IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.8, Issue.8, August 2020 E-ISSN: 2347-2693

Optimi-Zation Of Critical Deliberations in a Product type Industry Using Taguchi Method And Soft Computing Techniques

Kamlesh Kumar [1] and Amit Kumar[2]

[1,2] Dept. of Mechanical Engineering,BRCM, CET, Bahal, Bhiwani, Haryana-India

*Corresponding Author: rehimanshu199495@gmail.com

Available online at: www.ijcseonline.org

Received: 05/Aug/2020, Accepted: 17/Aug/2020, Published: 31/Aug/2020

Abstract— Taguchi technique of eminence engineering used to optimize asset of deliberations, which give the desired result. In this Paper, Taguchi methodology applied on friction stir welding operation, which is one of modern welding method. Three of most significant deliberations in FSW (rotation speed, welding traverse speed, and tilt angle) used to find out optimum set for the three responses (average absorbed energy, energy for crack initiation, and energy for crack propagation). Experiment enterprises by Taguchi enterprise of experiment and, and optimization of results by apply Taguchi technique. The analysis of variance (ANOVA) done to find the influence of each deliberation on the responses. The proposed model considers progression optimization in a general case where analytical relations and interdependences in a progression are unknown, thus making it applicable to various types of progression optimization problems. This paper represent the overall performance and enhance of product eminence.

***Index Terms*—Taguchi method, optimization, orthogonal array, FSW, soft computing, overall performance, enhancement method, artificial neural network, swarm optimization, etc**

I INTRODUCTION

Taguchi theory and application for eminence enhancement in manufacturing field

In the eminence enhancement journey, at the beginning of the year [01] Dr. Genichi Taguchi presented a new methodology for the eminence enterprise knows by Taguchi Method, also called the Robust Enterprise method, and greatly improves engineering productivity. Initially it was developed for improving the eminence

The Taguchi method considers enterprise of product more important than the manufacturing progression in eminence mechanism and tries to eliminate variances in manufacture before they can occur Taguchi defines eminence as, "The eminence of a product is the (minimum) loss imparted by the product to the society from the time product is shipped" Cost of eminence is a term that has widely used and widely misunderstood. The "cost of eminence" is not the price of creating a eminence product or service.

It is the cost of NOT creating a eminence product or service. Every time work is redone, the cost of eminence increases viz. reworking of a manufactured item, retesting of an assembly, rebuilding of a tool, correction of a bank statement, reworking of a service, such as the reprogressioning of a loan operation or the replacement of a food order in a restaurant. In short, any cost that would have not expended if eminence were perfect contributes to the cost of eminence. By consciously considering the noise factors (environmental variation during the product's usage, manufacturing variation, and component deterioration) and the cost of failure in the field the Robust Enterprise method helps ensure customer satisfaction. Robust Enterprise focuses on improving the fundamental function of the product or progression, thus facilitating flexible enterprises and concurrent engineering. Indeed, it is the most powerful method available to reduce product cost, improve eminence, and simultaneously reduce development interval.

Nowadays, the aspect of reduce the cost of Eminence by implementing robust enterprise as a tool. The dimensional tolerance plays an important role in acceptance and rejection of a product. Any product that fails to reach the target value is termed as loss in robust enterprise, in contrast to traditional enterprise methodology where product with in a tolerance range are accepted as product of good eminence.

Significant research has been done on various aspects of eminence still the area of Taguchi eminence loss function is unexplored in various fields of manufacturing such as dimensional tolerance of a product, relating cost of eminence of a product with robust enterprise, etc. Methodology for reduction in cost of eminence by implementing robust enterprise will explain in the further section [80].

Taguchi's philosophy can be summed up by these 4 statements:

- We cannot reduce cost without affecting eminence.
- We can improve eminence without increasing cost.
- We can reduce cost by improving eminence.

- We can reduce cost by reducing variation. When we do so, performance and eminence will automatically improve.

Taguchi Philosophy and the non- visible cost (hidden cost) of eminence

Dr. Genichi Taguchi's method combines engineering and statistical methods which contribute for achieve rapid improvements in the products and services from the eminence and cost side by increasing eminence without any additional in the cost. This feature or advantage can obtained through optimizing product enterprise and manufacturing progressions. The three statements apply for the methods:

- We cannot reduce cost without affecting eminence;
- We can improve eminence without increasing cost and;
- We can reduce cost by reducing variation or by improving eminence.

1. 1 Orthogonal arrays (OAs)

Taguchi array or orthogonal array, is orthogonal matrix were developed by Ronald A Fisher at the beginning of the twentieth century and used to mechanisms the experimental error. Initially, they used to focus on planning excrements so that the random error in physical experiments has minimum influence in the approval or disapproved of hypothesis .Then, at the middle twentieth century, when Dr. G. Taguchi, has envisaged a new method of conducting the enterprise of experiments which are based on well-defined guidelines. This method uses a special set of arrays called orthogonal arrays. These standard arrays stipulates the way of conducting the minimal number of experiments, which could give the full information of all the factors that affect the performance deliberations. The crux of orthogonal arrays method lies in choosing the level combinations of the input enterprise variables for each experiment. This orthogonal array uses to plan of the experiment where, the dimension of the matrix is the number of the factors and number of their levels. Dr. Genichi Taguchi founded the general matrix of orthogonal arrays, and it enterprises as a type of general fractional factorial. This orthogonal array balanced to ensure that all levels of all factors considered equally and allow evaluating each factor independently from others.

Friction stir welding (FSW) is a relatively new solid-state joining progression. It has invented and patented by Wayne Thomas at TWI Ltd (the UK) [02] And, from that time it has started Spread fast until became one of the most important welding types in the fabrication and assembly industry, that is because of several of Influential advantages on the eminence of product beside, the advantages of this progression high reproducibility, short manufacture time and low energy input [02].

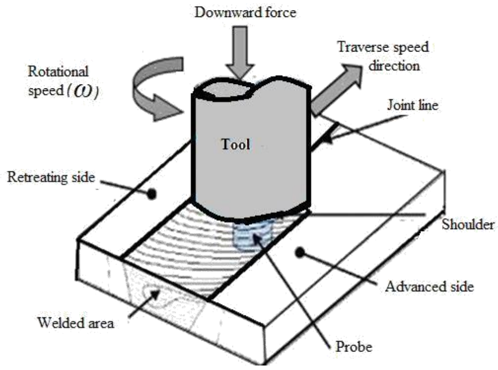


Fig 1.0 FSW machine representation

1.2 Taguchi method

We applied the Taguchi method, which discussed in the preview chapter three, in our work here. We used Taguchi orthogonal array L16 (suitable matrix for three deliberations with four levels for each of them) and for robustness enterprise S/N large is better LB was used; the analysis to find out the optimum set of deliberation levels ANOVA were don.

1.3 Problem Definition

In today‘s manufacturing environment, many large industries have attempted to introduce flexible manufacturing systems (FMS) as their strategy to adapt to the ever-changing competitive market requirements. To ensure the eminence of machining products to reduce the machining costs and increase the machining effectiveness, it is very important to judiciously select the machining deliberations when the machine tools are selected. The traditional methods for solving this kind of optimi-zation problem include calculus-based searches, dynamic programming, random searches and gradient methods. Some of these methods are successful in locating the optimal solution, but they are usually slow in convergence and require much computing time. Other methods may risk being trapped at a local optimal which fails to give the best solution. Compared to traditional optimi-zation methods, Genetic Algorithm (GA) is robust, global and may be applied without recourse to domain-specific heuristics. It can be used not only for general optimi-zation problems, but also in different optimi-zation problems and unconventional optimi-zation problems. It is most appropriate for complex non-linear models where location of the global optimal is a difficult task. It may be possible to use GA techniques to consider problems which may not be modeled as accurately using other methodologies. Therefore, GA appears to be a potentially useful methodology for optimization of machining progressions, Holland [03]

1.3.1 Taguchi technique.

Taguchi is applied to find out the optimum set of three deliberations in friction stir welding progressions for one response. Particularly in modern industries, manufacturing progressions becomes more complex and mechanisms led by multiple inputs (factors) and out puts (responses) and optimize one response will degrade other responses. therefore, a new work using multi responses optimization progression which may include more input factors as (plunge depth, axial force, tool geometry) to find out optimum set for multi responses outputs from the mechanical properties such as (yield and ultimate stress, hardness, fatigue, est.). Further researches needed by using an integrated intelligent multi response optimization methodologies

1.4 Aim & Objectives of the Research Work

This research work presents the optimization of mechanisms deliberations for various machining progressions which affect the machining performance using GA. The objectives of the paper are as follows,

1. To study the characteristics of different contemporary machining progressions and their applications.
2. To study the application of various optimi-zation techniques in order to optimize the desired responses of various machining progression as per the requirement of the industry.

3. To search for an efficient soft computing technique to optimize machining operations as experimental methods are cumbersome and at times not feasible.
4. To optimize desired responses using the data obtained from enterpriseed experiments using GA.

    a. To select deliberations of complex machined parts that require many machining constraints.

    b. To compare the GA and proposed predicted results.

5. To prepare a chart mentioning the progression mechanisms deliberations and the objective values for ease of reference as a guiding tool for the operators in the industries.
6. To apply GA to optimize various machining progressiones. Various objectives or responses are to be optimized by searching the entire search space for potential and feasible combination of progression mechanisms deliberation values.
7. To perform multi objective optimi-zation using Genetic Algorithm such that conflicting objectives are simultaneously optimized.

1.5 LITERATURE REVIEW

Mohamed *et al.* [01] stated that "the application of systematic methodology is to view the eminence super vision as a big and holistic system". They mentioned that it is a critical part of the super vision of eminence to achieve an association's vision, mission, and goals. This progression, called strategic planning or strategic super vision, includes the formulation of a strategic plan that integrates eminence as a core component. Some of the factors to be taken into account in the strategic planning progression are: environmental factors, financial strength of the association, marketing strategy, associational enterprise and associational climate Shadur, [01] .

Literature review on Optimi-zation of Progression Deliberations for Welding using Taguchi method

Saluja and Moeed [02] adopted the factorial enterprise methodology to examine the Metal Inert Gas welding variables (viz. current of welding, welding speed, and welding arc voltage and stick-out distance of electrode) on aluminum by measuring geometry of weld bead and penetration of weld. For sound eminence bead width, bead penetration and weld reinforcement on butt joint was investigated by the development of a mathematical model. The welding current was found to be the most influencing deliberation on the weld geometry. Patel and Gandhi [2] recorded tensile strength for deliberations of MIG welding such as current, arc voltage, welding speed and shielding gas flow.

Joshi et al. [03] adopted the full factorial method in their enterprise of experiment to generate the tensile strength values for all combination levels of the different variables of welding (viz., current of welding, flow rate of gas and wire feed rate of MIG welding, whereas welding current and gas flow for TIG welding). The grey relational analysis (GRA) technique has been used to perform parametric optimi-zation. The method of methodology followed by Joshi et al. [03] required more number of experiments. It is preferable to have less number of experiments.
Aghakhani et al. [04] have carried out research on optimi-zation of GMAW progression deliberations to enhance eminence and productivity. They have chosen ST-37 steel plate as work piece, 80% argon combination with 20% CO_2 as shield gas depends on type of base metal being welded. The experiment was enterprises by Taguchi with L27 orthogonal array and it was carried out by Analysis of Variance (ANOVA) by considering weld dilution as output characteristic and wire feed rate, welding voltage, nozzle to plate distance, welding speed, and gas flow rate were as the input deliberations.

1.6 Research Methodology

- Selection of factors and/or interactions to be evaluated**.**
- Selection of no. of levels for the factors and appropriate Orthogonal Array.
- Assignment of factors and/or interactions to columns and conduction of tests.
- Analyzing the results and conduction of confirmation test.

Taguchi technique has been adopted widely for various manufacturing industries application. Several researches are going on which are focused on the optimi-zation of Taguchi technique. There are some important features of Taguchi technique, as discussed below:

- This technique is implemented at enterprising stage itself so that optimized enterprise will be received for further progressioning.
- According to this technique, rather than concentrating on inspection, eminence concentration can improve overall manufacturing.
- This progression focuses on robust enterprise concept due to which products don't get disrupted during manufacture.
- Using statistical procedures in the enterprise phase only, at appropriate stages, and completely removing them from the manufacture phase.
- Relying on the models developed based on the philosophy "loss to the society" rather than statistical techniques during manufacture phase.

According to this methodology, below mentioned steps are followed:

Step 1: Initialization of Taguchi Configuration
Step 2: PSO configuration deliberation initialization
Step 3: Define Pareto Optimal solutions
Step 4: particle fitness computation
Step 5: initialization of personal and global best solution
Step 6: Factors and level computation for each particle
Step 7: Update Particle positions for each particle
Step 8: initialize Taguchi Swarm Generation and orthogonal array selection.
Step 9: New particle generation
Step 10: compute fitness and S/N ratio
Step 11: optima solution selection.

1.7 The main steps for the deliberation enterprise phase of the Taguchi method are:

1. First of all identify the main objective of the experiment.
2. Identify the output response and its system of measurement.
3. Find out the different factors that may affect the output response, level and main interactions.
4. Choose the suitable orthogonal array.
5. Perform the experiments given by the trials in the OA.
6. The data can be analyzed by using the statistical techniques signal to noise ratio, the analysis of variance and factor effects to find the significance of progression deliberations.
7. Find out the optimal levels of variables.
8. Confirmatory experiments done for the verification of the optimal enterprise deliberations.

1.8 SIMULATION WORK AND RESULT DETAILS: Calculation and analysis

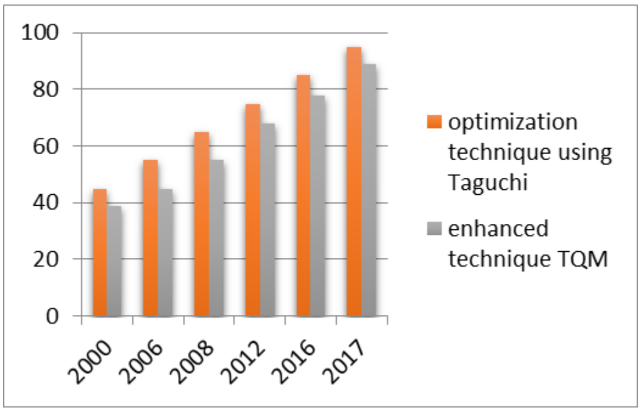
The data analysis procedure using Taguchi experimental frame work involves Analysis of means (ANOM) and Analysis of variance (ANOVA). In this case of ANOVA which involve S/N ratio calculation for output deliberations (penetration, width and reinforcement), pre-Pooled and Pooled ANOVA for output deliberations. The main factors effects are calculated and the results are used to find percentage influence of all factors. The same are tabulated in table 5.

Graph result and discussion by simulation tool.

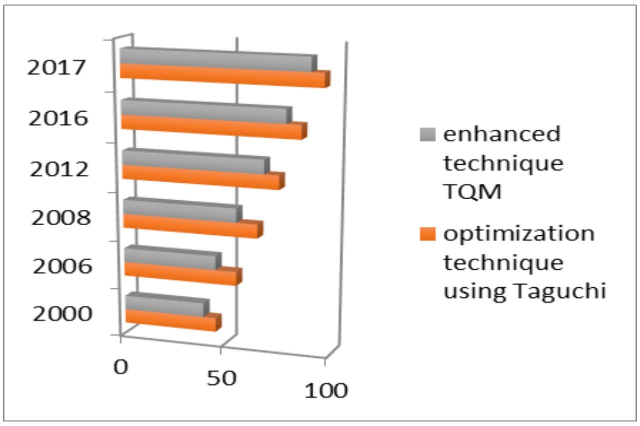
Analysis by simulation tool for determining Taguchi method for optimize deliberations analysis for manufacture and eminence mechanisms for industry plant implementation.

Table 1.0 Percentage Influence of all factors

Factors	Penetration	Width	Reinforcement
A	A2 (25.314)	A2 (28.456)	A1 (3.659)
B	B3 (39.848)	B3 (33.489)	B2 (22.269)
C	C2 (3.454)	C2 (35.133)	C2 (36.863)
D	D3 (32.097)	D3 (2.5)	D1 (37.165)



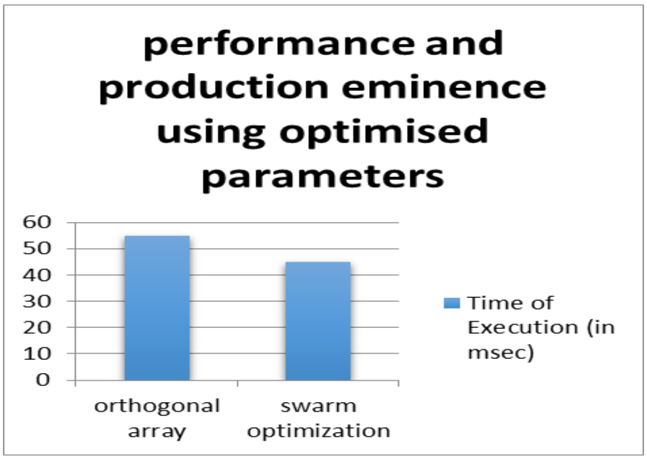
Graph 1.0 Taguchi optimize technique and TQM



Graph 2.0 analysis based on yearly basis representation

Table 1.1 welding implementation Taguchi and TQM.

welding plant implementation	
Taguchi deliberations optimize	115
TQM super vision	75



Graph 3.0 compare analysis of orthogonal array and swarm optimization

1.9 CONCLUSION ANDE FUTURE SCOPE

The present research work describes the use of Taguchi method and statistical techniques for analyzing and optimizing the minimum residual stresses and maximum hardness in MIG welding of low carbon steel. From the study, the following conclusions are drawn:-

1. From the ANOVA results, it is found that welding voltage contributes 57.3% towards the variation observed in residual stresses. The welding current contributes over 26.14% of the total variation observed on minimum residual stresses. Also, welding voltage contributes 61.59% towards the variation observed in hardness. The variable travel speed contributes over 32.28% of the total variation observed in hardness.
2. Main effect plots reveal that voltage and travel speed has significant influence on hardness whereas welding voltage and welding current has considerable effect on residual stresses.
3. The optimum welding condition obtained by Taguchi method for maximum hardness is A1B2C1D2 (i.e. current = 150 ampere, voltage = 22 volts, travel speed = 12.24 cm/min and welding passes = 3) and for minimum residual stresses are A3B2C3D1 (i.e. current = 200 amperes, voltage = 22 volts, travel speed = 19.32 cm/min and welding passes = 2).
4. Confirmation test confirms the improvement of hardness and residual stresses which also indicate the validity of the present optimi-zation procedure by using Taguchi method.

REFERENCES

[01] Isaiah O.Ugboro and Kofi Obeng, "Top Super vision Leadership, employee empowerment, job satisfaction, and customer satisfactions in TQM associations: an empirical study",The Journal of Eminence super vision, Vol.5, pp .247-272,2000.

[02] Salman D. Al-Shobaki , Rami H. Fouad and Adnan Al-Bashir, "The Implementation of Total Eminence Manage ment (TQM) for The Banking Sector in Jordan", Jordan Jou rnal of Mechanical and Industrial Engineering, Vol.4, No.2,pp.304-313, March. 2010.

[03]. Esin Sadikoglu and CemalZehir, "Investigating the effects of innovation and employee performance on the relationship between total eminence super vision practices and firm performance: An empirical study of Turkish firms", International Journal of Manufacture Economics, Vol.127, pp.13–26,2010.

[04] Senda Wali and Younes Boujelbene, "Cultural Inf luences on TQM Implementation and Financial Performance in Tunisian Firms", Journal of Economic and Super vision , Vol.3, pp.30-45, 2011

[05] Faisal Talib, Zillur Rahman and M.N. Qureshi, " A study of total eminence super vision and supply chain super vision practices", International Journal of Productivity a nd Performance Super vision, Vol. 60,No.3,pp. 268-288, 2011

[06] Abdelkader Daghfous and Reza Barkhi, "The stra tegic super vision of information technology in UAE hotels:An exploratory study of TQM, SCM, and CRM implementations", Journal of Technovation, Vol.29,p p.588– 595,2009.

[07] Ruey-Shiang Guh, "A hybrid learning-based model for on-line detection and analysis of mechanisms chart patterns", Journal of Computers & Industrial Engineering, Vol.49, pp. 35–62, 2005.

[08] s Jian-bo Yu and Li-feng Xi, "A neural network ensemble-based model for on-line monitoring and diagnosis of out-of-mechanisms signals in multivariate manufacturing progressiones", Journal of Expert Systems with Applications, Vol.36,pp.909– 921,2009

[09]Muhammad Asim ,Sohaib uz Zaman and Tayyaba Zarif, "Implementation of Total Eminence Super vision in Construction Industry: A Pakistan Perspective", Jou rnal of Super vision and Social Sciences, Vol. 9, No. 1, pp.24-39,2013

[10] Javier GonzaH lez-Benito and Barrie Dale, "Sup plier eminence and reliability assurance practices in the Spanish auto components industry: a study of implementation issues", European Journal of Purchasing & Supply Super vision, Vol. 7, pp. 187-196,2001.

[11] VieraWardhania, Adi Utarinib, Jitse Pieter van Dijk ,Doeke Post and Johan Willem Groothoff, "Determinan ts of eminence super vision systems implementation in hospitals", Journal of Health Policy, Vol. 89,pp.239–251,2009

[12] Farzana Sultana,Nahid Islam Razive and Abdullahil Azeem, "Implementation Of Statistical Progression Contr ol (Spc) For Manufacturing Performance Improvement" , Journa l of Mechanical Engineering, Vol.40, No. 1,pp.15-21,June 2009

[13] S.Sivakumar and K.Muthusamy, "Critical Success Factors in Six Sigma Implementation– A Case Study o f MNCs in Malaysia", In proceeding of IEEE International C onference on Eminence and Reliability (ICQR),pp.536-540,2011.

[14] Dirk van Dyk and Leon Pretorius, "A System Dyn amics Methodology to Eminence enhancement Programs in a Heavy Engineering Manufacturing Environment: A Case Study", In Proceedings of PICMET '12 of Technology Super vision for Emerging Technologies, pp. 3287-3296,2012

[15] Yu-Jen Wu and Jiang-Liang Hou, "An employee performance estimation model for the logistics industry", Journal of Decision Support Systems, Vol.48,pp.568– 581,2010

