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## Assessment Of The Implementation Of Manufacturing Excellence In A Fiber Based Packaging Manufacturing Environment

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### Abstract

The paper industry is facing continuous decline due to a combination of input costs and competition. In addition to these concerns of input costs and competition, product quality has been an ongoing problem as customer complaints have been translating to cumulative increases to operational costs as observed by Evergreen Packaging. In a survey conducted by Evergreen Packaging in the year 2014 of customer complaints, these product quality issues materialized as an area of concern. As such, Evergreen Packaging felt the need to implement an improvement program with the goal of improving quality to increase customer satisfaction. The goal of the improvement program was to reduce the operating costs of the company through the reduction of the top five complaints, and the top five dollars lost due to complaints, in each facility by 90%. The improvement program followed the principles of Manufacturing Excellence, with the company working with external consultants who are experts in Manufacturing Excellence. Statistical tests were then conducted to determine the improvements of the improvement program following a set period of time after its implementation

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### 1. Introduction

In today's manufacturing world, companies are faced with ways of reducing cost in order to be competitive. In a global market, companies are competing with competitors on price, wages, benefits, safety, throughput, and quality. Cost is a trigger that can drive profitability or kill all other efforts related to profit. Cost helps companies settle in on a price structures for their product. In addition, cost determines whether some products will be discontinued or whether other products are worth being initiated. The strategic system that will be implemented in this fiber based manufacturing environment is the concept of Manufacturing Excellence. Manufacturing Excellence utilizes the tools and techniques of the Lean Six Sigma methodology.

The goal of the project is the implementation of Manufacturing Excellence in a fiber based packaging environment, and in doing so, create a competitive advantage

and fundamental improvement that enables packaging companies to remain competitive in the marketplace. The fundamental improvement was tracked using quality claims and quality claim dollars.

A generally accepted factor that is crucial in the manufacturing business product quality, with quality defined as the fulfilment of customer requirement or specification with no defect in the product.[1] Quality management has been the general term utilized for all methods that translate to quality. Quality management consists of three processes: quality planning, quality control, and quality improvement.[2] Quality planning involves all procedures spanning from determining the needs and requirements of the customer to the development of the products, and the processes essential to meet these needs.[2] Quality control involves the examination of the reaction to flaws or irregularities in the manufacturing process.[2] Quality improvement, as defined by,[2] is the "organized creation of beneficial change; the

attainment of unprecedented levels of performance". Achievements in quality management, specifically the third process, quality improvement, are stated to be best reached through projects.[2]

Some firms have elected to develop strategies that will enable them to obtain a competitive advantage in the global market by improving their quality of product and process. The most common of these strategic methods are Six Sigma and Lean Manufacturing. These two strategies are powerful philosophies which are supported by extensive tools for the improvement of quality, productivity, profitability, and market competitiveness in a holistic manner.[12] The Six Sigma methodology is focused on eliminating process variation through the use of problem solving approach and statistical tools, while Lean Manufacturing is focused on eliminating waste and the improvement of process flows.[12]

Following the success of Six Sigma and Lean Manufacturing, a merging of the two methodologies was proposed, of which the integration of the philosophy was then called the Lean Six Sigma.[9, 10] The goal of the integration of the two methodologies is for organizations to be able to target every type of opportunity for improvement.[11] The philosophy of Lean Manufacturing is complemented by Six Sigma, with Six Sigma providing the necessary tools and knowledge to address specific problems that are identified in the process of implementing the Lean Manufacturing philosophy.[4]

### 1.1 Methodology

The main deliverable of this project is an applied case study in several fiber-based manufacturing facilities upon the utilization of the Manufacturing Excellence intervention. To aid the instruction of Manufacturing Excellence for the fiber-based manufacturing industry, a case study was constructed that focuses on reduction of customer complaints due to low product quality.

Manufacturing Excellence is a systematic approach to improve quality of process and product by making data driven decisions through the use of Kaizen events focused on: DMAIC process, 5S programs, employee involvement/ideas, standardized work, and analysis & improvement tools. Based on Six Sigma and Lean Manufacturing improvement methodologies, Manufacturing Excellence adapts the following tools from both methodologies: a.) quality maps/process maps, b.) check sheet, c.) Pareto diagram, d.) cause & effect diagram, e.) histogram, f.) run chart, g.) scatter diagram, h.) affinity diagram, i.) force field analysis, j.) selection matrix, k.) spaghetti mapping, h.) single minute exchange of dies (SMED), i.) failure mode effects analysis (FMEA), j.) root cause analysis (8D problem solving, is/is not analysis, 5 whys, fault tree analysis), k.) layered process audits, and l.) team leader skills. The teams involved in each facility were educated and trained to use the tools enumerated above, after which, they were tasked to address the processes related to the top five number of complaints, and top five dollars lost due to complaints, using the Manufacturing Excellence tools, adapted from Six Sigma and Lean Manufacturing.

## 2. Objective

This study was guided by the following research questions and hypotheses:

**RQ:** Does implementation of a continuous improvement method, specifically, Manufacturing Excellence, improve factory performance in terms of number of complaints and dollars lost from complaints?

**H1o:** The implementation of Manufacturing Excellence in (location) did not reduce the number of complaints from the top 5 number of complaints of the factory.

**H1A:** The implementation of Manufacturing Excellence in (location) significantly reduced the number of complaints from the top 5 number of complaints of the factory.

**H2o:** The implementation of Manufacturing Excellence in (location) did not reduce the dollars lost from complaints from the top 5 complaints with highest dollars lost of the factory.

**H2A:** The implementation of Manufacturing Excellence in (location) significantly reduced the dollars lost from complaints from the top 5 complaints with highest dollars lost of the factory.

**H3o:** Implementation of Manufacturing Excellence does not significantly reduce the total dollars lost from complaints for the company.

**H3A:** Implementation of Manufacturing Excellence significantly reduces the total dollars lost from complaints for the company.

This proposed research is an applied study with the implementation of Manufacturing Excellence in select Evergreen Packaging facilities. A quantitative method involving a comparative, pre/post quasi-experimental design and analyzed using unpaired samples *t*-test was utilized for data analysis. Multiple linear regressions will also be used to determine whether the total dollars lost from complaints for the company will be significantly reduced. Quantitative methodologies are used when the objective of the study is to measure variables and analyze variables using statistical analysis in order to explain the phenomena.[13] The data for the variables of this study are numerical, and are collected from existing data before the experiment, and data from when the experiment is implemented. In this proposed study, the objective is to determine the effect of the implementation of Manufacturing Excellence on the performance of fiber based manufacturing factories with regards to the DVs of number of complaints and dollars lost from complaints.

Table 1

#### *Kalamazoo facility complaints of interest*

<b>Top five number of complaints</b>	<b>Top five dollars lost due to complaints</b>
<b>Bowed carton / nip lean / fluff</b>	Side seam defect
<b>Poor print</b>	Bowed carton / nip lean / fluff
<b>Incorrect copy / product shipped / product ID</b>	Carton damage - sealer / packer / stretch wrap
<b>Side seam defect</b>	Incorrect copy / product shipped / product ID
<b>Carton damage - sealer /</b>	Bias

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