SMED increases OEE of an electronic SMT line

Background

Our client manufactures electronic products that are supplied mainly against government tenders. Having established the products in terms of quality and price, there was a spurt in demand over the past year and the current business volumes were more than 3X of the previous year. While, the downstream processes were ramped up by adding assembly lines and subcontracted activities, the upstream PCB soldering had become a constraint. The existing (Surface Mount Technology) SMT line was operating 24 x 7 and still unable to meet the full requirement. About 20% had to be outsourced at higher cost as well as increased lead time as the quality norms were being met only by an out of station vendor.

As part of an operations improvement and streamlining exercise, the SMT line was focused upon in an attempt to reduce dependency on outsourced product. The SMT team was already tracking various parameters such as down time, quality and performance data available from the software of the automated line. KIAP worked with the team to calculate the OEE through an initial study and identified the following:

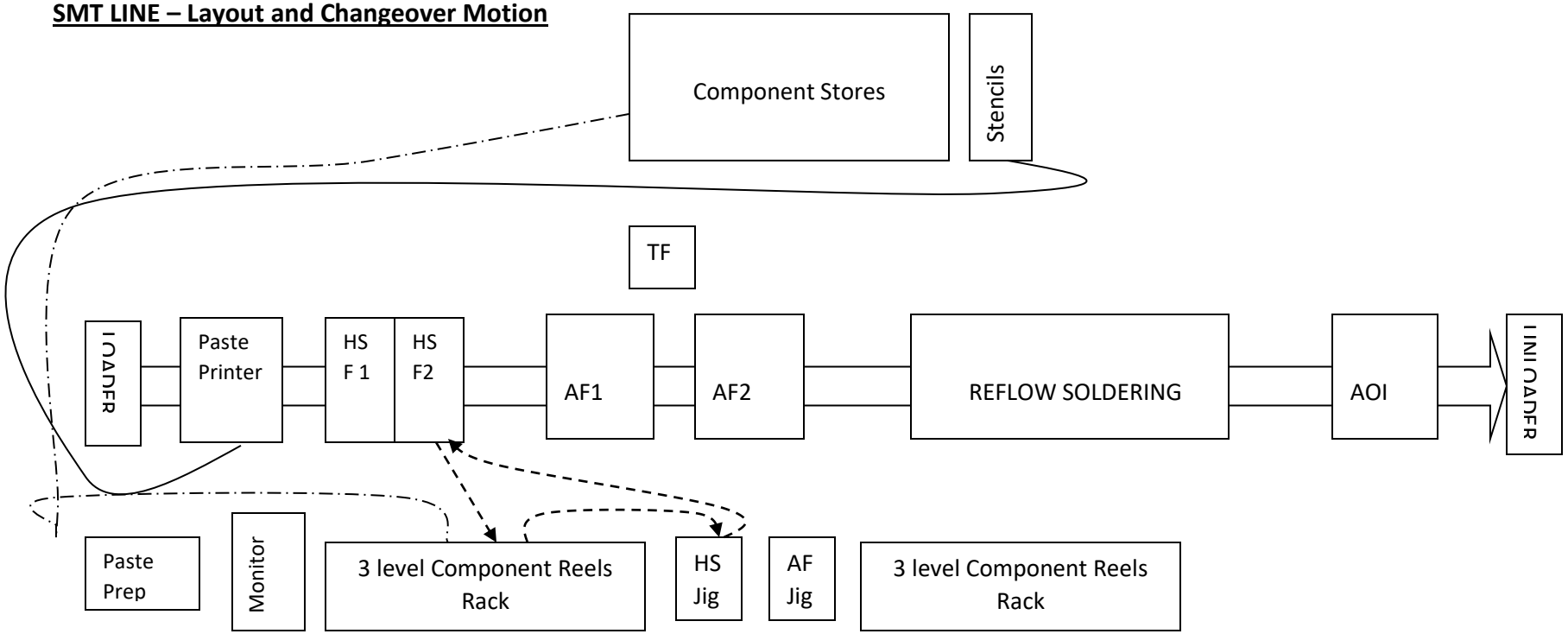
- Overall Equipment Effectiveness (OEE) was only 60%
- Changeover time was the single highest loss – there was at least one changeover every day and the time varied from 90 - 240 minutes depending on the complexity

The SMT Process

The SMT line process flow is depicted below; the four main processes being

1. Paste Application – done through the printer using a stencil specific to each PCB
2. Component Placement & Assembly – two high speed pick & place machines,2 semi auto machines and 1 Tray Feeder each with provision for multiple components are in line
3. Reflow Soldering – done through an oven
4. AOI Visual Inspection with predefined reference templates loaded

SMT LINE – Layout and Changeover Motion



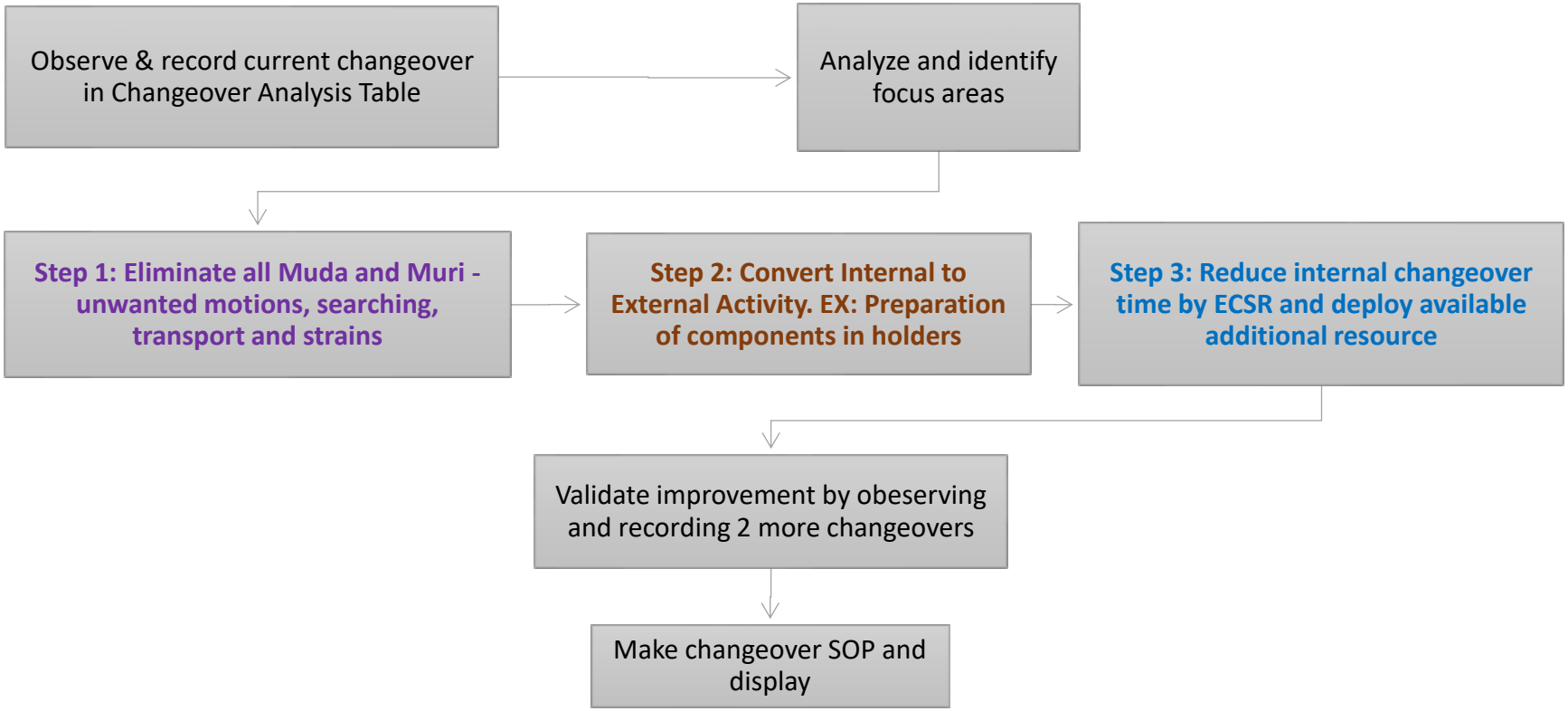
Key Steps during Changeover

1. Changing stencil and paste on printer
2. Component loading on feeder reels and verification
3. Program calling on all stations, template calling in AOI
4. First piece visual inspection before reflow and AOI . Followed by another 4 boards inspection and then line run clearance.

Note: Each product has anywhere from 30 -50 components most of them unique which means loading of 30-50 feeders during changeover – the movements shown between the jig, rack and Pick & place machines are repeated for each component loading

Our Approach

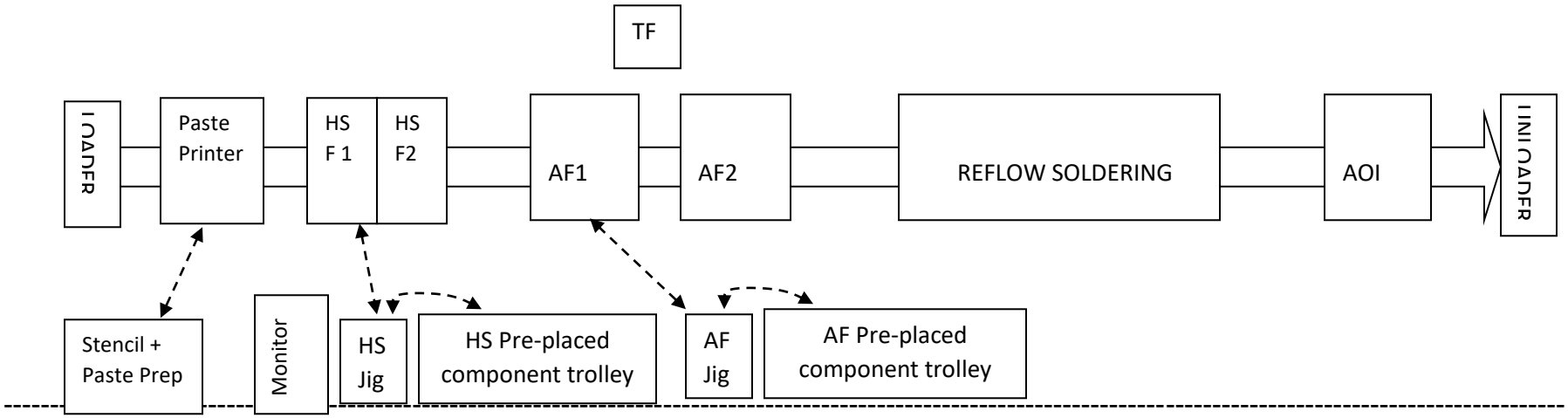
A 3-day SMED workshop was conducted by KIAP experts to record, observe, analyze and improve changeover on the SMT line. `



Key Actions Implemented to reduce the changeover time

- Layout of feeder jigs, racks, stencils and other supporting activities changed to eliminate unwanted motion and strain
- One component rack cleared of unwanted materials and used for placing of component reels in the same sequence as required in for the available program – these component reels will be loaded in the feeder during the changeover without searching
- Verification by line operator eliminated and Re-verification process by QA person after loading feeders continues.
- Other than line operator, AOI operator also involved in changeover. External component preparation completed in general shift by supervisor and kept ready for changeovers in night shift as well
- First piece inspection – the procedure of visual inspection of first board before reflow and then AOI check and clearance followed by another 4 boards before giving clearance for line run meant 20 minutes delay as that much time is taken to pass from first stage to AOI. This was replaced by allowing 5 boards to run through and get cleared at AOI directly
- Stencil inspection workstation made with provision for paste preparation and the regularly used stencils shifted next to it

Revised Layout showing the Operator movement during changeover



Once the benefits of SMED were validated, the standard SOP and checklist were accordingly made. Changeover times were displayed on a visual board next to the SMT Line monitor. Depending on the number of components and complexity of changeover (i.e existing vs new product), the changeover time was reduced anywhere from 40 -60%. For example, a unique product which was having a 3.5 hour changeover was now happening in about 2 hours.

Long term actions implemented subsequently over the next 2 months included

- Getting additional feeders for the high speed machine to facilitate external preparation of reel components
- Software for online verification of components in high speed feeder -The software provision for barcode scan of component reel and matching with feeder location was later activated to eliminate QA verification
- Modification of racks into slim trolleys capable of holding multiple component reels with visual identification

Outcome

1. Average reduction in changeover time by **40-50% over the long terms**
2. This resulted in a significant increase in **OEE** from **60% to 70%.** Further increase in OEE was later taken up by an improvement project for reducing short stops