ABSTRACT

Manufacturing management needs powerful tools to measure performance levels of industrial production systems which are complex and dynamic in nature. In batch manufacturing, fluctuating manufacturing lead times greatly affect the performance of equipment. A generalised model for analysing manufacturing systems under dynamic conditions is essential to improve capacity utilisation with maximum throughput.

In this doctoral thesis, analyses have been carried out to predict the Manufacturing rate Wanted at Factory (MWF) using a configuration of standard manufacturing inventory model and industrial dynamics approach. The MWF value is arrived at by feeding demand forecast, order backlog, rate of filling the orders and delay in filling the orders. The manufacturing rate wanted is realised through Stabilised Sequence Planning System (SSPS) maintaining lower Manufacturing Lead Time (MLT) leading to reduction in Work-In-Process (WIP) inventory. The strategies for capacity planning have been evolved using a generalised dynamic system simulation model.
Dynamic schedules of manufacturing systems like Job shop, Flexible Manufacturing System (FMS) and Flexible Manufacturing Cell (FMC) are generated through these algorithms facilitating changes in schedules of batch manufacturing. Due to random nature of processing of components in shop-floor, digital simulation study has been carried out on these manufacturing systems to investigate the effects of scheduling rules with/without urgent orders on shop performance.

A new type of FMC with automatic set-up features, which simultaneously process both positioning and machining of components on index pallet changer has been analysed for sequencing the components.

These analyses have brought out the conditions leading to optimal performance of manufacturing systems catering to dynamic markets.