# Excellence in Product Development

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# Introduction

- Product Development Excellence:
  - Integration of quality into product planning and design
  - Maximum return for cost and customer satisfaction

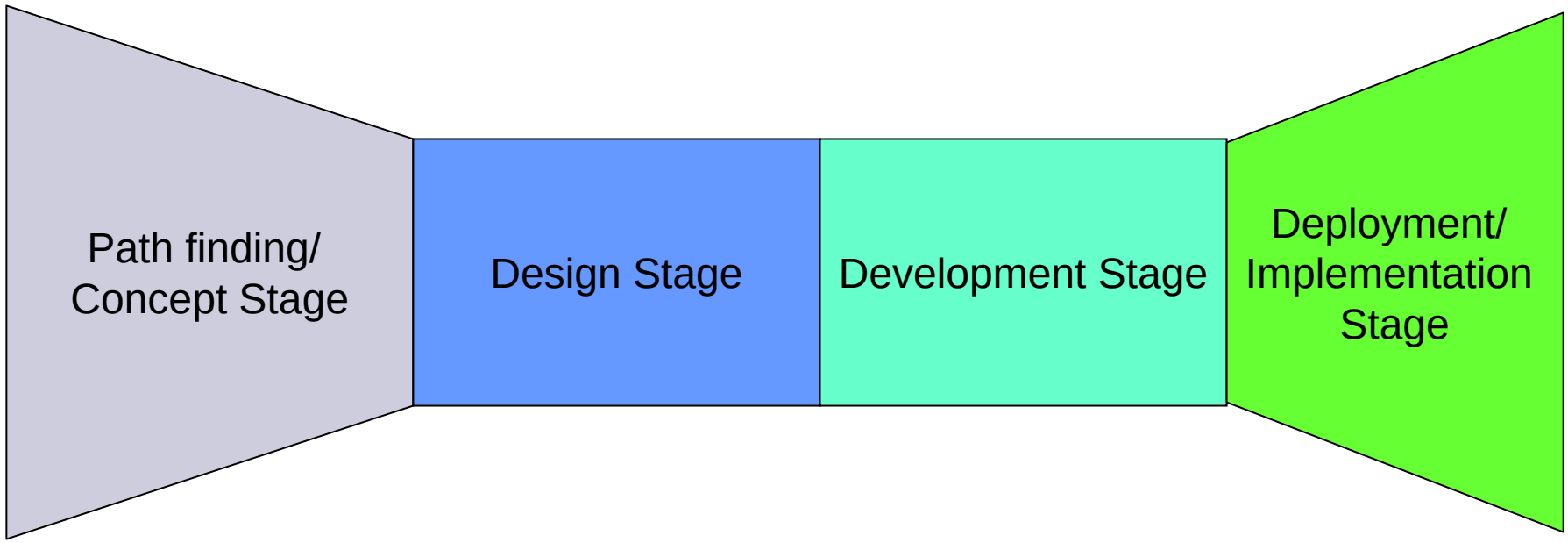
- This presentation is an overview of the product development stages.
- It focuses on the key deliverables and appropriate quality tools for each product development stage.

# Agenda

- Product Development Lifecycle
  - Path Finding/ Concept Stage
  - Design Stage
  - Development Stage
  - Deployment Stage
- Summary

# Product Development Lifecycle

- General Product Development Lifecycle



# Excellence in the Path Finding/ Concept Stage

- Objective: Establish the plans that will define the project activities.
- The Path Finding/ Concept Stage may consist of
  - Market opportunity & assessments
  - Competitive assessments
  - Supplier assessments (capability analysis)
  - Definition of cost targets, cost modeling, & ROI
  - Concept designs, specifications, modeling, & builds
  - Initial manufacturability analysis
  - Initial reliability analysis

# Excellence in the Path Finding/ Concept Stage

- Critical Steps:
  - Obtain and document requirements & expectations up front from all key stakeholders
  - Obtain a Management Sponsor for Project
  - Form a cross functional team. *Ensure commitment from matrixed team members.*
    - Sales
    - Marketing
    - Finance
    - Engineering
    - Operations/Manufacturing
    - Supply Chain
    - Quality
    - Reliability
    - EH&S

# Excellence in the Path Finding/ Concept Stage

- Critical Steps (continued):
  - Establish & follow a disciplined process approach
  - Define initial success criteria for each stage
  - Documentation must be completed, stored in an accessible location & may include:
    - Team charter with tangible deliverables and roles & responsibilities
    - Final Product requirements document
    - Project plan & critical milestones
      - Software
      - Hardware
      - Manufacturing
      - Quality
      - Reliability
      - Regulatory Requirements
      - EH&S Requirements
      - Verification & Validation initial plans

# Excellence in the Path Finding/ Concept Stage

- Quality Tools:
  - Design for Cost Model - Require initial design for cost model to be developed & completed at the beginning of each project.
    - Reference market competition, etc.
    - Define Cost Target
    - ASP & Projected ASP (Cost erosion over time (if price is dropping, does model include this to ensure that gross margin remains competitive))
  - Function Cost Analysis - Evaluate when designing a product for a specific customer or market.
  - Design for Manufacturability/ Test, etc Standards
  - FMEAs:
    - Process Failure Modes & Effects Analysis – Focus on how a process can fail and affect the product, process efficiency, or safety.
    - Design Failure Modes & Effects Analysis – Focus on how the product can fail and the impact of the failure.
    - Input should be based on review of historical like product performance, quality, and reliability data.
      - Process capability & yield review
      - Field performance in terms of failure rate (include in cost model)

# Excellence in the Design Stage

- Objective: Develop a product which meets customer requirements, qualify supply base, & develop manufacturing capability.
- The Design Stage may consist of
  - Supplier selection & qualification
  - Definition of critical to function / critical to quality parameters
  - Process Flow Charts
  - Statistical Process Control plans
  - Designed Experiments
  - Inspection & test criteria
  - Verification Procedures (including Hardware & Software)
  - Reliability Testing

# Excellence in the Design Stage

- Critical Steps:
  - Update actual costs vs. cost targets.  Compare with should cost.
  - Verification DOE & Reliability Testing.
  - Initial manufacturing yield analysis (internal & external)
  - Update of success criteria (yield targets vs. actual)
  - Key learning investigation & implementation for future projects
  - Documentation to be completed, stored in an accessible location & may include:
    - Supplier qualification plan & results
    - Test specification
    - Drawings
    - Process flow diagrams
    - DOE Plans and results, including reliability
    - Hardware & Software, verification, and results
    - Updated DFMEA and PFMEA
    - EH&S documentation
    - Specifications (individual materials/components and assembly)

# Excellence in the Design Stage

- Quality Tools & Activities:
  - Continuous Improvement Activities
    - Update DFMEA/PFMEA
    - Process capability improvement
    - Supplier capability improvement
  - Design for Manufacturability/ Test, etc Standards
  - Statistical Design of Experiments
  - Mistake Proofing Initiation
  - Value Stream Mapping

# Excellence in the Development Stage

- Objective: Deliver a qualified product and process which meets customer requirements.
- The Development Stage may consist of
  - Delivery of product user manuals
  - Final Software Verification
  - Customer Validation
  - Final manufacturing qualification
  - Product Launch Plan Development
  - Final Quality Inspection and Control Plans
  - Definition of Return Materials Authorization Process

# Excellence in the Development Stage

- Critical Steps:
  - Validation
    - Design validation testing Execution, Stage 2
    - Reliability Execution, Stage 2
  - Standardization
    - All specifications completed & approved.
  - Finalization of success criteria
  - Deployment plan completed, including yield targets established.
  - Final Actual cost vs. Target Cost/ Cost Model Evaluation
    - Update cost model, as required.
  - Cost Roadmap (maintain continuous cost reduction on product)

# Excellence in the Development Stage

- Critical Steps (continued):
  - Key learning investigation and implementation for future projects
  - Documentation to be completed & stored in an accessible location may include:
    - Supplier qualification plan & results
    - Test specification
    - Drawings
    - Process flow diagrams
    - DOE Plans and results, including reliability
    - Hardware & Software, verification, and results
    - Updated DFMEA and PFMEA
    - EH&S documentation
    - Specifications (individual materials/components and assembly)
    - Customer feedback

# Excellence in the Development Stage

- Quality Tools & Activities: Similar to Design
  - Continuous Improvement Activities
    - Update DFMEA/PFMEA
    - Process capability improvement
    - Supplier capability improvement
  - Gauge Repeatability & Reproducibility (Gauge R&R)
  - Statistical Sample Size Determination & Design of Experiments
  - Process Capability Analysis
  - Mistake Proofing Completion/ Continuous improvement

# Excellence in the Deployment Stage

- Objective: Full transfer of ownership for product manufacturing from the design engineering team to the operations team.
- The Deployment Stage may consist of
  - Training
  - Service Level Agreements
  - Joint engineering/operations ownership
  - Formal change control implementation
  - Long term reliability testing
  - Final audits

# Excellence in the Deployment Stage

- Critical Steps:
  - Volume Cost Curve analysis/ validation of cost model
  - Continuous improvement
  - Key learning investigation and implementation for future projects (repeat once project is completed, as well)
  - Final update of Design for Manufacturability standard.
- Documentation to be completed & stored in an accessible location may include:
  - Final Qualification reports
  - Training materials
  - Surveillance plans & initial results
  - Production Process Review
  - Final customer approvals
  - Summary of key lessons learned.

# Excellence in the Deployment Stage

- Quality Tools & Activities:
  - Statistical process control fully implemented
  - Process Capability Studies
  - Acceptance Sampling (AQL)

# Summary

- Excellence in Product Development is achieved through:
  - Disciplined, process approach to development
  - Clearly defined and documented deliverables and success criteria
  - Integration of cross functional team members during the entire development process
  - Supplier collaboration and qualification at least one stage ahead of the project Deployment
  - Effective implementation of quality tools and statistical methods