https://dx.doi.org/10.22161/ijaems.4.1.9 *ISSN: 2454-1311*

Packing Improvement by using of Quality Function Deployment Method: A Case Study in Spare Part Automotive Industry in Indonesia

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Abstract*—Sales for automotive in Indonesia especially for 4-wheels vehicles and 2-wheels production is increase every year. Increase sales in Indonesia will be related to the needs of Spare Parts of the vehicle. Based on that, sector spare part need improvement to increase the sales and quality of spare part to gain trust of customer for buy spare part original and not buy spare part not original. Improvement will focus for packing this is because packing is one of element which can be increased sales and the difficulty to make improvements in a short time and with low investment in the field of production. QFD will be used to find best improvements for packing. Planning improvement for packing such as change material carton box (flute), redesigning, adding barcodes and hologram stickers. Results Use QFD for packaging repair. Customers are more focused on unboxing easy packing with a value of 249.5 points from 40% and substitute solid material packaging with 135 pints with 22% of QFD Technical priorities. With the following results customers prefer secure packing compared with interesting packing.*

Keywords— Spare Parts, Sales, Packing, Indonesia, Improvement, QFD.

I. INTRODUCTION

Spare Parts are used to replace damaged parts in a machine. Automotive spare part sector in Indonesia there are two types. Part made by sole agent and made by the factory which specially made spare part modification. Spare part modification there are several types where the usage can be long life time or short life time.

Spare parts can be considered as an important business area [1]. Manufacturing and automotive industries are also important in many countries, with their respective share of the business in the spare-parts area [2]. Relationship of total car sales to the needs of automobile spare parts. Indonesia has achieved sales of 1.06 million per year and an estimated 4.5% increase in 2017 [3]. With the higher market share of spare parts, it is necessary to make improvements in order to increase sales and trust from customers. Increasing trust from customers, Customer will prefer to buy original spare part compared to the spare part is not the original from sole agent.

Making improvements for Packing is a very important issue in local and international business due to the tight competitive environment in which manufacturers are trying to improve the quality and design of product packages. Success of Product can be seen, from Packing contributes to a well-designed Product sale. No good Packing with bad products or quality products with bad Packing can increase sales. However, when the same product compares, packaging plays a distinctive role by creating distinctions among other products. With the role of packing relationship in the increase of sales. QFD will be used to determine the items to be repaired. This item improvement is expected after the improvement can improve customer confidence that impact on loyalty and sales. Focus for packing improvement will be packing using QFD method.

II. LITERATUR REVIEW

Packing is materials protect the product against external factors from the place of production to the end-consumer while promoting the product [6]. In designing the packing repairs should keep the part safe when shipping. Protective packing and planned transportation plan can decrease the loss and 1damage up to 75%.

Packing should provide protection, presentation and promotion product economically and environmentally-sensitive throughout the life cycle of it. The packing of a product should comply with its characteristics. Products with various characteristics require various packing and handling conditions. For instance, food materials, chemicals, fluid and hazardous materials and etc. require different practices [7].

The technical characteristics of packing vary in accordance with the products they contain. Materials with various characteristics are used in packing [8]: (a) Paper and Cardboard : Cardboard boxes , Fiber Boxes , Fiber barrels , bags and cases, (b) Metal : Aluminum foils and

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labels , Metal boxes , Barrels , kegs , Covers, Press tubes , Cage, Metal stripes, columns and bands, (c) Glass : Bottles , Jars , Syringes , Glass Containers , Bulbs, (d) Plastic (Including cellulose and rubbers) : Bags and sacks , Boxes and Kegs , Buffers and Filling material , Films, layers and plates , molded bottles , Heat-treated trays , containers and bubble wraps, (e) Wood (including plywood) ; Boxes , Cages , Baskets , Pallet and Containers , Wood Wool, (f) Textiles: Bailing Materials Bags and Sacks.

There are several reasons for preferring packages with different kinds and materials. These can be listed as below [8]: (i) Paper and Cardboard: It is among the ones among the first rank because, it is cheap and easy to process paper, (ii) Metal: Tin and aluminum are used for manufacturing metal packages. The most common field where tin is used is canning. Use of aluminum boxes have been gradually increasing because they are easy to use, weigh light, do not need any paint, suitable for heating and disposable, (iii) Wood: Wood packages are preferred because they can be used more than once and they are cheap. Wood packages as environmental friendly packages have been drawing quite attention recently, since environmental problems have been considered important, (iv) Glass bottles and jars: Usually, delicate food products are put in glass jars. It is not possible to change them with other packing materials. Glass bottles and jars are preferred because it is possible to use them for storing other products by washing them, (v) Plastic Packages: They are used extensively in packing because they are light, suitable for coloring and labeling and they are cheap. Packing is the last point of manufacturers for convincing consumers before consumers make the purchasing decision. An efficient packing should have some particular characteristics. It is possible to list them as in the following [7]: (a) Physical Characteristics, (b) Protecting product quality, (c) Product improvement characteristics, (d) Product information, (e) Usage efficiency, (f) Mechanical characteristics, (g) Storing characteristics, (h) Transportation specifications, (i) Compatibility for trading, and (j) Recycling specifications. Spare part using packaging with carton box type. Built to facilitate some of the Spare part using packaging. Facilitate price, storage location and safety when delivery from factory to customer.

Carton box or better known by the term cardboard in the community is needed. One of the main functions of course to pack or pack the goods / materials before shipped or marketed. Because of its light weight, low cost, ease of assembly and disassembly, good sealing performance, certain cushioning and anti-vibration ability and easy recovery and waste treatment, corrugated box is widely applied in various fields [20].

Types of materials used in cardboard boxes have a variety of types. Knowledge of the type of carton box is important to determine the type of carton to be ordered with the need and budget to order the carton box. Adjustment of carton box type material with the need will be very important to determine how strong the cardboard box we need. If you need carton box to carry goods with heavy weight, it is advisable to order carton box made with high quality materials and have a good level of strength so it is not easily broken. As for those of you who only need carton box to pack a light item, you can order carton box made with cheap material to save the cost of ordering.

Fig.1. Type of carton box

a) Single wall (3 layers of paper) / 3 ply: Such a carton material has a shape composed of a top layer, a bottom layer and a corrugated layer in the center. Thin material features make this type of cardboard box is usually only used for the distribution of goods delivery within the local area. Such materials are commonly used for the packaging of goods such as toys, electronic goods, beverages, food or as a barrier coating.
b) Double wall (7 layers of paper) / 5 ply : This type of cardboard box has a seven-layer arrangement of four flat layers interspersed with a wavy layer with one wavy layer on the middle that has the thickest thickness among the others. The total thickness of the double wall layer is 7 mm. This type of carton is widely used in the packaging of goods shipped to the local area and abroad because the material is thicker and stronger.
c) The carton box type triple wall has ten layers consisting of flat and wavy layers with a total thickness of 10 mm. This material is strongest among the two carton boxes materials so it is used as a packing tool of export goods sent overseas

Flute is the thickness of the cardboard itself. Flute has various models as shown below.

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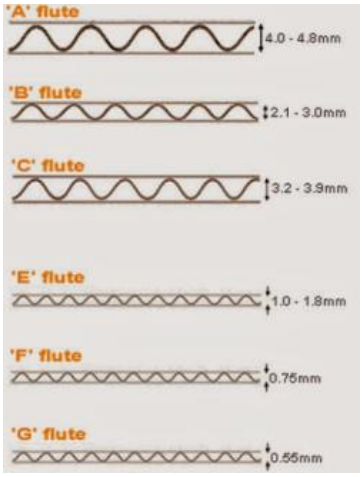

Fig.2. Type of Thickness Carton Box (Flute)

Kraft type paper is commonly used as the outer part of the box. Kraft type cardboard material has better strength than paper with medium material. This is because Kraft type of paper material made from wood base material with pine type which has long fiber then processed into pulp / pulp. At least this Kraft paper has at least 80% virgin fiber fibers and the rest improves recycled paper. The strength of Kraft paper can be used to measure the rate of possible breakage of the box or also called bursting strength. This type of paper has small moisture and moisture content compared to medium type paper. The paper weight itself is used as the power count parameter of the stacking power as well as the weight of the item to be packed inside the cardboard box. The weight of this paper is measured by cutting paper with the size of 1 meter x 1 meter and then weighed in units of gram / m2.

The Kraft paper is distinguished by the following types of gram: 469 gram, 127 gram, 125 gram, 120 gram, 112 gram, 110 gram. In Indonesia, Kraft liner paper available only ranges from 110 gram - 300 gram.

Fig.3. Kraft type Paper

Packing now have some communication function for sales. Packing reflects positive or negative ideas to consumers. Packing promotes the brand and product to consumers. Relation between the product and consumer is based on instruction characteristic of its package.

Sales for Spare part now already increase 19.5 in 2017 for Honda only in Indonesia and will be increase in Lebaran Holiday up to 20% from January sales [4]. Packing will greatly affect the price of goods, here are some examples. Firms can adjust the price through a certain number of changes to be made on packing. It is possible to list these changes as below [5]:

a) Decreasing the product amount without changing its package
b) Increasing the price by enlarging the package
c) Increasing the price by making the package smaller
d) Decreasing the price by enlarging the package
e) Decreasing the product amount by enlarging its package
f) Lowering the package, amount and the price
g) Changing only the package without making any changes on the product.

Sales Function Packing has an important effect on purchasing decision of consumer. Especially, packing has great impact on unplanned purchases. The consumers are firstly attracted to packages and therefore packing is one of the most important issues of sales. That's why, packing is called as "the silent dealer [8]. Consumers can decide to buy a product which they do not consider buying or do not know anything about only by considering information provided by its package.

New packing technologies provide competitive advantages in the markets. Packing technology has begun creating competitive advantage also in the logistic process. Packing costs, technological developments and environmental effects show that packing decisions are an extremely strategic issue for firms [8].

Packing has four basic characteristics to customer, [9]:

a) Visibility: It is a characteristic of packing which attracts the attention of consumers at the sales point. For instance; packages with creative and eccentric design and shiny colors.
b) Information: This is the information on the packages. For instance; benefits of the product, its contents, directions and etc.
c) Emotional Appeal: It is the effort of package for creating appeal on consumers. For instance, creating happiness, elegancy and etc. emotions on consumers.
d) Workability: Packing covers very different workability issues. For instance; protection, storing, keeping, convenience and etc.

The QFD process begins with the determination of customer requirements and ends with the realization of the processes necessary for production. The QFD methodology is generally understood as a work style and work philosophy with the aim of truly satisfying the customer. Focus on two major issues: What does the

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customer want and how can it be achieved? For this purpose, all employee knowledge and skills are involved in strategies and actions to achieve this goal, hereby avoiding irregularities [10].

QFD has the ultimate goal: success for customers, employees, and employers. Which are described with the following objectives [11]: (a) customer enthusiasm, (b) intensification of teamwork, (c) clear, coordinated and measurable objectives, (d) reduce losses in the value chain, (e) fewer and shorter development steps, (f) systematic documentation, (g) integration of expert knowledge, and (h) development and quality improvement.

III. METHODOLOGY

The concept for the improvement packing process to meet the needs of the customers indirectly. What makes a customer can choose goods based on from packing. To get the data we collect data, either by direct observation to the field and also collecting data from libraries, and analyzing competing products for the same market. The methodology used in this journal is:

a) Survey literature to know the desires of the customer
b) Gemba study (interview and questionnaire) to understand the type of packing that is on the market today
c) Analyze VOC Voice of customer for packing design needs
d) Analyze competitor products to benchmark to know the weaknesses and advantages of competitors' products.
e) Create QFD house with the calculation and determination of factor weights involving voice, technical requirements and competition and interconnection
f) Perform analysis based on QFD and create new design concepts based on the results of the value obtained

Using QFD can result in the development of better products at a price that the customer is willing to pay, based on its application in different companies [12]. The following advantages and benefits from QFD, there is customer satisfaction [13]. Reduction in product lead times [14], improved communications through teamwork [15] and better designs (Mehta, 1994). In addition, Bicknell and Bicknell (In Chan and Wu (2002a)) reported that tangible benefits when QFD is properly used are: a 30-50% reduction in engineering changes, 30-50% shorter design cycles, 20-60% lower startup costs, and 20-50% fewer warranty claims [16].

Surveys will be conducted to determine the effect of packing on customers to choose or buy a spare part. This survey was conducted to determine the voice of customer 'Voice of Customer "(VOC) to the goods desired by the customer. The data collected will be the basis in determining the improvement and basic data from QFD. Based on the needs of the customers will be arranged according to the interests of the subjects that will be allocated to the range. The rating is based on customer feedback obtained from customer surveys. To proceed to the next stage of product development, information obtained from a survey on customer requirements, technical description, and relative importance is used to build the House of Quality (HOQ) [17]. Next step to create customer need use range 1 -5. 5 show very need and the smallest scale is 1. This date we will use survey and as customer voice. To proceed to the next stage of product development, information obtained from a survey on customer requirements, technical description, and relative importance is used to build a Quality House [19]. Here are some examples of questionnaires submitted to buyers and sellers of spare parts. Questions addressed to the customer:

a) Are You Motorist?
b) Are you Biker?
c) What is your consideration to buy spare parts?
d) What is your favorite packing spare part?
e) Why you like it?
f) What is the most important factor for your packing spare parts?
g) What Your Opinion About Fake Spare Part for Packing?
h) What is your opinion about Original Spare Part for packing?
i) Have you ever bought a non-original Spare part?
j) Where do you usually buy Spare Part?
k) Does Packing be one of your parameters in determining the purchase of Spare Part?
l) Do you see first Part and Packing before being paired in a vehicle?
m) Do you bring home a broken Spare Part that has been replaced at the Workshop?
n) What is important is the guarantee of Original spare part in the original spare part?
o) Do you know how to distinguish between genuine and fake spare parts?

Next is to make a survey question to the spare part seller. Spare part seller who conducted the survey is a seller outside the sole agent:

a) Do you sell non-Original Spare parts?
b) Which is more in search by the customer for spare part (Original / Non-Original)?

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c) Which is more purchased by customer for spare part (Original / Non-Original)?
d) Which is more to buy by customer for spare part (Original / Non-Original)?
e) What is customer complaints against packing the original spare parts?
f) What is customer complaints against packing non-original spare parts?
g) Whether the customer is interested in packing spare parts?
h) Whether the customer is interested in the installation instructions part?
i) Is the customer concerned with packing material?
j) Is Customer concerned with Color packing?

IV. RESULT AND ANALYSIS

Packing process is very important which a plus in the eyes of customer. The priority for improvement is very important by knowing which priority so that the improvement process can be done and produce better value for the customer. The unimportant part in the customer's eyes can be changed by pressing the cost of replacing part of the packing itself with cheaper material or eliminating the part

Basically, there are have 7 steps that must be done in QFD, there is affinity diagram, tree diagram, the weighting of customer need, competitive benchmark, technical requirement (how's), interrelationship what's and how's, and design target and the house of quality [13].

Step 1 is preparing affinity diagram for grouping customer need based on data VOC (Voice of Customer). This data use to focus what is the value in customer for packing spare part in Indonesia.

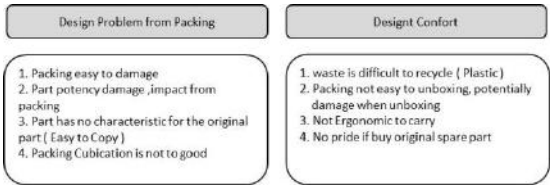

Fig.4: Affinity Diagram for Packing Improvement

Step 2: tree Diagram is used for plotting the issue from group in step 1 to determine the satisfaction aspect of customer need in the improvement effort packing design

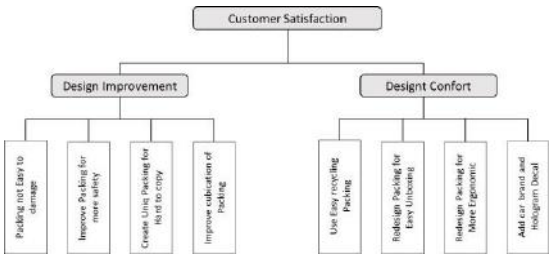

Fig.5: Weight of Customer Need (Voice of Customer)

Step 3: Weighting of Customer Need is used for conducting customer need priority to the product (motorcycle helmet), to know the level of customer interest to the product [19].

Fig.6: Weight of customer Needs (Voice of Customer)

By using range 1-5 and brainstorming results in Product Development that customer needs are most important with scale 5: Packing not easy to damage, Improve packing for more safety and add car brand and hologram decal. This option is based on to guarantee the part delivered and to the customer must be in good condition. Usually the customer only sees the packing first compared to the goods inside. They assume if the packing is damaged means the goods inside are also damaged.

Step 4: Competitive Benchmark is used for conducting benchmarks with competitors' products competitor A & competitor B based on survey results and brainstorming product development team to see the position of the product to competitors.

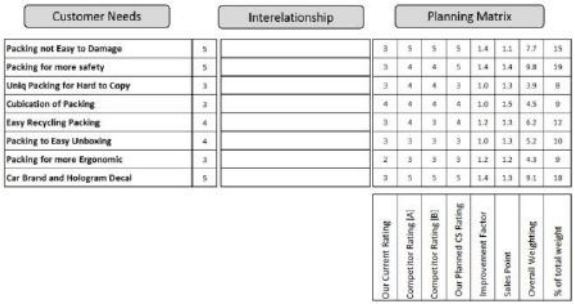

Fig.7: Competitive Benchmark

By using scale 1-5, and based on brainstorming results in Product Development, that the top three percentages in total benchmarking are: Packing not easy to damage (15%), improve packing to more safety (19%), Add car branch and Hologram Decal (18%). This shows that from the competitor side these three factors are very dominant in making the product design plan.

Example for calculation (*Packing not Easy to Damage)*

Improvement Factor :

((Our Planned CS Rating - CS Rating our textbooks) *0.2) + 1

: ((5 – 3)*0.2) + 1 = 1.4

With using same case

Overall Weighting :

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Weigh Customer Voice * Improvement Factor * Sales Point

: (5*1.4*1.1) = 7.7

% of total weight : (Overall Weighting Customer needs / Total Overall Weighting Total) *100

:

(7.7)/ (7.7+9.8+3.9+4.5+6.2+5.2+4.3+9.1) *100 = 15

CS Rating our textbooks, CS rating competitor A, CS rating competitor B, Our Planned CS Rating, and Sales Point there is input related with product development brainstorming and data collection.

Step 5: Technical Requirements (HOWs), to determine from technical aspect for product development plans to meet customer needs.

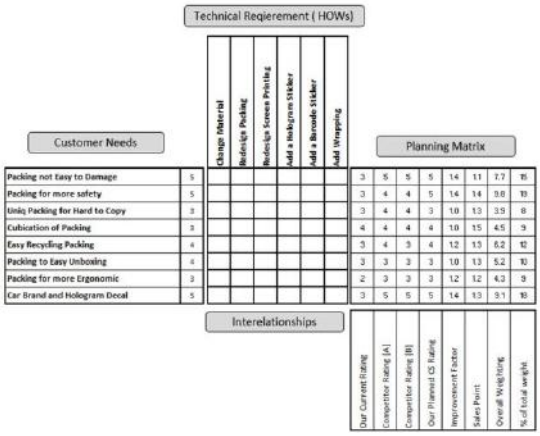

Fig.8. Technical Requirement (HOWs) Applied to the HOQC

Step 6: Interrelationship WHATs and HOWs, to determining the level of relationship (relation) between customers' needs and needs in terms of technical aspects

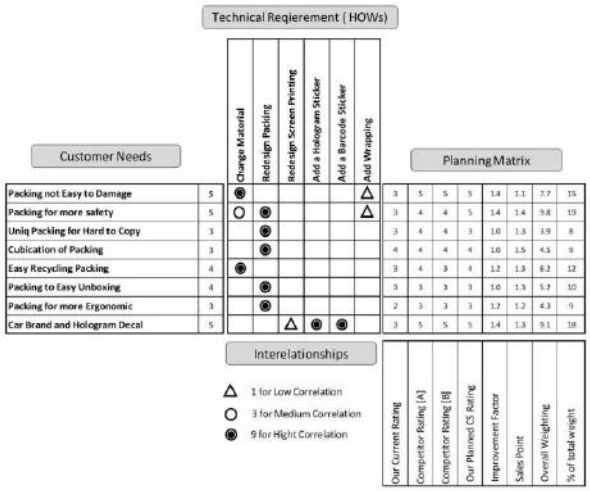

Fig.9: Interrelationship between WHATs and HOWs

By using score: 1 (week), 3 (Medium), and 9 (high), based on brainstorming results in sections Product Development obtained a high correlation is in several things, there are some of point for focus from interrelationship diagram:

a) Packing not easy to Damage vs Change Material (9 Point)
b) Packing for More Safety vs redesign packing (9 Point)
c) Unique packing for hard to copy vs redesign packing (9 Point)
d) Cubic of packing vs redesign packing (9 Point)
e) Easy recycling packing vs change material (9 point)
f) Packing easy to unboxing vs Change material (9 Point)
g) Packing for more ergonomic redesign packing
h) Adding Car brand and Hologram vs add barcode vs Hologram Sticker.

Step 7: Design Target and House of Quality, calculation, and weighting of design targets to determine priorities in conducting product development related to customer need (WHATs), technical requirement (HOWs) and benchmarking result to competitors so that the products produced in accordance with customer needs and able to compete with competitor products.

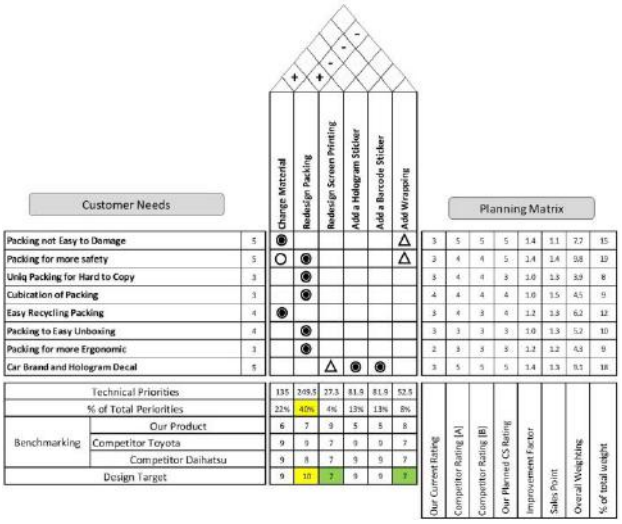

Fig.10: Completed HOQ

From the comparison result data in QFD House, Product Design for packing improvement spare part will be done with the following criteria:

a) The first point for improvement is redesign (10) customer needs packing that can guarantee the quality of the part. Secure packing until received by the customer. Packing a unique so as to facilitate the customer to disguise whether this part of the original or fake. With a compact design makes it easy for storage and also makes it easier when unboxing so it does not make parts to be damaged.
b) The second point, replacing the material (9). By replacing better and stronger material so that parts become safe and the replacement or addition of this packing material is sought which

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makes it easier to recycle by avoiding the use of Styrofoam.

c) The Third point for improvement is add Barcode (9) and Hologram (9). This improvement uses for increase trust customer because they already buy original part. And this barcode can connect to internet to check authenticity spare part

d) The Four point to improvement Redesign print screen (7) and wrapping (7). After we ask to customer and seller about these two issues we find that customer and seller is doesn't care about this issue. The most important is quality of part. Customer and supplier almost remove the packing of spare parts and spare parts that are damaged so the economic value is lost here. With this data we can do by not using the use of color print out carton and coated by plastic. This is done by doing a comparison with competitor spare parts where they also do the same thing.

Fig.11.Sample before Improvement

Fig.12. Sample Target Improvement

V. CONCLUSION

1. Based on a review of VOC's voice of customer. The color of the packing is not very influential on packing. Customers only want a more solid packing. The easiest thing is to replace the thicker carton box material called Flute. The process of replacing this material will certainly increase the cost of packing spare parts. But because the customer is not too influential with the color packing, this can be done budget transfer from print to a better material. By replacing the packing material will look more solid and more exclusive and this one of reasons customer chose the product
2. Another improvement has to be done to change the design from packing for easier unboxing process. This seems often unthinkable. Impact from difficult to unpacking the customer using sharp objects and potential of spare part material to be damaged.
3. Other improvements by removing the installation instructions (which in screen printing in packing). The installation instructions are rarely used by the customer because the spare part is usually installed in the workshop. One of the improvements that can be used by connecting the barcode code with website online, if the customer wants to see the installation process just by doing scan spare part and we can see instruction on website.

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