

IE368 – Quality Planning and Control
Spring 2023

Case Study 2

Due Date: May 2, 2023 (17:00)

XYZ Shoes is a shoe manufacturing company that mainly operates in the North American market, which has seen remarkable growth in its market share over the past few years. The company mainly produces sports shoes, and its success can be attributed to its unwavering commitment to the performance, quality, and innovation in the footwear industry. XYZ Shoes' mission is to provide customers with comfortable, stylish, and durable shoes that meet their needs and exceed their expectations. The company's vision is to become the leading provider of footwear solutions globally by expanding into other markets such as Europe and Middle East, leveraging technology and innovation to drive growth and sustainability. To achieve its mission and vision, XYZ Shoes invests heavily in research and development to create innovative products that meet the evolving needs of customers. The company also prioritizes sustainability and social responsibility in its operations, ensuring that its manufacturing processes are eco-friendly and ethical.

The product portfolio of XYZ Shoes' consist of sneakers, walking shoes, basketball shoes, soccer shoes, sandals, and slippers. Their best-selling products are the sneakers, where the competition in the market is also the highest. Thus, the strategy department of the firm prioritized the operations for their sneaker products to cement their place in the Northern American market before expanding into other markets. The task of the production department is to be committed to further increase its quality without sacrificing profitability.

The production of the shoes can be examined in 4 main categories: cutting, stitching, sole manufacturing, and assembly.

The cutting process involves using a pattern to cut the various pieces of the shoe from the selected materials. Typically, cutting machines or hand-held tools are used to cut the material precisely to the shape and size of each component of the shoe. The cutting process must be precise and accurate to ensure that the pieces fit together properly during assembly.

During the stitching process, different parts of the shoe that have been cut are sewn together. Depending on the type of shoe, different stitching techniques, such as lock stitching, chain stitching or zig zag stitching, different types of needles and threads can be used. Once the stitching is complete, the seams must be finished to ensure that they are secure and do not fray. This may involve trimming excess threads, using a serger to enclose the raw edges of the seam, or applying adhesive or seam tape to reinforce the seam.

The materials used to manufacture the sole will depend on the specific design and performance requirements of the shoe (e.g., durability, flexibility, traction, etc.). Common materials used for shoe soles include rubber, EVA (ethylene vinyl acetate), and PU (polyurethane) foam. For the manufacturing of the soles, the materials are mixed together in the appropriate proportions to create a moldable mixture. The mixture is then poured into the sole mold or pattern and allowed to cure or harden. Depending on the material being used, this may involve heat, pressure, or chemical reactions. Once the sole has cured, it is removed from the mold and trimmed to the appropriate size and shape. Any excess material is removed, and the sole is sanded or finished to ensure a smooth surface. Treads or other surface patterns may be added to the sole to improve traction.

The assembly step in shoe production involves putting together all the components of the shoe, including the upper, sole, and any other components like laces, zippers, or buckles. The first step in assembly is attaching the upper part of the shoe to the sole. This may involve stitching, gluing, or heat sealing, depending on the specific design of the shoe. Once the upper and sole are attached, any additional components like insoles, linings, or reinforcement materials may be added. If the shoe includes closures like laces, zippers, or buckles, these will be added at this stage. The closures may be attached using stitching or adhesives, depending on the specific design of the shoe. Lastly, once all the components are assembled, the shoe may undergo additional finishing touches like polishing, buffing, or cleaning.

The company has been receiving complaints about a particular type of sneakers, leading to a decline in their sales. To get to the bottom of this issue, the Board of Directors has decided to bring in a quality consultant, and your company has been hired for this task. During the meeting with the company associates, you were briefed about their production process. It was revealed that they didn't have a statistical process control system in place, but they were keeping track of the monthly

yield, number of scraps, and rework, in addition to customer complaints and warranty claims for all their products.

Your team has been tasked with helping the Quality Management Department analyze customer complaints related to a particular type of sneaker that people have been complaining about. To aid in this task, you were provided with Table 1, which summarizes the yield data from the previous month for this type of sneaker. The table shows the total number of sneakers that were produced (N: yield), the number of products that failed during production and were discarded (S: scrap), and the number of products that had defects but were repaired (R: rework).

Table 1 Yield data for the production steps

Production Step	N	S	R
Cutting	400000	46	116
Stitching	399954	104	242
Sole Manufacturing	399850	56	96
Assembly	399794	232	646

The Quality Management Department has claimed that the total first-time yield (FTY) is very high based on the data provided in Table 1, and they believe that there should not be a serious quality problem with the sneaker.

Do you think that looking just at the total FTY is appropriate in assessing the quality level of the process, as the Quality Management Department claims? What can you say about the rolled throughput yield (RTY) of the process? Which of the total FTY and RTY measures are more meaningful? Can you predict defects per unit (DPU) levels of the individual production steps besides FTY and first pass yield (FPY) of them? What is the normalized yield (NY)? Based on these measures, which production step should have the highest priority for improvement? Clearly explain and show your work.

You asked the company to provide you with daily defect data for the production processes of the sneaker for the next 30 days so that you could conduct further analysis. After considering cycle time, inspection cost, and other factors, you determined that a sample size of 2000 shoes would be suitable for data collection for each process. Table 2, which can be found in the ie368-spring2023-

case-study-2-data.xlsx file, contains the defect data that were collected. The data include counts of all defect opportunities.

Based on these additional data, can you claim that each of the production steps in statistical control? What can you claim further about the capability of these process steps considering defect opportunities? Considering the fact that a month is enough to observe special causes, can you comment on the long term and short-term sigma levels of these processes? Can you also estimate the DPU values of the process steps based on the last month's defect data? Do these estimates agree with the DPU predictions based on the data in Table 1 collected in the previous month? What could be the sources of discrepancies? Based on your analysis, which process step(s) should have priority for improvement? Is your choice different from the one(s) you have made using the results of the yield analysis above? Clearly explain and show your work.

What can you recommend to the Quality Management Department for future monitoring and improvement of these steps? Comment on how the factors such as external and internal quality costs and inspection errors that you might not have considered directly, could affect your selection of the production step for improvement.