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Mini Review

Application of Six Sigma in Improving Welding Quality

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Abstract

sigma is a tool that may be used in any business to improve the performance of existing processes, products, and components. Six-sigma is a quality tool that is used to increase productivity, reduce faults, and make processes more cost-effective. In addition, the six-sigma technique uses statistical techniques to assist maximize profitability, increase market share, and improve customer satisfaction, which can lead to quantum leaps in quality. This technique was tested in an experiment that involved the application of the welding processes. The goal of this work is to provide an overview of recent research on this technology with a focus on the critical aspects of welding.

Keywords: DMIC; Welding; Mechanical properties

Introduction

In a competitive and fast-growing industry, businesses are seeking for ways to improve their business processes in order to stay competitive and win a loyal consumer base. Six-sigma is a significant approach in this regard that has drawn not only world-class company titans to adopt this business excellence methodology, but also researchers in their quest for knowledge. Six-sigma is a well-structured strategy for producing near-perfect products and services with high consistency. Since its inception in 1999, six sigma business excellence methodology has been defined as "a business excellence methodology that focuses on the removal of variations or faults in any business process with a focus on the outputs that are critical to the customer." Sigma is a Greek letter that statisticians use to quantify variability in any form of business operation. The sigma level of an organization's running business processes is used to assess its process capacity. Bill Smith invented the six-sigma process at Motorola in the 1980s, and it was able to reach although goal of 3.4 faults per million defects [1].

Six-sigma has been successfully deployed in a variety of areas, including manufacturing, higher education, and services, and it attained excellence by improving business processes in 1995, when General Electric Company implemented it. The implementation of six sigma was first limited to the manufacturing industry, but in recent years it has expanded to practically every department and sector of any business, with the goal of reducing deviations, which are the real devils in any process [2]. When it comes to six sigma methodology, the most widespread misconception is DMAIC technique. When existing processes fail to meet customer requirements, the DMAIC technique is employed. There are two six sigma methodologies: DMAIC (define, measure, analyse, improve, and control) and DFSS (define, measure, analyse, improve, and control). DMAIC focuses on process improvements, whereas DFSS focuses on robust design enhancements (design for six sigma). DMAIC was the first business improvement strategy devised, and it's used to improve an existing process that isn't meeting consumer needs. General

Electric established DMADV (define, measure, analyse, design, and verify). Aside from DMAIC and DMADV, other methodologies such as IDOV (identify, design, optimise, and validate) and DIDES are utilised (define, initiate, design, execute and sustain) [3]. "Six Sigma adoption in the automobile and manufacturing sectors can deliver breakthroughs," says Amit Yadav, "particularly DMAIC technique that addressed in deep process difficulties [4].

Literature Review

A literature review was conducted with the goal of determining the history of various process improvement initiatives made to solve process-related issues. In Six Sigma, a thorough literature analysis was conducted with the goal of identifying the types of improvements made by different people in various organisations to address process-related issues. "Application of Six Sigma Methodology to Reduce Defects in a Grinding Process," by Antony et al. After the fine grinding process, the rejection rate of distance pieces was lowered to 1.19 percent from 16.6 percent as a result of the project [5].

Six Sigma is a quantitative methodology that may be used to any operation. It must be adapted to the domain of the process through appropriate metrics and analysis in order to be used. Essentially, it is a high-performance data-driven strategy to assessing and resolving business challenges. It connects a company's outputs to the needs of its customers. Six Sigma is a statistical measurement of a process's capacity to meet client criteria. Most managers and practitioners link Six Sigma with the DMAIC (Define, Measure, Analyze, Improve, and Control) methodology and toolkit. Six Sigma also creates an organizational framework by releasing and training process analysts (known as Black Belts and Green Belts) to focus solely on process improvement. Six Sigma has resulted in significant cost savings for user organisations [6].

Erry Rimawan, et al. [7] Using a SAW (Submerged Arc Welding) automatic welding system, researchers researched and analysed defect criteria of the welding process in order to reduce defect and rework. Defect criteria analysis, which affects quality acceptance requirements and rework costs, as well as customer satisfaction, safety standards, and financial performance of the organization, is critical to the success of research implementation, particularly in SMIs (Small and Medium Industries) in Indonesia. Guangyu Mu, et al. [8] The Six Sigma DMAIC method was used to regulate the welding assembly process of a car exhaust system in this study. The biting edge and stomata are the two most common weld flaws, accounting for around 85% of the total number of defects. It has also been demonstrated that the Six Sigma DMAIC technique works well. As a result, stomata flaws are decreased in the same way, product quality is raised from 3.55 to 4.52, and the enterprise's competitiveness is considerably enhanced.

Ibrahim Sabry, et al. [9] flaws in the fabrication sector employing six sigma approach, which can lead to an increase in the total component's six sigma level. The study also shows the many types of welding faults that were discovered during the experimental trial, as well as the DMAIC approach, which decreases welding defects and the time it takes to finish the welding of auxiliary pipe. In addition, the difference in sigma level of pipes seen before and after Six Sigma deployment was described.

Ibrahim Sabry, et al. [10] According to the findings, Six Sigma should be described as a whole new approach to quality management. The use of six sigma tools is used to reduce welding faults during the construction of a water tube boiler in this study. The implementation of Six Sigma has resulted in a significant reduction in product rejection rates. Ibrahim Sabry, et al. [11] Study to establish the types of welding faults and the variables that cause them, as well as activities taken to reduce the amount of defects and reduce production costs. The measurement findings revealed a total of 12499 productions with a fault rate of 21.6 percent (2712 pcs) and a sigma level of 3.1100 DPMO. Porosity flaws accounted for 724 pcs, undercut faults accounted for 613 pcs, slag defects accounted for 435 pcs, crack defects accounted for 491 pcs, and spatter defects accounted for 449 pcs. Adesh Thavre, et al. [1] A new welding quality evaluation approach based on fuzzy logic analysis and managing the process capabilities of friction stir welding of pipes was developed and then examined. This technology was developed by switching the FSW of pipes process major parameters: rotation speed, pipe wall thickness, and travel speed in an experimental operation. The tensile strength of the Al 6061 friction stir welded joints was controlled by the analysis. The study established the optimum values for the parameters from the corresponding range to get the best tensile strength.

Ibrahim Sabry, et al. [12] Using the six-sigma approach, this study investigates practical ways for improving welding operations performance. This principle lays out the metrics needed to set performance improvement objectives as well as a technique for measuring and assessing progress. The suggested method is predicted to result in more dependable workflows by lowering process variability to a suitable range, consequently enhancing overall performance through the assessment of existing welding operations' quality level. This case study has been presented to verify the suggested technique, and process evaluations have been undertaken to observe performance changes based on the six-sigma principle. As the sigma level climbs, critical comprehensive quality control is also considered. Ibrahim Sabry, et al. [13] describes how to apply welding process technology to the MIG welding process by employing (define, measure, analyse, improve, control) technology under Six-Sigma to improve tensile strength and hardness in aluminum pipe welding using MIG welding. Using a variety of pipe welding parameters. Using the six-sigma principle, this paper investigates practical ways for improving the performance of MIG welding operations. Ibrahim Sabry, et al. [14] The study and development of a unique welding quality evaluation strategy based on response surface methodology analysis and control of the friction stir welding (FSW) process capabilities of pipes. This approach was tested in an experiment by varying the major parameters of the FSW process: rotation speed, pipe wall thickness, and travel speed. The tensile strength of the Al 6061 friction stir welded joints was controlled by the analysis. To obtain the best tensile strength, the study found the optimum values for the parameters from the corresponding range. Kaushik P, et al. [15]

This work provides a novel welding quality evaluation approach for friction stir welding based on IMR and process capability analysis. The strategy was tested in an experiment that used rotation speed and travel speed. The tensile strength, elongation, and hardness of the Al 6061 friction stir welded joints were all controlled by the analysis. The three key factors in the friction stir welding process are rotation speed, material thickness, and travel speed. Changing these three variables resulted in different friction stir welded samples. As a result, the tensile strength, elongation, and hardness values of the process capability index Cpk improved from (0.86, 0.37, 0.81) to (0.69, 0.57, 0.58) [16-28].

A review of the Literature on GAPS

From the above literature survey, it reveals that, little work is done on the application Six-Sigma in FSW. It is really an advanced technique of welding. Few researchers have used the Six-Sigma for optimization technique in the field of ARC welding but very little in the case of FSW. UWFSW is not explored yet [29-32].

Conclusion

During this gift era, Six-Sigma is an innovative and developed form of improving welding efficiency methods. On top of the literature research, it was revealed that just a few investigations had been applied Six-Sigma conducted to improve the FSW and underwater FSW approach. It is recognized as a sophisticated welding procedure, with only a small number of researches utilizing the improvement technique in the field of FSW and UWFSW. However, FSW and UWFSW haven't been application Six-Sigma thoroughly investigated. By concentrating long-term analysis on it, we will be able to significantly improve and get reasonable weld results using the application Six-Sigma.

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Conflict of Interest

Conflict of interest on behalf of all authors, the corresponding author states that there is no conflict of interest.

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