Integrated Scheduling
Material Requirements Planning
Lean Process

SELP–695  System Engineering Integrative  Project
Alex Herrera
February  20 2012
AGENDA

- Project Plan (Schedule)
- Interview Process
- SE Engineering Process
- Enterprise
  - Goals, Process, Perspective
- Material Requirements Planning – (MRP)
- Master Schedule – Integrated Master Schedule (IMS)
- Lean Enterprise Process
- Understanding the different systems
  - Dissecting each system
- Conclusions
- Recommendations
- Questions
# Project Schedule

<table>
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<th>Task Name</th>
<th>Dur</th>
<th>Start</th>
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Interview Process

- **Lean Process**
  - Randall Schwalbe

- **Material Requirements Planning**
  - Marcia Pasquarella

- **Integrated Scheduling**
  - Alex Herrera

- **Questions**
  - What problems exist in your areas of discipline?
  - How do these problems impact your areas?
  - What recommendations can I bring up to improve current process between departments and systems?
SE Process

Customize an Industry Standard to Create the Company's Standard SE Process

Tailor the Company's Standard Process for an Individual Program

Use Continuous Improvement Methodologies to Update Processes (e.g., Six Sigma)
System Engineering Process

Process Input
- Customer Needs/Objectives/Requirements
  - Missions, Measures of Effectiveness,
  - Environments, Constraints
- Technology Base
- Output Requirements from Prior Development Effort
- Program Decision Requirements
- Requirements from Specs and Stds

Requirements Analysis
- Analyze Missions and Environments
- Identify Functional Requirements
- Define/Refine Performance and Design Constraint Requirements

System Analysis & Control
- Trade-Off Studies
- Effectiveness Analyses
- Risk Management
- Configuration Mgt
- Interface Management
- Data Management
- Performance Measurement
- SEMS
- TPM
- Technical Review

Functional Analysis/Allocation
- Decompose to Lower-Level Functions
- Allocate Performance and Other Limiting Requirements to All Functional Levels
- Define/Refine Functional Interfaces (Internal/External)
- Define/Refine/Integrate Functional Architecture

Synthesis
- Transform Architectures (Functional to Physical)
- Define Alternative System Concepts, Configuration Items and System Elements
- Select Preferred Product and Process Solutions
- Define/Refine Physical Interfaces (Internal/External) Verify

Design Loop

Verify

Related Terms
- Customer = Organizations responsible for Primary Functions
- Primary Functions = Development, Production/Construction, Verification,
  Deployment, Operations, Support, Training, Disposal
- Systems Elements = Hardware, Software, Personnel, Facilities,
  Data, Material, Services, Techniques

Process Output
- Development Level Dependent
  - Decision Database
  - System/Config Item Architecture
  - Specifications and Baselines

Military Standard 499B
Enterprise Goals

- Long Range Resource Requirements
  - How many satellites are we planning to build over the next 5–10 years?
    - What product line type?
    - Who will be our customers?
    - Can we handle the capacity of throughput in the factory?
    - Do we have enough people resources to get the job commitments met both in cost and schedule?
Enterprise Process

Processes and Procedures

- **Plan**
  - Develop and Manage 7 Baselines
  - Requirements
  - Technical Configuration
  - Technical Performance Measures
  - Organization
  - Information Systems
  - Schedule
  - Cost

- **Correct & Improve**
  - Conduct After Action Reviews
  - Manage Risk, Issues & Opportunity
  - Ask for help
  - Perform Change Management

- **Do the work**
  - Working together with our suppliers, we
    - Specify
    - Design
    - Build
    - Test
    - Integrate &
    - Deliver
    - to
    - Meet the Baselines
    - by
    - Following Program Operating Plans

- **Measure**
  - Quality
  - Technical Performance
  - Earned Value (Cost & Schedule)
  - Conduct Reviews

Company Resources and Infrastructure
MRP Concept

Inputs

- Demand
  - What must we have
  - When do we need it

- Product Structure
  - What's it made of

- Supply
  - What we have
  - What's on order

Process

Outputs

- Manufacturing Plan
- Detail schedule Requirements
- Recommended Actions
- Release order
- Move in order due date
- Reduce quantity
Material Requirements Planning – MRP

- Time Phased Planning of demand
- The Master Production Schedule (MPS) sets the Independent Demand for MRP
  - It is the basic plan of how many items will be produced and when
  - It is a set of planning numbers, the quantities and completion dates, that drive MRP and keep priorities valid
- Independent demand is an item that does not have a parent in MRP
  - For ex. Car needs 4 tires – Dependent Demand
  - Car needs 1 spare – Independent Demand
- The Master Production Scheduler reviews the Satellite Bill of Material (BOM) in Product Data Management (PDM) and loads the released Level 1 part numbers, quantities, project, due dates or milestone dates in IMS
- Level 1 part numbers are linked to the program milestone completion/forecast dates in IMS which are the item due dates in MRP
- Dependent demand has a parent in MRP
  - Ultimately driven by Master Schedule milestone
- MRP focus is work with supply chain management focus and order parts on Purchase Requisitions (PR’s) and Purchase Orders (PO’s)
**MRP Concepts**

- Example of Offsetting/Setbacks

- Each part number at each level of indenture carries a Total Lead Time (Lead Time 1 + 2 + 3 = Total Lead Time)

- The cumulative set back of any indenture is what dictates Start Dates and Due Dates for each part number
MRP to IMS Interface

- The Integrated Master Schedule (IMS), as it interfaces with MRP, has 3 segments:
  - 1st segment – Frozen
  - 2nd segment – Slushy
  - 3rd segment – Liquid
- At the liquid level items or orders can change with minimal to no impact to business
- At the Slushy level the BOM is firmed up, and long lead (LL) parts already ordered. Job is also Master Scheduled
- At the frozen level, changes to items already place through Supply Chain Management (SCM) are both costly in delivery time and dollars
Integrated Master Schedule – IMS

Schedule Hierarchy

- Program Master Schedule (Tier 1)
  - Major milestones (IMP Program Events)
  - Program manager's and customer direction/control

- Program Element Schedules (Tier 2)
  - Summary overview of major program elements
  - Selected IMP Significant Accomplishments
  - Customer and associate contractor interface milestones
  - Program managers direction

- IPT Team Schedules (Tier 3)
  - IPT integrated end-to-end product baseline
  - Selected IMP Accomplishments Criteria
  - Key interface milestones including Teammates
  - Selected contract data requirements
  - IPT leaders direction

- Cost Account Managers Schedules
  - Single IPT/Sub IPT performance
  - Detail measurable tasks
  - Basis for status and earned value mgmt
  - Control account mg's direction/control

- Earned Value Schedules (Tier 4)
  - Basic Schedule Commitment Record
  - Selected SDRL Deliveries
  - Hardware/Software Deliveries
  - Team to Team Handoffs

- Detailed Commitment Schedules

- Lower Level Schedules (Tier 5)
Master Schedule – MS Project

- A well networked Master Schedule is the basic plan illustrating how many parts are needed and when
  - Schedule lead-times will be determined from the schedule through a backward pass approach
- A Rough-Cut Capacity Plan is developed looking at resource constraints such as chamber availability or people shortage
- It is a set of planning numbers, quantities and completion dates for selected items that drives MRP and sets schedule priorities
- Parts must be correctly identified by number, aligned to the work breakdown structure (WBS), for MRP to plan accurate requirements
Master Schedule Process

- All Risk items must be in the schedule & tracked to closure with risk mitigation burn down plan
- Steps to perform before setting the IMS Baseline
  - Must perform diagnostics on data base to see if heavy on health metrics parameters
  - Must perform Monte Carlo Simulation to determine likely hood of achieving target need date
  - Must tag risk items, typically critical path tasks (ranking: low, medium, high) in in the schedule and track to closure on Boris Risk mitigation tool.
  - Provides greater confidence level in achieving need date
  - Histogram or Bell Curve diagram are provide as illustrations
- After baseline locked, status Master Project Weekly
- This includes % complete, and actual start and finish dates for task items in schedule
- Provide earned value % increases in schedule project
- Reforecast dates, while managing items on the critical path (task with least amount of float)
- Provide analysis to identify potential resource conflicts in production builds
- Look for ways to reduce product cycle time in factory through schedule management
Lean Is

- A set of principles, concepts and techniques designed to optimize product & engineering flow and relentlessly eliminate waste in our processes

- Waste is any action, process, or product that adds cost without adding value or enabling value, as perceived by our customers
"The Roots of Lean"

The "Roots" of "Lean"

Henry Ford
(continuous flow)

Jams Womack
("Lean Thinking")

Taiichi Ohno
("just-in-time")

American supermarkets
("pull")

Sakichi Toyoda
(mistake proof)

W. Edwards Deming
(Quality - the foundation for "Lean")

Eli Whitney
(mass production, interchangeable parts)
Six Lean Principles

1. Specify value: Value is defined by customer in terms of specific products

2. Identify the value stream: Map out all end-to-end linked actions, processes and functions necessary for transforming raw materials into products, after eliminating waste

3. Make value flow continuously: Make the remaining linked value-creating steps "flow" per common takt time

4. Let customers pull value: Customer’s “pull” cascades all the way back to the lowest level supplier, enabling the super-efficient just-in-time production

5. Pursue perfection: Pursue continuous enabling just-in-time production. Pursue continuous process of improvement striving for perfection

6. Respect People

LAI Lean Academy™

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Enterprise Lean

- Programs
  - Drive the business & the factory
  - Programs create the demand for resources, yet struggle for resources with other programs

- Enterprise
  - Needs to get away from vertical matrix and apply horizontal matrix
  - Eliminate stove pipe in matrix organization
    - Do not work in silo’s

MRP plans the detailed schedule for the factory
Lean Factory....

- Exactly what is needed
- Exactly when it is needed
- In the exact quantity needed
- In the correct order or sequence
- Without any defects (1\textsuperscript{st} time quality)
- At the lowest possible cost
- Applying 5S’s
**Lean Office**

**Was**
- Unique workstation designs, based on...
- Unnecessary items that employees had to work around...other, required items not in work area (excessive travel to acquire these as needed)
- Unable to determine if work stations had what was required to complete a task (no visual controls)

**Is**
- Standardized work layout to support common product flow
- Ergonomic design
- Work-station layout in work order sequence

**Lean Principle: Standardized Work Areas**
Supplier Business Ethics

- Ethics & Business Conduct programs are in place to foster a culture where only legal, proper, and ethical behavior take place.
- Employees & business unit members all participate in an annual Ethics training.
- Employees may not solicit gifts or courtesies from suppliers.
- Employees must keep all business & personal activities separate.
  - Having a personal & business involvement with a supplier may create a potential or actual “Conflict of Interest”.
- Employees shall comply with the Anti-Kickback Act and report any suspected kickbacks.
Rational for Recommendations

- Results of Interviews
  - All areas short staffed
  - Limited backups; people mostly “single point of failures”
- Communication is limited between groups
  - Employees need to interface more, communication is limited between departments and employees
- Training/Mentoring
  - Need more training to bring awareness between departments on how to improve productivity and efficiency
  - Mentoring new or younger generation people
Questions