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Improving the Quality of Frozen Chicken Sempol Products Using the Six Sigma Method at MSME Suropati Pasuruan

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ABSTRACT

Suropati MSME is a frozen chicken abacus producer in Pasuruan Regency. More and more competitors require compani to improve the quality of their products as a step to prevent consumers from moving to competing products. Quality problems have not been fully implemented by Suropati MSME as seen from the large number of defective products. The purpose of this study is to determine the factors that cause product defects and provide suggestions for improvements that are in accordance with the conditions of MSME so as to achieve zero defects. The method used is six sigma DMAIC (Define, Measure, Analyze, Improve, and Control) with Failure Mode and Effect Analysis (FMEA). The sigma value obtained is 2.821 while the % final yield is 81.358%. The contributing factors are man (33.33%), machine/equipment (16.67%), method (33.33%), and environment (16.67%). The proposed improvements given are additional employees, the use of alarms, the use of production equipment according to production capacity, and temporary closure of the selling place.

Keywords : Defect Product, DPMO, FMEA, Six Sigma, Suropati MSME

1. INTRODUCTION

Progress and developments over time have changed the way consumers choose the products they want. Apart from the price factor, quality is also very important in choosing a product. Through quality control, it is hoped that companies can increase the effectiveness of control in preventing defective products, thereby reducing waste in terms of materials and labor, and ultimately increasing productivity [1], [2]. The aim of quality control is to reduce the number of defective or damaged products, maintain products in accordance with predetermined standards, and prevent defective products from reaching hands [3] Several factors that cause defects in a product when produced are materials, machines, people, methods and the environment[4] One of the tools that can be used to carry out quality control is six sigma.

Six Sigma is a comprehensive approach to process improvement through the DMAIC (Define, Measure, Analyze, Improve, and Control) approach. DMAIC is a series of six sigma analysis processes that ensure the voice of the customer throughout the process so that the final product meets customer needs [1], [4], [5]). Based on the six sigma measurement results, the failure reduction strategy was then analyzed using Failure Mode and Effect Analysis (FMEA). FMEA aims to identify and evaluate defects that could potentially result in reduced product quality. A defect in the methodology is defined as something that reduces the speed or quality of a product or service when it is delivered to a customer [6], [7], [8]

MSME Suropati is one of the UMKMs that produces frozen chicken sempol as its main product. As time goes by, more and more MSMEs are producing chicken sempol in Pasuruan. This makes Suropati MSMEs have to control product quality in order to remain competitive with other MSMEs that produce chicken sempol. Quality control needs to be carried out primarily to prevent the occurrence of unwanted products (defectives) so that MSMEs will not experience rejection in every production. The quality control carried out at MSME Suropati has not been implemented well as proven by the discovery of defective products above tolerance limits and not being able to identify the causes of defects in detail.

The product defects experienced by MSME Suropati were the shape of the chicken sempol which did not meet the MSME standards (peeling/not joining with the puncture or there were holes in the shape of the sempol) and the weight of the chicken sempol which exceeded the MSME standard (> 14-16 g/pcs). For this reason, Suropati MSMEs must ensure that products are of truly high quality by taking preventive measures against the possibility of failure or defects, whether caused by machines, production processes, materials or humans.

Efforts made to ensure product quality are by preventing and minimizing product and process failures. The aim of this research is to determine the factors that cause product defects in Suropati MSMEs and provide repair solutions that suit the conditions of MSMEs in order to achieve zero defects.

2. RESEARCH SIGNIFICANCE

MSME Suropati Pasuruan is one of the producers of frozen chicken sempol which faces challenges in maintaining consistent product quality. Through the application of Six Sigma, this research aims to identify sources of defects in the production process and develop specific improvement steps. In this way, these MSMEs can increase customer satisfaction, reduce production costs due to product defects, and strengthen their position in the market.

This research has high significance in improving the quality of frozen chicken sempol products at MSME Suropati Pasuruan. The Six Sigma method, which focuses on reducing variation and defects in the production process, can provide a systematic and measurable solution to improve product quality. In the context of MSMEs, the application of Six Sigma is not only relevant for improving quality but also for operational efficiency.

Furthermore, this research also provides practical contributions for other MSMEs who wish to adopt the Six Sigma method as a quality improvement strategy. The successful implementation at Suropati Pasuruan MSMEs can be used as a model for other MSMEs to increase the competitiveness and sustainability of their businesses. Thus, this research is not only beneficial for Suropati Pasuruan MSMEs but also has a positive impact on the MSME industry as a whole.

3. RESEARCH METHODS

This research was conducted to analyze the factors causing product defects and provide suggestions for improvements using six sigma and FMEA in the chicken sempol production process at MSME Suropati. The process of data collection to data processing will be carried out in May 2024 – June 2024.

This research uses primary data. The primary data collection process begins with interviews and observations. In this research, data collection was carried out by observing the production process, observing each product produced, and weighing the weight of each product at MSME Suropati. Sampling was carried out 9 times with 1 time taking 450 pcs of chicken sempol.

In this research, the six sigma DMAI (define, measure, analyze and improve) method was used. At the define stage, production process identification will be carried out, determining critical to quality (CTQ), creating a check sheet, and creating a histogram. The next stage is measuring sampling, normality testing, creating a p control chart, calculating DPO, DPMO, and sigma values, and calculating process capability. In the analyze stage, create a cause and effect diagram, and in the improve stage, use the help of FMEA and create a Pareto diagram and provide suggestions for improvements.

4. RESULTS AND DISCUSSION

4.1 Define Stage

In the Define stage, MSME Suropati identifies the problem encountered in the production of frozen chicken sempol. The aim of this stage is to find the processes that contribute most to causing defects that affect product quality. This stage consists of two main steps: definition production process and identification of quality characteristics (CTQ) [6], [7], [9].

Production process identification is carried out to understand the course of production frozen chicken sempol. This step also aims to find the process part often produces defective products. This process is carried out at the boiling stage, soaking, draining, and cooling because these stages often occur product nonconformity or defects in frozen chicken sempol. boiling process, draining, and cooling causes defects in the shape, during the process immersion can produce serious defects. Once the production process is identified, The next step is to determine critical to quality (CTQ).

This CTQ determination stage aims to identify the type of defect in frozen chicken sempol products. Based on the results of observations and interviews carried out, there are 2 types of defects found in frozen chicken sempol, namely defect shape and serious defects. Defects in shape can be in the form of holes, holes or deformities peeling away from the puncture. Defects in shape can occur caused by the capacity of the boiling process not being suitable for the location used, the draining process using a small baking pan, and the cooling process which is too long causes the chicken sempol to stick to one another more strong. Meanwhile, serious defects in frozen chicken sempol products can be caused by The soaking process exceeds the MSME regulations, namely ±10 minutes until the water will absorb into the chicken sempol and result in an increase in the weight of the sempol up to 19 g/pcs, different from the MSME standard, namely 14-16 g/pcs.

Soaking at high temperatures can cause swelling and development of the starch granule structure, the starch granules will absorb water so that more water will be absorbed into the material. Apart from that, it takes a long time to soak This can cause water to more easily penetrate and become trapped in the cavities. starch granule cavity[10], [11].

Table 1. Check Sheet for Chicken Sempol Defect

Sub grup	Production Quantity (pcs)	Product Defect		Number of Defect (pcs)
		Heavy (pcs)	Form (pcs)	
1	450	72	5	77
2	450	67	6	73
3	450	125	15	140
4	450	110	9	119
5	450	59	7	66
6	450	68	2	70
7	450	71	7	78
8	450	50	10	60
9	450	66	6	72

Amount	4050	688	67	755

Identification of the types of defects in chicken sempol products is carried out by manufacturing check sheet. Check sheets are specially designed by users, enabling users to interpret the results easily [3], [10], [12] Check sheet on this research can be seen in Table 1. The main defects in chicken sempol products are shape defects with a total of 67 defects and serious defects of 688 pcs. So that total defects in chicken sempol products amounted to 755 pcs. Data on check sheet summarized for use as an analysis of which defects provide the most dominant contribution to chicken sempol products.

Table 2. Data on Chicken Sempol Product Defect

Defect	Frequency (pcs)	Cumulative Quantity (pcs)	Presentage of the Total (%)	Cumulative Presentage (%)
Heavy	688	688	91,1	91,1
Form	67	755	8,9	100

Table 2 shows that this type of severe disability provides the contribution of disability is 91.1% greater than disability form, namely 8.9%. So, it is necessary to carry out a quality control process especially for processes that cause serious defects the contribution of severe disability can be reduced. Not only serious disabilities, quality control also needs to be carried out to achieve zero defects in shape defects. The next step is creating a histogram. Histogram of defects The product can be seen in Fig.1.

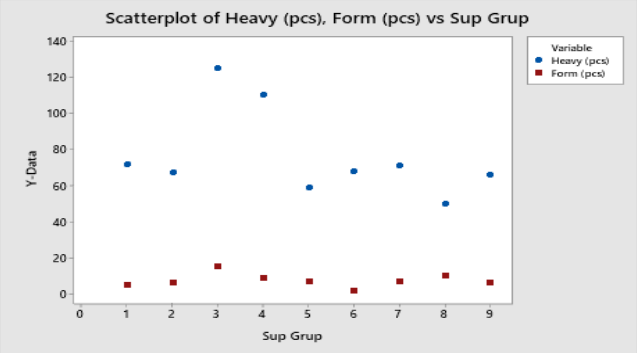

Fig.1. Product Defect Histogram

Fig.1 shows that the number of defects in the defect parameters Forms and fillings occur in the 1st week to the 9th week sometimes decreased and sometimes experienced a marked increase XYZ MSME have not made good quality improvements.

4.2 Measure Stage

This measuring stage carries out a normality test process to find out whether the data has been distributed normally or not. If value significance > 0.005 means the data is normally distributed, likewise on the contrary [6], [9] These results show that the data The selected samples are normally distributed. This can be known from the value Asymptotic significance 2-tailed (Asymp.Sig. 2-tailed) is 0.2 > 0.05. Stages The next step is to create a control plot p to be used so that when the data processing process does not occur so that overdispersion of the data The results will be more accurate [4], [11], [13]. Control chart p for defects Sempol products can be seen in Fig.2.

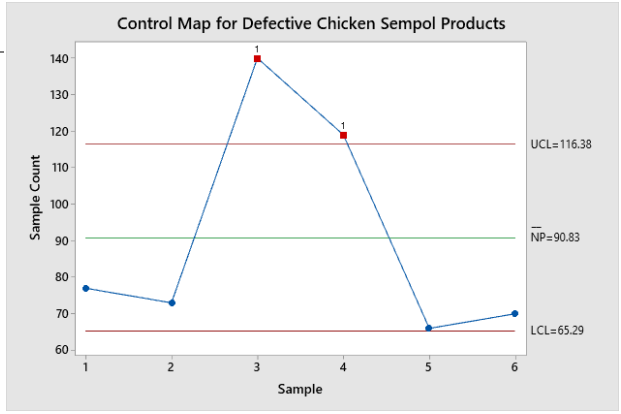

Fig.2. Control Map for Defective Chicken Sempol Products

Table 3. Recapitulation of Sigma Values

Sub Grup	Production Amount (pcs)	Number of Defect (pcs)	CTQ	DPO	DPMO	Sigma Value
1	450	77	2	0,086	85.556	2,869
2	450	73	2	0,081	81.111	2,898
3	450	140	2	0,156	155.556	2,513
4	450	119	2	0,132	132.222	2,616
5	450	66	2	0,073	73.333	2,951
6	450	70	2	0,078	77.778	2,920
7	450	78	2	0,087	86.667	2,862
8	450	60	2	0,067	66.667	3,001
9	450	72	2	0,080	80.000	2,905

Amount	**4050**	**755**	**2**	**0,093**	**93.210**	**2,821**

If the proportion of defective products in a period is still between the limits upper (UCL) and lower limit (LCL), this indicates that the proportion of products is defective is still within the permissible limits [6], [9], [14] Map p control depicted in Fig.2 shows that there are two subgroups which are outside the control limits, namely the 4th and 5th subgroup sample data. This visible from the proportion points that exceed the upper limit. Therefore, MSME Suropathy requires improvement to reduce the level of disability. The next stage is to calculate the DPMO and determine the sigma value. The DPMO calculation aims to determine the number of defects per million the product produced. Convert overall DPMO value to value sigma can be seen in Table 3.

From the results of the DPMO calculations at MSME Suropati, the figures were obtained amounting to 93,210, with a sigma value after conversion reaching 2.821. Sigma value This is considered quite good because it exceeds the industry average in Indonesia, which is at level 2.00. However, quality control is still important to increase the sigma value to minimize potential defects in the future coming. The higher the sigma target achieved, the better the performance industrial system [8], [15], [16]. Next, calculate the process capability to reflect the ability of a process to produce output according to customer specifications and needs [17], [18]. Measuring process capability aims to assess the extent This process is capable of producing suitable products. Determination of value Process capability can be seen from the final yield percentage (%final yield) of production process. Data regarding the overall final % yield can be found in Table 4.

Table 4. Recapitulation %Final Yield

Sub Grup	Production Amount (pcs)	Number of Defect (pcs)	%Final Yield (%)
1	450	77	82.889
2	450	73	83.778
3	450	140	68.889
4	450	119	73.556
5	450	66	85.333
6	450	70	84.444
7	450	78	82.667
8	450	60	86.667
9	450	72	84
Amount	**4050**	**755**	**81,358**

The calculation results show that the total %final yield in the process production was 81.358%. Process capabilities in the production process can be said to be suitable for Indonesian standards.

4.3 Analyze Stage

At the analysis stage, focus is given to the type of defect that affects it quality of chicken sempol products. This analysis process involves identifying the causes of the problems that occur. To carry out this analysis, a cause-and-effect diagramming approach is used. This diagram is used to illustrate several causes of defects which are analyzed based on several aspects, such as people, methods, machines, raw materials and the environment. It is known that the two types of defects that appear are shape defects and severe defects. Therefore, both types of defects are analyzed using a cause-and-effect diagram.

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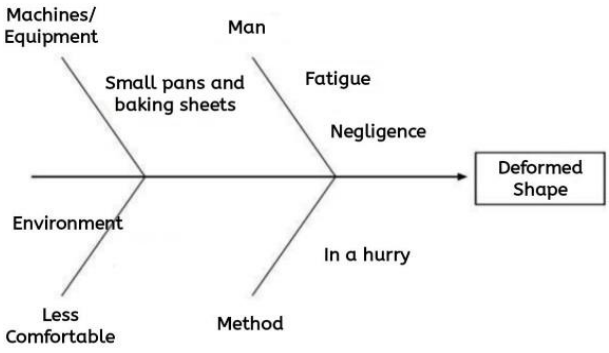

Fig.3. Cause and Effect Diagram of Shape Defects

Fig.3 explains the Cause and Effect Diagram of Shape Defects There are 4 factors that cause deformities, namely humans (fatigue and negligence), machines/equipment (pans and baking sheets small), method (rushed), and environment (less comfortable). Factor Human factors that can cause failure include carelessness or lack of thoroughness of the workforce in carrying out the production process. Negligence and lack of attention from human factors greatly affect quality of the product so that to maintain this quality the workforce must works optimally and requires stricter supervision by the company [4], [5], [19] Fatigue and negligence in human factors This is caused by the production process being carried out by 1 person, employees too doing 2 jobs at once, namely selling and producing sempol chicken, the location of the production site and sales area are far from each other production place, and the last one is that there is no time reminder or alarm for the soaking process that

requires a time limit.

The second factor is machines/equipment. The equipment factor that causes deformities in chicken sempol products is use small pans and baking sheets. The use of a pan in the boiling process does not match the capacity of the inserted sempol causing each each sempol coincides with each other. Not just coincident with Just the sempol, it was also seen that several sempol had been collided with The satay skewers used resulted in the production of chicken sempol being defective form. Using a small baking pan is more or less the same as using a pan that does not match its capacity. When the process is carried out In a hurry, employees tend to immediately pile up the waste one with another randomly (not in the same direction) so causing a collision between the sempol and other sempol satay sticks and cause the deformation.

The final factor that influences shape defects in sempol products chicken is an environmental factor. Uncomfortable work environment, such as the lack of conduciveness of the production space and the surrounding environment, becomes main factor. This is caused by a lack of visible air circulation from non-functioning ventilation and poor hygiene. Circulation Air, room temperature, and lighting are environmental factors work which greatly influences the comfort of workers. Proper regulation of lighting and temperature is essential to increase comfort of workers [2], [19], [20] Apart from that, at the production site There is also a noise that is quite disturbing because there is a repair process coming from the house of one of the relatives of the MSME owner, which disturbs the comfort of the employees so that the employees tend to rush. Rush in carrying out all stages of the production process.

There are 3 factors that cause severe defects, namely negligence, soaking for too long, and an uncomfortable working environment. Human factors that cause serious defects in sempol products chicken, namely employee negligence in monitoring the soaking process. This is caused by not recording or not remembering when the start and end of the immersion process. So employees tend to only use their feelings in the immersion process whether it has been going on for 10 minutes or not. Apart from that, because of the position of the room production and stalls that are far apart result in employees forgetting to check the chicken sempol that has been soaked earlier and makes it heavy excess in chicken sempol products.

The second factor is method. This method is the implementation of SOP which is not good, causing unexpected defects. The method factor that causes serious defects is time soaking that is often missed or too long. This can be done resulting in more water being absorbed by the chicken sempol, causing the weight of the product produced to exceed MSME standards. Part from that, employees sometimes forget to confirm when the soaking time is starting or ending, causing no soaking time consistent.

The final factor is the environment. In this case, it is the MSME owners who at the same time, employees feel less comfortable with the environment chicken sempol production place. This can be seen from the damp kitchen conditions, dirty, and there is noise around the production room. Additionally, employees also performs two tasks at once, namely as a shop employee so that when there are buyers, the employee must serve them first and usually Soaking time is often missed due to this.

4.4 Improve Stage

At the improvement stage, improvements are made to the causes of defects previously identified form and severe defects. The first step is to carry out risk priority analysis to determine appropriate actions most suitable for the repair process. Through the FMEA table, analysis is carried out to find initial solutions for improvement based on Risk Priority calculations Number (RPN), which is calculated from the product of the severity level (Severity), frequency of events (Occurrence), and detection capabilities (Detection) of any potential failure. Values for each item in the FMEA table are obtained through discussions with MSME owners. By considering the values With this value, it can be identified which failures are priorities the main thing is to repair it immediately so as not to disrupt the smooth running of the process production.

Table 5. FMEA For Product Defects

Factor	Cause	S	O	D	RPN	Rank
Human	Fatigue	5	8	5	200	4
	Negligence	7	10	8	560	2
Machinery/ Equipment	Small Saucepan and Baking Sheet	8	8	10	640	1
Method	Hurry	7	8	8	448	3
	Long soaking	3	10	6	180	5
Milieu	Less comfortable	3	10	5	150	6

The highest RPN value based on Table 5 is obtained from factors machine/equipment that causes small pans and pans with a value of 640, followed by the human factor, namely negligence with a value of 560 and the third namely the method factor with the cause being rushed with a value of 448. After getting the RPN calculation results, the next step is prepare improvement proposals. Priority of proposed improvements is based on value The highest RPN, then drops to a lower value. Main focus given to potential problems that have the highest RPN value to be repaired first [11], [21], [22]. RPN value data from Table 15 are sorted from highest to lowest for use in analysis and making Pareto diagrams between RPN and causes of factors that cause product defects in chicken sempol in

XYZ MSMEs. The order of RPN data from highest to lowest can be seen in Table 6. Table 6. Highest to Lowest RPN Data.

Table 6. Highest to Lowest RPN Data

Cause	RPN	RPN Cumulative	Presentage of Total (%)	Cumulative Presentage (%)
Small saucepan and baking dish	640	640	29,4	29,4
Negligence	560	1200	25,7	55,1
Hurry	448	1648	20,6	75,7
Hurry	200	1848	9,2	84,8
Long soaking	180	2028	8,3	93,1
Less comfortable	150	2178	6,9	100

Table 6 shows the causes of product defects in sempol Suropati MSME chicken which has the highest RPN percentage is pan and small pans at 29.4%, followed by negligence at 25.7%, rush 20.6%, fatigue 9.2%, long immersion 8.3%, and for less comfortable by 6.9%. The next stage is making a diagram pareto from the RPN data that has been obtained.

The results of this Pareto diagram show the dominant and dominant factors not dominant. Pareto diagram will help focus on the damage problem more common products, indicating which ones will be most beneficial if handled. In this case what is meant is the percentage of the RPN which is a priority for improvement [7], [8], [16]

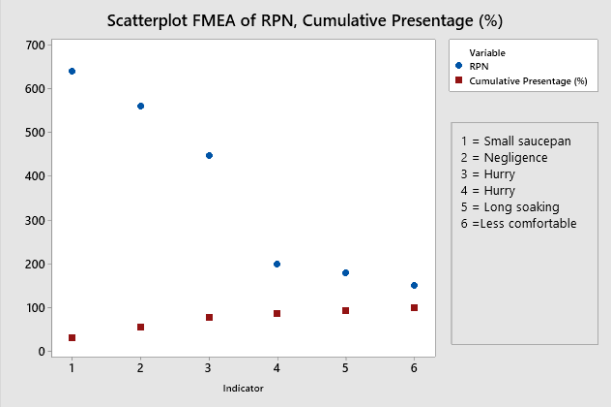

Fig.5. Diagram Pareto FMEA

The application of Pareto's law is that 80% of company losses are caused by 20% primary risk. Focus on 20% of the main risks, then 80% of the impact company risks can be overcome [6], [18], [21]. So based on Pareto diagram, causes of product defects in the sempol production process chicken that is above 80%, namely small pans and pans, negligence, and in a hurry. Through the Pareto diagram you can see the number of each the type of product defect and the type of defect that is categorized as CTQ and CTQ is sorted from most priority to most not a priority [5], [12] Statement from [20] different from this research. In this study there were only 2 CTQ so that the 2 CTQ become priorities. How ever, the principle of [5] can be applied to the priority improvements made. In this case, priority improvements are made to 3 existing causes the RPN value and the highest percentage are causes and small pans, negligence, and in a hurry. Referring to the Pareto diagram and the results of the RPN values resulting, then suggestions for improvements can be given to MSME Suropathy is related to product defects in shape and weight, namely:

Machine/equipment factors that cause small pans and pans, namely It is best to use pans and baking pans according to production capacity or replace according to capacity. Apart from that, MSME can also reduce production capacity, especially during the boiling process and draining to suit the equipment used during the production process. By implementing the proposed machine/equipment factors, it is hoped that this can be achieved reduce the number of defects that occur.

The second factor is humans whose cause is negligence. As for The proposed improvement given is to add additional employees to production and sales processes so that no work assignments occur too heavy. The next step is to build a nearby production site with a place to sell. The third is to make improvements employee discipline, and the last thing is that there are time reminders or alarm to signal the end of the soaking process.

The final factor is the method which causes it to be rushed. Proposal What can be given is that employees must be able to prioritize work which one must be completed first and if there is a buyer as much as possible perhaps the chicken sempol production process was not implemented. Besides that, increasing the number of employees can also be a solution to the rush employees in carrying out the boiling and draining process. And a more detailed SOP can also be made regarding the boiling, soaking, draining and cooling.

5. CONCLUSIONS

There are 2 types of defects (shape and size), which are based on results DPMO value conversion results show that the sigma value is 2.821 so it could be said to be good and above the industry average in Indonesia. % Final The yield is 81.358%, so the ability to produce products Chicken sempol is decent and good for Indonesian standards.

There are several factors that can cause product out-of-sync Chicken sempol in the production process is a human factor, namely fatigue and negligence while working,

factors such as machines/equipment that use pans and small baking pan, the method factor is rushing the boiling process and draining and soaking for too long, and environmental factors namely less comfort in working due to an unclean environment and noise. And the follow-up improvements made were by addition employees, increased employee discipline, temporary closure of place to sell while production is in progress, space construction production close to the place of sale, using a boiling place and draining according to the capacity of the sempol product or reduction sempol products at that stage using old equipment, use an alarm as a reminder of the soaking process time, and prioritize the work done.

6. ACKNOWLEDGEMENTS

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7. AUTHOR CONTRIBUTIONS

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Approval of final publication: Muchamad Hengki Riawan Putra
Resources, technical and material supports: Muhammad Saiful Huda
Supervision: Muchamad Hengki Riawan Putra

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