Testing Of Steel Tube Welding By Using Six Sigma DMAIC Techniques

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Abstract

Since its inception at Motorola, Six Sigma has been widely adopted by many different types of organizations. The effectiveness of Six Sigma is well supported by anecdotal evidence. However, academic research on Six Sigma is still in its early stage. This paper first reviewed the current literature on Six Sigma, and then performed a critical analysis of Six Sigma in light of the management literature. The review and analysis suggested that Six Sigma is best defined as a new approach to quality management. Consequently, Six Sigma provides an interesting context for a number of research questions. We then discussed these prospective research questions. This study laid a foundation for future research on Six Sigma.

Keywords: *Six Sigma, DMAIC, Steel Tube Welding*

1. Introduction

Six Sigma is an important advance in quality management and process improvement in the last two decades. Six Sigma has gained wide popularity in various types of organizations since the 1990s. Most Fortune 500 companies have adopted Six Sigma (Goh, 2002). Rich anecdotal evidences showed that Six Sigma can help firms achieve significant performance improvement. For example, Motorola reported $16 billion benefits from Six Sigma for the period of 1986-2001 (Eckes, 2001; Hendricks and Kelbaugh, 1998; Motorola, 2003). Other firms such as General Electric (GE), Honeywell, and 3M reported similar results (3M, 2003; Arndt, 2004; GE, 2002; Honeywell, 2002). The benefits of Six Sigma include but are not limited to cost reduction, customer satisfaction improvement, and sales revenue growth (Pande et al., 2000).Comparing to its impressive track records in practices, research on Six Sigma was at a rather low level due to several reasons. Some scholars view Six Sigma as applying a set of statistical tools and techniques (e.g., Das et al., 2008). Naturally it is not a serious research subject. Others believe that Six Sigma is simply a repackaging of the well-known total quality management (TQM) program, i.e., “old wine in new bottle” (e.g., Beer, 2003). Lastly, there is a collective concern that Six Sigma might be a management fad. Apparently, studying a management fad is not likely to make significant contributions to the literature (Abrahamson, 1996). However, as more and more Six Sigma success stories were published, there is a need to revisit the set perceptions about Six Sigma. Consequently, research interest on Six Sigma began to soar (Goh, 2002). Recently, several papers on the subject of Six Sigma have appeared in top journals. But overall, research on Six Sigma is still lagging behind. Lack of research on Six Sigma has two significant implications. First, the concern of Six Sigma being a management fad has prevented many scholars from conducting rigorous research on Six Sigma. However, if Six Sigma is not a management fad, this means we have lost precious opportunities to advance knowledge. Ironically, the question whether Six Sigma is a management fad can only be truly answered by rigorous research. Second, Six Sigma implementation generally requires millions of dollars of investment and years of effort. Practicing managers need scientific knowledge to guide their Six Sigma implementation effort. Without scientific research, the daunting task of exploring effective implementation method is at the mercy of trial and error, leading to higher chance of Six Sigma failure. Therefore, the urgency of conducting more research on Six Sigma can be clearly seen. For research on Six Sigma to make solid progress, directions are needed. Since scientific research follows a cumulative tradition, it is necessary to first understand what has already been studied. Therefore, a vital first step is to gain an in-depth understanding of Six Sigma by reviewing the current literature. However, the lack of research on Six Sigma suggests only literature review is insufficient. A critical analysis of Six Sigma in light of the management literature was thus performed subsequently. This analysis identified a number of areas that could lead to fruitful research insights. This paper is organized as follows. The second section provides an overview of Six Sigma. The section also argues that Six Sigma is not a management fad and it deserves serious research effort. Section 3 describes the literature review method. Section 4 reports the overall impression of the current literature. The definition of Six Sigma is deliberated in Section 5. The distinctive elements of Six Sigma are summarized in Section 5 as well. Research issues surrounding Six Sigma are discussed in Section 6. Section 7 concludes the paper with a summary of the main findings and a discussion of contributions from this study.

Several electric resistance welding (ERW) processes are available for tube and pipe production. While each process has different characteristics, all ERW processes have one thing in common–all of them produce a forged weld. A forged weld is created by applying a combination of heat and pressure, or forging force, to the weld zone. A successful forged weld uses the optimum amount of heat, which is normally slightly less than the melting point of the material, and a nearly simultaneous application of circumferential pressure to the section, which forces the heated edges together (see **Figure 1**).

This document is set in 10-point Times New Roman. If absolutely necessary, we suggest the use of condensed line spacing rather than smaller point sizes. Some technical formatting software print mathematical formulas in italic type, with subscripts and superscripts in a slightly smaller font size. This is acceptable.

2. Methodology

The DMAIC (Define-Measure-Analyze-Improve-Control) is the classic Six Sigma problem-solving process. Traditionally, the approach is to be applied to a problem with an existing, steady-state process or product and/or service offering. Variation is the enemy—variation from customer specifications in either a product or process is the primary problem. Variation can take on many forms. DMAIC resolves issues of defects or failures, deviation from a target, excess cost or time, and deterioration. Six Sigma reduces variation within and across the value-adding steps in a process. DMAIC identifies key requirements, deliverables, tasks, and standard tools for a project team to utilize when tackling a problem.

The DMAIC methodology uses a process-step structure. Steps generally are sequential; however, some activities from various steps may occur concurrently or may be iterative. Deliverables for a given step must be completed prior to formal gate review approval. Step Reviews do occur sequentially. The DMAIC five steps are

Step 1: DEFINE the problem and scope the work effort of the project team. The description of the problem should include the pain felt by the customer and/or business as well as how long the issue has existed. Hence, identify the customer(s), the project goals, and timeframe for completion. The appropriate types of problems have unlimited scope and scale, from employee problems to issues with the production process or advertising. Regardless of the type of problem, it should be systemic—part of an existing, steady-state process wherein the problem is not a one-time event, but has caused pain for a couple of cycles.

Step 2: MEASURE the current process or performance. Identify what data is available and from what source. Develop a plan to gather it. Gather the data and summarize it, telling a story to describe the problem. This usually involves utilization of graphical tools.

Step 3: ANALYZE the current performance to isolate the problem. Through analysis (both statistical and qualitatively), begin to formulate and test hypotheses about the root cause of the problem.

Step 4: IMPROVE the problem by selecting a solution. Based on the identified root cause(s) in the prior step, directly address the cause with an improvement. Brainstorm potential solutions, prioritize them based on customer requirements, make a selection, and test to see if the solution resolves the problem.

Step 5: CONTROL the improved process or product performance to ensure the target(s) are met. Once the solution has resolved the problem, the improvements must be standardized and sustained over time. The standard-operating-procedures may require revision, and a control plan should be put in place to monitor ongoing performance. The project team transitions the standardized improvements and sustaining control plan to the process players and closes out the project.

3. Results

This present work deals with the manufacturing process in which welding is done on the steel. The electrical resistance welding is used in manufacturing process. In this work with consideration of various parameters we will find out the reasons responsible for leakage problem in the tube.

Welding type: Electric Resistance Welding at low voltage high current Cooling medium water

For corrosion reduction: Nitrogen gas used Electrode angle: 90 degree By the variations in different parameter in tube welding process the yield stress and tensile stress are increased When we are change the thickness (variable) then improve the welded tube strength show below in table and graph.

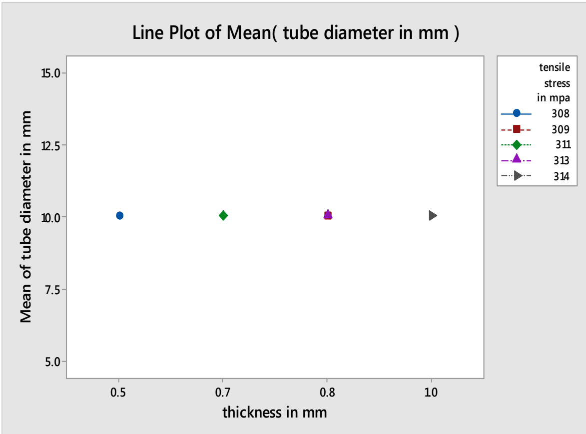

Fig. 1: Thickness v/s tensile stress

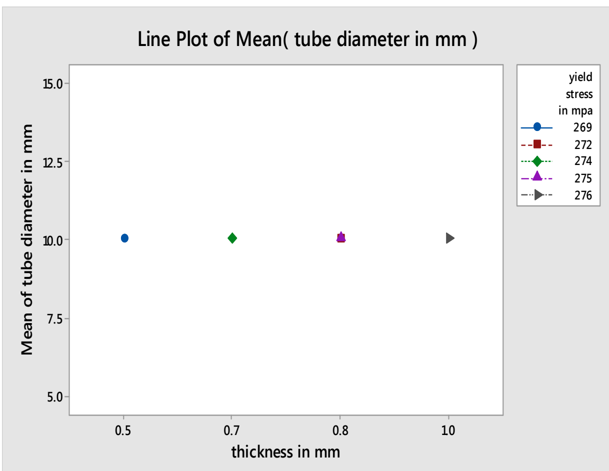

Fig. 2: Thickness v/s yield stress

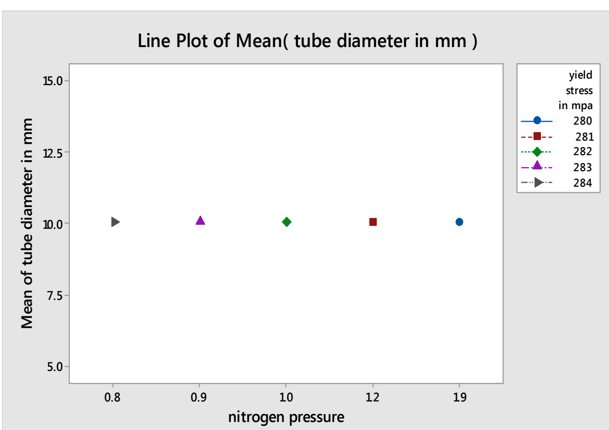

Fig. 3: Nitrogen gas pressure v/s Yield stress

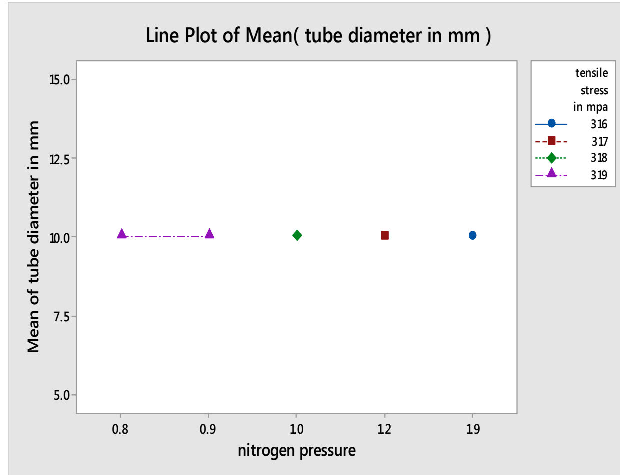

Fig. 4: Nitrogen pressure v/s Tensile Stress

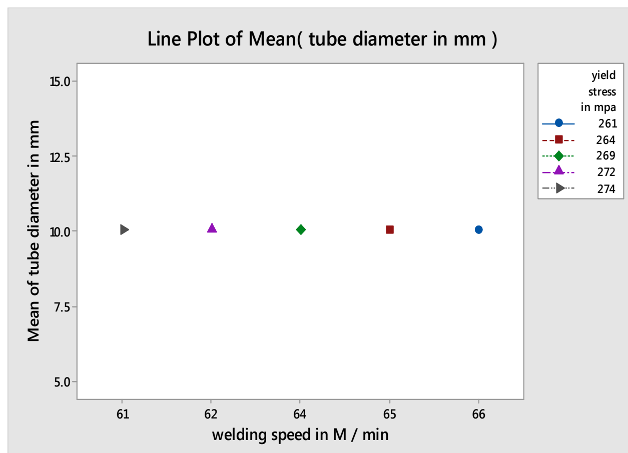

Fig. 5: Welding Speed v/s Yield Stress

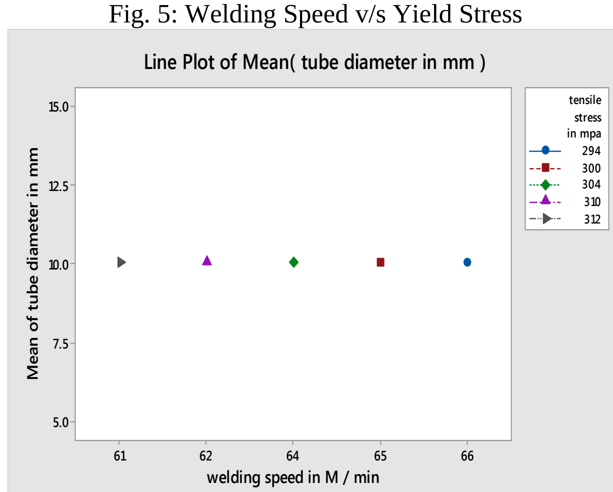

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Fig. 6: Welding Speed v/s tensile Stress

3. Conclusion

In this work with consideration of various parameters we found the various reasons responsible for leakage problem in the tube. The various parameters such as use of nitrogen gas, change in welding pressure, increase in strip thickness and reduction in welding speed were taken under consideration in order to find the better results are taken as nitrogen gas pressure V/S yield stress and tensile stress (yield stress=285 Mpa and tensile stress=320Mpa) to find the welding leakage problem. The tensile strength increases with increase in welding speed. As the diameter increases, tensile strength increases. Tensile strength increase with increase in base current, peak current and pulse frequency. By implementing six sigma DMAIC technique the tube leakage problem is minimized and strength of tube welding is improved. By the implementing of six sigma quality level is increased which reduces the rework cost process capability value are increased and also increases the value of upper specification limit and lower specification limit as a result of which the value of standard deviation is increased. Due to variation in diameter and thickness of the tube and by the change of parameters in the tubes we meet the required standard therefore improvement in the selection of diameter and thickness of tubes was required.

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