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AN OPTIMIZATION TECHNIQUE TO ASSEMBLY LINE BALANCING IN APPAREL INDUSTRY

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Balancing the assembly line in the apparel industry, which is crucial for maximizing production efficiency, requires effective assignments of machine operators (MOs) based on their skills and availability to reduce production delays. This study aims to increase the production rate by developing an optimization model as a two-phase Integer Linear Programming Model (ILPM). In the first phase, based on the MOs' efficiency, an ILPM is implemented to increase the total production rate by assigning them to operations while identifying bottleneck operations which contribute to lower the production rate. In the second phase, the total skill level of the assembly line is minimized. The predetermined bottleneck production rate is used as an indicator, ensuring that the production rate which is maximized in the first phase is kept fixed. The reassignment of the remaining MOs is based on their skill levels, while the bottleneck operations and operators are isolated in the second phase. The proposed method assigns MOs to maximize the production. Sequentially, it seeks to minimize the overall skill usage to ensure efficient utilization of operator skills. The bottleneck operation, identified in the first phase, ensures that the most efficient MOs are assigned where needed, while other operations are conducted by MOs based on a compromise solution between their skill levels and availability. This approach guarantees that the maximum production rate remains intact while optimizing operator efficiency. This proposed method offers flexibility in assigning operators with an optimum production rate and identifies the optimum number of MOs needed to perform the set of operations. Isolating bottleneck operations in the second phase minimizes their negative effect on the production efficiency and allows to reallocate resources to less critical operations. This two-phase approach compromises between production rates and skill levels, and ensures a balanced and efficient workflow. This approach can be adopted to any production line with the necessary modifications.

Keywords: Assembly line balancing, Bottleneck operation, Machine operator, Production rate, Two-phase integer linear programming