

# Unit -2

## Mixed Models, Sequencing, and Unplaced Lines

### 1. Introduction

In modern manufacturing, assembly lines often face the challenge of producing a variety of products (mixed models) with varying degrees of complexity. This necessitates careful planning and optimization to ensure efficient production flow, minimize bottlenecks, and maximize overall productivity. This section delves into the critical aspects of mixed model sequencing, the concept of unplaced lines, and their profound impact on manufacturing efficiency.

### 2. Mixed Model Sequencing: The Challenge

- **Defining Mixed Model Production:** Mixed model production involves assembling a variety of products with different features, options, and levels of complexity on the same assembly line. This introduces significant challenges compared to producing a single, standardized product.
- **Work Content Variability:** The primary challenge arises from the varying work content associated with different product models. Some models may require additional components, specialized operations, or longer processing times at specific workstations.
- **Workstation Load Fluctuations:** This variability in work content leads to fluctuating workloads at different workstations. Some stations may become overloaded, while others may experience significant idle time, leading to production inefficiencies.
- **Maintaining Smooth Flow:** The key objective of mixed model sequencing is to determine the optimal order of production for different models to minimize these fluctuations and maintain a smooth, consistent flow throughout the assembly line.

### 3. Sequencing Techniques

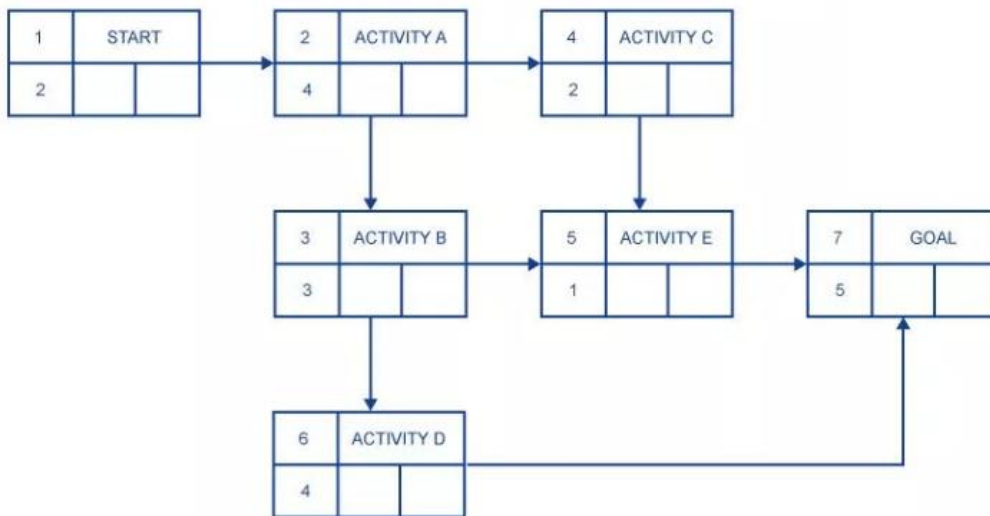
- **Level Scheduling:** Aims to produce a consistent mix of models over a given period, smoothing out the demand fluctuations and minimizing the impact of work content variations.
- **Mixed Model Line Balancing:** Involves optimizing task assignments to workstations, considering the varying work content of different models. This often requires flexible work assignments and potentially rebalancing the line as production needs evolve.
- **Buffering:** Strategic placement of buffers between workstations can help absorb minor fluctuations in production rates and prevent bottlenecks from cascading through the line.
- **Advanced Sequencing Algorithms:** More sophisticated techniques, such as genetic algorithms, simulated annealing, and constraint programming, can be employed to optimize complex mixed model sequencing problems, considering factors like due dates, inventory levels, and resource constraints.

#### 4. Unplaced Lines: A Flexible Approach

- **Concept of Unplaced Lines:** In an unplaced line, workstations are not rigidly fixed in a linear sequence. Instead, workstations can be reconfigured and moved as needed to accommodate different product mixes and production requirements.
- **Benefits of Unplaced Lines:**
  - **Flexibility:** Enables rapid adaptation to changes in product demand, production schedules, and process improvements.
  - **Reduced Bottlenecks:** Allows for dynamic adjustments to workstation locations to alleviate bottlenecks and improve overall line flow.
  - **Improved Utilization:** Enables better utilization of resources by allowing workstations to be reconfigured to match the current production needs.
- **Challenges of Unplaced Lines:**
  - **Increased Complexity:** Requires careful planning, coordination, and potentially more sophisticated control systems.
  - **Higher Investment:** May require more flexible infrastructure and potentially higher initial investment costs.

#### 5. Visualizing Mixed Model Sequencing

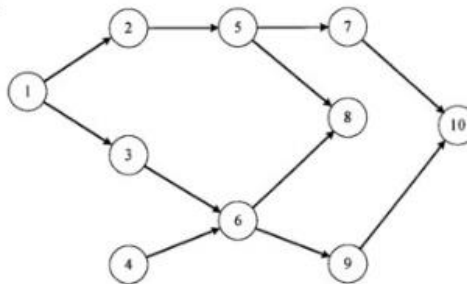
- **Precedence Diagram for a Simple Product:**



- simple precedence diagram for a single product

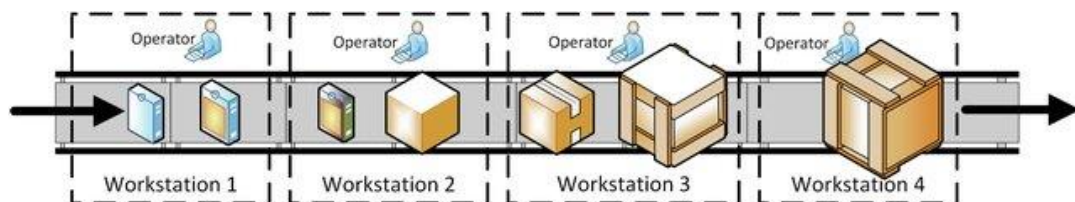
- **Precedence Diagram for a Mixed Model Product Family:**

Equipment	$E_1$	$E_2$	$E_3$
$EC_j$ (\$)	100 000	100 000	60 000
Task 1	8	6	
Task 2	13		14
Task 3	49	40	
Task 4	15		17
Task 5	18	14	
Task 6	15	12	20
Task 7	10	8	
Task 8	10	8	13
Task 9	33		38
Task 10	25	20	28

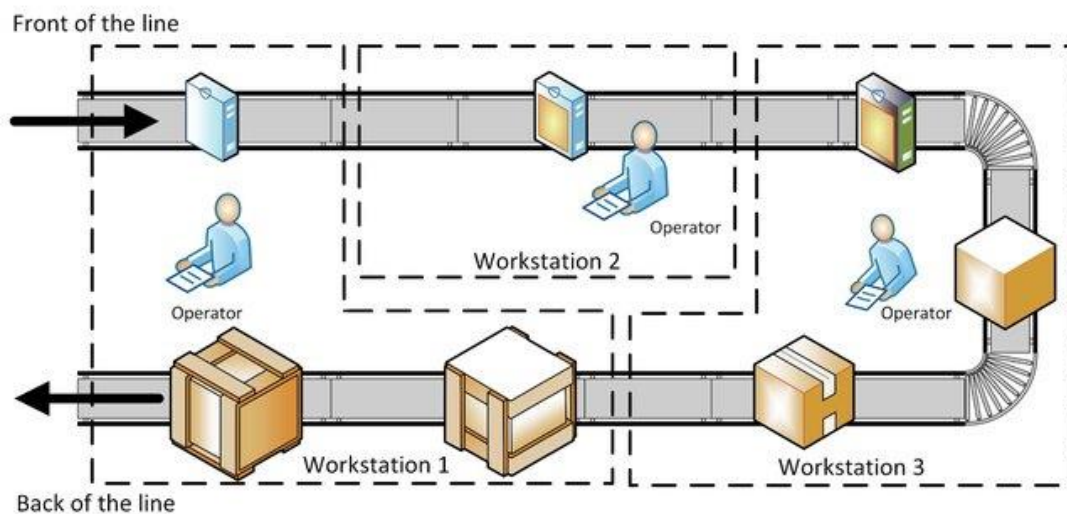


- precedence diagram showing variations in tasks for different product models within a family

- **Line Balancing for a Mixed Model Line:**



(a) Straight assembly line



(b) U-shaped assembly line

assembly line diagram showing task assignments to workstations for different product models

- **Unplaced Line Concept:**



flexible assembly line with movable workstations

## **6. Conclusion**

Mixed model sequencing presents significant challenges but also offers opportunities for increased flexibility, efficiency, and responsiveness in modern manufacturing environments. By carefully considering sequencing strategies, implementing flexible line designs, and leveraging advanced technologies, manufacturers can effectively address the complexities of mixed model production and achieve competitive advantages.