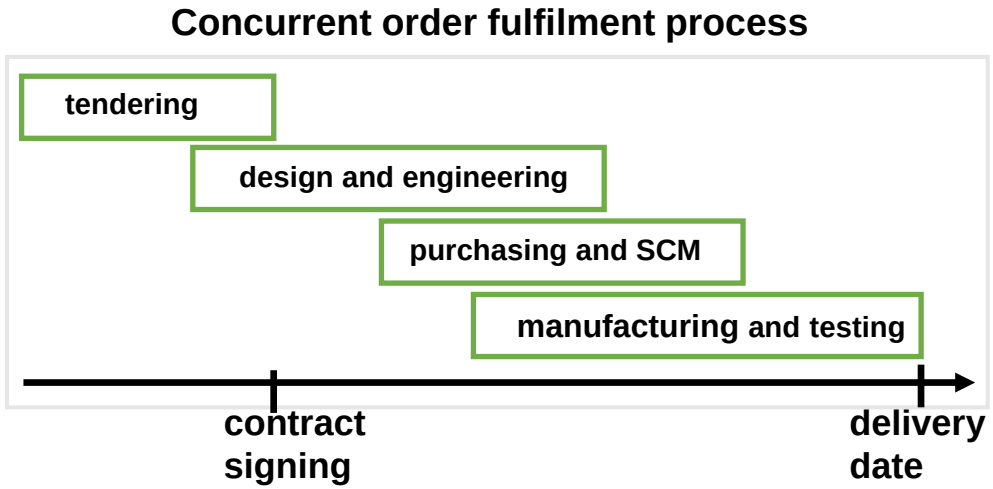
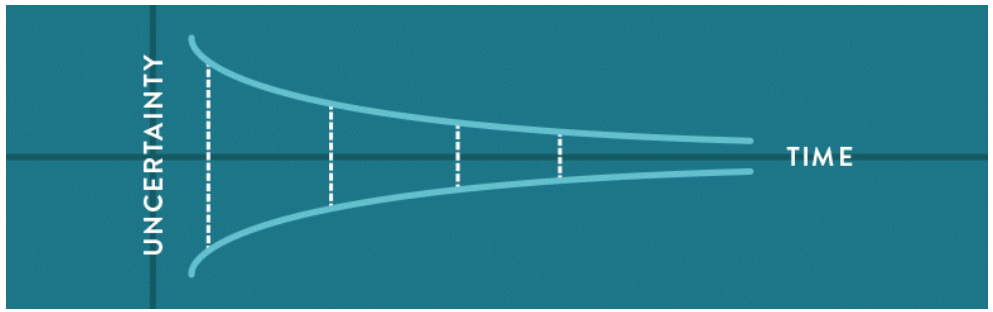
Planning in low volume production

ETO, MTO, LV/HV, Non repetitive production, assembly job shops, etc.

Engineer to Order manufacturing





Characteristics

Volatile market

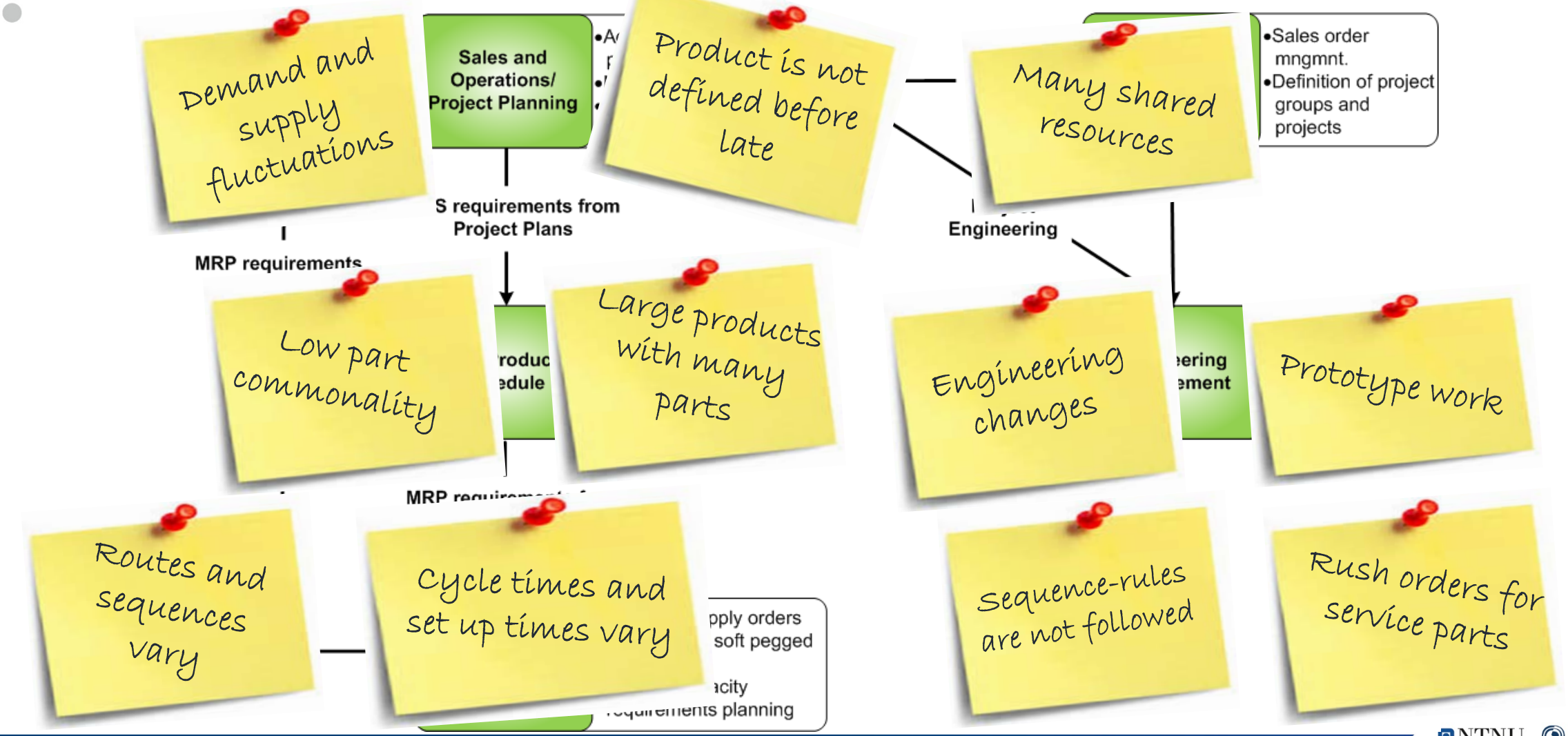
Deep products structures

Product design uncertainty

Long project duration

30 unique projects at the same time

Engineer to Order Challenges



ETO planning challenges

Sales and Operations Planning:

- The final product structure, routings, and processing requirements are not known before detailed engineering is complete.
- At this stage, product data, processing times and lead times are estimates which leads to some uncertainty regarding the capacity and supplier constraints.

Master Production Scheduling (and material requirement planning):

- Different mix configurations generate large variations in work content and shifting bottlenecks.
- Rescheduling is initiated by customer changes, supplier changes, and shop floor challenges

Shop floor control

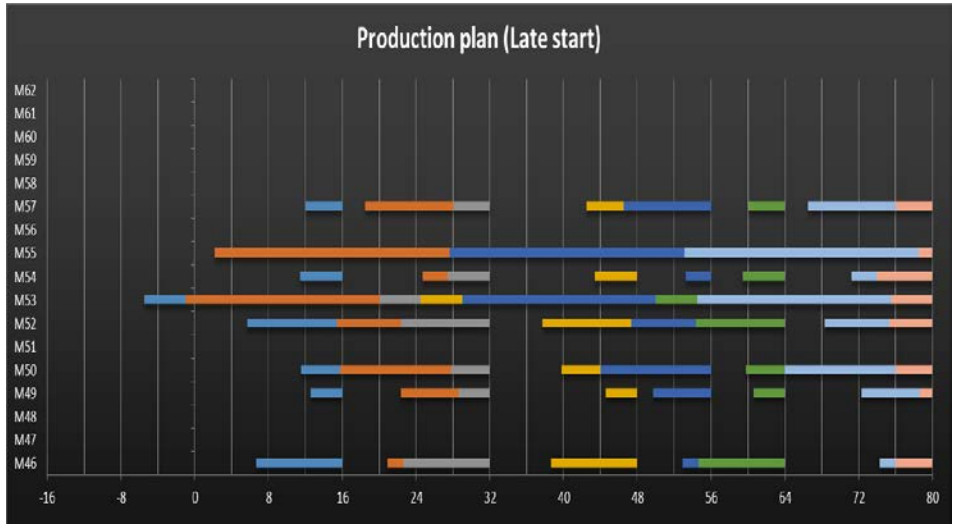
- As the assembly stations receives a broad range of manufactured and purchased parts, the risk of delay is substantial.
- The main task for the planner is to cope with all variations and create a flow of parts that reduces delays in assembly

Considerations for low volume shoop floor control addressed in this presentation

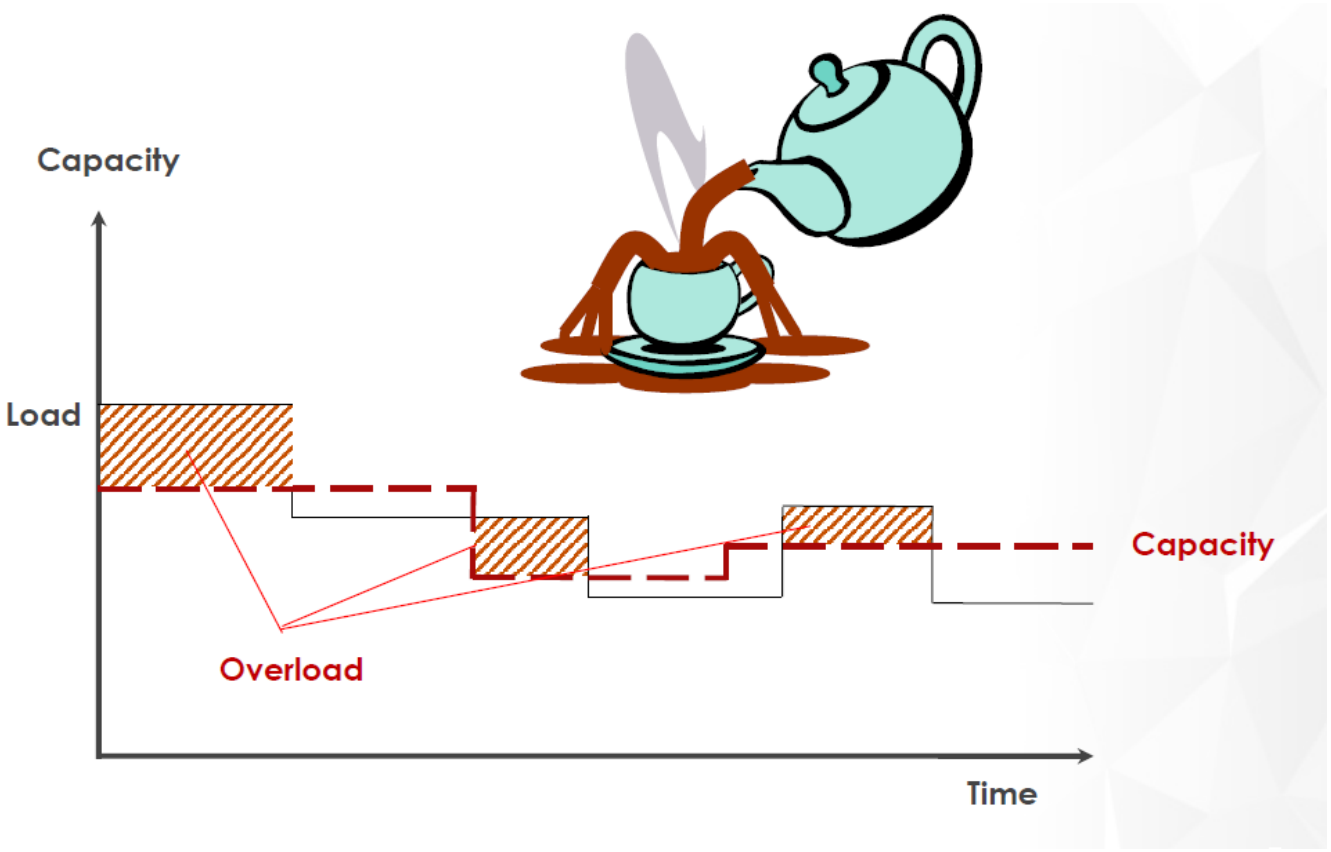
- Uncertainty and variations
  - Non-standard parts – no buffer stocks, only time and/or capacity buffers
  - Time buffers increase throughput times directly
  - Capacity buffers are excess production capacity and thus increase cost of production
  - The start of assembly processes require high inbound delivery precision. Estimation of the necessary time buffer is tricky as the finish (start) of assembly depend on the worst outcome of preceding activities. The likelihood of bad outcomes (necessitating large slack) also increase with the number of parts to assemble
- Shifting bottlenecks and capacity utilization
  - Variations in product structure and routing will create shifting bottlenecks
  - Full capacity utilization can only be attained at bottleneck resources, but the sequencing of different orders may increase overall capacity utilization by mixing orders with different "bottleneck" resources.
  - A balanced workload will give overall fastest throughput, but the production of parts for a product needs also to be synchronised for assembly.

The idea

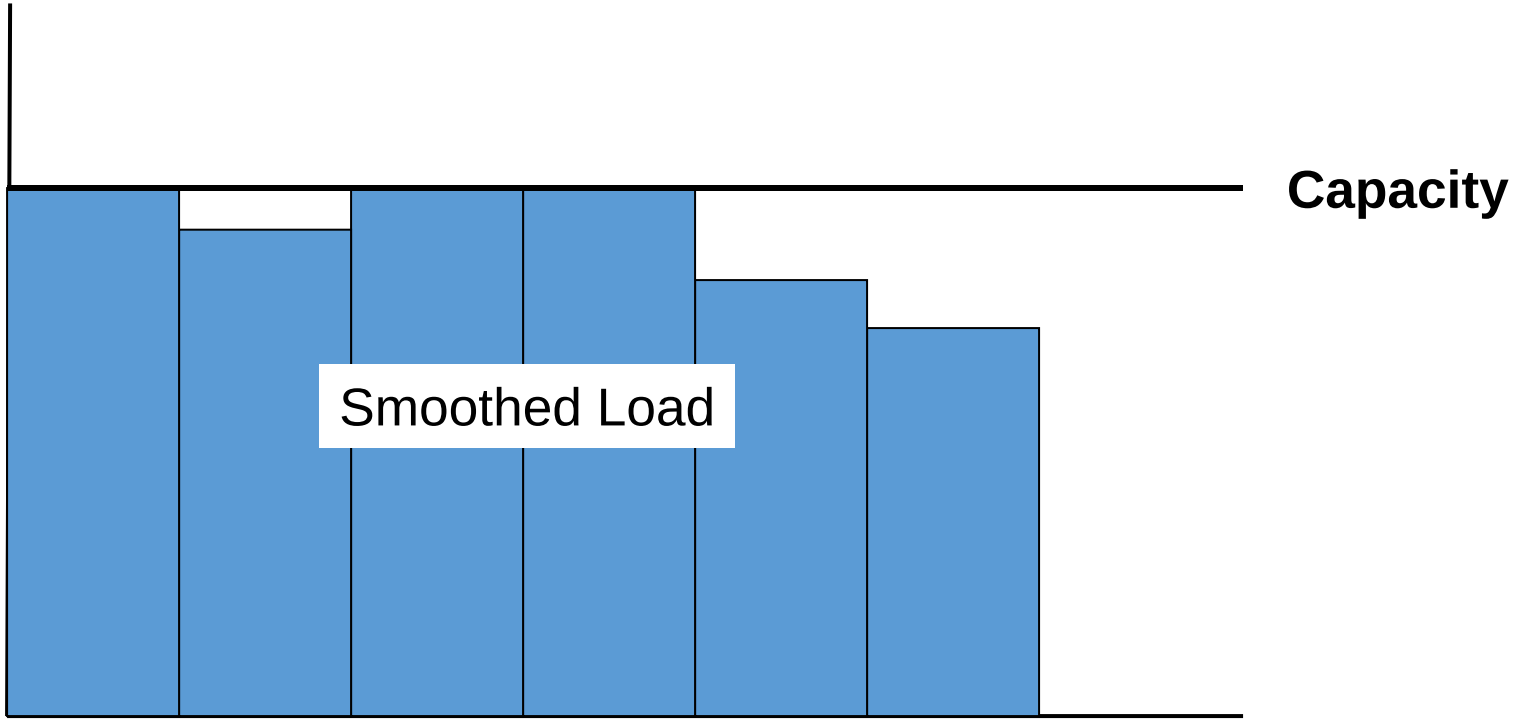
- Three step ERP planning – Use results from first two steps to identify bottleneck resources.
- Plan the activities for bottleneck resources for the projects in sequence with respect to capacity limitations of identified bottlenecks.
- Check that the sequence of projects are possible with respect to finishing dates for all other workflows.



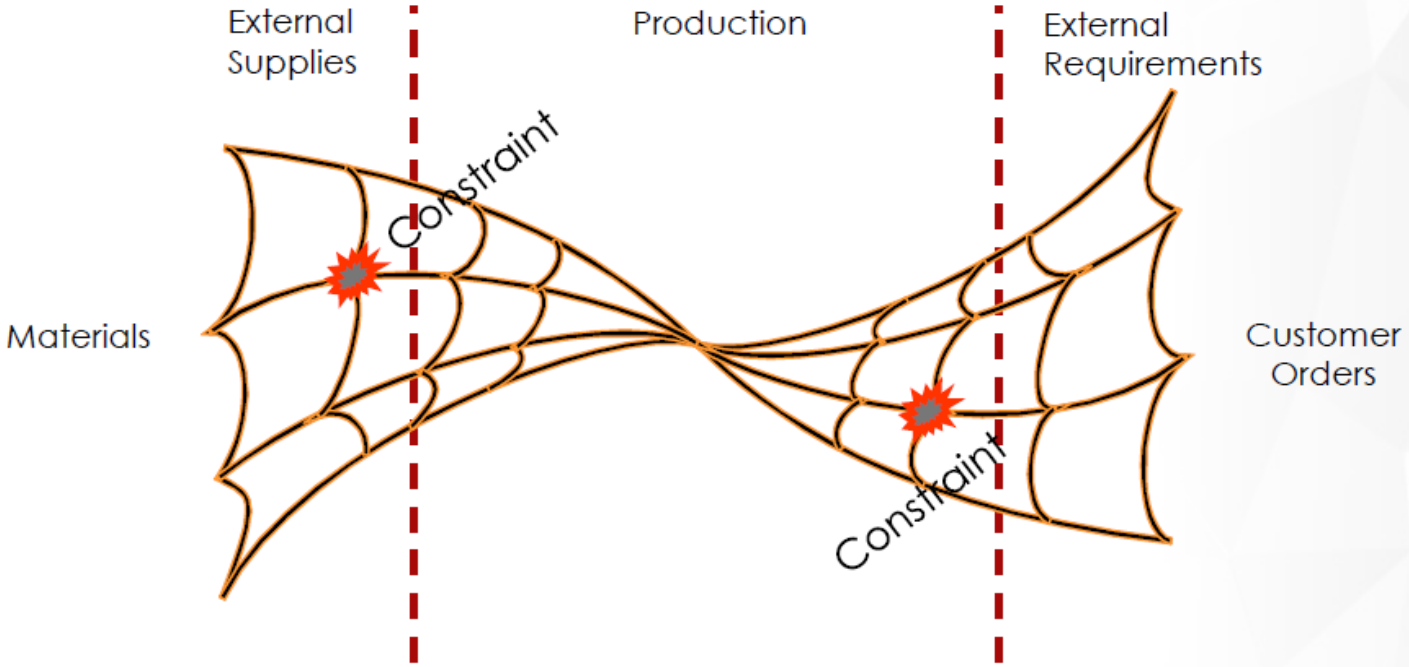
MRP plan – Plan with infinite capacity



Finite Load Profile



Balancing several constraints



Scheduling Techniques

- Forward Scheduling:
  - Start when the order is received and resources are avialable.
  - May finish early
  - Used to determine the earliest completion/delivery date
  - Determine promise dates
  - Builds inventory
- Backward Scheduling:
  - Uses MRP logic.
  - Schedule last operation to be completed on the due date.
  - Schedule previous operations back from the last operation.
  - Reduces inventory.
- Determine optimal schedule: APS

Production sequence of orders needed.

No sense in waiting for latest possible start if the resources are available.
All variations in use of bottleneck resources will delay delivery

Difficult model to understand

Advanced Planning and Scheduling

Unlike ERP Systems,
APS calculate Material
& capacity requirements
simultaneously to avoid multiple
recalculations to obtain a
feasible plan
both materials- and capacity
wise.