

Scenario-Based Strategy of Mass Customization in Application to Korean Industrial Cases

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Abstract - The goal of mass customization (MC) is providing customers as much variety as possible for their diverse needs with as low cost as possible for product development and production. The key element in enabling MC is the introduction of product platforms as a part of solutions to reduce additional cost and time for customizing. Currently, a number of methods to apply product platform architecture have been developed to implement MC. However they are only considering the manufacturing process of the product life-cycle even though the cost and time for manufacturing process is lesser than a half of those of whole processes. The goal of this paper is to proliferate the strategy in MC to find the most appropriate strategy for a specific company. It is performed by means of applying strategies for product diversification to other sub-processes. Contrary to the strategy simply for efficient manufacturing, we extended application to other sub-processes such as basic design, purchasing raw materials, and packaging for efficient logistics. In this way, companies are able to provide customized products without changing the current manufacturing system. The extension can yield considerable savings in time and cost in spite of diverse products. In this paper, a scenario-based method is proposed to enlarge the strategy on whole product life-cycle in different ways for maximizing the cost and time savings and customer satisfaction simultaneously. The process and benefit of the proposed a scenario-based method are verified by real world cases of a Korean health food company through several scenarios.

Keywords — Mass Customization, Strategy Proliferation, Sub-Process, Cost and Time Savings, Scenario-Based Strategy.

I. INTRODUCTION

To compete in the global market, many companies are developing products using platforms. This strategy can fulfill the customers' specific needs by increasing the product variety and decreasing the additional cost and time simultaneously [1]. Derived platforms for the strategy in the past decades are developed only by considering manufacturing process and common components of product themselves without considering other sub-processes such as logistics, purchasing, etc. However, in the real situation for many products, cost for packaging, logistics, purchasing and design is larger than the cost of materials and manufacturing in many cases [2, 4, 7]. Consequently, companies are needed to consider the extended application of platform-based product development for not only manufacturing but the whole processes for the product life-cycle.

Because of various customer requirements, companies offer diversity on products by implementing MC. Even though companies offer diverse products, they also have to

keep the cost low by proper strategies [7, 8, 10]. When companies implement MC until now, they concentrate its effects on production process to reduce the additional costs. Platforms also have been used just for effective production. However, the scope of the strategy should be extended to the whole product life-cycle processes. In this study, we will deal with extended strategy to other sub-processes that enable companies to afford customers' satisfaction by variety on products at low cost. The variety can be offered in different ways in each of sub-processes. Consequently, main results attained through the methods for the strategy are integrated in a comprehensive framework. Through a comparative study of individual methods by the framework, it will be useful to select a proper way for a specific condition of a company.

Above-mentioned strategy is presented with a real world case of a Korean health food company to bring up the detail methods of proposed strategy. Company X is a health food manufacturer in Korea whose products include candies, sweet jellies and a variety of drinks. Health food industry has lots of potentials to be expanded for customizing products. As shown in Fig. 1 [12, 13], the market grows up explosively. Besides, the recognition of health food is pretty high and most of customers have experienced of buying health food products (Fig. 2-A). Customers also consider customized functionality mostly as the most important factor in purchasing of health foods (Fig. 2-B). For the implementation of MC in manufacturing a candy, we propose a proliferated strategy based on scenarios. We depict three possible scenarios that are applied to three different sub-processes.

In this paper, we investigate the possible methods of providing variety extension to the whole life-cycle process. Through analysis of scenarios and real world example, we investigate the effect of the proposed strategy. In section 2, three different sub-processes and related scenarios are given and discuss the related methods. In section 3, the analysis results of the strategy are given by a comparative study of three scenarios. In section 4, we conclude the research results and suggest future research directions.

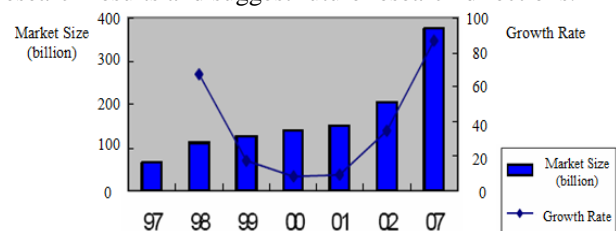


Fig.1. Market potential of health foods industry in global markets

II. SCENARIOS AS WAYS TO IMPLEMENT MC

Generally, the implementing of MC is initiated from obtaining relevant information from the customer. Using the information, the company translates the individual requirements into physical components for configuration on the basis of predefined modules and components. Then, the product is produced and delivered to the customer. To deliver high value added products to the customer at a small outlay, companies have to choose the best strategy to provide various products through efficient implementation of MC. MC is required a concrete set of sub-processes, which are development, interaction, purchasing, production, logistics, and information sub-process [2, 3, 5, 6, 11].

Among these sub-processes, only production sub-process with platform has been thought as the best way to provide various products. Other sub-processes are rarely involved in customization. In this paper, methods to offer diverse products are provided from a process point of view through three scenarios. Each one of them is correlated with production, logistics and purchasing sub-process. According to each scenario, customizing methods are decided by the feature of the scenario and they are explained through example of manufacturing candies. By analyzing each of scenarios, it is provided that how platform is constructed and what strength, weakness, opportunities and threats are identified in each of scenarios.

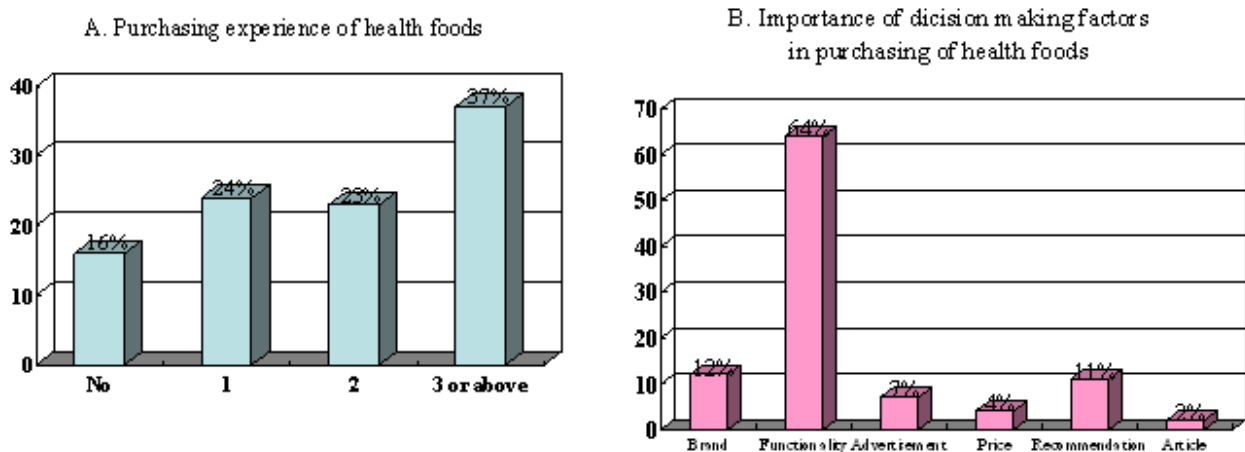


Fig.2. Appropriateness of health foods industry to implement MC

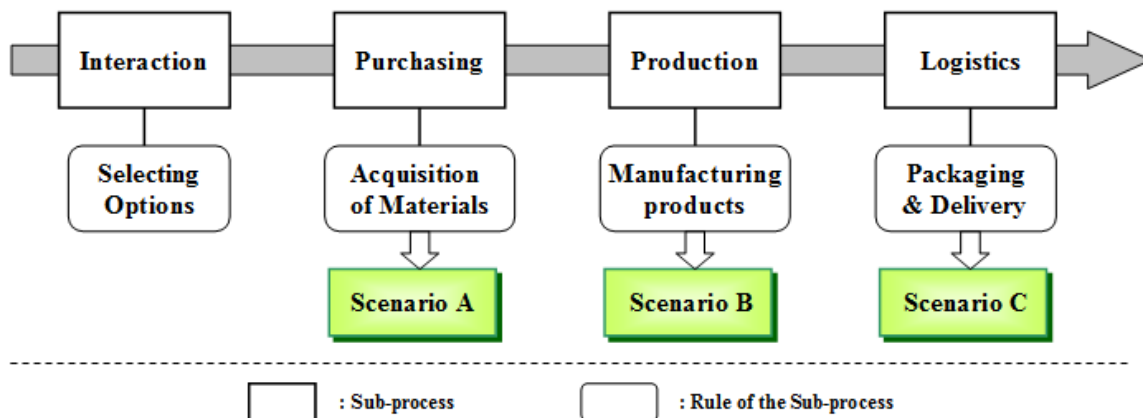


Fig.3. Sub-processes to implement MC and related scenarios

Customers want to choose a product from various products to satisfy their own needs. Once customer choice is identified, the company has to acquire components according to the customers' needs in purchasing sub-process. Then, production sub-process is operated with acquired components by specific manufacturing system and production plan. Finally, manufactured products are packed and delivered to the customers by logistics sub-process. In this paper, we depict three possible scenarios through sub-processes (Fig. 3). Scenario A concerns methods for providing diversity in purchasing sub-process. Scenario B deals with various customizing methods in production sub-process. And, Scenario C represents methods in

logistics sub-process. Each of scenarios is based on an identical whole product life-cycle from interaction to delivery with common components, parameters, design base, and modularity. The whole product life-cycle is partially modified in a step that is related with each scenario (Table I).

A. Scenario A

Companies should offer the chance of choice to customers for product customization. Especially in selecting foods, customers require specified ingredients for better taste and fragrance as components of the product. For the reason, companies are supposed to add or remove some ingredients according to customers' needs. It is practical

that companies provide customized candies without changing any production facilities by various combinations of ingredients. In Fig. 4, three variables are provided optionally for customizing. Customers can have a right of choice for own color, fragrance and sugar content of the candy. As purchasing ingredients to product candies, totally

six ingredients are required. Three of them are indispensable raw-materials, and the rest of three can be added, removed or changed by customers' needs. These options are based on identical production facilities and logistics services. That is, customization of a product can be carried out only small changing of composed ingredients.

Table I. Characteristic and comparison of scenarios

	Scenario A	Scenario B	Scenario C
Sub-process	Purchasing	Production	Logistics
Method	<u>Changing of ingredients</u> • Addition • Removal	<u>Changing of manufacturing system</u> • Rearranging the order • Modifying the processing system • Various mixing ratios of ingredients	<u>Changing of indirect materials</u> • Various capacity • Modifying packing materials • Building a system for delivery
Possible options	• Sugar content • Fragrance • Coloring	• The size of the candy • The strength of the candy • The shape of the candy	• Quantity • Packaging style • Delivery time and type
Assumption	• Same manufacturing system • Same logistics process	• Same ingredients • Same logistics process	• Same manufacturing system • Same ingredients

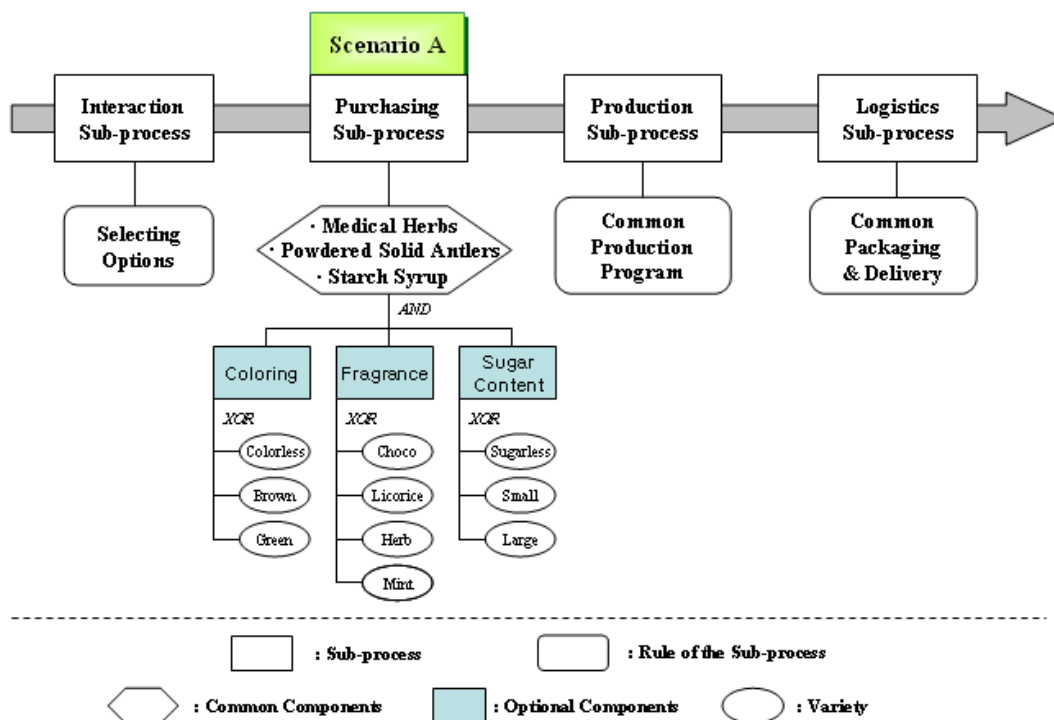


Fig.4. A diversification method of candy in purchasing sub-process on scenario A

Table II. Revised supplementary operations with implementation of scenario A

Supplementary operations	Sub-process
Developing options based on customers' needs (options are related to ingredients of candies)	Development
Safety inspection of new ingredients	Development
Offering customers a chance to select options	Interaction
Changes in kinds and quantities of materials for purchasing	Purchasing
Modifications of design and packaging according to characteristics of ingredients ex. ingredients supplement facts)	Logistics

Table II shows revised supplementary operations by implementation of scenario A. To offer several kinds of products with revised ingredients, the company needs to change the purchasing list and quantity. Through the modifications of ingredients, the company will have several supplementary operations in whole product life-cycle.

The scenario is assumed that production sub-process is not changed in spite of slightly different ingredients. In addition, information and feedback of each option should be included in interaction sub-process. By fulfilling the options, customers come up to their expectations and are satisfied with the product.

This scenario has benefits on providing of diverse options and they are easily modified because other sub-processes don't have to be changed mainly. Besides, companies can afford many market segments according to different ages, regions, seasons, trends with slightly modified candies. But compatibility tests for each combination of ingredients are required to validate proper product value. They are supposed to be performed in development sub-process prior to purchasing. Customization with offering diverse ingredients also induces the complexity in purchasing sub-process.

B. Scenario B

Generally, manufacturing systems and production programs are modified for the effective production of diverse products according to various customers' needs. Through just changing of manufacturing process with same raw-materials, companies are able to implement MC. In this way, companies don't need any additional operations in purchasing and logistics sub-processes for customization. Simple changing of production sub-process makes diversity on the product without any alteration of facilities and systems.

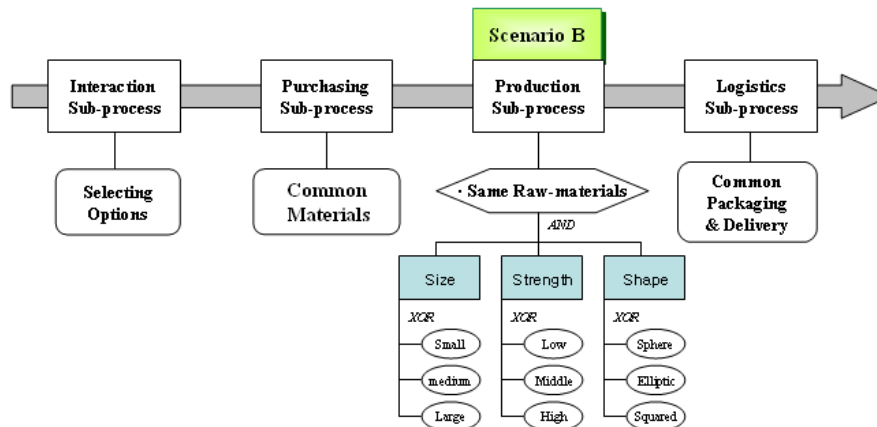


Fig.5. A diversification method of candy in production sub-process on scenario B

Table III. Revised supplementary operations with implementation of scenario B

Supplementary operations	Sub-process
Developing options based on customers' needs (options are related to external forms of candies)	Development
Offering customers a chance to select options	Interaction
Changes in molds or mixing ratios of ingredients for production	Production
Modifications of design and packaging according to characteristics of candies (ex. weight, ingredients mixing ratios)	Logistics

As shown in Fig. 5, scenario B is provided several kinds of candies with same raw-materials. It is based on simple change of manufacturing system. For example, candies are manufactured in different sizes and shapes by several molds. They are also made in different strength by several mixture ratios of materials. Adjustment of the manufacturing system is not required regardless of various options.

Additional operations from implementation of scenario B are in Table III. In scenario B, the company provides several kinds of external forms of candies as customers' choices. To fulfill this scenario, the company has to prepare additional molds for diverse candies. In addition, design and packaging materials need some modifications according to characteristics of candies, such as weight and ingredients mixing ratios.

It is hypothesized that the manufacturing facilities for candies need to be flexible for several types of molds and mixture ratios of materials. Operation efficiency for diverse

products also ought to be maintained. In addition, various products are serviced with the same logistics sub-process.

This scenario is beneficial to avoid additional complexity in other related strategy. Materials to manufacture several types of candies are common; therefore it doesn't lead to complexity in purchasing sub-process. Unlike scenario A, simple changes of external form of the product may not increase customer satisfaction as expected because the functionality of the product is still same. However, products can achieve customers' loyalty because products by application of several options on this scenario have maintained functionality and quality.

C. Scenario C

Companies can implement customization by simple change on accompanying elements of a product without changing the specification of the product. Providing diverse indirect materials is one of the good examples. Indirect materials for packing materials and delivery are essential to manufacture products in whole product life-cycle. For the reason, they enable company to implement MC as methods of providing diversity in logistics sub-process. For instance, companies are able to provide several indirect materials for customized packaging according to customers' needs. Customers hereby have a chance to request their own packaging style like gift-wrap, for business-use, etc. In the case of candy, the company provides several kinds of customized choices, which are quantity, packaging style and delivery process (Fig. 6). In the logistics sub-process, customers can be offered several quantities of product, select a packaging style by predefined phases and decide delivery time and type.

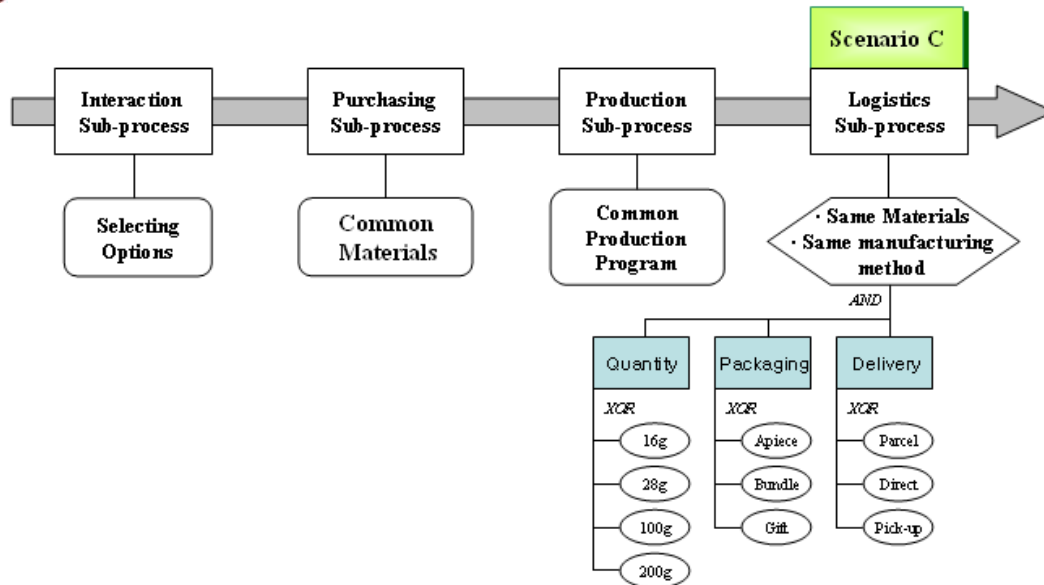


Fig.6. A diversification method of candy in logistics sub-process on scenario C

Table IV. Revised supplementary operations with implementation of scenario C

Supplementary operations	Sub-process
Developing options based on customers' needs (options are related to indirect materials of candies)	Development
Offering customers a chance to select options	Interaction
Changes in kinds and quantities of indirect materials for purchasing	Purchasing
Modifications of design and packaging (ex. size and shape of box, wrapping design)	Logistics

The company should be ready for this scenario with supplementary operations (Table IV). For example, several sizes of boxes have to be in stock for several quantities of product. For this reason, the whole product life-cycle is revised partially by additional operations to implement scenario C.

Customizing methods on scenario A and B are in need of modifying the ingredients and production process in practice. Scenario C is effective for providing customized product at a low cost and short time because this scenario does not require change in ingredients in the product. Besides, the quality can be ensured because of same ingredients and manufacturing system. For this reason, customizing is pretty easier than other scenario. That is, implementing this scenario can allow the company to attack different market segments at low cost. However, it is possible that customers may not think as customized products due to same functionality of products.

III. SCENARIOS AS WAYS TO IMPLEMENT MC

Additional cost and time are inevitable to implement MC. For this reason, many companies are developing methods to produce diverse products effectively. For example, companies are developing platforms as common components. These methods can fulfill the customers' customizing needs by increasing the product variety and

decreasing the additional cost and time simultaneously because the additional cost and time are inevitable to offer diverse products. In this paper, these methods are used by different ways in purchasing, production and logistics sub-processes. To select for the most appropriate method for a company, this paper make a comparative study of above mentioned scenario A, B and C. The research is conducted as compared with current situation which does not provide customization.

Cost and time of each scenario are individually evaluated by the rate of increase in comparison with current situation. Table V shows cost and time required to implement each scenario. One option of each scenario (scenario A: fragrance; scenario B: size; scenario C: quantity) represents relative scenario and each option has three varieties. For production of candy (1,200kg), each variety is produced in same volume (ex. Fragrance (3) in scenario A: mint 400kg, herb 400kg, licorice 400kg). For computing of time required, the sum of time for each sub-processes are not equal to total time because operations in sub-processes are progressed concurrently.

To evaluate scenarios, we project each criterion onto a scale from 1 to 7 (Table VI). Lower increased rates of cost and time are marked with higher scale and the highest scale means the most effective. In addition, the degree of customization is assessed by MC generic levels. Generally, higher customization level can make sure of higher customer satisfaction. Therefore, higher MC generic level has a potential to draw customers' interest in customized products and create more consumption. Moreover, we compared three scenarios in rank using Friedman analysis of variance by ranks. Customers indicate their valuations of scenarios as ranking 1 to 3.

Table V. Cost and time required for manufacturing a candy (1,200kg) in each of three scenarios

		Current	Scenario A	Scenario B	Scenario C
Sub-process		-	Purchasing	Production	Logistics
Option		-	Fragrance (3)	Size (3)	Quantity (3)
Cost required (\$)	Materials	1,418.4	1,826.4	1,418.4	1,418.4
	Processing	5,268.3	6,731.1	6,578.7	5,268.3
	Indirect materials	3,225.1	4,122.7	3,966.7	4,623.1
	Packaging	574.2	574.2	574.2	777.6
	Expense	1,767.3	2,198.1	1,997.7	1,776.9
	Total	12,253.4	15,375.8	14,535.8	13,864.3
Rate of increase (%)		-	20.3	15.7	11.6
Time required (day)	Development	33	46	38	42
	Design	19	22	20	26
	Purchasing	5	11	6	9
	Production	13	21	16	15
	Packaging	7	11	8	17
	Delivery	3	3	3	3
	Total	57	65	60	68
	Rate of increase (%)		-	14.1	5.3

* (): The number of varieties in each option (ex. Fragrance (3): mint, herb, and licorice)

Table VI. Scales for the rates of increased cost and time and MC generic levels

Scales	7	6	5	4	3	2	1
Rate of increase (%)	0 or below	0~4	4~8	8~12	12~16	16~20	20 or above
MC generic level	7~8	6	5	4	3	2	1
Customer preference	-	1~1.4	1.4~1.8	1.8~2.2	2.2~2.6	2.6~3.0	-

* The highest number for scale indicates that the scenario is the most effective.

The results from comparison of scenarios are presented in Fig. 7. Three scenarios are evaluated by criteria which are increased cost and time, customer preferences and customization level. In the position of company, the results show that each of scenarios have own merits and demerits. From the information, companies can select desirable method by the characteristics of markets and products. For better application, the combinations of each scenario are fairly possible. For example, a company can offer products from scenario A and C simultaneously. The company provides diverse optional components and packaging styles to increase the customer satisfaction in spite of additional cost and time. In the case of high-priced products, the company tries to guarantee the satisfaction because customers are willing to pay premium.

Each scenario induces higher complexity in each sub-process. As companies select a method, they have to decrease the complexities. Decreasing complexities is no less important than selecting the most appropriate method. For example on scenario A, complexity of purchasing sub-process is caused by diverse ingredients. Companies can decrease the complexity by reducing the number of suppliers. Selection a few best suppliers and placing long term contracts with them enables the achievement of advantages concerning the cost, quality, and delivery time [9].

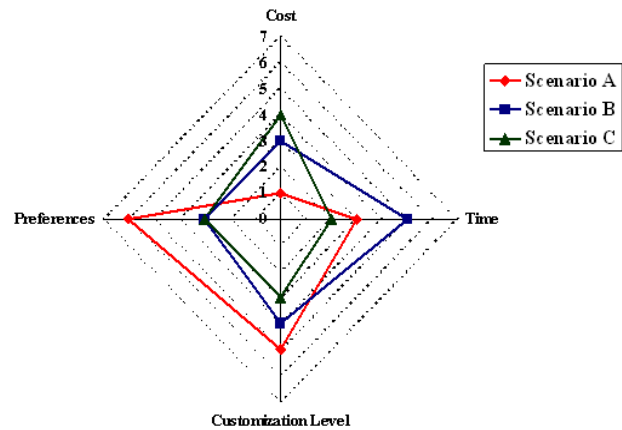


Fig.7. Comparison of criteria for each of scenarios

In addition, a flexible manufacturing system in little batch sizes and modular organization reduces the complexity in production sub-process [9]. Outsourcing the logistics operations to third-party logistics (3PL) can be a good strategy for reducing costs and complexity in logistics sub-process.

IV. CONCLUSION

Up to now, strategies for diverse products to implement MC are limited to production sub-process mostly. The fact that, only a narrow range of MC strategies was implemented in practice, leads us to research expanded MC strategies. In this paper, we research the proliferating strategy in MC to provide various products in several sub-processes through three scenarios. The scenarios from purchasing, production and logistics sub-processes are presented by the sequence of whole product life-cycle. Based on the scenarios, we verified the effect of each scenario by real world case. The effects of scenarios are compared and the results are helpful for companies to determine proper strategy. Even though we verified the effect of each scenario with application to a real company, the results for individual company may differ. In the future, we need to adopt more concrete and rigorous application techniques to evaluate and compare the methods. Especially, it is required that the effect of extension of companies' sales from each scenario should be measured.

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