# Tooling Mini Challenge: Activity 3.01

Overview

The “Mini Challenge” is a short activity that tests knowledge of additive manufacturing. The focus is “Design for Additive Manufacturing”. How well are you able to identify a “well-designed” 3D printed part? Complete the challenge as described below to be graded.

Scenario

You work at a company in the Manufacturing Engineering department, responsible for designing new manufacturing processes as products are developed. Your company has recently purchased a Stratasys Fortus 450mc FDM 3D printer to assist in various factory functions.

A new product, named the “front bracket” is announced as an urgent new project. It is a high-value machined metal bracket that requires a logo to be pad-printed on the top of it. See below:

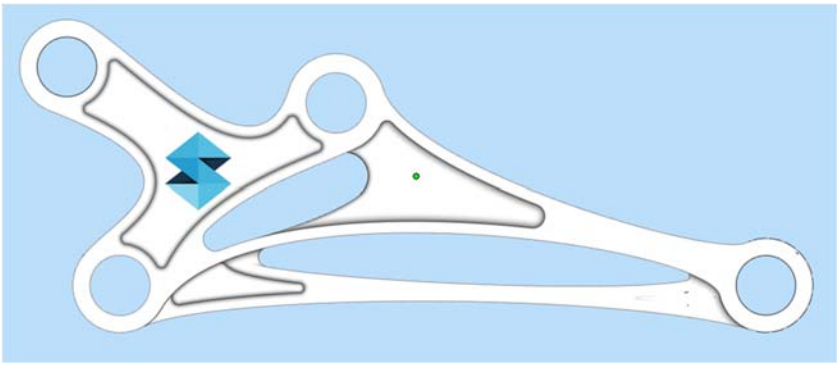

**Figure MC-1: The company’s new “front bracket” has a logo pad-printed on the top of it.**

Your manufacturing engineering team has to design a fixture that will hold this bracket in place while the stamp is being applied. During the manufacturing process, a long conveyor belt with 100 fixtures on it will cycle the fixtures through a pad printing process. See below a diagram of pad printing:

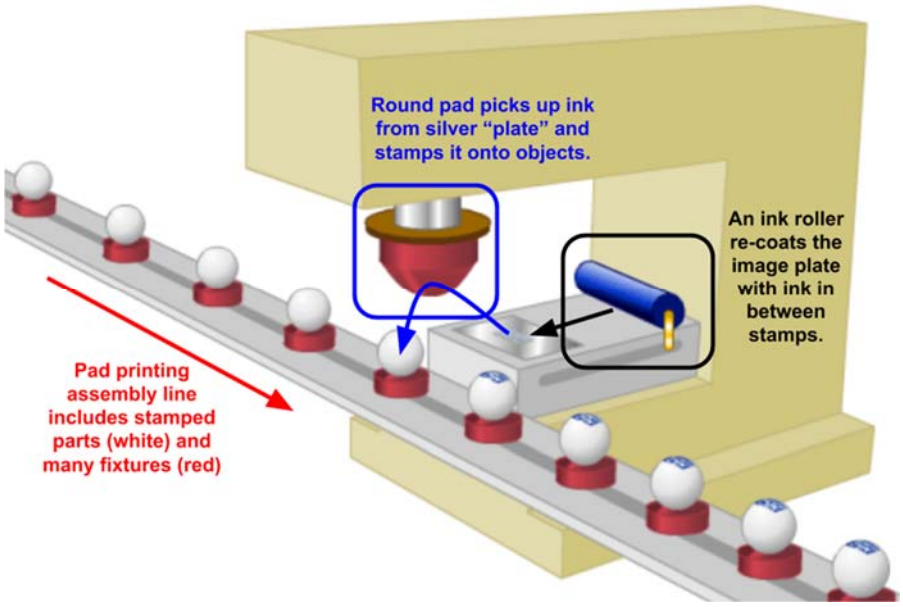


**Figure MC-2: A diagram showing the pad printing process. In this diagram, a rack of products undergo stamping. In the company's operation at hand, the rack is instead a conveyor belt with metal plates that rotate continuously.**

On Monday morning your team is tasked with designing and creating 100 fixtures for this important pad printing operation. The fixture requirements are simple:

1. They each need to have four ¼" **bolts on each corner for bolting down to metal plates on the conveyor belt**, and
2. They need to have **"centering pins" that allow a person to drop the "front bracket" in from above** while the conveyor belt is moving.

The fixtures need to be created very quickly, as production is already behind schedule. In fact, 100 fixtures need to be produced within 7 full 24 hour days (168 working hours at this 3-shift factory), in other words, by *next* Monday afternoon. During a team meeting, when everyone is scratching their head about how to do this, Team Member A raises his hand and suggest to 3D print the fixtures to save time. Everyone agrees that this may be the solution to creating the fixtures in a short time frame, so he designs a fixture that meets the 2 requirements above and estimates the time required to build it:

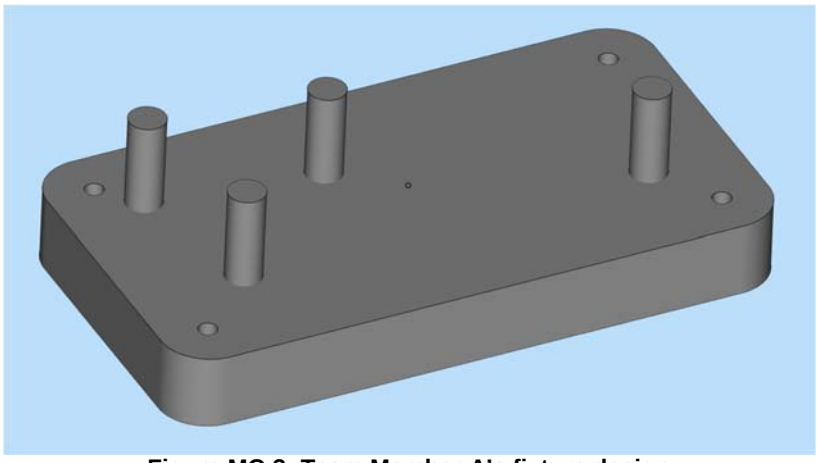

**Figure MC-3: Team Member A's fixture design**

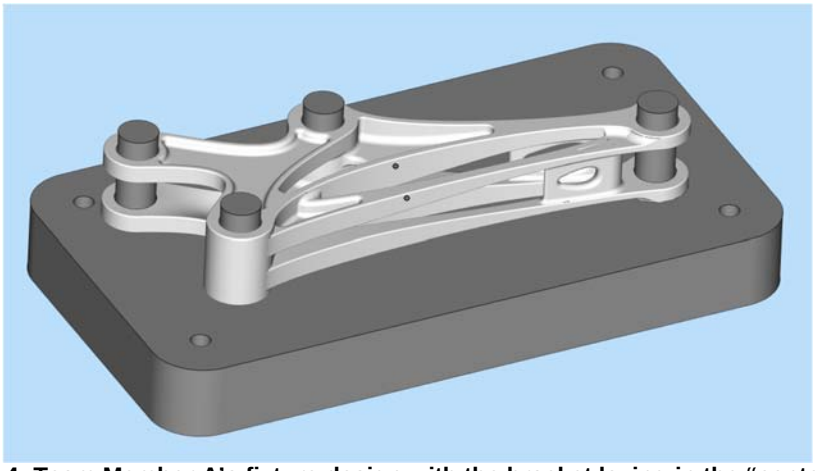

**Figure MC-4: Team Member A's fixture design with the bracket laying in the "centering pins"**

**Figure MC-5: A top view of Team Member A's fixture design**

Team Member A reports back to the team later on Monday morning that building each fixture will require 6 hours and 12 minutes (see the CMB file on your thumb drive).

**Question 1: Do the math**… if 168 printing hours are available, what does the per-part printing time (in hours and minutes) have to be to complete the order assuming 80% machine utilization rate ("up-time") and that 10% of the printed fixtures will not pass quality standards?

Team Member B scribbles some math onto a piece of paper and announces that the time will need to be dramatically reduced in order to meet the deadline. He adds that he'd be willing to redesign the bracket to save significantly on time and simultaneously improve the bracket's functionality.

An hour later, Team Member B presents the following design (MC-6 below) to the team, and declares that it only requires 1 hour and 3 minutes to print. He is congratulated for his creativity, and additive production of the fixture begins right away. See the CMB file of Team Member B's design on your thumb drive.

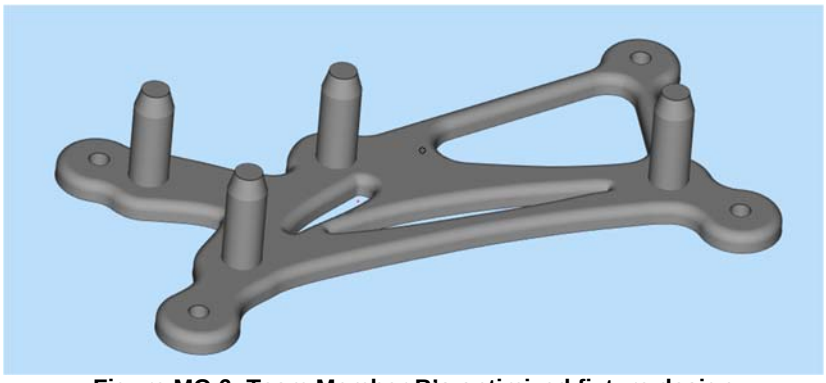

**Figure MC-6: Team Member B's optimized fixture design**

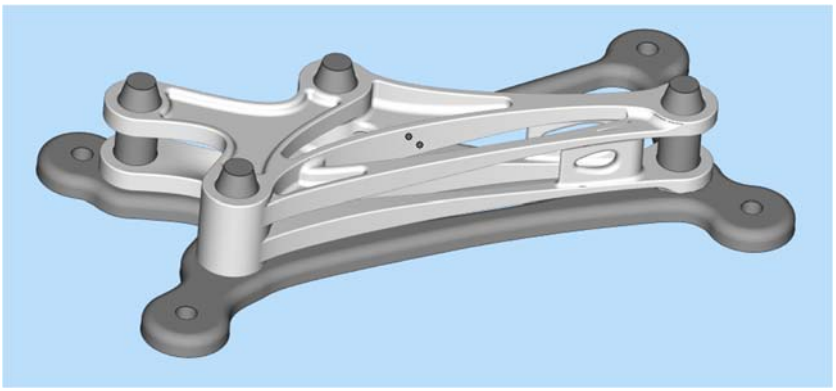

**Figure MC-7: Team Member B's optimized fixture design**

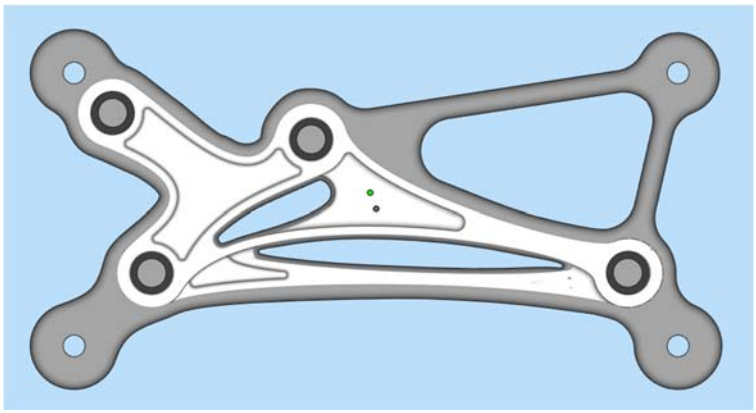

**Figure MC-8: A top view of Team Member B's optimized fixture design**

**Question 2**: **Identify any TWO time-saving changes** that Team Member B made to Team Member A's design. The ready-to-print CMB files for both designs are provided to you in your USB.

Team Member B boasts that his design also assists the operator who is loading the "front bracket" onto each fixture.

**Question 3**: **Identify the TWO functionality improvements** that Team Member B added that assist the operator in placing brackets onto the fixtures.

Team Member C expresses some concern about how thin the optimized design is. He picks one of the first printed fixtures up, twists hard, and it snaps along the red line shown in MC-9 below.

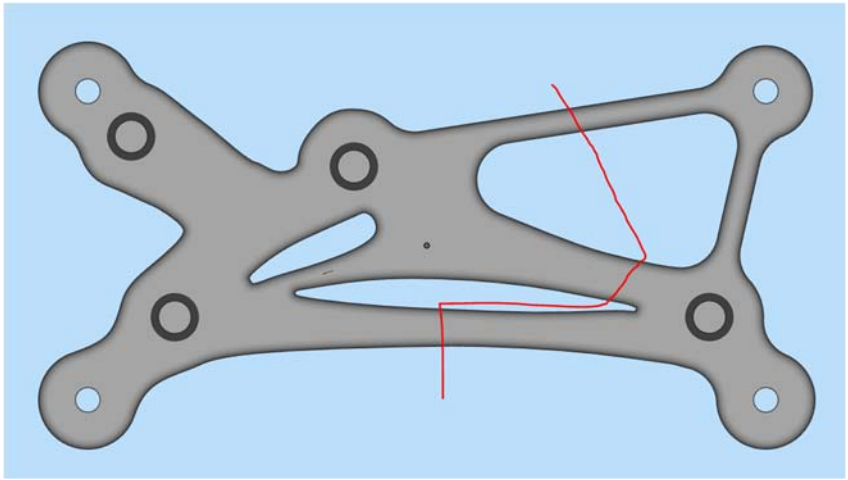

**Figure MC-9: The fracture path that Team Member C identifies when twisting the part.**

Team Member B reminds them of how the fixture will be used, and they all nod and dismiss Team Member C's concern.

**Question 4**: **Remind the team:** What did Team Member B specifically remind them of regarding the part's final use that makes Team Member C's concern irrelevant?