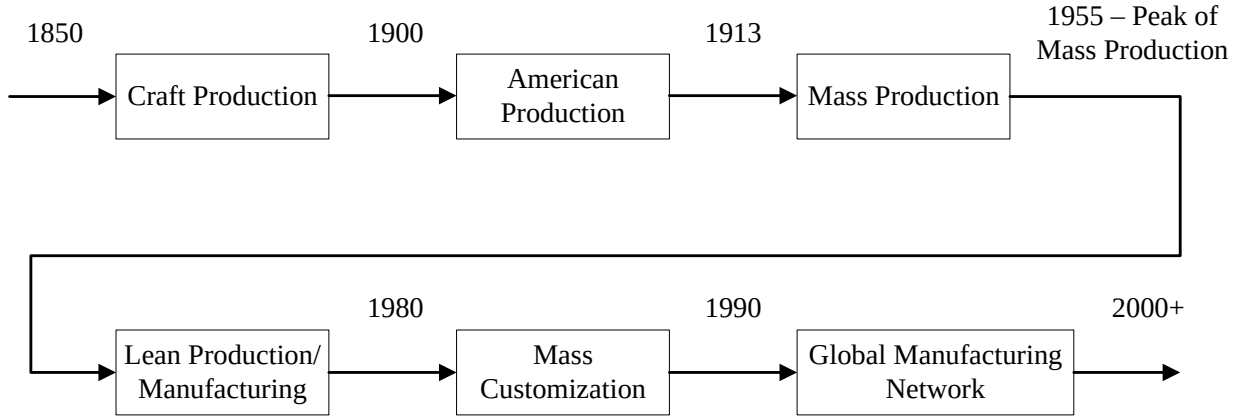

Figure 1. Manufacturing paradigm evolution

Mass Customization is a production system that uses cost and speed as well as mass production to meet the needs of the products or services individually, or can be regarded as a production system that combines mass production and individual demand (Xu, 2007). As for the difference between mass production and mass customization as shown in Table 3.

Table 3. Differences between mass production and mass customization

1	Mass Production 2	Mass Customization 3
Production Goal	Scale	Scale **Scope**
Desired Product Characteristics	Quality Cost	Quality Cost **Variety**
Customer role	Buy	Buy **Choose**
Production System	Dedicated Manufacturing Systems	Reconfigurable Manufacturing Systems

Source: Hu (2013)

Mass customization as the ability to provide individually designed products and services to every customer through high process, agility, flexibility and integration (Pine, Victor, & Boynton, 1993). According to Silveira, Borenstein, & Fogliatto (2001), MC associated with the company's ability to provide products or services varied through a flexible process. In mass customization, in addition to required to meet customers' satisfaction are also required to keep production costs, product pricing, and product quality, so that although MC is applied does not result in increased costs of which will impact on the price increase. Therefore, a company that will implement the MC should perform the appropriate production system design to meet these demands.

According to Matthews, McIntosh, & Mullineux (2011), there are three main strategies related to MC, namely: manufacturing flexibility, modularization and postponement. Manufacturing flexibility is the ability of a manufacturing system for facing uncertainty due to the complexity generated by advances in technology. When considering manufacturing systems for MC, the main concern is the process flexibility which is dominated by design-led activity (Matthews, Singh, Mullineux, & Medland, 2006). Modularization is a technique well known in the design of products, which products are designed into sub-assemblies and components so that a wide variety of products can be offered. With this strategy allows for customization for a variety of products made by each feature/function (Kumar, 2004). While the postponement is the delay to a process for producing a product as long as it is possible. With the postponement strategy would allow the company to reduce the inventory of finished products so as to reduce the cost of storage. The postponement concept can be divided into 4 (four) types, namely:

1. Form postponement (labelling postponement, packaging postponement, assembly postponement, dan manufacturing postponement),
2. Time postponement,
3. Place postponement, and
4. Logistic postponement.

Applying the concept of mass customization in a company is not easy. There are several key success factors implementation of MC, namely: product modular design, flexible manufacturing process, sophisticated order management, integrated information system, and postponement of assembly (Pollard, Chuo, & Lee, 2008). Demand uncertainty is a challenge for MC. If demand is lower than the production capacity, it will cause problems. To minimize the problem, delay in operation can be used as an alternative solution, therefore postponement strategy

can be used when demand is low. Just need to consider the operation which can be delayed in a production process.

4. MASS CUSTOMIZATION IN FOOD INDUSTRY

Increased customer's wands and needs will effect on the demand for product variety. It is one thing to encourage a shift in manufacturing strategy from mass production into mass customization. Application of mass customization (MC) in the food industry has not been widely studied. There are a few studies have been published that talk about the possibility of MC concept applied to the food industry, namely: Matthews et al. (2006) examines the flexibility of food processing; Boland (2006) put forward the idea of mass customization in the food industry for health, Boland (2008) discuss about the potential of the MC on the food industry to meet the nutritional needs are different for every individual; McIntosh et al. (2010) discuss about the growing issue related to the implementation of MC in the food industry; and Matthews et al. (2011) discuss about possibility of MC application in the food industry with opportunities and constraints.

Research about MC application in the food industry is still relatively small, probably due to differences in the manufacturing process in the food industry when compared to other manufacturing industries. In relation to the concept of postponement, the packaging stage is considered the most likely to apply the concept of MC. McIntosh et al. (2010) has identified 13 key factors that differentiate between the food industry with other manufacturing industries, namely: (1) chemical change, (2) Food product decay, (3) Maturing cycles/delay, (4) Mixing product and assembling products, (5) Recycling/recovery, (6) Cleaning/purging, (7) Packaging, (8) Simplifying product design for MC, (9) Access, (10) Delicate foodstuffs (handling), (11) Legal provisions (sell-by date and others), (12) Economics of scale, and (13) Distribution.

The application of mass customization in the food industry needs to be studied more in depth. Not all production systems for the food industry can apply the concept of MC, depending on the characteristics of the raw material, processing and final products, as well as customer needs. Table 4 shows several types of production processes in the food industry that allows it to be applied MC.

Table 4. Potential of MC application in various production processes in the food industry

Strategy **1**	**Flour** **2**	**Biscuit** **3**	**Bread** **4**	**Ice Cream** **5**	**Milk** **6**
Modularization	P	P	N	P	P
Manufacturing postponement	P	P	N	N	N
Assembly postponement	Y	P	P	P	P
Packaging postponement	Y	P	P	Y	P
Labelling postponement	P	P	P	P	P
Time postponement	Y	Y	N	N	N
Place postponement	Y	Y	N	N	N

P: possibility of application; Y: definite potential for application; N: no potential for application

The process of flour production, particularly wheat flour, can apply the concept of MC because almost every stage of the process involves only physical changes, in addition to the start of raw materials, intermediate product, until the finished product has a relatively long shelf life.

Flour product variants is relatively limited, which are already on the market only distinguished by the protein content and type of packaging. Similarly, the production process of flour derivatives, namely biscuits and cookies. What distinguishes, for biscuit and cookies products, should be quickly packaged as a finished product to maintain product quality.

Unlike the case with the production of bread, which is in between the stages of the production process involves the fermentation process would be difficult to apply the concept of MC, especially for manufacturing postponement strategy. In addition, the product has a shelf life of bread is short, so it is not possible to do time and place postponement strategy.

As for the production process of dairy products, including ice cream, liquid milk and powdered milk, it is still possible to apply the concept of mass customization. For the strategy of assembly, packaging, and labeling postponement is possible to be applied. But for the manufacturing postponement strategy is not possible, because at each stage of the process do not allow for delays. For time and place postponement strategies for powdered milk products is still possible, but for liquid milk and ice cream, special treatment is required to perform this strategy.

5. DESIGN FOR MASS CUSTOMIZATION

Today to ensure the survival of companies in the market and to meet customer satisfaction, mass customization (MC) is one of the main strategies that can be applied by a company. Mass customization can be done either through product or process variability (Daaboul, Da Cunha, Bernard, & Laroche, 2011). Product variety is defined as the variety of products produced by a production system to be offered to the market. While the process variety is a diversity or complexity in the production process to produce product variety and can be an alternative process for each product variation. Designing products for MC remains a major challenge for a company to meet customer requirements, because the MC concept focused to customer as a major component.

Design is a process of transformation or mapping processes from functional domain to physical domain to meet the functional demands which have been established with the limitations that have been identified. Design Method is a model that uses a series of steps or stages to determine the development process. While the design tool is an instrument that can be used to perform certain processes in the development process as a whole (ElMaraghy & ElMaraghy, 2014).

Companies should consider the customer in designing their products. In an era of mass customization, the company should be able to understand what the customer needs in order to avoid fatal errors before MC strategies applied. Mass customization trying to offer products or services that best fit customer requirements. A number of researchers have conducted research related to the analysis of customer requirements to determine the optimal product variations using various methods as shown in Table 5.

Modularization in the design of the product or service is a method that is essential to the concept of mass customization (Pine et al., 1993; Tu, Vonderembse, Ragu-Nathan, & Ragu-Nathan, 2004). Companies are necessary to apply modularization concept to achieve economics of scale (Kumar, 2004).

Kumar (2004) designed a framework related to the application of the concept of mass customization through modularization. This framework describes the concept of modularization capabilities to create customized product on the one hand and efficiency of mass production on the other side. Type in the mass customization process starts from the customer co-design up by sending a customized product to consumers.

Table 5. Methods of determine optimal product variations

Authors 1	Customer Requirements 2	Customer Preference 3	Product Configuration 4
Askin & Dawson (2000)	QFD	Utility theory	Mathematical programming
Liu & Hsiao (2006)	ANP	NA	Goal programming
Sireli et al. (2007)	QFD	NA	Statistical testing
Chen & Chuang (2008)	NA	NA	Taguchi method
Lin et al. (2008)	AHP	NA	TOPSIS ranking
Delice & Gungor (2009)	QFD	NA	Mixed integer programming
Chauduri & Bhattacharrya (2009)	QFD	Conjoint analysis	Integer programming
Kwong et al. (2012)	QFD	NA	Genetic algorithm
Wang & Chen (2012)	QFD + fuzzy DEMATEL	NA	Linear integer programming
Wang & Hsueh (2013)	DEMATEL	AHP	AHP
Wang & Shih (2013)	QFD + DEMATEL	Conjoint analysis	TOPSIS ranking
Wang & Wang (2014)	NA	Fuzzy AHP	Zero-one integer programming

Source: Wang & Wang (2014)

MC model development for production systems in the textile and clothing industry has been carried out by Watcharapanyawong, Sirisoponsilp, & Sophatsathit (2011). The model developed shows the connection relationship relating to the needs of customers on an industrial level, which mostly is an Original Design Manufacturer (ODM). There are three main interrelated involvement, namely: customers, ODM, and suppliers, associated with the framework in developing MC.

Dong, Jia, Li, & Dong (2012) has reviewed the implementation of the MC in the garment industry. This paper mentions that the method to solve the problem by providing modules and standard products. Semi-finished products manufactured with the concept of mass production, at this stage, the key success factor for the company is to keep manufacturing costs to be reduced as low as possible. In the next stage of the product in the form of modules manufactured in the form of customized products tailored to customer needs.

To apply the concept of mass customization in an industry need to be developed design for mass customization. According to Boland (2006, 2008), there are two aspects in product design on the MC, namely sensory performance and functional performance. Sensory performance of MC associated with the appearance (fashion, design, color), sound (programming on the iPod), or the flavor and aroma of food. While functional performance of MC related to various aspects of performance, such as speed, power and handling of the car, the screen size and memory capacity of the computer.

Market demands for product variety can be realized by implementing a mass customization. To be able to determine the exact design of product variety must first know what

the customer wants. It can be found by conducting customer requirements identification. The orientation of consumers towards a product one of which is based on the product quality.

Quality can be defined as the time in which consumers receive information on product characteristics at the time of purchase or after taking it. According Fandos & Flavian (2006), based on the customer's perception of the quality of ratings, the concept of quality can be divided into 2 (two) groups of factors: intrinsic and extrinsic attributes.

a. The intrinsic attributes is an attributes that measures the quality of the product by function and the physical properties of the product. Intrinsic attributes are specific to each product, these attributes will disappear when consumed and can not be changed without changing the nature of the product itself.
b. Extrinsic attributes are aspects related to the product but physically not part of the product itself, such as a name or brand image and price. This attribute is known as variable image, physically not part of the product but is strongly associated with the product and should be considered in the product characteristics evaluation.

Based on the intrinsic and extrinsic attributes, especially for agricultural products and foodstuffs, Sanzo et al. (2001) in Fandos and Flavian (2006) established the concept of quality perception by the consumer perception into 2 (two), namely the central attributes and peripheral attributes.

a. Central attributes are those components that appear as intrinsic properties of the product, both in terms of representing the nature of nutrition or nutritional value as well as the organoleptic, such as vitamin and mineral content, texture, flavor, aroma, color, appearance, and others.
b. Peripheral attributes is extrinsic components of products that enable the differentiation of the product's ability to compete, such as brand, label, design, information on the uses and benefits, authenticity, commitment to the environment, as well as social and cultural connotations.

Several previous studies has assessed the quality attributes of products in the food industry, both intrinsic and extrinsic, as shown in Table 6.

Based on the existing attributes, then developed a product design through product configuration selected in accordance with customer requirements. Several studies have been conducted by several researchers associated product design , among which is the research on the evaluation of alternative product designs to suit customer needs using AHP-modified TOPSIS (The Technique for Order Preference by Similarity to Ideal Solution) approach (Gangurde & Akarte, 2013). While Li, Tang, Luo, & Xu (2009), using a combination of rough set theory, Kano's model, analytical hierarchy process (AHP), and scale method, to determine interest level of CRs (customer requirements) in PPHOQ (Product Planning House of Quality). Furthermore, to produce a product configuration that has been selected to do the design development process.

With the increased variety of products, we need a design process in which the production process to produce the variety of products will also vary both the needs of the machinery, equipment, labor, and others. The structure of the general process and will need to be designed from the general process of this structure will be developed based on the concept of modularization and manufacturing flexibility to produce products that vary. Modularization is one of the most popular concepts in the design development process for the adoption of mass customization (Wang, Chen, Zhao, & Zhou, 2014).

Table 6. Product attributes in food industry

No. 1	Authors 2	Products 3	Product Attributes 4
1	Sanzo et al. (2001) in Fandos & Flavian (2006)	Agricultural and foodstuffs products	Intrinsic: nutritive and organoleptic (vitamin, mineral, tekstur, flavor, aroma, color, appearance, etc) Extrinsic: brands, label, design, information on the use and benefits, authenticity, commitment to the environment as well as social and cultural connotations
2	Fandos & Flavián (2006)	meat-ham	Intrinsic: fine, flavor, delicate, aroma, appearance, and color Extrinsic: shapely, elongated and rounded form of the ham, brand
3	Iop, Teixeira, & Deliza (2006)	Food products	Intrinsic: color, aroma, flavor, and texture Extrinsic: brand, price and context
4	Espejel, Fandos, & Flavián (2007)	Traditional food	Intrinsic: color, flavor, smell, and appearance Extrinsic: brand, denomination of origin, and traditional product image
5	Hersleth, Monteleone, Segtnan, & Næs (2015)	dry-cured ham	Intrinsic: sensoris quality (appearance, aroma, flavor, and texture) Extrinsic: price, nutritional value and processing conditions
6	Lee, Lusk, Mirosa, & Oey, (2015)	Fruit juice	Extrinsic: brand, nutrient content, ingredient labels, shelf life, price, and the country produces
7	Ma et al. (2015)	Soy milk	Instrinsic: attribute sensoris (soymilk aroma, smoothness in the mouth, thickness in the mouth, sweetness, colour and appearance, and overall acceptability), oil and protein conten, fatty acids, soluble solid
8	Verain, Sijtsema, & Antonides (2016)	Milk, meat, fruit&vegetables, and fish	Attributes: sustainability, health, taste, and price
9	Nishimura et al. (2016)	Garlic concentrate	Attributes: flavor, aroma and texture

6. CONCLUSION AND RESEARCH AGENDA

The application of the mass customization concept in the food industry will cause problems in terms of how to appropriate MC design that can be implemented efficiently. Therefore, it is necessary to develop the design for mass customization, particularly for product design and process design. Moreover, the food industry that have different characteristics, mainly related to processes characteristics and properties of the perishable product.

Based on this, it is necessary to develop the design for mass customization in the food industry that implement MC to be able to determine appropriate variations products according to customer's wants as well as to determine the optimal design process to produce a variety of products according to customer's wants and needs. There are two aspects in product design on the

MC, namely sensory performance and functional performance. Product design on the food industry not only on sensory performance but also functional performance. So it will involve consumer preferences vary considerably, not only related with the taste and aroma, but it can also preferences related to color, texture, and even the nutritional value of the food product which is functional performance.

One important element in the successful implementation of mass customization is the customer's wants. Therefore the early stages of design for MC is to identify customer requirements, both consumers desire at this time or the possibility of desire in the future. To obtain customer requirements through surveys. Based on the results of customer requirements identification continue to do design for product variety to determine the variation of appropriate products in accordance with the consumer's wants and needs. Followed by a phase of determining the optimal process design in order to produce the variety of products in accordance with the the consumer's wants and needs.

7. REFERENCES

Austin, J. E., (1983). *Agroindustrial project analysis*. EDI Series in Economic Development, The Johns Hopkins University Press Baltimore and London.

Boland, M., (2006). Perspective mass customisation of food. *Journal of the Science of Food and Agriculture*, *86*(1), 7–9.

Boland, M., (2008). Innovation in the food industry: Personalised nutrition and mass customization. *Innovation: Management, Policy & Practice*, *10*(1), 53–60.

Daaboul, J., Da Cunha, C., Bernard, A., & Laroche, F., (2011). Design for mass customization: Product variety vs process variety. *CIRP Annals - Manufacturing Technology*, *60*(1), 169–174.

Davis, S. M., (1987). *Future Perfect*. Addison-Wesley Publishing Company, Inc., Canada.

Dong, B., Jia, H., Li, Z., & Dong, K., (2012). Implementing mass customization in garment industry. In *Systems Engineering Procedia 3*, 372-380.

ElMaraghy, W., & ElMaraghy, H., (2014). A New Engineering Design Paradigm – The Quadruple Bottom Line. *Procedia CIRP*, *21*, 18–26.

Espejel, J., Fandos, C., & Flavián, C., (2007). The role of intrinsic and extrinsic quality attributes on consumer behaviour for traditional food products. *Managing Service Quality*, *17*(6), 681–701.

Fandos, C., & Flavián, C., (2006). Intrinsic and extrinsic quality attributes, loyalty and buying intention: an analysis for a PDO product. *British Food Journal*, *108*(8), 646–662.

Gangurde, S. R., & Akarte, M. M., (2013). Customer preference oriented product design using AHP-modified TOPSIS approach. *Benchmarking: An International Journal*, *20*(4), 549–564.

Hersleth, M., Monteleone, E., Segtnan, A., & Næs, T., (2015). Effects of evoked meal contexts on consumers' responses to intrinsic and extrinsic product attributes in dry-cured ham. *Food Quality and Preference*, *40*, 191–198.

Hu, S. J., (2013). Evolving Paradigms of Manufacturing: From Mass Production to Mass Customization and Personalization. In *Procedia CIRP*, Vol. 7, 3–8.

Iop, S.C.F.; Teixeira, E.; Deliza, R., (2006). Consumer research: extrinsic variables in food studies. *British Food Journal*, *108*(11), 894–903.

Jiao, J., & Tseng, M. M., (2004). Customizability analysis in design for mass customization. *Computer Aided Design*, *36*, 745–757.

Kumar, A., (2004). Mass Customization: Metrics and Modularity. *The International Journal of Flexible Manufacturing System*, *16*, 287–311.

Lee, P. Y., Lusk, K., Mirosa, M., & Oey, I., (2015). An attribute prioritization-based segmentation of the Chinese consumer market for fruit juice. *Food Quality and Preference*, *46*, 1–8.

Li, Y., Tang, J., Luo, X., & Xu, J., (2009). An integrated method of rough set , Kano's model and AHP for rating customer requirements' final importance. *Expert Systems With Applications*, *36*(3), 7045–7053.

Ma, L., Li, B., Han, F., Yan, S., Wang, L., & Sun, J., (2015). Evaluation of the chemical quality traits of soybean seeds, as related to sensory attributes of soymilk. *Food Chemistry*, *173*, 694–701.

Matthews, J., McIntosh, R., & Mullineux, G., (2011). Contrasting opportunities for mass customization in food manufacture and food process. In F. S. Fogliatto & G. J. C. da Silveira (Eds.), *Mass customization: Engineering and Managing global operations*, Springer, London.

Matthews, J., Singh, B., Mullineux, G., & Medland, T., (2006). Constraint-based approach to investigate the process flexibility of food processing equipment. *Computers & Industrial Engineering*, *51*, 809–820.

McIntosh, R. I., Matthews, J., Mullineux, G., & Medland, A. J., (2010). Late customisation: issues of mass customisation in the food industry. *International Journal of Production Research*, *48*(6), 1557–1574.

Mourtzis, D., & Doukas, M., (2014). Design and planning of manufacturing networks for mass customisation and personalisation: Challenges and Outlook. *Procedia CIRP*, *19*(RoMaC), 1–13.

Nishimura, T., Saiga, A., Nagao, A., Odahara, T., Sugise, T., Mizoguchi, N., & Nosho, Y., (2016). Phytosterols in onion contribute to a sensation of lingering of aroma, a koku attribute. *Food Chemistry*, *192*, 724–728.

Pine, B. J., Victor, B., & Boynton, A. C., (1993). Making mass customization work. *Harvard Business Review*.

Pollard, D., Chuo, S., & Lee, B., (2008). Strategies for mass customization. *Journal of Business & Economics Research*, *6*(7), 77–86.

Silveira, G. Da, Borenstein, D., & Fogliatto, H. S., (2001). Mass customization: Literature review and research directions. *International Journal of Production Economics*, *72*(49), 1–13.

Tseng, M. M., & Jiao, J., (1996). Design for mass customization. *CIRP Annals-Manufacturing Technology*, *45*(1), 153–156.

Tseng, M. M., & Jiao, J., (2001). Mass Customization. In G. Salvendy (Ed.), *Handbook of Industrial Engineering: Technology and Operations Management*, Canada: John Wiley & Sons, Inc.

Tu, Q., Vonderembse, M. A., Ragu-Nathan, T. S., & Ragu-Nathan, B., (2004). Measuring Modularity-Based Manufacturing Practices and Their Impact on Mass Customization Capability : A Customer-Driven Perspective. *Decision Sciences*, *35*(2), 147–168.

Verain, M. C. D., Sijtsema, S. J., & Antonides, G., (2016). Consumer segmentation based on food-category attribute importance : The relation with healthiness and sustainability perceptions. *Food Quality and Preference*, *48*, 99–106.

Wang, C., & Wang, J., (2014). Combining fuzzy AHP and fuzzy Kano to optimize product varieties for smart cameras : A zero-one integer programming perspective. *Applied Soft Computing Journal*, *22*, 410–416.

Wang, Z., Chen, L., Zhao, X., & Zhou, W., (2014). Modularity in building mass customization capability: The mediating effects of customization knowledge utilization and business process improvement. *Technovation*, *34*(11), 678–687.

Watcharapanyawong, K., Sirisoponsilp, S., & Sophatsathit, P., (2011). A Model of mass customization for engineering production system development in textile and apparel industries in Thailand. In *Systems Engineering Procedia 2*, 382–397.

Xu, X., (2007). Position of customer order decoupling point in mass customization. In *Proceedings of the Sixth International Conference on Machine Learning and Cybernetics*, Hong Kong, 302–307.