

# Development of Variable-Line Balancing Chart by Risk Assessment Using Monte Carlo Simulation

## Abstract

Line Balancing Chart is one of the most used lean tools for determining cycle time (CT) and lead time (LT) in the production line processes flow, from raw material input until finished product output. However, for traditional Line Balancing Chart, only the average (mean) CT and LT are considered which causing inconsistent performance of the actual production line throughput rate (productivity). In this study, Variable- Line Balancing Chart (V-LBC) is introduced by considering the dynamic CT and LT in a form of (Minimum, Most Likely (mean), Maximum) for each process involved in the production line. The risk assessment for Value-added (VAA) and non-value added (NVAA) events in the flow are also considered for this V-LBC. A Monte Carlo simulation by using @Risk software is utilized to simulate each process CT distribution capability. As a result, each process in the V-LBC could be represented in horizontal and vertical time variables that involve a variable CT (VAA and NVAA) and risk assessment using Risk Assessment- Failure Mode and Effect Analysis (RA-FMEA) approach. The actual root cause led to the process variation also could be identified more accurately from the V-LBC. Hence the correct action could be taken in order to reduce the variation which indirectly increase the production line productivity.

## Keywords

Failure Mode and Effect Analysis (RA-FMEA), Variable; Standard Operation Combination Chart (V-SOCC); Variable- Line Balancing Chart (V-LBC), Monte Carlo simulation, Risk Assessment