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DETERMINING PROCUREMENT PROCESS PARAMETERS FOR A CONSTRUCTION PROJECT FOR MANAGING RESOURCES IN AN OPTIMAL SETTING

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ABSTRACT

The procurement of raw material and the handling equipment for the construction work involves varied sources of supply with varying cost and other liabilities while arriving at the most effective proposal. The obvious parameters for arriving at a purchase decision are Cost, Lead time and Quality of the commodity being purchased. Typically, suppliers are located in the vicinity of the site though their prices could vary amongst themselves as well as the index for the quality. A distant supplier might seem economic for the given price while the lead time might not justify the choice. These contrasting needs of the purchasers underline the need for optimal or balanced method of evaluating the impact on the said resources. This work shall employ Taguchi method or suitable methodology for performing Design of Experiments while preliminary investigation shall be conducted using ANOVA. The software MiniTab shall be engaged for this Analytical assessment of the problem. Data shall be secured from a live source and its effectiveness shall be validated through a trial experiment involving process simulation for the output parameter.

Keywords: *Construction material, DOE, MiniTab, ANOVA, Optimization, Taguchi methods*

I. INTRODUCTION

With the advent of new materials and processes in the construction industry coupled with pressing deadlines for the projects, the need for organized procurement planning has gained more importance to this date. The lack of structured procedures, based on good information, for the selection of construction procurement system sometimes inhibits the opportunity for clients to choose a procurement option in a fully informed manner. The selection and use of an unsuitable procurement approach could eventually lead to project failure. To formalize the procurement selection procedure, clients should establish a set of appropriate selection parameters based on their distinctive characteristics and objectives, project requirements and external environment. The construction industry differs from most other industries, because it tends to produce a one-off prototype, whereas the other industries are mass producers. Only when the prototype emerges as a model and is replicated, the constructions can be compared with mass products. Unlike with mass production, the client usually takes the initiative to have constructions designed and build. The client is the actor who pays for the construction. The client may sell or let the construction later. Thus the client is the one who orders the construction.

II. LITERATURE REVIEW

1) A Study of wear resistance of Non-ferrous Roller Burnished Components R. murli Krishna and Eshwara Pi rasad koorapat:

The present paper is an attempt to study the improvement in the wear resistance of non-ferrous roller burnished components. Roller burnishing is a surface modification process in which a hard roller is pressed against a rotating work piece, which results in improved surface characteristics like surface finish, wear resistance, corrosion resistance, hardness, fatigue life etc.

Roller burnishing is primarily a surface finishing process .But the major conclusion was observed that the process also improves also improves the wear resistance the wear resistance of the non-ferrous components. The reasons for the improvement in resistance of roller burnished components were investigated.

2) Optimization of the weld Bead Geometry Tungsten arc Welding By the Taguchi Method

Y.S. Tarang and W.H. Yang :In this paper taguchi method is used for optimization of the weld bead geometry in the gas Tungsten arc Welding. Gas tungsten arc weld quality is strongly characterized by the weld Bead geometry. This is because the weld bead geometry is plays an important role in determining the mechanical properties of the weld and also welding process parameters are strongly correlated to the weld bead geometry. Tguchi proposed that the engineering optimization of a process or product should be carried out in the three-step approach .

In this paper three parameters are used with the optimal weld bead geometry such as System design, parameter design and tolerance design. To select an appropriate orthogonal array for experiments, the total degrees of freedom must be computed. The degrees of freedom are defined as the number of comparisons between process parameters that must be made to determine which level is better and specifically how much better it is. Once the degree of freedom required are known, the next step is to select an appropriate orthogonal array to fit the specific task. In the Taguchi method, a loss function is defined to calculate the deviation between the experimental value and the desired value. Analysis of variance is occurring to investigate which process parameters significantly affect the quality characteristic. Optimal level of process parameters is selected, the final step is to predict and verify the improvement of the quality characteristic using the optimal level of process parameters. In this paper it is clearly shown that the front height, front width, back width of the weld are greatly reduced by using the optimal welding process parameters. Through the analysis of variance it is seen that welding speed, welding current and polarity ratio are the important welding process parameters for the determination of weld bead geometry.

3) Optimization of multi-stage closed-die forging process by coupled simulation of the machine and the forging processes C. Brecher, W. Klein, M. Tannert-

Investigation of this paper is the use of finite element analysis in the development of closed-die forging process is widely established in industry. However, the simulated and the real work piece dimensions differ from each other in a significant way, as the interactions between the forging significant process and the production machine are not adequately considered in the simulation.

But the multistage dies in particular often need to undergo an experimental time consuming optimization process on the production machine.

In this paper a method is presented that allows the coupling of the forging simulation with external machine tool simulation systems and non-linear elastic press models in order to consider the interactions between the process and the machine, and to improve the accuracy of the forging simulation. This method of coupled simulation was integrated into a software tool and may be used for single stage as well as for multistage process in closed-die forging operation.

This optimization process is challenging, particularly due to the complex interaction between the single die stages of multi stage dies(5). This time consuming optimization process in conjunction with the unproductive downtime of the press leads to high overall costs, thereby having a negative effect on the cost calculations of the work piece.

After the comparison reveals of two aspects. Firstly the mean thickness of the work piece in the forging test (34.9mm) differs considerably from the specified height of 32.9mm. The reasons for this are the press behavior consisting of nonlinear starting deflection and linear elastic part and the elastic deformation of the dies. Secondly the simulation does not calculate the work piece dimensions of the forging test in a precise manner.

When coupling the process and the machine simulation, it is firstly the process loads on the dies that are transferred from the forging simulation system to the machine simulation. Based on the forging load that arises, the displacements between the press ram and the press bed are calculated before then being transferred back as a resulting tool displacement to the forging simulation.

A coupling step proceeds as following:

1. Transfer of the tool node coordinates and node forces of the forging simulations to the coupled simulation
2. Calculations of the overall press load in the coupled simulation and transfer to the machine simulation
3. Calculation of the press behavior in the form of ram displacement and ram tilting in the machine simulation and transfer to the coupled simulation.
4. Calculation of the resulting tilting and displacement of the individual die stages in the coupled simulation. Information on the displacement of each tool node relative to the ideal stroke is transferred to the forging simulation.
5. Import of the data by the forging simulation and adaptation of the tool FE mesh. Calculations of the next simulation step.

The models of the conventional FE simulations of the forging process were used as input parameters for the coupled simulation. There is a significant correlation between the parameters determined dynamically and those detected in a static press measurement. The dynamic stiffness values are between only 4 and 12% lower than the static ones. The machine parameters determined dynamically were used for generating simulation models of the presses for the coupled simulation.

The coupled simulation achieves more realistic simulation results. The analysis of these results may be used for attaining simulation-aided tool optimization to make individual die adjustments possible even as early as the design stage of the tools and long before the tryout phase on the press.

4. Optimization of machining parameters for hard machining: gray relational theory approach and ANOVA - Bala Murugan Gopalsamy. Biswanath Mondal. Sukamal Ghosh

This paper investigate the machine ability study of hardened steel and to obtain optimum process parameters by gray relational analysis. An orthogonal arrey, gray relations, gray relational coefficients and analysis of variance (ANOVA) are applied to study the performance characteristics of machining process parameters such as cutting speed, feed, depth of cut and width of cut with considerations of multiple responses, i.e. volume of material removed, surface finish, tool wear and tool life. Tool wear patterns are measured using optical microscope and analyzed using scanning electron microscope and X-ray diffraction technique.

Taguchi method can be applied for optimization of process parameters to produce high quality products with lower manufacturing costs. Gray theory can provide an efficient solution to the uncertainty in multi-input and discrete data problems. It had been effectively applied to optimize the multi-response processes through the setting of process parameters. Gray relational analysis can be used to find out the relationship of the reference sequence with other sequences or the relational degree existing between the variations of any two different sequences.

In this paper, Taguchi L_{18} orthogonal array is integrated with grey relation theory to analyse the process parameters obtained from 18 experiments for rough and finish machining individually by varying four process parameters.

In this investigation four parameters are used such as cutting speed, feed, depth of cut and width of cut. In this the grey relation coefficient and corresponding grey relational grade for each experiment for rough and finish machining are calculated. The higher value of grey relational grade is near to the

product quality for optimum process parameters. The cutting tool performance is evaluated mainly by tool life as it is important parameters.
The final conclusion from that investigation is the grey relational analysis is the effective and efficient method for optimizing multi response process parameters. Process parameters for end milling whilst hard machining of hardened steel are optimized with L18 orthogonal array and grey relation analysis. The result are compared with ANOVA .It has been observed with width of cut and depth of cut are most influencing parameters in the case of rough machining.

5 Application of Taguchi Method for the multi-Objective optimization of aluminium foam manufacturing parameters

Rossella Surace, Luigi Alberto Ciro De Filippis, Antonio Domenico Ludovico, Giancarlo Boghetich

In the present work aluminium foam manufacturing is Optimized by using the taguchi method. In this three parameters are used such as Silicon carbide content in powder mixture, the compaction pressure and the foaming temperature. The Taguchi method is used to design an orthogonal array and a multi objective optimization approach is then proposed by simultaneously minimizing the relative density and maximizing the absorbed energy. Verification test is also performed to prove the effectiveness of the presented technique. In aluminium foam manufacturing the primary objective is to get the relative density lower as possible without any failure happening. By taking confirmation experiment bot the relative density and energy efficiency are improved by using the optimal setting of the foaming parameters determined by the approach .Final conclusion of this study is time is saved and relative density and energy efficiency are improved simultaneously .

6)More Power 6.0 for ANOVA with confidence intervals and Bayesian analysis relational

Jamie I.D. Campbell, Valerie A. Thompson

More Power 6.0 is a flexible freeware statistical calculator that computes sample size, effect size and power statistics for factorial ANOVA design. The programe is unique in affording the direct comparison of these three approaches to the interpretation of ANOVA tests. Its high numerical precision and ability to work with complex ANOVA designs could facilitate researchers attention to issues of statistical power, Bayesian analysis and the use of confidence intervals for data interpretation. More Power 6.0 that calculates power related statistics (Sample size, Effect size and power)and relational confidence intervals(cls) for ANOVA effects and that performs Bayesian analysis of the null hypothesis (H0)versus the alternative hypothesis (H1).Power analysis Quantifies the sensitivity of a statistical test to detect an effect of a specific size. The use of relational Cls can reduce reliance on NHST by affording interpretation of a pattern of means without requiring an interference about the statistical significance of the difference between a given pair of means .Many online power and sampl-size applets are available as well as standalone programs for power analysis ,but more power provides numerous unique features. Complex designs and effects –including repeted measures factors, or combination of both types of factors –can be specified easily using drops-down menus. Relational Cls convey the degree of precision in the measurement of an effect and provide a graphic index of the replicablity of effect sizes that is not inherent in standard hypothesis testing .The radio buttons in the Analysis section allow the user to select form a set of six analysis types including ANOVA, one or two sample t test , one or two sample z test of proportions and simple correction .The design Factors And Effect of interest section are used to specify the design. The Effect size section provides several options for specification of the desired or computed effect size. The Upper Button is automatically selected when solving for sample size.

7) Optimization of Process parameters by Taguchi Method: Catalytic degradation of polypropylene to liquid fuel

Achyut k. Panda, R.K. Singh:

In the present work different parameters are used such as temperature, catalyst concentration and catalyst type. The main objective of the method is to produce high quality product at low cost to

manufacturer. The experimental design proposed by Taguchi involves using orthogonal arrays to organize parameters affecting the process and the levels at which they should be varied; it allows for collection of the necessary data to determine which factors most affect product quality with minimum amount of experimentation, thus saving time and resources. Taguchi method was used to optimize the process parameters for the production of fuel from waste polypropylene.
By using orthogonal arrays to design the experiment helps the designer to influence of multiple controllable factors on the average quality characteristics and variation in a fast and economic way. In the present reaction system three operating parameters, each at three levels are selected to evaluate yield of liquid fuel. By using interaction plots it can seen visually that there are non-parallel lines between temperature and acidity of catalyst also the plastic to polymer ratio does not show any significant interaction for yield of liquid fuel.
In the process of catalytic decomposition of waste polypropylene in a batch reactor the rank indicates that temperature has the greatest influence followed by acidity of catalyst and then plastic to catalyst ratio which can be observed. The conclusion of this experiment is the simulation experiment was successful in terms of achieving the main objective of the experiment, which was to quantify the main effect as well as interaction of potentially influential factors on the degradation of pollutants.

8) Combining the Taguchi method with artificial neural network to construct a prediction model of a co^2 laser cutting experiment

Ching-Been Yang, Chyn-shu Deng, Hsiu-lu Chiang:
When using taguchi method of L18 or L17 orthogonal array is usually adopted but this requires many experiments, consuming time and resources but this study proposes a progressive Taguchi neural network model, which combines the Taguchi method with the artificial neural network to construct a prediction model for a co2 laser cutting experiment. During co2 laser cutting energy from the moving laser is accumulative. This paper develops an integral equation of energy density during laser beam movement. The advantages of laser cutting are its quick processing speed, convenience of operation, high precision, small heat-affected zone, and minimum deformity. In this paper four parameters are used such as speed, power, material thickness, auxiliary gases each control factor has three levels. Floating parameters reduces the interaction between various control parameters and avoids unreasonable parameters. The data is transferred to the operation panel of laser cutting machine. After material was placed on the cutting table of the machine and lid was closed, the machine started to cut. During the L9 orthogonal array laser cutting experiment, after cutting each line four measurement points were selected to calculate the vertical cutting angle. In this paper L9 orthogonal array is taken as network training example, the input Modula includes four items: speed, power, material thickness, auxiliary gas. To compare the improved results of precision from progressive Taguchi neural network model, this study performed four prediction verification experiments. The error difference for the vertical cutting angle between the network and experiment values was developed. This paper proposes a prediction model of co2 laser cutting experiment using the progressive Taguchi neural network model. The analysis of progressive Taguchi neural network model shows that for stage 1 preliminary network due to its limited its limited number of training samples, good results is achieved in regions near Taguchi generated factors level points. For region further away the prediction results have greater errors. stage 2 because of its network‘s accuracy, provides better predictive results for all the region. Lastly results from network analysis confirm that the construction of Taguchi artificial neural network improves upon the traditional neural network which has the inherent disadvantage of requiring a large number of training samples.

9) A grey-based Taguchi method to optimize design of muzzle flash restraint device

Chung-Shang chang, Ren-chieh Liao, Kun-Li wen, Wen-Pai Wang:
A grey-based Taguchi method is proposed to discover the optimal design of the rifle muzzle flash reducer. In this paper five possible critical factors that may affect the performance of the reducer were contemplated following interviews with specific domain expert: 1) existence of the front cover 2) Diameter of the outside exhaust hole 3) location of the exhaust hole on the extension tube 4) diameter of the outside tube 5) length of the outside tube. Using these suitable input parameters the output

results of the combination of the muzzle reducer's control factors can be obtained. In product development, the designer's goal is to identify settings of product design parameters that make the products performance less sensitive to the effects of environmental variables, deterioration and manufacturing variation. In this paper Taguchi method is used to obtain an original factor-level combination or the rifle muzzle flash reducer. After presentation of the grey matrix analysis the combination of factors changed slightly. The use of these two methods does help in obtaining and verifying the critical design features. This will boosts our confidence that the chosen reducer's parameters will be able to achieve optimal quality. The same research model, using Taguchi design with grey matrix verification has been successfully applied to the design of the rifle muzzle noise reducer.

10) Optimization of Turning process Using Design Of Experiment: Review

Vishnu.D. Asal, chintan.A. Prajapati, Pintu.K. Patel:
Very manufacturing industry aims at producing a large number of products within relatively lesser time. But it is felt that reduction in manufacturing time may cause severe quality loss. The main purpose of this study is to check the whether quality lies within desired tolerance level which can be accepted by customers.

III. PROBLEM DEFINITION

The construction manager is faced with challenges involving decision making over the varied aspects and functions in the construction process. Procurement is one such function where the decision maker has to make a choice considering the nature of qualitative as well as quantitative aspect of the decision process. The raw material and the equipments to be procured has numerous variables or factors to be considered like the cost, lead time and quality of the construction goods. The vendors may be situated at locations varying in distance from the site of the construction. The rating for the quality could differ for each of this vendor as also the lead time too might vary for similar goods to be purchased considering the nature of these variables or factors and its effects on the performance parameter, the same needs o be evaluated in a quantitative manner using suitable mathematical or statistical methodology. The said methodology should address the need for optimal values for the factors while being effective and precise.

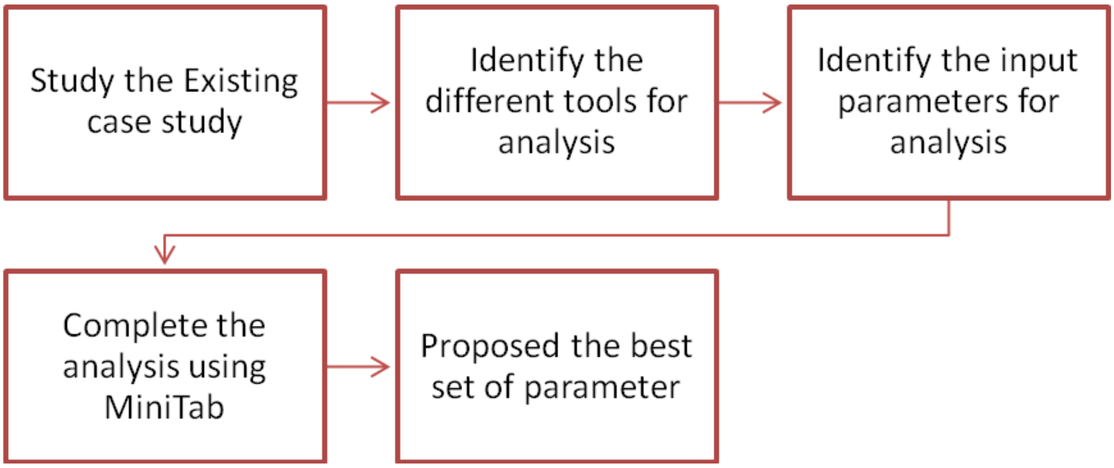
3.1 Research gaps / need

The project manager can make a sound decision only when the commercial data over the cost, quality and other relevant factors can be evaluated in a scientific manner to realize a solution. The tool should be handy and precise for arriving at the commercial decision at hand. Since a huge investment is at stake during this purchasing decision, the impact of a right or a wrong decision could be phenomenal. The need of the hour is to employ a reliable statistical tool to optimize the parameters to arrive at the desirable solution.

3.2 Objectives

- Study the case study
- Identify the process parameters for Analysis
- Identify the response parameter based on input parameter
- Implement the statistical methods for analysis such as Taguchi/ANOVA
- Compared the results
- Suggest the best parameters combination for the given process

IV. METHODOLOGY



V. TOOLS/ TESTINGS /SOFTWARES

For the analysis purpose, Minitab Software shall be used. In this dissertation work, we shall use the tools such as Taguchi Method/ANOVA/ Grey Relations analysis/Generic Algorithm/ Regression Equation.

VI. CONCLUSION

The materials used for construction being procured from various sources with varied prices and lead times, poses a challenge for optimization using traditional methods. Statistical treatment using ANOVA and Taguchi methods seem to be promising for deriving optimized results. The significant parameter can be identified using ANOVA while the optimization can be pursued using Taguchi methods for determining optimal values for the significant parameters

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