Specific Fish-Based SME's Production System Typology to Perform Industrial Development in an Archipelago System

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Abstract—**Fish is a superior commodity in Province of Maluku with fish production potential about 1,627 million ton or 20% of total national fish and only 33% or 528.000 tons used for fish processing. This is caused by less infrastructures and fish production facilities as smoked fish product (in local term called Ikan Asar). This paper is aimed to formulate a particular production/manufacturing system typology for a small enterprise and produce a production system design in *large batch (repetitive) manufacturing*. First performed was identification of an existing fish production system, then formulated configuration of respond to customer design, process design, and production planning and control system design in *large batch (repetitive) manufacturing*. The results are Make-to-stock for respond to customer strategy, large batch (repetitive) manufacturing as process design, and Just in Time Pull System as production planning and control system design.**

Index Terms—**smoked fish, production planning and control, small enterprise, *large batch manufacturing, archipelago***

I. INTRODUCTION

A hard challenge for an archipelago area to develop its industry is that its narrow islands where unattractive for the investors to invest their money in such that area. Moreover the local government has an obligation to develop their potential to serve themselves. That's one reason why, whatever how hard it will be, industrial development must established in the archipelago area.

For A country like Indonesia, one of its archipelago Province, Maluku, has been commenced as The National Fish Barn since 2011, and encouraged to increase its fishery production facilities. Based on the Record of Department of Marine and Fishery, 2011, usage of fishery potential has just 33% of 587.000 tons of fish potential, and from that 33%, only less then 10% for industrial fish production [1]. Based on the last 20 year data showed that in Indonesia, processed fish production is only 23 – 47% and the rest sold as fresh fish or wet fish. Traditional processing method such as salting, drying, smoking, and fermentation are more dominant than modern processing such as freezing and canning. It can be temporary concluded that fish percentage for

traditional processing has always high, though this kind of product has less prestigious image or used to be called as "fish for the poor". This illustration indicates that traditional fish processing has prospect to be developed by improvements to fulfill the quality and security requirements [2]. Most production facilities for fish-based product are still in small scale production system or Small Enterprise scale (SME).

A fish based SME has its own characteristics as the other SMEs for its small capacities, traditional managed production system, etc. But, in another point of view, it has particular product sound which determined the way of its production system run. This paper is aimed to find out and identify such unique characteristics and conclude it as the specific pattern of production system typology for the SME. Its further goal is to make it easier for a manager and also the authorities to develop the SME, so that they can courage industrial development and local economic progression.

Smoked fish is preserved fish by heat and smoke from firing hard woods which are highly produce smoke and slowly burned. There are two ways of smoking, traditional way and cold way. In traditional way, smoke produced by wood firing or others biomass (such as coconut fiber, acacia powder, and mango powder). Materials for smoked fish are: fish, wood (or coconut shell), and salt (*optional*). Equipment for smoking process are smoking barn (*a traditional wooden barn with bamboo shells*) to smoke the fish, knives and cutting board. The processes are preparation process where the fish have to be cleaned, cut in half, and filleting; then smoking process and packing process [3].

II. METHODOLOGY

This research is a qualitative research by using description (survey) as the research method. Data collected using observation and interview to some owners and employees of fish product SMEs. The data then used to identify characteristics of the existing production system by using four classifications of production system:
1) According to The Process for Output
   a. Continuous Process
   b. Intermittent Process
   c. Repetitive Process
2) According to Operational Goal

a. Engineering to Order
b. Assembly to Order
c. Make to Order
d. Make to Stock
3) According to Operation Flow and Product Variation
a. Flow Shop
b. Continuous Shop
c. Job Shop
d. Batch
e. Project Shop

Algorithms

We have developed procedure to construct such typology based on the logic of how we seen the system run:

Step 1: Identification of the existing system
Step 2: Formulation of the existing production system
Step 3: Alternatives designs of manufacturing system
Step 4: Criteria of choosing
Step 5: Determination of respond strategy toward the customers
Step 6: Determination of production process strategy
Step 7: Determination of production planning and control system strategy

III. RESULTS

A. SME System Sumarry

The first thing when approaching a problem situation is to familiarize yourself with the situation, its processes and structures, the people involved, their aims and desires, the relationships between them, the hierarchy, or power structure, the resources available, the sources of data and information [4], … to depict a complex situation is by drawing a Rich Picture Diagram.
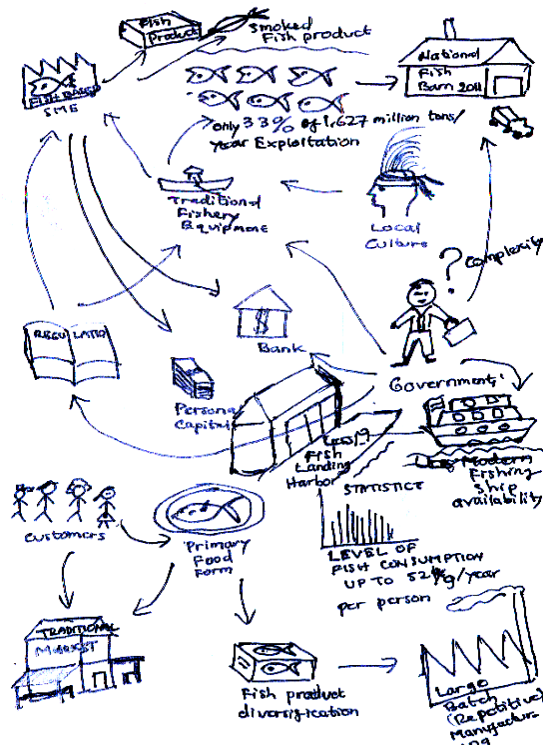

Figure 1. Rich picture for fish-based SME.

To summary the SME system in Maluku, which has many elements and constraints involved, we constructed a Rich Picture as shown in Fig. 1.

The system is a stochastic system characterized by some behavior of the member or components or the system may be affected by random or stochastic inputs. There are three major components of the situation represented in the rich picture:

1) Elements of structure, are: production facilities, fish availability, customer's preferences, market or demand, government, information and data, fish products, etc.
2) Elements of process, are: fish catching, fish processing, distribution and logistics, marketing, governmental controlling and guidance, etc.
3) Relationship between structure and process and between process, such as: fish availability affects fish production volume, customer's preferences determine the the level of consumptions, etc.

The components involved in the system are the SME managers, fishermen, the government, customers, and the society. The way of how SME runs its operations effected by the culture of Maluku society, while at the same time variety of customers' preferences and market progress pushed it to re-configure its old pattern of operations and production system. The government has responsible to encourage the fishermen to raise their fish catch from view of production push and production pull, but on the contrary, common condition and cultural characteristics of the people on the contrary seem to hardly change from the customer community to producer community.

B. Three Level Characteristics of Manufacturing

This research observed a SME production system, and had concluded the pattern of traditional SME as shown in Table I.

TABLE I.   THREE LEVEL CHARACTERISTICS OF MANUFACTURING

No	Attribute	Exist	Don't Exist	Description
Process Level				
1	Raw material	√		Fresh fish
2	Labor	√		4 workers
3	Technology	√		Manual
4	Financial	√		Self funded and bank
5	Product	√		Smoked fish (Ikan Asar)
6	Revenue	√		Selling IDR. 22.500.000,00
7	Profit	√		± IDR. 13.500.000,00/month
8	Pollution	√		solid, liquid, gas
9	Process	√		Traditional
Operation Level				
1	Material flow	√		No inventory.
2	Scheduling of job		√	-
3	Machining maintenance	√		Cleaning
4	Pricing	√		Traditional: base on design
5	Promotion		√	-

6	Post-sales		√	-
7	Environmental	√		residue, dust, damaged product
8	Accounting	√	√	Traditional
9	Organizational structure		√	Only different between owner-worker
10	Work force	√		4 worker include the owner
11	Training		√	-
12	Product liability		√	
13	Occup. & health safety act		√	-
Strategic Level				
1	New technologies		√	-
2	Research & development	√		Box package
3	New market	√		
4	Partnerships	√		Experience & customer loyalty
5	Finance		√	
6	Socio/Political		√	

These characteristics are typical for a SME as the same for common SMEs, but these characteristics has its own characters in term of how they make the system performs.

C. Typology of the SME's Production System

Base on the fact condition in the SME, the typology of the production system can be shown as in Table II. The colored rows are specific types of the existing SME's production system.

TABLE II.   TYPOLOGY OF THE SME'S PRODUCTION SYSTEM

Type	Characteristics	Description of the Real System
1. According to Process for Output		
Continuous Process	- mass product number - few product variations - standardized - same product type - short set-up time - facility lay ot base on the products made (Product Lay Out)	- 60 – 100 sticks/day - Smoked fish product/Ikan Asar - ≤ 20 minutes - Each production output is a batch of smoked fish, with the same operation sequence from beginning to end
Intermittent Process/Discrete System		
2. According to The Goal of Operation		
Engineering-To-Order		
Assembly-to-Order		
Make-To-Order		
Make-To-Stock	- safe end product - level of inventory depends on respond time, demand, and demand variability. - short lead time - intensive capital - production schedule determined by demand estimation	- Raw fish has directly processed to smoked fish - Number of material to buy has estimated from demand estimation - Continuous supply of self funding
3. According to Flow of Operation and Product Variation		
Flow shop	output units sequently have to pass the same operation sequence	For each production, fish material processed by the same sequence process sequent
Job shop		
Continuous		
Batch		
Project		

D. Concept of Modern Small Enterprise Manufacturing System Development

Based on the Deming Wheels, this paper also formulated steps to develop an existing SME into a Modern SME on the characteristis of an archipelago System as shown in Fig. 2.
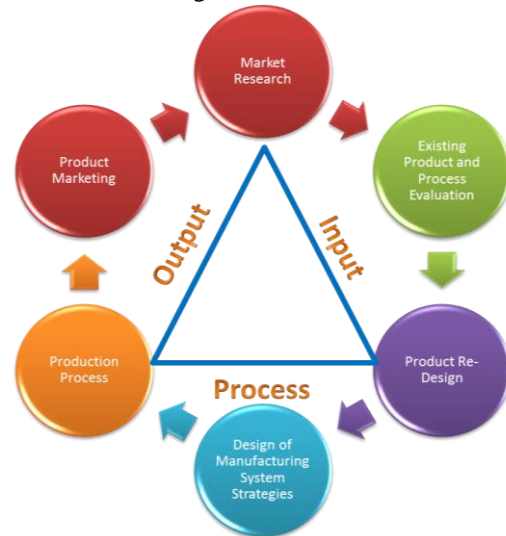

Figure 2.   Six circle cycle for SME's development (Sitnah, 2015)

The SME's development can be maintained into six steps:
Input:
-    Market Research,
-    Existing Product and Process Evaluation
Process
-    Product Re-Design
-    Design of Manufacturing System Strategies
Output
-    Production Process
-    Product Marketing

E. Modern Manufacturing Strategy

1) Respond strategy toward customer

It is possible for a fish-based SME to primary categorized as a make-to-stock respond strategy toward customer since the continuous and abundant availability of raw materials (fish) and opportunity to increase their production capacity, and the high demand of fishery products.

Figure 3.   Respond to demand and manufacturing process matrix

In Fig. 3, bold lined rectangle means primary match. It means that for large batch (repetitive) manufacturing and continuous flow process can use make to stock system, since basically repetitive process produces standard commodities with a high volume, short customer lead time, operated in constant or nearly constant level [5].

2) Manufacturing process strategy

Make-to-stock strategy is suitably used by a Large-Batch (Repetitive) Flow Process, because basically repetitive process produces standard commodities in high volume and commonly has short customer lead times and more efficient then Project Process, Job Shop Process, Small-Batch Flow Process, Continuous Flow Process, or Agile Flexible Manufacturing System [5].

Figure 4.   Product type and manufacturing process matrix

In Fig. 4, shows relationship between manufacturing process and product type. For a Large Batch (Repetitive) Flow of the SME, we considered a system from low volume – one type fish product production system to medium volume - few type fish product production system.

3) Production/Manufacturing planning and control system strategy

Design of production planning and control system strategy has to count on the dependency between both respond strategy toward the demand and manufacturing process. This dependancy can be shown as in Fig. 5.

Figure 5.   Product type and manufacturing process matrix

In Fig. 5, the Capital J means Just in Time Pull System and the small m is the Material and Capacity

Requirement Planning (M&CRP)-MRP II System. The capital means major applicability while small letter means minor applicability. Rectangle with thick line means primary match between respond toward customer and manufacturing process..

Just in Time Pull System will best plan and control Large Batch (Repetitive) Manufacturing. Material Requirement Planning Model in M&CRP system can be applied in this kind of manufacturing process, but the CRP can't be. [5].

IV.   Conclusion

Here are some conclusions to be made:
1) The result for identification of the three level characteristics of manufacturing shows that the smoked fish SME can be concluded into small enterprises or *Industri Kecil dan Menengah*.
2) The smoked fish SME can be developed to Continuous Process (according to the process for output), Make-To-Stock (according to goal of operation), Flow Shop (according to operation flow and product variation).
3) As a make to stock system, the smoked fish SME can be characterized as follows: Product (standard), Product need (can be forecasted), Capacity (can be planned), Production time (not important to the customer), Key of competition (logistic), Operation complexity (distribution), Operation unclearliness (lowest), Top management focus (marketing/ distribution), Middle management focus (stock control), Type of saved product (final product), Level of inventory (depends on time of respond, demand, and demand variability), Impact of Lead Time (shorter, fewer level of inventory, faster unpredicted demand, need flexible capacity), Capital continuity (intensive), Customer Character (No or short waiting time), Production schedule (Determined by estimation to the demand), Base of selling (Base on Available to Promise (ATP), portion of unallocated inventory).

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