Design of working procedure for handling the breakdown machine in parameter of reaction time based on Jidoka system approach in cement company

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MATEC Web of Conferences **204**, 03008 (2018) https://doi.org/10.1051/matecconf/201820403008
IMIEC 2018

Design of working procedure for handling the breakdown machine in parameter of reaction time based on Jidoka system approach in cement company

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Abstract. Packaging is not a complementary of the product. Packaging is an interface between producer and consumer in a supply chain. Portland cement is one of the products which is usually distributed in unit packed with bags made of kraft paper. Cement production that done with large capacity machines requires the amount of bag in quantity that much anyway. The production of bag factory in Cement company line 4 ideally could reach 9-10 million bags per month. In fact, the average production of cement bag from January to June 2012 is 6.5 million bags per month. In addition, the average defects of work in process in the range of the same month reached 56,000 tubes per month. This indicates that engine breakdown is happen frequently and there is a lack of good performance in term of production process quality control. Long reaction time of operator against the possible breakdown and the breakdown that occur is the cause of the length of time handling problems on the machine, so much going on a lot of waste in time and there are work in process defects that pass to the next process. Minimizing the reaction time to the breakdown of machine can be done with the implementation of jidoka system on the production floor. Andon which is the tool of jidoka will ensure operator and other parties (operators, technicians, foreman) gather to repair the machine effectively and also efficient in term of time. The lights that flashing and the sound of alarm that raised by andon will ensure this happen. Working procedures with the jidoka system approach is proven can minimize the reaction time to the breakdown of machine. Based on calculations, minimizing of time can reach up to 93.66%. The mathematical model for the jidoka system approach that has been valid then converted to a standard operating procedure in handling the breakdown of machine in bag factory. The standard operating procedure that proposed will be technically efficient and effective in terms of time and method to handle the breakdown of machine.

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1 Introduction

Cement company in West Sumatra, Indonesia, also known as Padang Cement Company, has its own bag factory consists of 4 line. Line 1 and 2 are produce the sewing bag (using suture thread), while line 3 and 4 are the pasted (using glue as an adhesive). Currently, the production lines running 24 hours in line 4, while the 1, 2, 3 rarely operated. Line 4 has a length of 72 meters and 24 machines. The bags are produced by using the principle of one-piece-flow that produces it from one line arrangement machine. There are two groups of machines in the manufacturing of pasted cement bag: Tuber machines and Bottomer machines. The problem in one machine in tuber will make all of tuber machines stop operating, as well as the Bottomer machines. Operator of the machine is not adopted the full concept of autonomous when abnormal condition is detected on the machine, even though each operator has a good ability to analyze the condition of the machine. Operators sometimes have to ask to the others or the head shift about the problem encountered. This is ensued the longtime of reaction time.

Automation or the Japanese language called jidoka is the second pillar of the Toyota Production System. The term "autonomation" is a combination of autonomy and automation or allowing a process to be able to make its own decisions, thereby giving it a human touch [1]. Jidoka means automation with a human touch or equipment/machining with the help of human intelligence [2]; [3]. In the implementation, when the equipment shut down, then there will be a flag or light usually together with the music or an alarm which used as a sign to ask for the help from the others to handle the problem. This marking system called andon.

There were some previous studies related to implementation of Jidoka system approach in manufacturing industries and service industries as well. Baduka, Veza, and Bilic [4] conducted study about application of lean in automotive industry by integrated lean approach (tools and principles) in Process Failure Mode and Effect Analysis (PFMEA). Some of those lean tools and techniques integrated in PFMEA are Genchi Genbutsu, Kaizen, standardized work, Jidoka, and 5 why.

Jidoka system approach or error proofing devices can also applied in service processes which are not physically observable [5]; [6]. Lopez et al. [5] suggested that Jidoka's application to service environments should entail alert systems which detect failures in service and stop its supply whenever its occur.

2 Research Methodology

The bag factory currently has implemented two working procedures to handle the breakdown of machine. This study will look at the ability of the jidoka system approach to minimize the reaction time on the machine breakdown handling procedures. The parameter of measurement is personnel reaction time. Valid model will be transformed into the proposal of work procedures to handling the breakdown of machine in the bag factory, Padang Cement Company.

2.1 Working Procedure

There were four working procedure has been designed in this study i.e.:

1. Handling the breakdown of machine (Auto-Off) based on work procedure in Line 4, cement bag factory (Working Procedure 1)
   a. The personnel finds out which machine is involve with the breakdown
   b. Personnel who close with the broken machine have to fix it together
   c. If the personnel could not fix the broken machine, the personnel have to call the others for the help
2. Handling the breakdown of machine (Auto-Off) based on jidoka system approach (Working Procedure 2)
   a. All personnel see andon board to find out what machine is involved with the breakdown
   b. Personnel who have the responsibility to fix the certain machine have to do it together
3. Handling the breakdown machine that turned off by the personnel (autonomous) based on working procedure of Cement Company (without andon) (Working Procedure 3)
   a. Operator of Machine (Personnel 1) have to turn off the machine when the abnormal condition is detected
   b. Other personnel have to find out what machine is involved with the breakdown
   c. Personnel who close with the broken machine have to fix it together
   d. If the Personnel could not fix the broken machine, the personnel have to call the others for the help
4. Handling the breakdown of machine based on Jidoka principles (Working Procedure 4)
   a. Operator of machine (personnel 1) have to turn off the machine when the abnormal condition is detected
   b. All personnel see andon board to find out what machine is involved with the breakdown.
   c. Personnel who have the responsibility to fix the certain machine have to do it together

2.2 Model Formulation

Deficiencies in the work procedure 1 (number of uncontrollable inputs) will be anticipated by the work procedure 2, as well as work procedure 3 against 4. Work procedure 2 and 4 are not implemented in the factory, so the mathematical models required in this case in order comparing the performance of work procedure 1 against 2 and 3 against 4 in parameter of reaction time.

2.2.1 Mathematical Model of Work Procedure 2

$$RT = \max (R_1 , R_2 , \dots , R_n) \quad (1)$$

where;

$$R_i = S_iX + M_i + C_i \qquad (i = 1,2,\dots n) \quad (2)$$

$$S_iX = A_i + EF_i + RF_i \quad (3)$$

$A_i = 0{,}17$ second

$EF_i = 0{,}2628$ second

$RF_i = 0{,}1818$ second

$S_iX = 0{,}17$ second + 0,2628 second + 0,1818 second
$= 0{,}6146$ second (the machine code is 1 word)

So that the RT is as follow:

$$RT = \max ((0{,}6146 + M_1 + C_1) , (0{,}6146 + M_2 + C_2) , (0{,}6146 + M_3 + C_3) , \dots , (0{,}6146 + M_n + C_n)) \quad (4)$$

$$M_i = s / v \qquad (i = 1,2,\dots n) \quad (5)$$

Example for the perforating unit machine is as follow in Table 1.

Table 1. Duration of personnel go to the damage perforating unit machine

No	Operator and Other Personnel	Distance to the location of breakdown (*s*)	Walking speed (*v*)	Duration of Moving to the location of breakdown *(second)*
1	Printing Machine Operator	13,6861	1,116	12,264
2	Paper Roll Stand Operator	9,9302	1,116	8,898
3	Cutting Unit Operator	3,4183	1,116	3,063
4	Mechanic 1	2,1821	1,116	1,955
5	Mechanic 2	19,2209	1,116	17,223
6	Tuber Machine Watchman	6,1093	1,116	5,474

Reaction time against the breakdown of perforating unit machine by 6 personnel that be responsible to handling can be formulated is as follow:

$RT = \max((0{,}6146 + M_1 + C_1), (0{,}6146 + M_2 + C_2), (0{,}6146 + M_3 + C_3)), (0{,}6146 + M_4 + C_4), (0{,}6146 + M_5 + C_5), (0{,}6146 + M_6 + C_6))$ second

$= \max((0{,}6146 + 12{,}264 + C_1), (0{,}6146 + 8{,}898 + C_2), (0{,}6146 + 3{,}063 + C_3)), (0{,}6146 + 1{,}955 + C_4), (0{,}6146 + 17{,}223 + C_5), (0{,}6146 + 5{,}474 + C_6))$ second

$RT = \max((12{,}878 + C_1), (9{,}513 + C_2), (3{,}678 + C_3), (2{,}570 + C_4), (17{,}838 + C_5), (6{,}089 + C_6))$ second

Explanation:
RT= Reaction time against the breakdown of machine by *n* personnels (second)
R_i = Reaction time of personnel *i* ($i = 1,2,...,n$) (second)
S_iX = Reaction time of personnel *i* against the andon alarm and lamp (second)
M_i = Moving time duration of personnel *i* to reach the location of machine breakdown (second)
C_i = the time of personnel *i* to start handling machine
A_i = Auditory reaction time of the personnel against the andon alarm (second)
EF_i = Eye focus time (second)
RF_i = Reading time (second)
s = Distance of personnel movement (m)
v = Walking speed of personnel (m/s)

There are 24 machines in the bag factory, Padang Cement Company. The result from same way to calculate the total of reaction time in 3 another machines can be described as follows:

1. Printing Machine
   $RT = \max(R_1, R_2, \ldots, R_6)$
   $= \max((1{,}464 + C_1), (3{,}676 + C_2), (14{,}704 + C_3), (13{,}576 + C_4), (29{,}192 + C_5), (17{,}532 + C_6))$
2. Semi-Automatic Paper Roll Stand 1
   $RT = \max((2{,}867 + C_1), (1{,}787 + C_2), (13{,}313 + C_3), (12{,}185 + C_4), (27{,}809 + C_5), (16{,}141 + C_6))$ second
3. Semi-Automatic Paper Roll Stand 2
   $RT = \max((4{,}376 + C_1), (1{,}574 + C_2), (11{,}612 + C_3), (10{,}482 + C_4), (26{,}118 + C_5), (14{,}438 + C_6))$

2.2.2 Mathematical Model of Work Procedure 4

$RT = R_1X + \max(R_1, R_2, R_3, \ldots, R_n)$ (6)

where

$R_1X = RE_1X + M_1X + V_1X + MP_1X + P_1X$ (7)

$RE_1X = 0{,}12$ second

$V_1X = 0{,}42$ second

$P_1X = 0{,}1224$ second

$R_1 = M_1 + C_1$ (8)

$R_i = S_iX + M_i + C_i \quad (i = 2,3,\ldots,n)$ (9)

$S_iX = A_i + EF_i + RF_i$ (10)

$A_i = 0{,}17$ second

$EF_i = 0{,}2628$ second

$RF_i = 5{,}05$ TMU x sum of word

$S_iX = 0{,}17$ second + 0,2628 second + 0,1818 second

$= 0{,}6146$ second (machine code is 1 word in andon board)

There is no off button in each of machine, so that operator must go to the location of machine breakdown even though the machine is turned off by him. General formula to calculate total reaction time with this procedure is as follow:

$RT = R_1X + \max((M_1 + C_1), (0{,}6146 + M_2 + C_2), (0{,}6146 + M_3 + C_3), \ldots, (0{,}6146 + M_n + C_n))$ (11)

Reaction time of personnel 1 to turn off the machine is shown in Table 2.

R_1X on the cross pasting unit machine is:

$R_1X = RE_1X + M_1X + V_1X + MP_1X + P_1X$

$= 0{,}12$ second + 1,171 second + 0,42 second + 0 second + 0,1224 second

$= 1{,}833$ second

So that the mathematical model to calculate the breakdown reaction time of cross pasting unit machine is as follow:

$RT = R_1X + \max(R_1, R_2, R_3, \ldots, R_n)$

$= R_1X + \max((M_1 + C_1), (S_2X + M_2 + C_2), (S_3X + M_3 + C_3), (S_4X + M_4 + C_4), (S_5X + M_5 + C_5), (S_6X + M_6 + C_6))$

$= 1{,}833$ second + max ((0 + C_1), (0,6146 + 13,777 + C_2), (0,6146 + 10,409 + C_3), (0,6146 + 2,005 + C_4), (0,6146 + 16,393 + C_5), (0,6146 + 4,646 + C_6)) second

$RT = 1{,}833$ second + max ((C_1), (14,391 + C_2), (11,023+ C_3), (2,619 + C_4), (17,008 + C_5), (5,260 + C_6)) second

Table 2. Reaction time of personnel 1 to turn off the machine

Machine	Name of Machine	Personnel who responsible to the machine	Distance of the personnel to the machine (s)	Distance of the personnel to the off button (s)	Walking speed of Operator (v)	Duration of personnel 1 go to abnormal machine M_1X (second)	Duration of personnel 1 go to off button machine MP_1X (second)	Duration of personnel 1 go to breakdown machine (second) M_1
1	Printing Machine	Printing Machine Operator	0,9475	0	1,116	0,849	0	0
2	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator	1,3089	0,4035	1,116	1,173	0,362	0
3	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator	1,3435	0,453	1,116	1,204	0,406	0
4	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator	2,3665	0,92	1,116	2,121	0,824	0
5	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator	4,2402	1,053	1,116	3,799	0,944	0
6	Automatic Web Brake	Paper Roll Stand Operator	6,1805	0,8693	1,116	5,538	0,779	0,779
7	Edge Position Controller	Mechanic 1	4,2343	2,3778	1,116	3,794	2,131	2,131
8	Web Drawing Unit	Mechanic 1	3,1656	1,2668	1,116	2,837	1,135	1,135
9	Perforating Unit	Mechanic 1	2,0508	0	1,116	1,838	0	0
10	Cross Pasting Unit	Mechanic 1	1,3063	0	1,116	1,171	0	0
11	Longitudinal Pasting Unit	Mechanic 1	1,3817	0	1,116	1,238	0	0
12	Tube Forming Unit	Cutting Unit Operator	2,6502	0,8105	1,116	2,375	0,726	0
13	Cutting Unit	Cutting Unit Operator	4,0979	0,693	1,116	3,672	0,621	0
14	Stacking Unit	Cutting Unit Operator	7,3672	0	1,116	6,601	0	0
15	Counter	Rotary Feeder 2 Operator	2,1586	0	1,116	1,934	0	0
16	Press Tube	Bottomer watchman	7,8535	0,955	1,116	7,037	0,856	0
17	Rotary Feeder	Rotary Feeder 1 Operator	0	0,4745	1,116	0	0,425	0
18	Alignment Unit	Rotary Feeder 1 Operator	0	0,4745	1,116	0	0,425	4,291
19	Creasing Station Pin Hole Unit	Rotary Feeder 1 Operator	0	0,4745	1,116	0	0,425	5,990
20	Bottom Opening Unit	Mechanic 3	3,3788	0	1,116	3,028	0	0
21	Valve Inserting	Mechanic 3	1,3618	0,991	1,116	1,220	0,888	0
22	Bottom Pasting Unit	Mechanic 3	1,0022	0	1,116	0,898	0	0
23	Bottom Turning Unit	Mechanic 3	4,6029	0	1,116	4,124	0	0
24	Stacking Unit	Mechanic 3	8,8185	3,7913	1,116	7,902	3,397	3,397

Explanation:
RT= Reaction time against the breakdown of machine by n personnel (second)
R_1X = Reaction time of personnel 1 to turn off the machine (second)
RE_1X = Reaction time of personnel 1 against the abnormal condition of machine (second)
M_1X = Moving time duration of personnel 1 go to the abnormal machine (second)
V_1X = Time of personnel 1 to check the machine condition (second)
MP_1X = Time of personnel 1 go to off button of machine (second)
P_1X = Time to push the off button of machine by personnel 1 (second)
R_1 = Time of personnel 1 to handling the machine after the machine is turned off (second)
M_1= Moving time duration of personnel 1 to reach the location of machine breakdown (second)
C_1 = Time of personnel 1 to analyze the condition of machine (second)
R_i = Reaction time of personnel i (i = 2,3,...,N) (second)
S_iX = Reaction time of personnel i against the andon alarm and lamp (second)
M_i = Moving time duration of personnel i to reach the location of machine breakdown (second)
C_i = the time of personnel i to start handling machine
A_i = Auditory reaction time of the personnel against the andon alarm (second)
EF_i = Eye focus time (second)
RF_i = Reading time (second)
s = Distance of personnel movement (m)
v = Walking speed of personnel (m/s)

The result of three another machines can be described as follows:

1. Perforating Unit
   RT = 2,5 second + max ((C_1) , (12,878 + C_2) , (9,513 + C_3) , (3,678 + C_4) , (17,838 + C_5) , (6,089 + C_6))
2. Longitudinal Pasting Unit
   RT = 1,9 second + max ((C_1) , (15,465 + C_2) , (12,096 + C_3) , (1,785 + C_4) , (14,936 + C_5) , (3,247 + C_6))
3. Tube Forming Unit
   RT = 3,763 second + max ((C_1) , (18,419 + C_2) , (14,846 + C_3) , (3,669 + C_4) , (13,489 + C_5) , (2,388 + C_6))

2.3 Model Validation

This research used the experimental validation to proving the jidoka system approach is better to implemented in bag factory. Experimental validation tested the value and accuracy of solution in answering the problem and lookout the significance of models parameter. Value of C_i (time of personnel to start handling machine) on the jidoka system approach was assumed equal with C_i on procedure. If the number of personnel required is less than the estimated number of personnel in the model, then the value of C_i at other personnel is 0,42 seconds. The model can be valid if the duration of personnel reaction time to breakdown machine can be minimized by jidoka system approach. Table 3 represents total reaction time by work procedure 1.

A. Breakdown on cutting unit machine
   Caused by : paper stuck
   Duration : 1 minute 45 seconds
   Off explanation : automatic

Table 3. Total reaction time by work procedure 1

Personnel	Activity Explanation	Duration (second)
1	Time of Personnel 1 to start handling the machine	2
	Personnel 1 handling the machine	31
2	Time of Personnel 2 to start handling the machine	4
	Personnel 2 handling the machine	9
3	Time of Personnel 3 to start handling the machine	1
Total Reaction Time		47

With the same breakdown, jidoka can perform the result as follow:

RT = max ((19,735 + C_1) , (16,162 + C_2) , (4,287+ C_3) , (5,307 + C_4) , (11,348 + C_5) , (2,109 + C_6)) second
= max ((19,735 + 0,42), (16,162 + 0,42) , (4,287 + 4) , (5,307 + 1) , (11,348 + 0,42) , (2,109 + 2)) second
= max ((20,155) , (16,582), (8,287) , (6,307) , (11,768) , (4,109)) second
RT = 20,155 second

B. Breakdown on cross pasting unit machine
   Caused by : glue spilled
   Duration : 2 minutes 57 seconds
   Off explanation: turned off by personnel 1
   Table 4 represents total reaction time by work procedure 3.

Based on the results obtained, the mathematical model to determine the reaction time with jidoka system could be declared as the valid model and would be good to implemented. Work procedure with jidoka system approach has many advantages because it can eliminate the ineffective elemental work on existing work procedure in bag plant.

Table 4. Total reaction time by work procedure 3

Personnel	Activity Explanation	Duration (second)
1	Personnel 1 turn off the machine	3
	Time of personnel 1 to start handling machine (discuss with head of production sector)	37
	Personnel 1 handling the machine	18
2	Time of personnel 2 to start handling machine (discuss with head of production sector)	6
	Personnel 2 handling the machine	51
	Personel 2 memanggil bantuan ke personel 3	3
3	Personnel 3 walk to machine location	7
	Time of personnel 3 to start handling machine (get instruction from personnel 2 and take the tools)	15
Total Time		140

Table 5 shows the comparison between plant procedure and jidoka system approach procedure.

Table 5. Existing procedure versus jidoka

Breakdown	Procedure of PT Padang Cement		Procedure base on *Jidoka* System Approach	
	Duration (second)	Number of Personnel	Duration (second)	Number of Personnel
1	119	4	19,089	6
2	29	2	24,109	6
3	47	3	20,155	6
4	73	2	20,155	6
5	140	3	38,833	6
6	288	4	18,258	6
7	55	4	20,155	6
8	30	4	20,155	6
9	29	3	17,428	6
10	68	2	20,155	6

3 Working Procedure based on Jidoka System Approach

Establishment of the procedure begin with determine the personnel who is responsible to overseeing each machine in the line 4, bag factory. It will be shown in Table 6. Tuber machine that is turned off will not affect the bottomer machine. This condition requires the instruction about personnel who will execute the breakdown.

3.1. Standard Operating Procedure to Handling The Auto-off Machine Breakdown

The procedure is as follows.

1. The personnel should be stand by and watch the machine in the predetermined location point.
2. When the machine is off automatically (indicated by an alarm andon), the personnel directly have to see the andon board. Information on andon board should have been caught in 0.6146 seconds or less.
3. The personnel who responsible to execute the machine, immediately go to the location of the machine breakdown with walking speed is 1.116 m/s (can cover a distance of 2 meters in 1.8 seconds).
4. When the personnel has reached the location of machine breakdown, all personnel have to analyze the condition of the machine quickly (try in 0.42 second or less).
5. All personnel who responsible to execute the machine should participate in the repair process.

Table 6. Personnel who responsible to overseeing each machine

Machine	Name of Machine	Personnel who responsible to the machine
1	Printing Machine	Printing Machine Operator
2	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator
3	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator
4	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator
5	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator
6	Automatic Web Brake	Paper Roll Stand Operator
7	Edge Position Controller	Mechanic 1
8	Web Drawing Unit	Mechanic 1
9	Perforating Unit	Mechanic 1
10	Cross Pasting Unit	Mechanic 1
11	Longitudinal Pasting Unit	Mechanic 1
12	Tube Forming Unit	Cutting Unit Operator
13	Cutting Unit	Cutting Unit Operator
14	Stacking Unit	Cutting Unit Operator
15	Counter	Rotary Feeder 2 Operator
16	Press Tube	Bottomer watchman
17	Rotary Feeder	Rotary Feeder 1 Operator
18	Alignment Unit	Rotary Feeder 1 Operator
19	Creasing Station Pin Hole Unit	Rotary Feeder 1 Operator
20	Bottom Opening Unit	Mechanic 3
21	Valve Inserting	Mechanic 3
22	Bottom Pasting Unit	Mechanic 3
23	Bottom Turning Unit	Mechanic 3
24	Stacking Unit	Mechanic 3

3.2 Standard Operating Procedure to Handling The Machine Breakdown That Turned Off by Operator (Personnel 1)

1. The personnel should be stand by and watch the machine in the predetermined location point.
2. When the abnormal condition is detected, personnel 1 (personnel who watch the machine) should be able to push the off button of machine in the following time or less. After pushing the off button, personnel 1 immediately go to the location of machine breakdown with walking speed is 1.116 m / s (can cover 2 meters in 1.8 seconds). The

recapitulation of duration time until the off button of machine pushed will be shown in Table 7.

3. When the machine is off (indicated by an alarm andon), the personnel directly have to see the andon board. Information on andon board should have been caught in 0.6146 seconds or less.
4. The personnel who responsible to execute the machine, immediately go to the location of the machine breakdown with walking speed is 1.116 m/s (can cover a distance of 2 meters in 1.8 seconds).
5. When the personnel have reached the location of machine breakdown, all personnel have to analyze the condition of the machine quickly (try in 0.42 second or less). All personnel who responsible to execute the machine should participate in the repair process.

Table 7. Duration until the off button of machine is pushed

Machine	Name of Machine	Personnel who responsible to the machine	Duration until the off button of machine is pushed (second)
1	Printing Machine	Printing Machine Operator	1,511
2	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator	2,197
3	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator	2,272
4	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator	3,607
5	Semi-automatic Paper Roll Stand	Paper Roll Stand Operator	5,405
6	Automatic Web Brake	Paper Roll Stand Operator	6,979
7	Edge Position Controller	Mechanic 1	6,587
8	Web Drawing Unit	Mechanic 1	4,634
9	Perforating Unit	Mechanic 1	2,500
10	Cross Pasting Unit	Mechanic 1	1,833
11	Longitudinal Pasting Unit	Mechanic 1	1,900
12	Tube Forming Unit	Cutting Unit Operator	3,763
13	Cutting Unit	Cutting Unit Operator	4,955
14	Stacking Unit	Cutting Unit Operator	7,264
15	Counter	Rotary Feeder 2 Operator	2,597
16	Press Tube	Bottomer watchman	8,555
17	Rotary Feeder	Rotary Feeder 1 Operator	1,088
18	Alignment Unit	Rotary Feeder 1 Operator	1,088
19	Creasing Station Pin Hole Unit	Rotary Feeder 1 Operator	1,088
20	Bottom Opening Unit	Mechanic 3	3,690
21	Valve Inserting	Mechanic 3	2,771
22	Bottom Pasting Unit	Mechanic 3	1,560
23	Bottom Turning Unit	Mechanic 3	4,787
24	Stacking Unit	Mechanic 3	11,962

4 Design of Andon Board

There are two signals that would indicate the off machine: alarm as an auditory stimulus and the light as the visual signal. Figure 1 is andon (the unit is meter) while Figure 2 describing the tool that used to sounding the alarm. 855XH Hazardous Location Horns can sounding the alarm at 110 dB sound power up to 117 dB. Line 4 that has 2 groups of machines: bottomer and tuber can cause miss or error communication in calling the personnel who responsible to execute the machine. This was anticipated with the 2 types of alarms that serve each group machine.

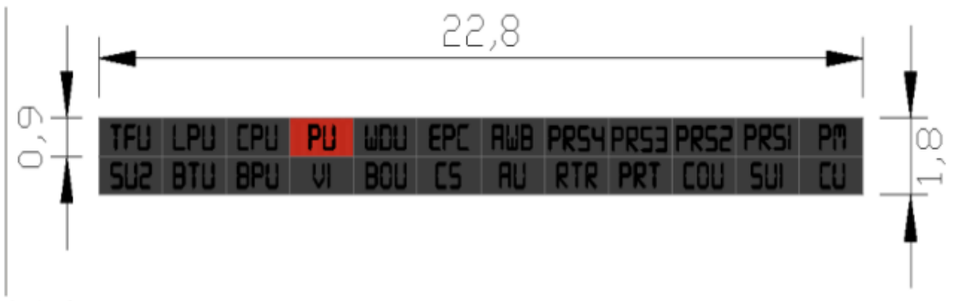

Fig 1. Andon

Fig 2. 855XH Hazardous Location Horns [7]

5 Conclusion

Work procedure of bag factory, Padang Cement Company to handling the machine breakdown is considered less effective in term of the way and less efficient in term of time. This can be resolved by jidoka and genchi genbutsu that will ensuring shorter reaction time to handling the machine breakdown and the problem will fixed together effectively. One thing that important too is there is no problem hidden for anybody in factory. In general, the advice that can be proposed for bag factory, Padang Cement Company is applying the jidoka and genchi butsu intensively according with the emendation proposal. This will ensure the reaction time to the abnormal condition of the machine and machine breakdown could be shortened significantly. Jidoka and genchi genbutsu are also directly expected to minimize the duration of machine breakdown. Discipline and seriousness as well as the control and supervision of personnel from the related parties are the very important things needed to achieve the goals of these two principles.

The authors appreciate the financial support for this research provided by Engineering Faculty of Andalas University grant under contract no. 024/UN.16.09.D/PL/2018 and we also would like to acknowledge to Cement Padang Company that has allowed us to conduct research on its bags factory.

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