

## New Product Development from Inactive Problem Perspective in Indonesian SMEs to Open Innovation

**RonyPrabowo, Moses Laksono Singgih,  
Putu Dana Karningsih and Erwin Widodo**

*Department of Industrial and Systems Engineering, Industrial Technology Faculty,  
InstitutTeknologiSepuluhNopember Surabaya, Jl. Teknik Kimia, Keputih, Kec.  
Sukolilo, Kota SBY, JawaTimur 60111, Indonesia;*

**RonyPrabowo**

*Department of Industrial Engineering, Industrial Technology Faculty,  
InstitutTeknologiAdhi Tama Surabaya, JalanAriefRachman Hakim,  
KlampisNgasem, Sukolilo, Kota SBY, JawaTimur 60117, Indonesia*

### ABSTRACT

New product development is an important innovation that should be done to meet consumers' new trends. This paper is prominent as it discusses new product development through the inactive problem perspective in SMEs in Indonesia as a way to explore customers' expectations, which are often challenging to analyze. The capability to develop a new product based on the inactive problem perspective allows SMEs to become pioneers that possess various competitive advantages, including strong brand awareness. This study included 14 samples of SMEs to represent the characteristics of SMEs in Indonesia between 2016 and 2018. We used the particle swarm optimization approach for the decision making of several SME parameters with the profit maximization function. This paper is the first paper to discuss the relationship between the cost of ideas and production costs in the types of SMEs with an inactive problem perspective in Indonesia to obtain maximum profits by considering various factors that affect the costs and revenue of SMEs. This paper also analyzes the cost used for an idea realization to get maximum profit. This study shows that differences were found in each type of SME, and these difference were related to the amount of funds that were used to explore, realize, and make a profit out of a specific idea.

### ARTICLE INFO

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### 1. INTRODUCTION

Product excellence, market potential, the fulfillment of customers' needs, pre-development, capability, and the utilization of resources are factors that give significant effects to the performance of a new product . There are two perspectives of the new product development approach to meet the needs of customers, and these are the active problem and inactive problem perspectives. Within the active problem perspective, companies convince their customers that they have specific problems, and the companies provide certain products as the best solution to those issues. Within the inactive problem perspective, however, companies are required to analyze customer behaviors that are related to the uncovered problem (problem capture) to be able to provide a precise solution to the problem in the form of new products. The inactive problem approach is characterized by the fact that the customers have not yet realized their issues that are related to specific product consumption companies have fewer information about customers' problems and demands and customers show conative behaviors (psychological behavior that leads to actions) to fulfill their needs. The inactive problem approach has some advantages because it shows brand awareness that engages loyal customers, gives longer life cycles to their products because other companies have not yet designed any product through the inactive problem perspective, and it provides a company with a supernormal profit that enablesthe company to make other derived products because the other companies still need a longer time to make replica products . However, the use of an inactive

problem perspective in developing new ideas has some weakness including the relatively longer time that is required for the realization of a certain idea and the need for highly qualified human resources, high costs, and high product prices. The characteristics of business management in SMEs to obtain maximum profit are quite complex because various problems that are related to complicated combinatorial optimization require the use of many intricate iteration procedures. Thus, to solve the problems that are related to the optimization of the use of capital, ideas, and products, the PSO (particle swarm optimization) method can be employed. This model only requires a few parameters and provides optimization results that are closer to the real condition. Therefore, PSO is expected to give more efficient results. PSO is a non-deterministic optimization method that regards the swarm intelligence known as the behaviorally-inspired algorithm as an alternative to the genetic algorithm; this is otherwise known as an evolution-based procedure. This method is simulated in a certain dimension by using several sets of iterations to which each particle is positioned in order to aim at a certain target (the minimization or maximization of certain functions). Iteration is done up to the maximum point or up to specific termination criteria.

This paper explains the results of an analysis of the factors of SME types, managerial concepts, and the characteristics of consumers, all of which have a certain influence on new product development through several indicators. The results of the analysis were used as the basis in determining mathematic equation models by using the PSO approach in which financing capability and new product design were set as the parameters to measure the primary target: the profit maximization of SMEs. The developed mathematic models are expected to provide information that is needed in the planning and management of SMEs in Indonesia in order to make Indonesian SMEs more advanced and possess adequate global competitiveness.

## 2. MATERIALS AND METHODS

### 2.1. *New Product Development*

The word “product” refers to anything being offered to fulfill the needs and expectations of other people. Products are offered in the form of goods, services, experiences, events, people, places, properties, organization, information, and ideas. Meanwhile, new product development refers to (1) appearance or form changes that should improve the look and the form of a product (2) performance improvements that deal with how to improve the function of a product based on its primary purpose, design, and appearance (3) ingredient changes that deal with modifications in the structure, production process, and formulation of a product (4) price/value changes that modify the product’s price.

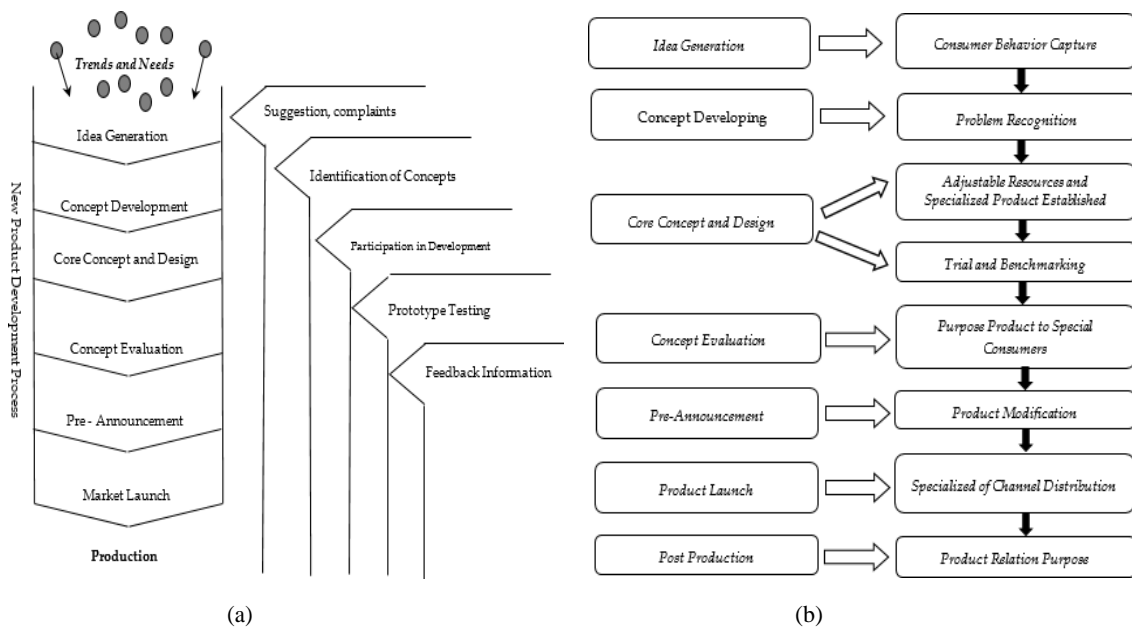
A new product should be characterized by better product quality that refers to the upgraded ability of a product in performing its function, including durability, reliability, and outcome accuracy. The new product should also provide better features that make a product more competitive than others even when it is compared to other companies’ products. Furthermore, new products should be wrapped in a better look and design to increase the product’s value for the customers. Well-designed products attract customers’ attention, improve product performance, decrease production expenses, and give definite competitive advantages.

### 2.2. *New Product Development within the Inactive Problem Perspective*

Idea generation within the inactive problem perspective can be obtained through observation and inferring customers’ expectations from their behaviors. The identification of a concept within the inactive problem perspective can be made by determining target customers’ problems. The core concept and design should be adjusted to the available resources and product criteria. They should undergo various trials or simulations and be compared to the products of other SMEs or benchmarking products. Concept evaluation is done by directly offering the product to specific customers. Specific customers are those who limitedly understand that the product that is provided by individual SMEs can fulfill their problems that are related to the product’s function. In this pre-announcement phase in which the inactive problem perspective is directly applied to the product modification phase, this type of product is slightly customizable. In product launching, companies should create specifically limited distribution pathways to market their product while in the post-production phase, within the inactive problem perspective, development should be done to certain product functions that can be modified from products that have been previously made or from other derived products.

Figure 1a illustrates the stages of product development with an active problem perspective, while Figure 1b illustrates the stages of product development with an inactive problem perspective. Collecting consumers’ problems with the inactive problem approach is more needed by companies in new product development than that done with the active problem approach. The difference between inactive problem and active problem approaches can be seen in Table 1.

**Figure 1.** Differences in the stages of new product development with active problems and with inactive issues. (a) The stages of product development with an active problem perspective (b) The stages of product development with an inactive problem perspective.



**Table 1.** Differences between inactive problems and active problems.

No.	InactiveProblem	ActiveProblem
1.	Consumers have not yet realized the existing problems that are related to the need to consume products.	Consumers are aware of problems that are related to the demand for products.
2.	Companies have little information that is related to problems with products that are needed by consumers.	The company has a lot of information about product problems that are needed to be fixed by consumers
3.	Consumers show conative behavior (psychological behavior that leads to action) to meet needs .	Consumption decisions are based on effective aspects (how to respond to products by accepting, responding, and judging) and cognitive aspects, namely how consumers remember and understand products

An inactive problem is a condition where consumers have not yet realized the needs and problems of the products they consume. In an active problem, companies only convince consumers that they have problems, and brand marketers are the most powerful solution to the problem. In an inactive problem, companies must be able to understand consumer behavior when utilizing the products they consume.

*2.2.1. The Characteristics of SMEs in Indonesia*

According to data from the Ministry of Cooperatives and Small and Medium Enterprises of the Republic of Indonesia in 2018, there are 4.5 million SMEs in Indonesia. SMEs in Indonesia have four types, and some SMEs have more than one type of business. SMEs in Indonesia were chosen as the subject of this study because they have unique characteristics. Some attributes of SMEs are presented in Table 2.

The result of the literature review shows that there has not yet been any comprehensive study on the correlation among the variables of new product development through the inactive problem approach. One study described the four types or classifications of SMEs in Indonesia—artisanal, active, dynamic, and advance—but did not discuss new product development in SMEs. Research that is related to SMEs in Indonesia still descriptively discusses the role of SMEs in Indonesia, obstacles that are faced by SMEs, and the success factors of SMEs in Indonesia, and there have been many qualitative studies on such . Meanwhile, the authors of discussed the process and the types of new product development in SMEs, but they have not yet made any SME classifications and have not yet explained the correlation among the influencing factors of new product development to reach the maximum profit.

SMEs that can develop new products should possess acknowledgment of innovative managerial types, but no study has yet explained business analysis aspects, including cost, profit projection, and risk assessment. The two kinds of consumers within the inactive problem perspective are the passive and conative types . Passive consumers tend to purchase a product impulsively and irrationally, requiring companies to use creativity in ensuring their purchase of their products. Meanwhile, conative consumers are those who involve feelings or emotions when they have to choose whether or not to buy a certain product. Unfortunately, these studies have not yet explicitly categorized the producers as SMEs and have not explained the concept of collaboration within new product development.

**Table 2.**The characteristics of SMEs in Indonesia.

Types of SMEs	Criteria
Artisanal	<ol style="list-style-type: none"> <li>1. Low productivity and low wage.</li> <li>2. Stagnant (no market expansion, low investment rate or production, no production improvement method, slow organizational management, and slow organizational development).</li> <li>3. The target market is the local market (consumer-oriented and low profit)</li> <li>4. Uses traditional tools.</li> <li>5. Some producers do not have an adequate comprehension of company management, and they tend to be rather passive in marketing their products (producers do not have any creative idea related to their market).</li> <li>6. Role of middlemen is dominant (producers rely on middlemen for the product marketing).</li> <li>7. Low rate of cooperation or specialization among other SMEs (no vertical collaboration between companies).</li> <li>8. No external network that supports the enterprises.</li> </ol>
Active	<ol style="list-style-type: none"> <li>1. SMEs have recruited labors with specific specializations and the use advanced technology.</li> <li>2. SMEs have broad marketing networks in a country or abroad.</li> <li>3. SMEs supply the products for the national and export markets.</li> <li>4. SMEs have an excellent comprehension of product quality.</li> </ol>
Dynamic	<ol style="list-style-type: none"> <li>1. SMEs have broad market networks abroad.</li> <li>2. The internal environment of SMEs consists of various heterogeneous skills.</li> <li>3. SMEs employ the advancement of technology well.</li> <li>4. SMEs serve the market.</li> <li>5. SMEs can become pioneer SMEs that hold crucial roles.</li> </ol>
Advance	<ol style="list-style-type: none"> <li>1. SMEs have high degrees of specialization.</li> <li>2. SMEs have broad cooperation in the form of a comprehensive network, as well as connections with reliable suppliers to provide raw materials, components, tools, and other inputs.</li> <li>3. SMEs can provide business service for sellers, distributors, banks, and other parties who want to grow together.</li> <li>4. SMEs cooperate with government institutions, universities, research centers, and training centers within both the local and national scales.</li> <li>5. SMEs are registered in a national and international trading organization to make export easier.</li> </ol>

This paper comprehensively examines the correlation among the variables of new product development in SMEs in Indonesia through the inactive problem perspective for each type of SME in Indonesia. Costs for idea realization to obtain a maximum profit were analyzed to provide adequate insights in the business concept analysis, and these insights can be developed into appropriate business strategies that match with the characteristics of SMEs, including information on the right times to use the active problem and inactive problem method.

*New Product Development in SMEs*

In well-developed countries, SMEs are sources of innovations in production and technology, the development of creative and innovative businesses, new job opportunities, and flexibility in the production process to face the rapid changes of market demand . Smaller-scale industries are usually more efficient than bigger ones in satisfying rapid market demand. The ability of small-scale industries is determined by many factors, including human resources, technology advancement, accessible information, output, and input markets.

Problems that appear in the new product development of SMEs are often related to the deficiency of limited resources and technology, risks in the market, and precise action at the exact time (not too early and not too late) in creating new products; these are the main challenges of company management.

Small scale enterprises have different roles from the bigger ones in conducting new product development, as this process relies on the available resources in the forms of knowledge and skills . Small scale companies deal with limited resources, low market effects, and informal communication, and these are different from bigger companies. SMEs often adopt the product development of bigger companies . Product development is a part of innovation that is mainly a conceptual activity to create ideas to solve specific problems while simultaneously bringing economic value for a company and social value for society. New product development in SMEs often

starts from already existing products that are then given with extra values, or it starts from something ordinary by listening to the opinions and complaints of consumers, employees, the environment, and society. Regarding those explanations, new product development through the inactive problem perspective is more appropriate for SMEs than for big companies.

*Open Innovation for SMEs with an Active Problem Perspective*

In a dynamic business, SMEs should be oriented to innovation. If a company succeeds in applying compatibility between innovative strategic orientation and a dynamic environment, organizational performance will be further improved. The creative ideas of an SME will succeed if the organization implements innovation well because organizational performance is dependent on innovation. Innovation is divided into four dimensions (1) administrative and technical innovation, (2) product and process innovation, (3) radical and incremental innovation, and (4) innovation initiation and implementation. Developing countries often experience difficulties in determining specific innovations. SMEs in developing countries require different decision making processes compared to large companies. The difficulties in determining specific innovations are due to limited human resources and other resources; as such, it is difficult for SMEs in developing countries to implement the dimensions of innovation.

SMEs that have limited resources can open innovation, which can provide positive benefits including the potential for broader marketing, and there is the potential for increased productivity because broader marketing provides many perspectives in managing resources, increases the accuracy for market research and targeting customers, provides potential synergy between internal and external innovation, and reduces the costs of research and product development.

Some open innovation models that can be developed in developing country SMEs, especially in Indonesia, include Idea Competitions: In this model, it is necessary to implement a system that encourages competitiveness among contributors to provide positive ideas. This method provides a positive impact on SMEs to obtain innovative ideas with cheap access in large numbers while also providing deeper insights related to customer needs.

1. Customer Immersion: This method involves extensive customer interaction through SME employees themselves. Companies can thus accurately combine customer input while also allowing them to be more closely involved in the design process and management of product cycles.
2. Innovation Networks: This model is closely related to idea competitions. SMEs can utilize a network of contributors in the design process by offering certain rewards in the form of innovation incentives. A network of contributors is used to develop solutions to problems that are identified in the process of developing new products. The ability of SMEs to ensure value creation in open innovation with this method is strongly influenced by the type of management and the size of the SME network.
3. In Science: This innovation model poses challenges to consumers, users, and even vendors to express consumer ideas or consumer problems, even ones that seem extreme or difficult to be solved by SMEs. Thus, SMEs can spur employees to try to fulfill these problems.
4. Product Platforming: In this method, SMEs provide a framework or tool for idea contributors to access, adapt, and exploit. The aim is for contributors to facilitate the transfer of information and to more fully accelerate the review of a new product with the consideration of many parties.
5. Collaborative Product Design and Development: SMEs can open innovation by collaborating with various parties such as companies that have produced new products, suppliers, or even competitors through what can be called cooperation. With this method, SMEs can make savings in the development of new products, and products can be quickly made or marketed.

SMEs with active perspective problems in developing new products must involve and consider various aspects and elements of collaboration with governments, academia, competitors, and suppliers; they must also consider the characteristics of an open industry that is strongly influenced by the structure of market demand, the nature of purchases, and the types of decision and decision making processes. An open industry structure has side market demands and characteristics including (1) The open industrial market has fewer buyers but is of greater value; (2) industrial market customers are more geographically concentrated; (3) industrial buyer demand is derived from end-consumer demand; (4) demand in industrial markets is more inelastic or less affected by short-term price changes; and (5) demand in industrial markets is faster and more volatile.

Meanwhile, the nature of purchases in open industries has characteristics such as (1) purchases in the industrial market involve more buyers; (2) purchases in the industrial market involve a more professional purchase effort (3) purchases of goods are more continuously made (periodically continuous); (4) purchases are reciprocally made (each company makes purchases of each product); (5) purchases are made through formal purchasing terms (with binding agreements for cash, credit, cash purchases, or leasing); and (6) purchases are



dependently made (generally influenced by various organizational factors). SMEs with an active problem perspective in product development must also consider various types of decisions and decision-making processes when marketing their products in open industries because (1) Buyers in open industrial markets usually face complex decision making; (2) the purchase process is more formal; (3) in purchasing, the seller and buyer work more closely and build long-term relationships; (4) the buyer is influenced by intra-organizational aspects, inter-organizational aspects, and interpersonal relationships.

Market behavior in the open industry illustrates what is done by each SME to compete with others. This component includes various pricing strategies and products that are carried out by companies or industries . Market behavior includes advertising, research, development, and collaboration between companies to exploit markets in the form of collusion or even mergers. The form and intensity of behavior that can be done by each company are very dependent on the market structure in which they operate. Their performance will ultimately illustrate the results of company behavior that is made possible by the market structure that is formed. Theoretically, a relatively concentrated market structure will give rise to market forces for the dominant firm to set prices and inhibit the entry of potential competitors. If this market power is utilized, greater profits compared to its competitors will be obtained. Performance can also be reflected in the growth of assets, which, if accumulated for the entire industry, will shape overall industry growth.

### 3. METHODOLOGY

This study was conducted through some methodological steps that are explained as follows:

#### 3.1. Research Objects

There were 14 manufacturing SMEs who participated as the samples of this study in various areas that were considered able to represent SMEs in Indonesia in survey research. Some criteria were used to select the samples: The SMEs had to be established for more than three years, had to have developed new product at least five times, and have employees with specific skills. Table 2 shows information related to the objects of this study.

#### 3.2. Mathematic Model

##### Objective Functions

Maximum profit can be measured through the availability of capital, generated ideas, product price per unit, production cost, idea generation cost, units of product that can be produced, number of employees, and expert workers, as follows.

$$\begin{aligned}
 \text{Max Profit} = & \left\{ P_i x \sum_{i=1}^m f(x_{ij}) \right\} + \left\{ P_j x \sum_{i=1}^m f(x_{ij}) \right\} - \left[ C_i x \sum_{i=1}^m f(x_{ij}) \right] \\
 & - \left[ C_j x \sum_{i=1}^m \sum_{j=1}^n f(x_{ij}) \right]
 \end{aligned} \tag{1}$$

where:

- $P_i$  = Price of Idea
- $P_j$  = Price of Product
- $f(x_i)$  = Number of Product Design per period
- $f(x_j)$  = Number of Produced Product per period
- $C_i$  = Cost of Idea Generation
- $C_j$  = Cost of Production

##### Limit Function

To obtain the maximum profit out of the available capital and ideas through the inactive problem perspective, idea optimization can be employed by using the available money. Thus, a limited amount of capital and passive consumers were the main limitations of this paper.

$$\text{Maximum Profit if } X_i \leq \text{Available Capital} \tag{2}$$

$$X_i > 0 \text{ (Capital Spend Non Negative)} \tag{3}$$

$$\sum_{i=1}^{i=14} X_i \leq 2 \text{ Billion} \tag{4}$$

$$\text{Number of Employees} = \sum_{i=1}^{i=14} E_i \geq 5 \text{ People} \tag{5}$$

$$\text{Number of Expert Worker} = \sum_{j=1}^{j=14} E_j \geq 2 \text{ People} \tag{6}$$

Where  $E_i$  and  $E_j$  are the independent variables that determine the correlation between certain phenomena, which, in this context, refer to the amount of capital that is available with the profit obtained from the production process in SMEs.

### 3.3. Optimization Using the Particle Swarm Optimization (PSO)

Here, the application of PSO employed the capital of SMEs, which was called the swarm, and the idea realization through the utilization of capital was called a particle. Each particle moves at a speed that is adapted from the searching area and stored as the best achievement position. The steps of optimization when using PSO were: (1) Determine the initial parameter  $u$ ,  $\alpha$ ,  $\beta$ ,  $\gamma$ , where iteration was set at 1; (2) select the random sample  $X_1, \dots, X_N$  from a certain probability distribution function  $f(-;u)$  and the selected sample  $(1 - \gamma)$  from the ranked performance; (3) use the same samples to adjust the parameter values; (4) apply the equation  $\tilde{v}_t = \alpha w_t + (1 - \alpha) \tilde{v}_{t-1}$  to run the vector  $\tilde{v}_t = u$ . When going back to Step 2 with new parameter value, it was determined that the iterations =  $it + 1$ ; (5) analysis is stopped when the stopping criteria are fulfilled.

Based on Figure2, the stages of completion with PSO in this study can be explained as follows: 1.The

#### 1. Determination of Research Parameter

##### a. Constant Parameter.

A constant parameter is a parameter whose value is assumed and maintained constant during the research. Here, the constant parameters included (1) the amount of labor; (2) the number of expert workers (human); and (3) normal production volume (unit).

##### b. Process Parameter.

A process parameter is a controllable variable, and its value can be determined based on the objectives of the study and other considerations. Here, the process parameters included changes in the capital amount, idea realization, changes in the number of consumers, and the obtained profit.

#### 2. The Curve Plot of Profit Performance

The profit curve was created based on capital and idea realization, which was measured by using a computerized calculation.

#### 3. Validation of Optimization Data

Data that were obtained from the PSO method were then validated by correlating the obtained values from the PSO method to the accrual profit of SMEs in the field. The measurement was done by correlating every piece of capital that was used by each SME to get the ideas of new product development by using the inactive problem perspective from the result of the optimization toward the real profit value. The correlation measurement resulted in a correlation coefficient that was then used to measure the validity of each item and to determine if an item was usable. A variable was stated as valid if it shared a significant correlation with the values of other variables (see Table3).

Figure 2. Flowchart for the proposed particle swarm optimization (PSO) algorithm.

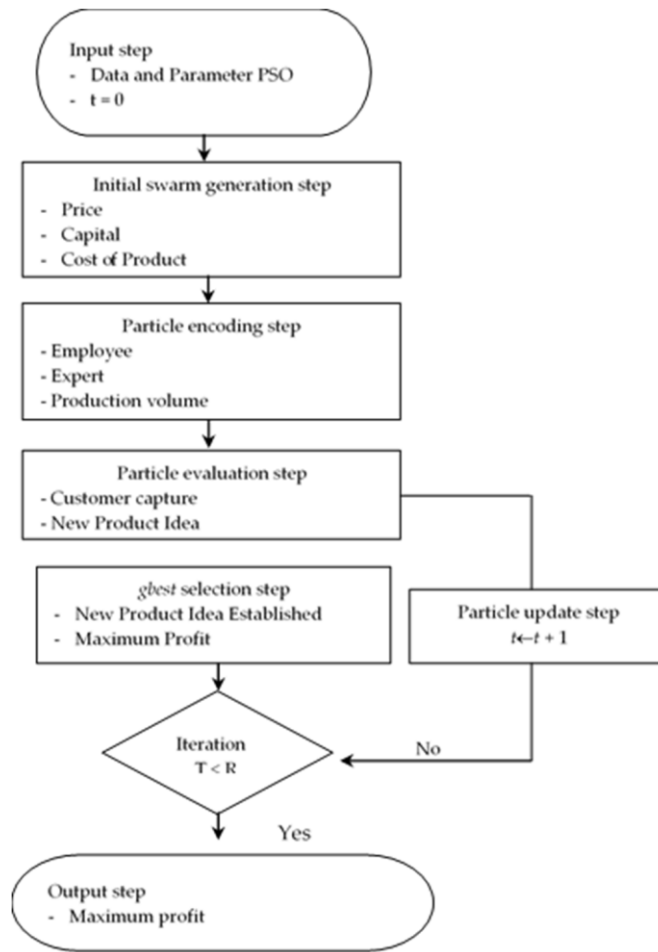


Table 3. The characteristics of research objects.

No.	Field of SMEs	Initial of SMEs	Types of SMEs	Area	Number of Employees (Person)	Number of Expert Workers (Person)	Duration (Years)	Average Orders per Month	Number of Regular Customers	Average Types of NPD That Can Be Made Per Year	Marketing Area
1.	Woodcraft	AJ	Active	East Java	12	3	11	18	42	14	East Java, Central Java, West Java, South Sumatera, East Kalimantan
2.	Textiles	LM	Active	Central Java	16	7	17	119	81	24	East Java, Central Java, West Java, Bali, West Sumatera, East Sumatera
3.	Papercraft	JN	Active	Bali	15	5	10	108	54	30	East Java, Central Java, West Java, North Sulawesi, East Sumatera, West Kalimantan
4.	Jewelry	DH	Dynamic	South Sumatera	36	10	22	52	102	15	East Java, Central Java, West Java, Bali, Timor Leste, West Nusa Tenggara, East Kalimantan, Central Sulawesi, South Sumatera
5.	Pottery and Glass Crafts	ZR	Dynamic	Madura	22	8	28	96	112	22	East Java, Central Java, West Java, West Sulawesi, Southeast Sulawesi, West Kalimantan, East Kalimantan, West Papua, Bali
6.	Rotavator	SG	Dynamic	East Java	41	12	19	12	65	6	East Java, Central Java, West Java, East Sumatera, West Kalimantan, East Kalimantan, East Nusa Tenggara
7.	Pistons	AO	Dynamic	Central Java	38	15	17	62	84	5	East Java and Central Java
8.	Machine Shipping	SP	Dynamic	East Java	53	16	26	8	16	8	East Java, Central Java, West Java, South Sumatera, West Kalimantan, West Papua, Central Sulawesi, North Sulawesi
9.	Tractor	UA	Dynamic	East Java	28	12	19	22	22	4	East Java, Central Java, West Java, and North Sumatera
10.	Sprinkler	PA	Advance	Central Java	56	10	30	16	26	6	East Java, Central Java, West Java, North Sumatera, East Sumatera, West Kalimantan, Central Sulawesi, Malaysia and Thailand
11.	Transplanter	HK	Advance	Central Java	62	15	26	18	14	7	East Java, Central Java, West Java, South Sumatera, East Kalimantan, West Papua, Malaysia, Brunei Darussalam, and Philippines
12.	Processed Vegetable Food	RF	Active	West Java	17	2	18	62	230	18	East Java and Central
13.	Sawdust	EG	Advance	Central Java	57	9	14	15	24	4	East Java, Central Java, West Java, East Sumatera, North Sulawesi, Timor Leste, Malaysia, Philippine and Vietnam
14.	Coal Briquet	KP	Advance	East Java	53	18	26	9	18	3	East Java, Central Java, West Java, West Nusa Tenggara, South Sumatera, Bali, North Sulawesi, Malaysia, Brunei Darussalam, Philippine and Vietnam



## 4. ANALYSIS OF RESULTS

### 4.1. Results of Calculation Using PSO Algorithm and Discussions

In this study, SMEs of the artisanal type were not used as research objects because artisanal type SMEs in Indonesia often change businesses, are easily bankrupted, not well managed, do not pay attention to product quality, and are very dependent on middlemen. Additionally, finding and collecting data on artisanal type SMEs is very difficult, and efforts to develop products also do not exist. Artisanal SMEs prefer to copy products that are already on the market.

The results of data analysis on the use of capital and attainable ideas for new product development within the inactive problem perspective of each SME are presented in Table 4.

**Table 4.** Result of data analysis when using PSO.

Type of SME	Initial Population ( <i>N</i> ) 100 and Iteration 500			
	Minimum Capital (Rp)	$F_{max}$	$X_{opt}$	Effective Capital (Rp)
Active SMEs	50,000,000	22,681,046–89,359,153	5	50,000,000–750,000,000
Dynamic SMEs	325,000,000	145,723,582–283,712,718	8	325,000,000–1,150,000,000
Advance SMEs	400,000,000	265,772,572–398,507,295	10	400,000,000–2,000,000,000

Table 4 shows the  $X_{opt}$  value, which reflects the attainable ideas in new product development, while  $F_{max}$  indicates the achievable profit. Active SMEs have been able to develop new products by using sufficient capital of around Rp 50,000,000–750,000,000 to explore 8–10 ideas. Thus, the minimum obtained profits were between Rp 22,681,046 and 89,359,153. In active SMEs, the use of capital higher than Rp 750,000,000 leads to the inefficient allocation of capital and, as such, overproduction, oversupply, and the procurement of unnecessary facilities.

Dynamic SMEs have been able to put specific ideas into realization in new product development by using capital of around Rp 325,000,000–1,150,000,000 to realize 6–8 plans, resulting in a minimum profit of between Rp 145,723,582 and 283,712,718. In dynamic SMEs, the use of capital higher than Rp 1,150,000,000 leads to inefficient capital use and allocation in the forms of over-promotion, over marketing, the recruitment of more employees, and an increase in transportation costs, none of which are entirely necessary.

Advance SMEs can put their ideas into realization by spending an adequate capital of around Rp 400,000,000–2,000,000,000 for 5–7 designs and obtaining a minimum profit of around Rp 265,772,572–398,507,295. In active SMEs, the use of capital above Rp 2,000,000,000 triggers inefficient capital utilization and allocation in the forms of unnecessary machine procurement, employee recruitment, and the oversupply of raw materials.

### 4.2. Result of the Graphic Analysis

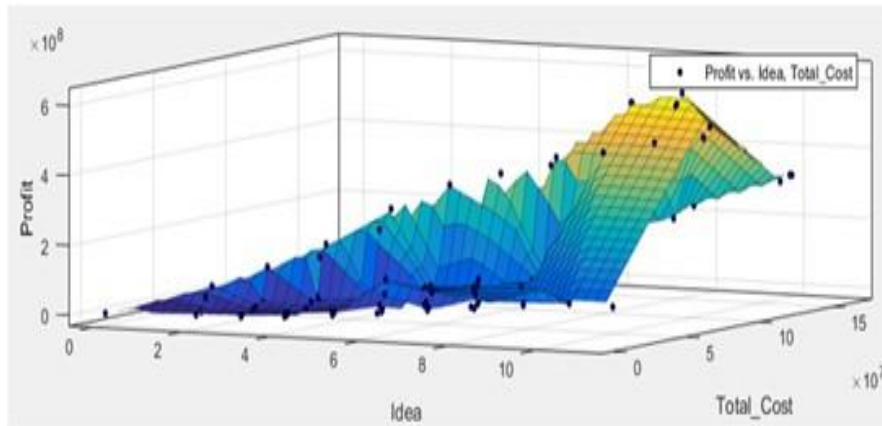
Active SMEs initially had a constant line forming saturation patterns, which indicates that the cost and idea realization strongly determine the obtained profit in new product development within the inactive problem perspective. However, at specific points, the higher cost of idea realization was found to decrease profit. The correlation between these two variables was rather linear. However, it was found that more ideas trigger higher costs, as the expenses to pay for expert workers and work duration increase (Figure 3).

Figure 4 shows that in ideal conditions, active SMEs can obtain a maximum profit if the  $C_p$  value (production cost) is between 1 and 1.5 by the  $C_i$  value (idea cost). This indicates that if  $C_p/C_i < 1$ , then the profit will not be obtained at the maximum amount. On the other hand, if  $C_p/C_i > 1$ , the profit declines.

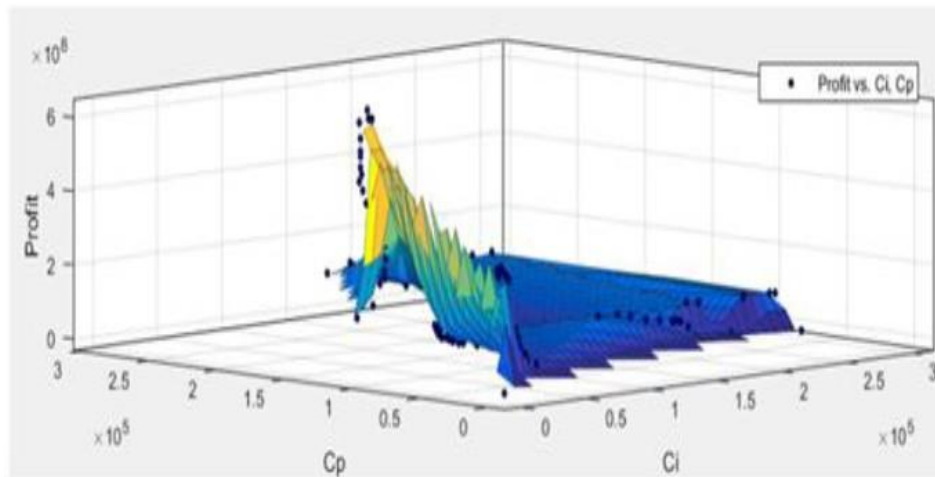
It was found that dynamic SMEs show an increase in cost and increase in ideas that strongly influence the amount of obtained profit in the development of new products through inactive problem perspective. However at some points the higher the cost and idea the lesser the amount of profit.

(Figure5). More ideas result in higher costs for new product development, while the consumers of dynamic SMEs are rather passive by only accepting any ideas offered by the producers.

**Figure 5.**The curves of correlation between ideas, total cost, and profit in dynamic SMES.



**Figure 3.**The curves of correlation between idea, total cost, and obtained profit in active SMES.



**Figure 4.**The curves of correlation between idea cost and production cost in active SMES.

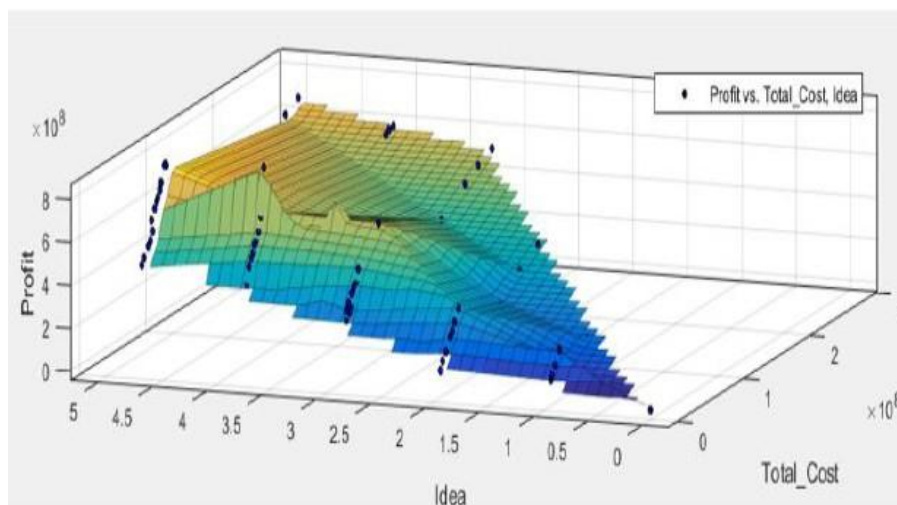
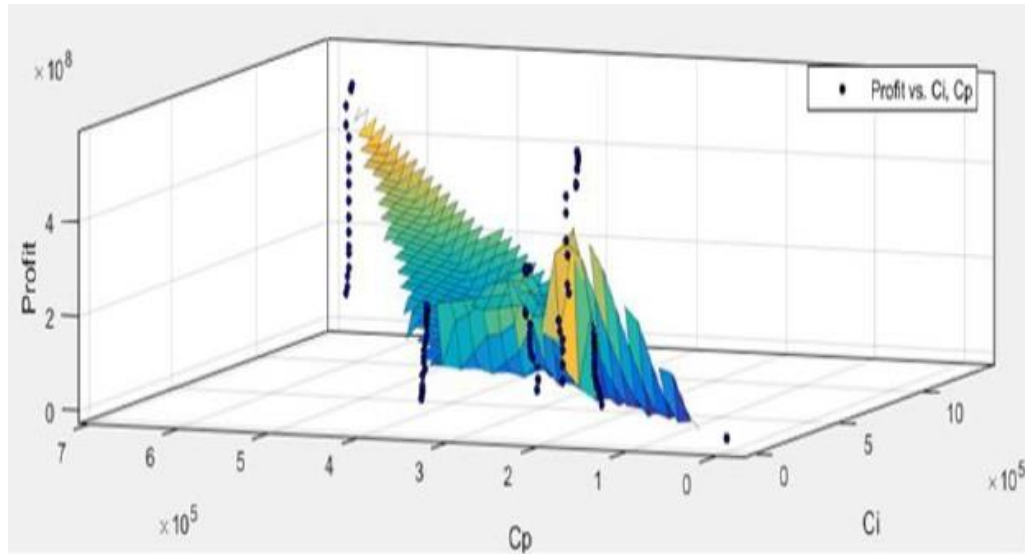


Figure6shows that dynamic SMEs can obtain a maximum profit when the  $C_p$  value (production cost) is between 5 and 7 by the  $C_i$  (idea cost). This indicates that if  $C_p/C_i < 5$ , the profit will not be obtained at the maximum amount, while if the  $C_p/C_i > 7$ , the profit declines.

**Figure 6.**The curves of correlation between idea cost and production cost in dynamic SMES.



Advance SMEs show increases in cost, and the addition of more ideas strongly influences the amount of profit of new product development through the inactive problem perspective. In this context, the higher the amount of invested capital, the more ideas for the new product development that can be realized which eventually increases the amount of profit as shown in Figure7. This condition is quite relevant and typical of the consumers of advance SMEs who are rather conative, as they always want to be involved in the new product development process.

**Figure 7.**The curve of correlation between ideas, total profit, and profit in advance SMEs.

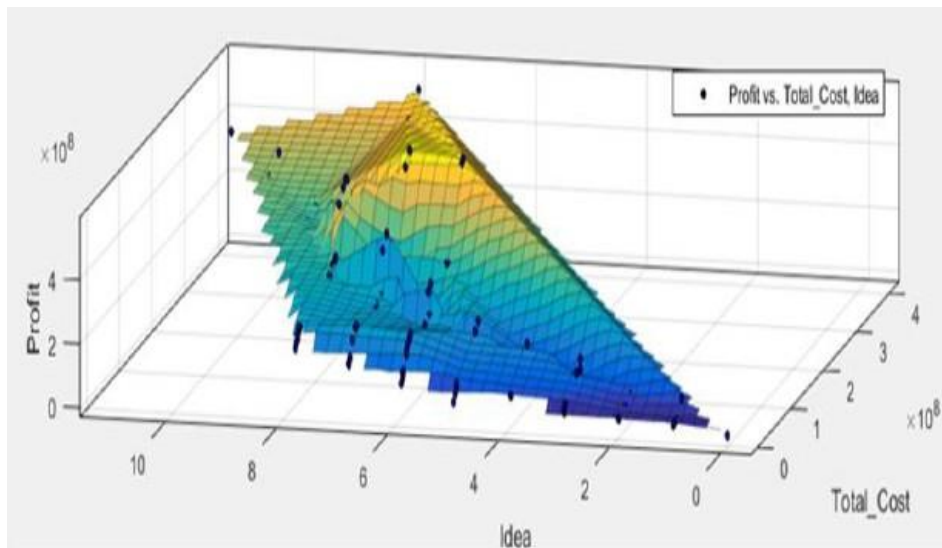
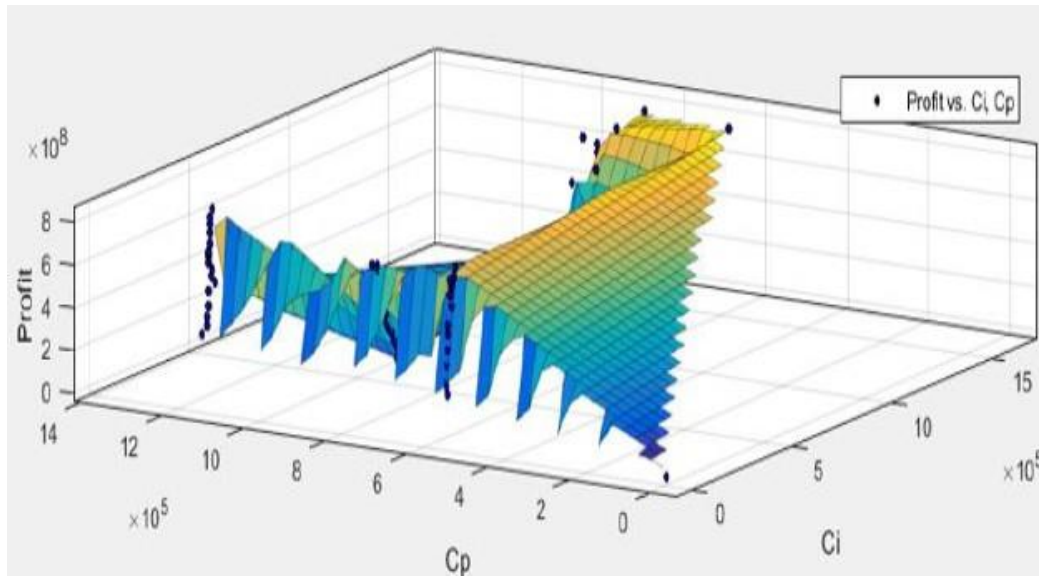


Figure8shows that within the ideal condition, to obtain the maximum profit of advance SMEs, the  $C_p$  value (production cost) should be between 4 and 8 by the  $C_i$  value (idea cost). This indicates that if  $C_p/C_i < 4$ , maximum profit will not be obtained, but if the  $C_p/C_i > 8$ , the profit will decline.

**Figure 8.**The curve of correlation between idea cost and production cost in advance SMEs.



4.3. Optimization of Validation Data

The validation of the data that were analyzed in the optimization procedure was done by administering a field survey in SMEs, in which two SMEs represented each type of SME. The second validation was done by using the Pearson correlation measurement. The data that were obtained from the field survey are presented in Table5.

**Table 5.**The results of validation.

Types of SMEs	Active SMEs	Effective Capital	F <sub>max</sub>	X <sub>opt</sub>
Active SMEs	AJ	185,000,000	34,580,000	8
	RF	122,700,000	24,750,450	9
	LM	156,200,000	18,230,750	8
	JN	171,600,000	30,550,000	7
Dynamic SMEs	Dynamic SMEs	Effective Capital	F <sub>max</sub>	X <sub>opt</sub>
	DH	874,975,000	96,114,000	9
	ZR	1,150,292,000	124,650,700	10
	SG	958,654,000	81,448,700	8
	AO	683,973,000	156,702,000	7
Advance SMEs	SP	850,610,000	87,900,120	9
	UA	1,025,085,000	201,045,000	7
	Advance SMEs	Effective Capital	F <sub>max</sub>	X <sub>opt</sub>
	HK	1,360,750,500	285,771,390	8
	PA	1,600,875,000	386,812,720	9
	EG	780,550,000	183,563,000	11
	KP	1,200,000,000	305,664,040	6

In the initial names of SMEs mentioned in Table3, SE = an SME making wood crafts with various models; UM = an SME making handicrafts from woven cloth and traditional batik with multiple motifs; JN = an SME making souvenirs and handicrafts from processed paper with numerous models, writing,

pictures and combinations; RF= producers of high nutrient snacks for children who dislike vegetables; DH = an SME making souvenirs and jewelry from metal with various models and combinations of other materials; EG = producers of patterned glass; AJ = a manufacturer of spare parts and agricultural machinery for retail sales with superior rotavator products; AO = producers of rare automotive spare parts; SP = producers of spare parts and ship machine repairs; UA = producers of customizable environmental-based agriculture tools with superior tractor products; HK = producers of customizable environmental-based agriculture tools with superior transplanter products; PA = a manufacturer of spare parts and agricultural machinery for retail sales with superior sprinkler products; ZR = a producer of long-term alternative fuels from wood powder; and KP = manufacturers of alternative fuels from coal formed and pressed with calories and composition to suit the needs and uses of consumers. Generally, validation was done by conducting a field investigation, the result of which was then analyzed by using the PSO algorithm approach based on the real condition of SMEs. However, one SME under the advance SME category, EG, showed a different result in which the obtained profit was lower than the result of the PSO optimization. However, it had more realizations of ideas than the consequence of PSO optimization. A more in-depth analysis on this phenomena showed some influential factors including the fact that EG cooperated with other business allies in producing its products, hired a relatively high number of contract expert workers, conducted direct field surveys, and employed exciting promotions to attract consumers all of which decreased the amount of obtained profit. The different results related to the number of realized ideas might have been caused by the job done by expert workers in capturing consumers' thoughts—besides, this company received product orders from other companies.

Correlation measurement was administered to the result of the capital optimization by comparing it to the result of idea realization. The analysis showed a fairly significant correlation in which the Pearson correlation value was found to 0.349 higher than the  $r$  table for the two-tailed test at  $\alpha = 0.05$ . A field survey showed that the factors that caused this decline included an increase in capital amount without being followed by the enhanced ability of employees in developing new ideas, developing production tools, and utilizing the available materials. Employees of active SMEs found difficulties in capturing consumers' behaviors for further new product development. Thus, at certain the culmination point, the graphic moved away from the gradient line. Additionally, the decline might have been caused by the tendency of active SME owners in investing capital increase by building more branches or buying more machines.

## 5. DISCUSSION

Profit increase in each type of SME in new product development, as seen from the inactive problem perspective, is generally driven by the ideas of product development that can be realized and the amount of capital that is invested to pay for the costs. However, increases in the number of ideas and capital investment do not always lead to higher profit in SMEs. Some factors cause this occurrence, including the tendency of SME owners to prioritize investment outside production or idea realization, market absorbance failure of specific products, and different characteristics of consumers in different SME types. It can be implied from the field survey that some SMEs often produced various products out of an idea, but the products mostly had functions similar to the number of the units that kept growing. SMEs have to enhance the quality of their resources to be able to capture consumers' behaviors through programs that are made to improve employees' capability, the use of advanced technology, and efficiency in the production process through new job management or distribution systems.

The results of this study contribute to the decision-making process of related managerial systems by utilizing capital for developing new products, which makes capital spending more efficient because new products can be optimally designed to obtain a maximum profit. Additionally, this study gives particular insights for company management related to the production target and productive employment of workers, as well as minimum orders through the use of PSO analysis, which can be projected upon specific realized ideas, available resources, and strategies to maximize company profit within the consideration of various determining factors in business competition.

The results of the analysis presented in the graphics provide the management or SMEs owners in Indonesia with comprehensive consideration about aspects that are related to the use of the active problem and inactive problem perspectives. Active SMEs can use the inactive problem perspective if  $0.5 C_p \leq C_i \leq 2.5 C_p$ ; however, if  $0.5 C_p \geq C_i$  or  $C_i \geq 2.5 C_p$ , the active problem perspective is more recommended because, at this point, the use of the inactive problem perspective decreases profit and even leads to financial loss due to the inefficient use of funds. Dynamic SMEs are recommended to use the inactive problem method if  $3 C_p \leq C_i \leq 7 C_p$  and to use the active problem method if  $3 C_p \geq C_i$  or  $C_i \geq 7 C_p$  because at this point, the use of the inactive problem perspective decreases profit and leads to financial loss because it triggers higher product prices that drive consumers to look for other products or alternative producers. Advance SMEs are suggested to employ the inactive problem method if  $4 C_p \leq C_i \leq 8 C_p$ ; however, when  $4 C_p \geq C_i$  or  $C_i \geq 8 C_p$ , they are recommended to use the active problem



method because the use of the inactive problem perspective at this point decreases profit and financial loss because it takes longer time to realize an idea that also requires higher expenses and a higher product price.

This study spotted the weakness of the PSO algorithm, as it can only provide a solution by comparing its chosen solution to other solutions within the iteration period. The solutions that are supplied by those algorithms do not possess the concept of an optimal solution. To make idea development more explorative, it is essential to run an optimization analysis on the quality of the expert workers, production machines, and the technology that is used in the process. Rather than hand their concept to a third party and cause higher expenses, this optimization is the most feasible solution to obtain ideas based on the specified targets set by SMEs.

This study suffers from several limitations, including the use of only some SMEs as its samples, the focus which was limited by capital-related considerations, ideas, the number of workers, and profit. Future researchers are encouraged to consider other aspects, such as the types of consumers, the types of management, and the number of distribution channels.

## 6. THEORETICAL AND MANAGERIAL CONTRIBUTIONS

The results of this study contribute to the decision-making process for related managerial systems by utilizing capital for developing new products, which makes capital spending more efficient because new products can be optimally designed to obtain a maximum profit. Additionally, this study gives certain insights for company management related to production targets and the productive employment of the workers, as well as the minimum orders through the use of a PSO analysis that can be projected upon certain realized ideas, available resources, and the strategies to maximize company profit within the consideration of various determining factors in business competition.

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## 7. CONCLUSIONS

This study shows the influence of idea realization on new product development, costs, and the different amounts of profit that can be obtained by each type of SME. Active SMEs can obtain the a maximum profit if the parameters of production cost and idea cost are at  $0.5 C_p \leq C_i \leq 2.5 C_p$ ; however, if  $0.5 C_p \geq C_i$  or  $C_i \geq 2.5 C_p$ , they are suggested to use the active problem method because the use of inactive method, at this point, decreases profit and leads to financial loss due to the ineffective use of funds. Therefore, the most appropriate method for active SMEs in new product development and profit improvement is the allocation of capital for hiring more employees and procurement production machines. This strategy is considered appropriate with the characteristics of active SMEs, as they need to focus on controlling production quality and product quality, both of which can be realized by hiring more workers who understand product quality and production machines.

Dynamic SMEs obtain profit when the parameters of production cost and idea cost are between  $3 C_p \leq C_i \leq 7 C_p$ ; however, if  $3 C_p \geq C_i$  or  $C_i \geq 7 C_p$ , it is suggested that they use the active problem method because the use of the inactive problem method, at this point, decreases profit and leads to financial loss because it increases product prices, driving consumers to seek other products or other alternative producers. Capital allocation for the enhancement of distribution and market networks, as well as the employment of expert workers is considered as the most appropriate strategy for new product development and profit improvement among dynamic SMEs. This strategy is more suitable for the characteristics of dynamic SMEs, which are still required to focus on developing their business networks, which takes more dependable marketing staff.

Advance SMEs obtain a maximum profit when the parameters of production cost and idea cost are around  $4 C_p \leq C_i \leq 8 C_p$ . When the values are around  $4 C_p \geq C_i$  or  $C_i \geq 8 C_p$ , it is suggested that they use the active problem method because the use of the inactive problem method at this condition decreases the profit and leads



to financial loss because the new product development process is longer, thus causing higher expenses that increase product prices. This type of SME should allocate their capital to the addition of high tech machines and investment on raw material for better production, as they should still focus on developing their market or international trading networks. Hence, they need to ensure that their products have better quality and are produced from high-quality materials.

### Conflicts of Interest:

The authors declare no conflict of interest.

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