Journal of Industrial Engineering Scientific
Vol. XX, No. XX, <Month>, <Year>, p.XX – XX e-ISSN: xxxx-xxxx

Analysis of Dominant Factors Causing Product Defects Using the Screening Method in the Manufacturing Industry

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Article Information

Manuscript Received xxx
Manuscript Revised xxx
Manuscript Accepted xxx
Manuscript Online xxx

ABSTRACT

Study This aim For analyze factor dominant reason disabled products in industry manufacturing with use method *screening* in approach *Design of Experiments* (DOE). Object study is a production process in one of the company manufacturing that is experiencing level disabled product relatively high and has an impact on the decline quality as well as efficiency production . Problems main issues faced is Not yet identification the most influential process factors to occurrence disabled product , so that effort repair Not yet walk optimally and in a targeted manner . Method *screening* used For test a number of process factors in general simultaneous use determine factors significant impact quality product . Research results show that there is a number of factor dominant , namely machine parameters , material conditions , and methods work , which is significant contribute to emergence disabled product . Interpretation results show that variations in factors the cause inconsistency of the production process so that increase potential defects . Advantages results study This lies in the ability method *screening* in filter factors important in a way efficient with amount relative experiment a little , so that capable focus effort improvements in the most influential variables . Research results This can implemented in a way practical as base taking decision in control quality and improvement of production processes in industry manufacturing with similar process conditions , in particular in effort lower level disabled product in a way systematic and sustainable .

Keywords: *Design of Experiments* , Method *Screening* , Disability Products , Control Quality , Process Optimization

1. INTRODUCTION

Design of Experiments (DOE) is technique designed statistics For planning , implementing , and analyzing experiment in a way systematic use obtain valid and efficient data of a complex process . DOE helps researchers determine influence various factor to variables response as well as optimize process conditions before implementation scale production [1]. In context industry manufacturing , methods This used For find combination of process parameters that are capable of minimize disabled products and improve output quality [2]. DOE also becomes effective tool in critical process identification and improvement quality in a way sustainable [3].

Method *screening* is stages beginning in Design *of Experiments* used For filter a number of big process variables find the most influential factor to variables measured output . In the context of the manufacturing industry, this method allows researchers to efficiently identify critical variables before conducting further analysis or process optimization [4]. By reducing the complexity of experiments and the number of factors tested, screening *helps* save resources while ensuring focus on the dominant factors contributing to product defects. This approach This support strategy improvement better quality directed and data -driven [5].

Disabled product is conditions in which the results production No fulfil standard quality that has been set so that influential negative on performance operational and satisfaction customers . The height amount product disabled can cause material waste , increase cost production , and disruption of the distribution process [6]. Factors that often become reason disabled product covering error operational , process variation , quality material standard , and lack of process control [6], [7]. Therefore that , understanding to characteristics disabled as well as identification reason mainly important done so

that the steps repair quality can implemented in a way effective and sustainable .
Control quality is a systematic process For monitor and ensure that products produced fulfil standard quality that has been set . In industry manufacturing , control quality very important For lower level disabled products and improve efficiency production . Approach statistics like *Statistical Process Control* (SPC) is used For identify process variations and determine dot, dot, dot deviation before product produced in a way mass [8]. Implementation control quality allows company do action corrective in a way appropriate time and sustainability so that quality product can maintained in accordance hope consumers [9]. This supports process improvement and optimization of overall production performance [10].

2. RESEARCH SIGNIFICANCE

Study about analysis factor dominant reason disabled product become very important remember height demands quality and efficiency in industry manufacturing . Defects product No only cause material waste and increase cost production , but also has an impact on decreasing Power competition as well as trust consumers . The complexity of the production process involving Lots variables often make things difficult company in determine factor main reason defects . Therefore, the use of *screening methods* is urgent in this research because it can systematically and efficiently identify dominant factors. The research results are expected to form the basis for decision-making in process improvement and continuous quality control.
Study in five years final related disabled products in industry manufacturing generally focused on implementation method control quality like *Statistical Process Control* , *Lean Six Sigma* , *FMEA* , and *Root Cause Analysis* . Methods the effective For identify and reduce defective , but part big study Still nature descriptive and not yet emphasize determination factor dominant in a way statistics from Lots process variables . In addition that , the use of method *screening* in *Design of Experiments* For filter most influential factors Still relatively limited . Therefore that , is necessary research that applies screening method systematic use identify factor dominant reason disabled product in a way more efficient and measurable .

Table 1. *State of the Art* DOE Research Design Factorial

Year	Methods Used	Key Findings	Lack Study
2020	Statistical Process Control (SPC)	SPC is capable identify process and point variations control reason disabled product	No capable determine factor dominant when amount many process variables
2021	Root Cause Analysis (RCA) & Pareto Diagram	Factor human and machine become reason main disabled product	Analysis nature qualitative and not measure influence factor in a way statistics
2022	Failure Mode and Effect Analysis (FMEA)	Priority risk disabled product can determined through RPN value	No test connection cause and effect between process variables
2023	Lean Six Sigma (DMAIC)	There was a decrease in product defect rates and an increase in process capabilities.	Focus on improvement, not filtering out dominant factors from the start
2024	Method Quality Conventional (SPC–Pareto)	Identification type disabled dominant succeed done	Not yet use screening method for filter factor critical in a way efficient
2025	Design of Experiments Screening Method	Factor dominant reason disabled product can identified in a way statistics and efficiency	Limited to the stage of identifying dominant factors, not yet at the stage of process optimization

3. RESEARCH METHODS

3.1 Material

Study This use approach *Design of Experiments* (DOE) with method *screening* For evaluate influence a number of process factors on level disabled products in industry manufacturing . Method *screening* chosen as stage beginning study For test Lots process variables in a efficient before done analysis advanced or process optimization .
Object study in the form of a production process with observed responses is percentage disabled product . In study here , there is seven the process factors being tested , namely speed machine , process temperature , pressure , material quality , method work , processing time , and conditions environment . Each factor set at two test levels , namely low level (−1) and high level (+1), which are adjusted with condition operational actual production process .
Design experiments used is design *Plackett –Burman* , which allows testing a number of factor in a way simultaneous with amount test relative limited . All combination treatment designed For produce representative data to production process variations . Result data the experiment obtained furthermore used as base analysis *screening* For evaluate influence each factor to response disabled product .

3.2 Experimental Procedure

Procedure experiment in study This done in a way systematic For obtain representative data in accordance with design *screening Design of Experiments* . Stage beginning started with determination process factors and test levels based on condition operational actual production process . Factors that have been set

furthermore arranged to in design experiment *Plackett -Burman* with seven factors and two levels of testing .
Every combination treatment executed in accordance order design experiments , with observed responses in the form of percentage disabled products on each experiments . Data collection was performed on each run of the experiment to ensure consistency and repeatability of the process. All data from the results test recorded and compiled in form table as base analysis .
Data obtained Then analyzed use device Minitab software for count effect each factor to response disabled product . Analysis done use Pareto chart as tool main at the stage *screening* For filter potential factors own influence dominant to disabled product . Analysis results furthermore discussed in chapter results and Discussion .

4. RESULTS AND DISCUSSION

Table 2. Screening Design of Experiments Experiment Data

Run	Speed Machine	Process Temperature	Pressure	Material Quality	Method Work	Processing Time	Environment	Disabled Product (%)
1	−1	−1	−1	−1	−1	−1	−1	12.4
2	+1	−1	−1	+1	+1	−1	+1	5.1
3	−1	+1	−1	+1	−1	+1	−1	6.8
4	+1	+1	+1	−1	+1	−1	+1	13.6
5	−1	−1	+1	+1	−1	+1	+1	6.0
6	+1	−1	+1	−1	+1	+1	−1	11.9
7	−1	+1	+1	−1	−1	−1	+1	9.7
8	+1	+1	−1	+1	+1	+1	−1	4.8
9	−1	−1	−1	+1	+1	+1	+1	5.3
10	+1	−1	−1	−1	−1	+1	−1	11.2
11	−1	+1	−1	−1	+1	−1	+1	10.1
12	+1	+1	+1	+1	−1	−1	−1	6.2

Table 2 presents the results data test screening *Design of Experiments* used in study this . Experiment designed For evaluate influence seven process factors on percentage disabled product , namely speed machine , process temperature , pressure , material quality , method work , processing time , and environment . Each factor tested at two levels, namely low level (−1) and high level (+1), according to with approach screening design .
Design the experiment used allows testing combination factor in a way efficient with amount limited trials , so that suitable applied at the stage beginning analysis For identify potential factors dominant . The response observed in each run of the experiment is percentage disabled the resulting product , as shown in the column final table .
Result data test This furthermore processed use device Minitab software with method *Plackett –Burman Design* . Data processing aims For count effect each factor to response disabled products and determine level significance its influence . The results of the analysis served in form Pareto *Chart of Standardized Effects* used as base in identify process factors that have influence significant to level disabled product .

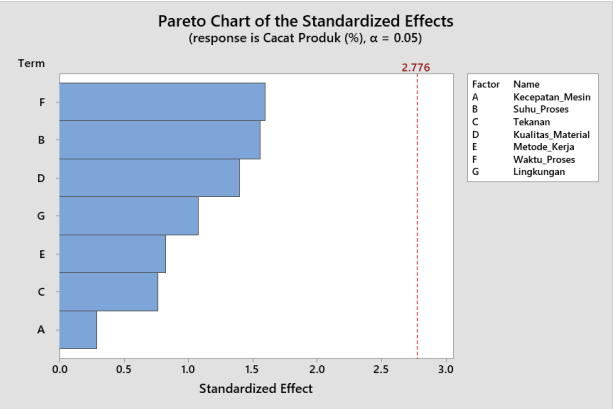

Figure 1. Pareto Chart of Influence Process Factors on Disabled Product

Figure 1 shows The resulting Pareto *Chart of the Standardized Effects* from analysis *screening* use method Plackett –Burman Design with response in the form of percentage disabled product . Graphics This display size effect standardized from each process factors on disabled products , as well as line limit significance statistics at the level 95% confidence level (α = 0.05). Factors that have mark effect standardized exceed line significance stated influential significant to observed response .
Based on Pareto chart , Process Time factor (F) shows the biggest influence to level disabled product , followed by Process Temperature (B) and Material Quality (D). The three factor the own mark effect standardized highest compared to factor others , so that can categorized as factor dominant at the stage *screening* . This is indicates that variations in process time , process temperature , and material quality contribute significant to improvement or decline disabled product .
Temporary that , factor Environment (G), Method Work (E), Pressure (C), and Speed Machine (A) shows mark more effects small and under limit significance . Factors the considered No significant at the stage *screening* and can eliminated from analysis continued . With Thus , efforts repair quality should focused on factors dominant that has identified For reach decline disabled more products effective and efficient .

5. CONCLUSIONS

Study This aim For analyze factor dominant reason disabled products in industry manufacturing use method *screening Design of Experiments* with design Plackett –Burman. Analysis results show that method *screening* capable identify influential process factors significant to level disabled product in a way efficient with amount limited trial . Based on Pareto chart , factors process time , process temperature , and material quality are factor dominant who has the biggest influence to percentage disabled product . Factor others , such as speed machine , pressure , method work and conditions environment , shows relative influence small at the stage *screening* this .
With Thus , the implementation method *screening* Plackett –Burman can made into base taking decision in control quality as well as as step beginning For study continued at the stage production process optimization .

6. ACKNOWLEDGEMENTS

Writer say accept love to lecturer guardian eye studying Statistics Industry 2 above guidance , direction , and knowledge that has been provided given during lectures . Research and writing article This arranged as part from fulfillment task Final Semester Exam (UAS) for the subject studying said . Speech accept love is also conveyed to colleagues who have give support and assistance in settlement study this . Besides that , the writer value use device Minitab software as analysis tools supporting statistics data processing in study This .

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