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The effective enforcement of quality management system and its strategy on fish cake product in bening food Small and Medium-sized Enterprises (SME)

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Abstract

Product development not only focuses on the production process but also in terms of quality, food safety and quality management system. The aim of this research was to evaluate the Prerequisite Program (PRP), critical point and defect with Statistical Process Control (SPC) approach and design quality management system enforcement strategy on SMEs. Prerequisite program irregularities in bening food was found 8 aspects. Raw materials used by bening food does not appropriate the Indonesian Nation Standard (SNI) criteria. The evaluation of the critical point with the SPC approach shows that this SME has not been well controlled. Two of the most influential actors in implementing quality management systems at SME level are government and business actors. The initial strategies that must be applied are to create a national priority policy of the quality management system implementation on SMEs, campaigning the quality management system implementation throughout the stakeholder and improve the competence of human resources.

Keywords: Indonesia, Pre-requisite program, SMEs, Statistical process control

1. Introduction

Increased intensity of food trade has been reported to have facilitated the spread of disease (foodborne illness) around the world. Quality control effectiveness was vital to prevent adverse effects on human health and banned as an economic consequence ^[1]. Nowadays, consumers are more concerned about what they are consuming and the level of consumer awareness on health increases with lifestyle changes ^[2].

The world food industry is currently very concerned about food safety. Some developed and developing countries impose strict requirements on trade, in order to ensure food safety for consumers in their country ^[3]. In addition, the competition between companies in the globalization era and food liberalization is increasing. The sustainability of a company is depends on the ability to provide changes in quality improvement and food safety. The goal could be achieved using the application of TQM and its continuous improvement.

Fish processing business especially Small and Medium Enterprises (SMEs) in West Java very rarely applied quality management system. Data in 2014 shows that from 7,927 fish processing business (UPI) in DKI Jakarta and West Java, only 22 units of UPI have the Certificate of PRP (SKP)^[4]. Conditions of concern as the state ensure food safety for the Indonesia people as stipulated in UU18/2012 about food, PP28/2004 about food safety, quality and nutrition and KepmenKP52A/2013 about fishery quality assurance requirements. This issue should be the main focus for ensuring food safety in Indonesia and maintaining the existence and enhancing the SMEs competitiveness to face the ASEAN free-market (AEC).

The study of SME quality management system and its implementation strategy development in Indonesia were very minimal. Several studies related to the quality management system conducted at major fishing companies in Indonesia, such as quality control in terms of Hazard Analysis and Critical Control Point (HACCP) to improve food security in Banyuwangi, Indonesia ^[5] and integrated quality management system development of export tuna products ^[6]. This research aimed to evaluate the PRP implementation, evaluate the critical stages and defects product with statistical process control (SPC) approach and identify the actors and strategies of implementing the quality management system in SMEs. Hopefully, this research could help fisheries products SMEs to be more competitive.

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2. Materials And Methods

The present research was conducted from April 2016 to January 2017 in SMEs Bening Food, Laboratory of Sensory Evaluation, Department of Aquatic Product Technology, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University and Laboratory of Nawa Agna Tech, Bogor City. The samples observed were raw materials (minced fish and surimi), fish cake, facilities, infrastructure, equipment, and production process. Proximate compositions [7] analyzed on raw materials and fish cake. Microbial contaminants [8] analyzed on raw materials, fish cake, and equipment. Sensory evaluation of taste parameter [9] analyzed on the fish cake. SPC evaluation [10] analyzed on the setting process (temperature), boiling process (temperature and time) and the taste consistency of the fish cake. SPC evaluation was observed by thirty repetitions. Evaluation of the PRP implementation using the SKP reference (PERMEN-KP No72/2016 about the requirements and procedures for issuing

the PRP certificate). Actors and strategies identification were analyzed by a combination of Analytic Hierarchy Process (AHP) [11] and Interpretive Structural Modeling (ISM) [12]. Experts in determining actors and strategies were business actors, government agencies (Maritime and Fisheries Affair), researcher (Bogor Agricultural University) and consumers by way of in-depth interviews.

3. Results and Discussions

3.1 Pre-requisite Program (PRP) evaluation

Bening Food has obtaining prerequisite program certificate (SKP). However, the evaluation result of PRP found non-conformity. The findings of non-conformity were of eight aspects (Table 1). The eight aspects found was clauses of the building, equipment, employee facilities, solid waste and other wastes, packaging, labeling and upgrading of human resources skills.

Table 1: Result of non-conformity identification in PRP application

No	Aspects	Non-conformity
1	Wall	Joints between floor and wall should not construct for ease of cleaning (elbow joint)
2	Ceiling/roof	Found a cracked ceiling in the boiling room
3	Windows and parts that can be opened	The windows in the boiling room and are unable to prevent the accumulation of dust/filth
4	Tagging	The equipment is not marked
5	Toilet sanitation equipment	The toilet does not have a hand dryer and flushing system
6	Waste shelter	The waste shelter is not closed
7	Labeling on the packaging	The packaging is not accompanied by a label describing the product, production place and date of production
8	Employee training	No scheduled training programs

Achievement of the quality management system implementation required some other analysis as empirical data and comparison. The analyses were proximate analysis on products and raw materials and microbial contamination on raw materials, fish cake, and equipment. The results of proximate analysis on raw materials and products and their comparison with Indonesian national standards (SNI) as exhibited in Table 2

The proximate analysis content of surimi was higher than minced fish. This is influenced by exogenous and endogenous factors. The main exogenous factor affecting the proximate composition of the fish is the feed, while the endogenous

factors are size, age, gender and maturity level gonad [13]. The proportion proximate composition of a fish is also influenced by the parts of the body in fish, where the abdomen has a higher fat content and lower protein than the dorsal [14,15]. The proximate composition of raw materials will affect the quality of fish cake products. This product is known as chewiness texture, hence the protein content of raw material was high. When compared to the requirements of the Indonesian National Standard (SNI), the raw materials and products produced by SMEs Bening Food were not in accordance with the established standards.

Table 2: Raw materials proximate compositions (%)

Contents	Minced fish	Surimi	Standard (SNI2694:2013)	Fish cake	Standard (SNI7266:2013)
Protein	7.55	6.38	-	5.19	Min 7
Fat	5.14	3.43	-	5.11	-
Water	68.12	65.38	80-82	65.19	Max 65
Minerals	0.11	0.82	-	0.24	Max 2

Fish products are one of the main sources of protein for human growth. However, the product becomes unprofitable, if it is not safe for consumption even harmful to health. Organizers of activities or processes of production, storage,

transportation, and distribution shall comply with sanitary requirements. Results of microbial contamination analysis in raw materials, fish cake, and equipment on SMEs Bening Food are exhibited in Table 3 and 4..

Table 3: microbial contamination analysis in raw materials and fish cake (CFU/gram)

Content	Minced fish	Surimi	Standard (SNI2694:2013)	Fish cake	Standard (SNI7266:2013)
ALT	2,2X10 ²	2X10 ²	Max 5 X 10 ⁵	3X10 ²	Max 1,0 X 10 ⁵

The results showed microbial contamination on raw materials and fish cake below the standards set by the Indonesian government in the Indonesian National Standard (SNI). This showed that the fish cake produced by Bening Food SMEs

were safe for consumption. However, Bening Food SMEs must evaluate the findings of nonconformities in order to control the potential contamination that would contaminate the product one day

Table 4: microbial contamination analysis in equipment (CFU/gram)

Weeks	Equipment		
	Food processor	Forming	Dewatering
1	1X10 ²	<10	-
2	1X10 ³	<10	-
3	1X10 ²	<10	<10

3.2 Quality Control with Statistics Process Control (SPC) Approach

Parameters that is decided to evaluate the SPC are the taste consistency (sensory), setting temperature and boiling temperature and time. These parameters were chosen based on discussions with SME management in reference to problems that were encountered during the processing and literature study.

3.2.1 Heating

Heating process is done twice. The first heating is called setting. The temperature used in the first heating was 40°C

and at that temperature, there will be gel formation in fish cake product. Second heating temperature above 90°C. The second heating process aims to finalize the product. The important factor to be considered in the heating process is temperature and time. The length of time used will affect the level of ripening and quality of the fish cake. This SME does not specify the temperature and time standards for the process of setting and boiling. Observations and control charts of temperature and time in the process of setting and boiling are presented in Fig 1.

Setting temperature distribution found one temperature outside the control limits on moving range and individual value. While boiling time distribution is not found time point beyond the control limit of individual value, but found time point outside control limit of moving range. Based on the conditions of the three parameters shows that SMEs has not been well controlled in the process of heating.

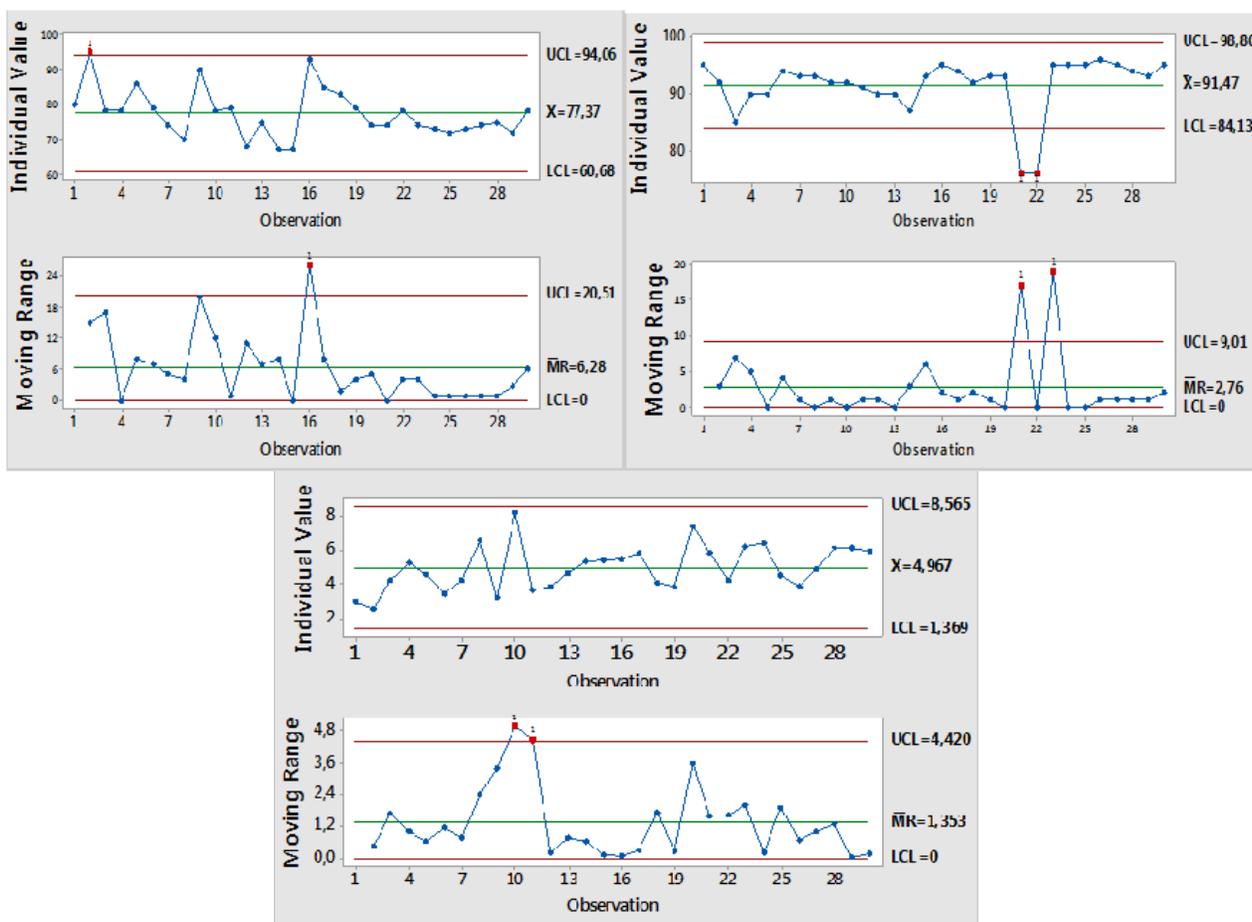


Fig 1: I-MR graph temperature of setting (A), boiling (B) and boiling time (C).

Nonconformance and uncontrolled temperature and time of setting and boiling process potentially affect fish cake quality. Temperature setting above 50 °C (*modori*) could decrease the chewiness. *Modori* temperature reported causes reversible degradation of the myofibril protein, resulting in the disintegration of the gel structure [16, 17]. Insufficient boiling time may result in the undercooked fish cake. The potential hazard that can be generated is microbial contamination has not reached the standard limit of human consumption. The minimum temperature and time during the boiling process

were reported at 80 °C for 5 minutes [18].

3.2.2 Taste consistency

Taste acceptance level is one of the important parameters in the fish cake attributes. The taste parameter can determine the consumer's final decision to accept or reject. Taste consistency is one of the factors that influence the success in food product business. Observations and control charts of taste consistency are presented in Fig 2.



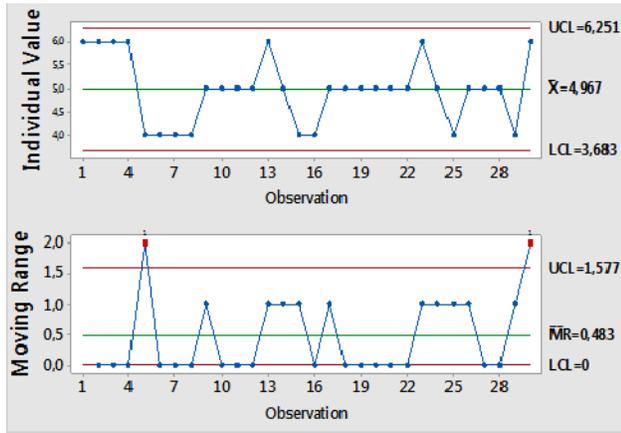


Fig 2: I-MR graph taste consistency

Taste consistency distribution is not found a point beyond the

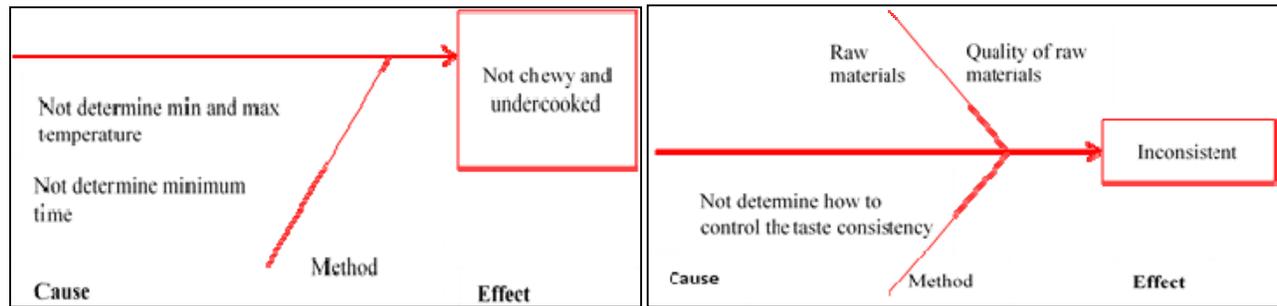


Fig 3: Cause-effect graph of setting and boiling process (A) and taste consistency (B)

3.3 Quality Management System Implementation Strategy on SMEs

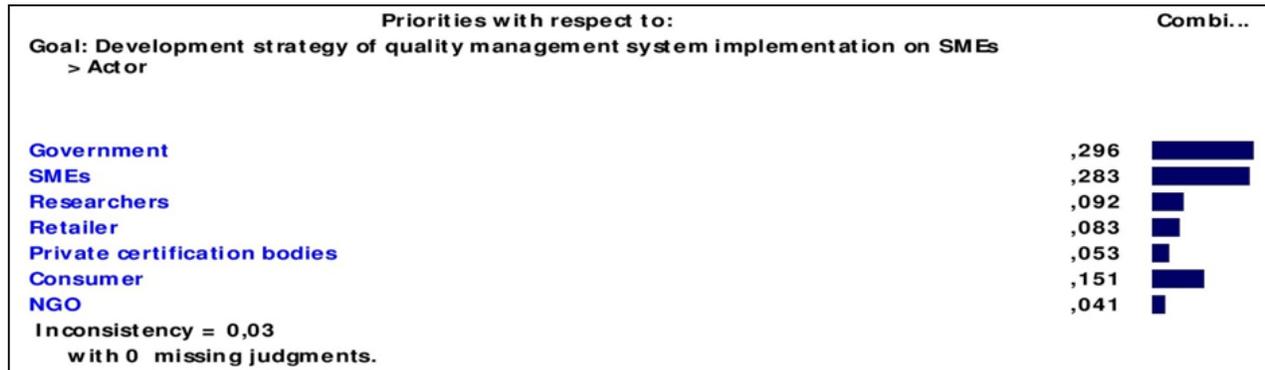
The quality management system policy of Indonesian fishery SMEs involves many elements. The two main elements were actors and strategies. The actors were stakeholders in SMEs, and the strategies are a meticulous plan for the realization of quality management system implementation on SMEs. Hierarchical results between actors and strategies are presented in Fig 4.

control limit of individual value but found time point outside upper control limit of moving range. The inconsistent taste of fish cake could reduce the regular customers. Fish cake taste inconsistency was influenced by many factors, among others influenced the use of frozen raw materials and quality of the raw materials. Frozen raw materials have the potential to reduce protein and fat composition. Storage of raw materials at -20 °C to -50 °C at 21 days can decrease protein (denaturation) and fat content, especially triglyceride fraction [19].

3.2.3 Identify cause and effect

The process defects found must be corrective action immediately. Corrective action is performed using cause and effect diagrams. This diagram will further analyze why these defects can occur at each stage or parameter being analyzed. The cause-effect diagram is shown in Fig 3.

Successful implementation of quality assurance system is highly dependent on the commitment and motivation of SMEs. Another very influential actor is a government agency (Maritime and Fishery Affair). Government agencies act as adviser, guarantor, and supervisor of Indonesian fishery food safety. Other important actors are consumers. The third important actor is the consumer. Consumers are entitled to choose products based on their respective references, such as assured safety.



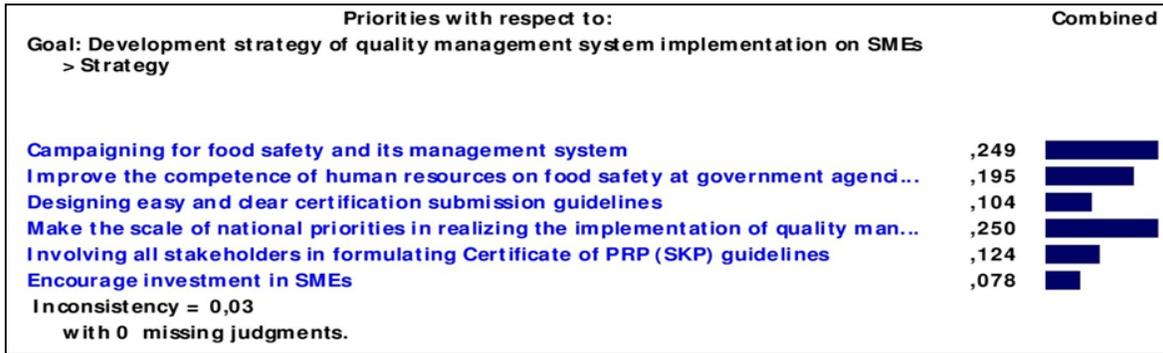


Fig 4: Priority elements of actors (A) and strategies (B)

The fourth actor is the researcher. The researcher's contribution is to give advice to the government based on the results of his research. The last actors are retailer, private certification bodies and NGO. These three actors have no direct impact.

Quality management system implementation at SMEs experienced complex constraints. SMEs often have problems in facilities that support quality management systems, financial capabilities, and creating a brand. This problem is rarely found in large industries, so the government should give more attention to SMEs. In addition to making national priorities, another strategy that should be done by the government is to campaign for food safety and its management system for all stakeholders.

The third highest score strategy is to improve human resources. The outcome of this strategy is to improve the reliability of two important actors (government agencies and SMEs). HR has a significant relationship with performance. Employee performance can increase as much as 33.37% by developing human resources [20, 21]. The next strategy is to involve all stakeholders in preparing the SKP. Involving all stakeholders is expected to eliminate the constraints of the quality management system implementation, such as the determination of certification mechanism and content in the SKP requirements for SMEs in accordance with the classification of products produced without reducing or eliminating the principles of the quality management system. The last two strategies are Designing easy and clear certification submission guidelines and encourage investment in SMEs. Current conditions often found cases of large industrial fisheries and SMEs who do not know the flow or distribution permit that must be met before distributing the

product. This is due to the many instances of the various sectors involved in the management of food safety. This overlap is confusing SMEs, even industry in general. The last strategy is to encourage investment in facilities that support the quality management system implementation in SMEs. SMEs have financial problems for many reasons. Government agencies as the builder must assist the equipment and physical development in order to realize PRP (SKP) certified SMEs. This investment is expected to increase SME acceleration in obtaining SKP.

The strategy then analyzed the classification based on driving power and dependence power (DP-D) in each alternative strategy (Fig 5). The analysis results obtained two strategies in the independent quadrant, that are making the scale of national priorities in realizing the quality management system implementation and campaigning for food safety and its management system. It showed both strategies have great power and influence other strategies.

Linkage quadrant obtained one strategy that improves the competence of human resource on food safety at government agencies and SMEs. These strategy cause instability of the system as their power of affecting and getting affected by the other strategies is high.. Strategy to improve human resources can be applied to independent strategies because the value of driving power is less than independent strategies. Quadrant dependent obtained three strategies that involving all stakeholders in formulating certificate of PRP (SKP) guidelines, designing easy and clear certification submission guidelines and encourage investment in SMEs. These strategies have high dependent power value, that getting high affected by the other strategies. This makes the dependent quadrant strategies applied most recently

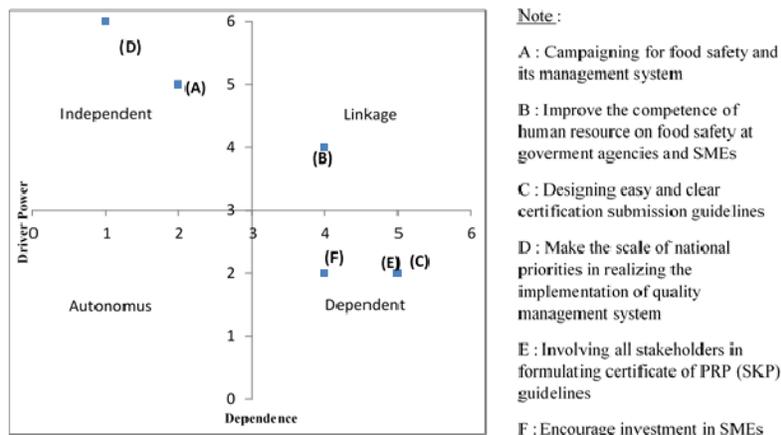


Fig 5: MICMAC Graph classification strategy

4. Conclusion

The PRP implementation of SMEs Bening Food has not been effective. The raw materials used by SMEs and the fish cake are not yet in accordance with SNI. The result of evaluation of critical point and defect using SPC shows not yet fully controlled. The most influential actors in realizing the quality management system implementation in SMEs are government agencies and SME actors. The first strategy to be implemented is to make national priorities, campaign the quality management system implementation throughout the stakeholders and improve the competence of human resources.

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