An Introduction to Early Equipment Management

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Budapest
V1.0

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Who are DAK?

- We help companies to deliver year in year improvement in performance through a blend of consultancy advice, training and practical hands on support. (Contributors to 3 TPM books published by Butterworth Heinemann)

- DAK has helped many well known and award winning organisations to accelerate the pace of improvement.

- DAK Academy training courses and Continuous Improvement Network provide additional support to develop improvement leader at capabilities at all levels.
Learning Goals

- Raise awareness of Early Equipment Management (EEM) and how to incorporate this into best practice capital project delivery
- Explain how to identify weak components/mechanisms, assess potential vendors and work with them to lower total asset life cycle costs;
- Help participants to
  - Capture knowledge and codify into a form which supports equipment design and procurement decisions
  - Compare and select vendors who can deliver equipment with added value
  - Apply value engineering principles to each design step to reduce life cycle costs and enhance capital project return on investment.
Agenda

**Introduction**
- Learning goals
- Capital project deliver, what goes wrong and why?

**Specification Delivery**
- How to capture and apply the current shop floor knowledge to design a better equipment specification
- Using models, sketches and simple simulation processes to explore ideas, refine options and reduce operational life cycle cost
- Steps to deliver flawless operation from day 1

**Design Effectiveness**
- Identifying weak components and setting improvement targets
- Developing equipment design standards
- Assessing design options
- Maintenance Prevention
- Defect Prevention/Enhancing project value

**Project Governance**
- Avoiding common pitfalls that are the root causes of late and costly capital projects
- Selecting and working with equipment vendors
- Capturing lessons learnt and cross project learning

**Action Planning**
- Assessing current capital project management processes
- Implementing improved project delivery processes
- 100 day action plan

**Review of the workshop**
Early Equipment Management: Toyoda Case Study

The Main Causes of Capital Project Problems are not Technical

- Specification not complete enough to guide option selection
- Not involving/releasing the right people at the right time
- Incomplete design guidance
- Vendor disputes/specification errors
- Unforeseen, reliability/safety issues
- Difficult to operate/maintain
- No time to optimise plant
- Knowledge not transferred from project to operations

Traditional Approach

Section Header
EEM Case Study Extracts

- **BNFL** 30% reduction in minor stops, 30% increase in MTBI
- **JM** Delivered step our project in 25% less time, double product value, increased ROI by over 300%.
- **RHM** £500k investment avoidance
- **Rolls Royce** Capital avoidance of £17m by resolving 9 design weaknesses and increasing capacity of bottleneck process by 25%.
- **3M** increased capacity of new product line by 25% and improved material yield to reduce LCC by 10%
- **BP** delivered flawless operation from day 1 for deep sea oil platform increasing revenue from deep sea oil platform sufficient to repay capital cost in the first year of operation. Vessel was able to maintain operation in weather conditions where other vessels had to shut down production.
Benefits of Using EEM

- Development of in house capability to deliver:
  - Flawless operation from day 1, low operational life cycle costs and increased return on investment

- EEM captures and unlocks tacit knowledge to support
  - Cross project learning
  - Clarity of investment priorities
  - Project ownership
  - Innovation

- EEM is an improvement process for projects to
  - Speed up project delivery;
  - Improve collaboration across functional/company boundaries;
  - Improve design, specification and project management systems and processes.
# Understanding Equipment Weaknesses

<table>
<thead>
<tr>
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<th>Common Perception</th>
<th>Reality</th>
<th>Benefit</th>
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Focus on Equipment Engineering and How it is Used
Paint Line Process Steps
## Top Level Criticality

### Case Study: Paint Line

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<tr>
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<th>S</th>
<th>A</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>M</th>
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<th>EM Target Assessment</th>
<th>Rating against Benchmark</th>
<th>Overall assessment</th>
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<td>OK</td>
<td>Weak</td>
<td>64% 60% 59% 53% 56% 54%</td>
<td>59% OK</td>
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</table>
Spray Filter Box Schematic

- **Spray Head path**
- **Extraction flow under conveyor**
- **Filter Box**
- **Filter**
- **Conveyor Flow**
## Case Study: Spray Box

### Current

<table>
<thead>
<tr>
<th></th>
<th>Safety Risk (SRM)</th>
<th>Reliability (APR)</th>
<th>Operability (PQR)</th>
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<td>Filter x 2 Fine</td>
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### EM Target Assessment

- Weak 55% 57% 38% 48% 33% 55%
- Poor 50% OK

### Overall assessment

- Weak 55% 57% 38% 48% 33% 55%
- Poor 50% OK
## Setting Condition Standards

<table>
<thead>
<tr>
<th>Rate</th>
<th>Condition</th>
<th>Possible Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Poor</td>
<td>Well below standard, unsafe difficult to operate, high scrap rate unreliable, does not hold tolerance</td>
<td>Scrap or restore and improve safety clean up, begin planned maintenance</td>
</tr>
<tr>
<td>2. Fair</td>
<td>Barely acceptable, below standard, not easy to operate, limited capability, unpredictable scrap rates</td>
<td>Restore, improve safety, clean up, improve planned maintenance to stabilise accelerated deterioration</td>
</tr>
<tr>
<td>3. Acceptable</td>
<td>Meets requirements, not too many problems, average scrap rates, needs regular intervention</td>
<td>Improve asset care to stabilise wear rates/component life and contain sources of contamination.</td>
</tr>
<tr>
<td>4. Good</td>
<td>Reliable, no recurring problems, zero breakdowns achieved, optimum conditions identified, reducing level of intervention needed</td>
<td>Reduce contamination towards zero, reduce necessary adjustments/ intervention. Strive for optimum conditions and early problem detection</td>
</tr>
<tr>
<td>5. Excellent</td>
<td>No touch production achieved, no scrap, zero breakdowns, increasing to better than new performance</td>
<td>Reduce variability of process, tooling and procedures. Improve visibility of minor defects due to normal deterioration</td>
</tr>
</tbody>
</table>
SPRAY BOX

- Existing design is hard to clean.
• Damage to the filter housing allows for unwanted airleaks, bypassing the filters causing dust buildup in the air ducts and insufficient extraction of laquer dust
  • Is this normal or accelerated wear?
Current condition of the extract filtration allows for, bypassing the filters causing dust buildup in the air ducts and insufficient extraction of laquer dust.
Collating Operational Knowledge

EEM data provides an insight into the operational reality to highlight weak components and opportunities for improvement. Not all of the tools below are required for every project.

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
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<tr>
<td>Criticality assessment</td>
<td>Designed to identify weak components and provide a measure of design effectiveness</td>
</tr>
<tr>
<td>Condition appraisal</td>
<td>Designed to assess if basic conditions are in place, identify sources of accelerated deterioration and actions needed to achieve flawless operation from day one for assets which are not being replaced but which can impact on the</td>
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<tr>
<td>Day in the life of</td>
<td>Designed to tease out tacit knowledge about operational conditions and constraints as a trigger for setting standards, defining areas of risk, priorities and checklist points</td>
</tr>
<tr>
<td>OEE and Life Cycle Cost</td>
<td>Where are the main contributors to capital cost, operational cost and OEE hidden losses.</td>
</tr>
<tr>
<td>Analysis</td>
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Capital Project Delivery

Logical but False Sequential Project Models

Iterative Project Reality

Focus on Processes and Potential to add value at each step

Focus on tools and techniques

Increasing granularity of decision making by step

Get the right Design

Define Scope

Get the design right

Design Installation

Implement the Right Design

Refine Operation

Optimise Design Performance

Improve Capability

Beneficial use

Install

Procure

Develop Design

Identify need
Common Project Management Failings

- Planning tasks take too long/are incomplete
  - Patchy knowledge of project methodology
  - Confusion over roles and responsibilities,
  - Authority levels are unclear
  - Poor discipline/inconsistent project management practices

- Collaboration is limited
  - Project team dispersed in multiple locations
  - Ad hoc networking but no formal process in place
  - Sharing knowledge is on a one to one, ad hoc basis
  - Decisions are made in isolation are poorly communicated and of poor quality

- Knowledge is hard to find
  - Documentation management systems inadequate or duplicated,
  - Access restricted even to those on the project
  - Cabinets full of unused out of date documents,

- Limited learning from experience
  - Lessons are not passed on from site team to project team
  - Resources are not allocated to the task of capturing lessons learned
  - Designers don’t use experience from past projects
  - Mistakes are repeated
  - Blame culture encourages hiding of mistakes
Get the right Design
Get the design right
Optimise Design Performance

Increasing granularity of decision making by step

Define
Design
Refine
Improve

Concept
High Level Design
Detailed Design
Prefab Construction
Install
Commission Test
Stabilise
Optimise

Social Nature of Capital Projects

Logical but False
Sequential Project Models Don’t Reflect Reality
Without Informed Iterative Learning, the Quality of the Solution Depends on Luck
Measuring Design Effectiveness

1. Intrinsically Safe/Environmental robust
   - Prevent Human Error
2. Intrinsic Reliability
   - Minimum intervention
   - Tolerant of material variation
3. High Operability
   - Control Contamination/Scattering of Dirt and Dust
   - Minimise Accumulation Errors
   - Ease of start up steady state and close down
4. High Maintainability
   - Stabilise and extend component life
   - Simplified Asset Care
   - Visual inspection
   - Define and establish optimum conditions
5. Customer Value
   - Meets current and likely future customer product and service features
6. Low life cycle costs
   - Minimise total of capital and operating costs

Assess each design goal on a 1 to 5 scale:
- 1 = Little or no capability
- 2 = Limited or weak
- 3 = Acceptable
- 4 = Easy to do right
- 5 = Refined/difficult to do wrong
## EEM Design Goals

<table>
<thead>
<tr>
<th></th>
<th>Definition</th>
<th>3. Acceptable</th>
<th>5. Optimum</th>
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<tbody>
<tr>
<td><strong>Safety and Environmental</strong></td>
<td>Function is intrinsically safe, low risk, fail safe operation able to easily meet future statutory and environmental limits</td>
<td>Little non standard work Moving parts guarded, few projections Meets SHE and fire regulations Easy escape routes and good ergonomics</td>
<td>Foolproof/failsafe operation High level of resource recycling Uses sustainable resources</td>
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<tr>
<td><strong>Reliability</strong></td>
<td>Function is immune to deterioration requiring little no intervention to secure consistent quality</td>
<td>Low failure rate Low idling and minor stops Low complexity/quality defect potential Flexible to technology risks Good static and dynamic precision</td>
<td>High MTBI Stable machine cycle time Easy to measure Flexible to material variability</td>
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<tr>
<td><strong>Operability</strong></td>
<td>Process is easy to start up, change over and sustain “normal conditions”. Rapid close down, cleaning and routine asset care task completion.</td>
<td>Simple set up and adjustment mechanisms Quick replace tools Simple process control Auto load and feeder to fed processing</td>
<td>One touch operation for height, position, number colour etc Flexible to volume risk Flexible to labour skill levels</td>
</tr>
<tr>
<td><strong>Maintainability</strong></td>
<td>Deterioration is easily measured and corrected, Routine maintenance tasks are easy to perform and carried out by internal personnel.</td>
<td>Easy failure detection/repair Off the shelf/common spares used Long MTBF, Short MTTR Easy to inspect and repair</td>
<td>Easily overhauled Self correcting/auto adjust Inbuilt problem diagnostic Predictable component life Fit and forget components</td>
</tr>
<tr>
<td><strong>Customer Value</strong></td>
<td>Process is able to meet current and likely future customer QCD features and demand variability. Provides a platform for incremental product improvement</td>
<td>Easy order cycle completion Maximum control of basic and performance product features Flexible to product range needs</td>
<td>Capacity for future demand Robust supply chain Simple logistics/forecasting needs Flexible to potential market shifts Access to high added value markets</td>
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<tr>
<td><strong>Life Cycle Cost</strong></td>
<td>Process has clearly defined cost and value drivers to support Life Cycle Cost reduction, enhance project value and maximise return on capital invested</td>
<td>Clarity of current capital and operational cost drivers and process added value features Potential for value engineering gain Resource economy</td>
<td>High level of resource recycling Flexible to financial risks (e.g. vendor) Easily scalable to 400% or to 25%</td>
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Spray Box Cleaning

- Cleaning requires around 4 hours per day to maintain quality of operation with a further in-depth clean per week of 4 hours.
- Filters in the extraction get clogged and have to be changed every week.
  - In total, worth around 25% of current available time.
- Cleaning the build-up of dried paint overspray involves the use of a hammer and chisel, which causes damage to the filter box (accelerated wear).
- The filter box no longer fits correctly.
- The gap allows paint spray directly into the extraction system so the extraction system becomes less and less effective.
- How would you incorporate this insight into the specification for a new line using the EEM design goals?
Understanding Design Complexity

The source of complexity is shown by this more detailed analysis. In addition if we deal with the condition issues, the current asset design effectiveness would be much improved.
Setting Project Roles and Accountabilities

Who Should be involved?

- Commercial
- Technical
- Operations

Customer and Financial Issues
Intrinsic Reliability and Safety
Operability and Maintainability Issues
Defining the EEM Organisation

EEM Project Organisation

EEM Core Team

Rest of Organisation

Consult, Inform, Engage

Commercial

Operations

Technical

Project Functional Support
Involvement fluctuates depending on project step needs

Remain with the project from Concept to Stable Operation

Stage Gate Review Team

Define

Funding

Design

Refine

Day 1

Improve

1. Concept

2. High Level Design

3. Detailed Design

4. Pre fab Construction

5. Install

6. Commission Test

7. Stabilise

8. Optimise
Set Incremental Quality Milestones

Steps 1 and 2 focus on getting the right design

Steps 3 and 4 focus on getting the design right

Steps 5 and 6 focus on delivering flawless operation

Steps 7 and 8 focus on delivering year on year performance improvement

<table>
<thead>
<tr>
<th>Define</th>
<th>Design</th>
<th>Refine</th>
<th>Improve</th>
</tr>
</thead>
</table>

Funding Day 1

Deciding what to do  Making it happen
Goals Evolve With Each Step

**Equipment**
- De-palletise
- Pasteuriser
- Filler
- Pack
- Palletiser
- Infeed conveyors
- Transfer
- Pasteurisation
- Discharge
- Services
- Pump/Pipework
- Belts/Drives
- Doors/Seals

**Process**
- De-palletise
- Pasteuriser
- Filler
- Pack
- Palletiser

**Function**
- Transfer
- Pasteurisation
- Discharge

**Component**
- Infeed conveyors
- Transfer
- Pasteurisation
- Discharge

**Working Method**
- Start up
- Steady State
- Close Down
- Pre start up checks
- Set up
- Material Supply
- Remove guarding
- Fit change parts
- Set/align
- Run/First off checks

**SOP**
- Task
- Working Method

**EEM Concept**
- (Define Expectations/Select Vendor)

**EEM High Level Design**
- (Evaluate Options)

**EEM Detailed Design**
- (Collaborate with Vendor)
Capture Knowledge as Standards and Checklists

**Concept**

- De-palletise
- Pasteuriser
- Filler
- Pack
- Palletiser

**HLD**

- De-palletise Pasteuriser Filler Pack
- Infeed conveyors
- Transfer
- Pasteurisation
- Discharge
- Pump/Pipework
- Belts/Drives
- Doors/Seals
- Op10.1 QA
- Op10.2 Changeover
- Op10.3 Handling
- Op10.4 Storage

**EEM Target Operability categories**

- Commercial
- LCC
- Maintainability
- Operability
- Reliability
- Safety

**Operability categories**

- Ops5 Data Collection
- Ops6 Hygiene Standards
- Ops7 Environmental Standards
- Ops8 Access for Operations
- Ops9 Manning / Resource
- Ops10 Materials Control
- Ops11 Building Environment

**High Level Design Questions**

- How can we design this out
- What outline ways of working could be relevant
- How will needs change as a result of this project
- Do we know what is critical and how to control it
- Have we taken into account lessons learned and best practices
- What outline prevention, inspection, servicing methods could apply
- Do we know what we need, can we reduce the list
- What outline operational/clean out activities could be relevant
- Do we know what is required, can we improve it
- Has a relevant risk assessment been carried out and actions identified
- Does the project increase risk levels, how can we simplify/improve control
- What standards apply
Use Checklists To Refine Ideas/Add Value

High Level Design Questions
- How can we design this out
- What outline ways of working could be relevant
- How will needs change as a result of this project
- Do we know what is critical and how to control it
- Have we taken into account lessons learned and best practices
- What outline prevention, inspection, servicing methods could apply
- Do we know what we need, can we reduce the list
- What outline operational/clean out activities could be relevant
- Do we know what is required, can we improve it
- Has a relevant risk assessment been carried out and actions identified
- Does the project increase risk levels, how can we simplify/improve control
- What standards apply

Installation Questions
- Will the asset be installed to make it easy to use and maintain
- Are working methods defined
- Has a suitable training and skill development regime been identified
- Have we plans to update our systems and procedures to account for this
- Has spares provision been made, are there plans to update CMMS before day one production
- Have production materials been sourced are there plans to update production management systems

Detailed Design Questions
- How to improve this to prevent potential problems
- Does the design make it easy to do right and difficult to do wrong, are skill gaps identified
- How to design in compliance to required standards
- How to assure compliance with best practice
- Does the design support maintenance prevention standards
- Are spares identified
- Does the design make it easy to do right and difficult to do wrong
- Are skill gaps identified

Commissioning Questions
- Do we know how we will manage this on day 1 operation
- Has competence been assured
- How can we achieve flawless operation
- Do we know how we will manage this on day 1 operation
- Have we taken all steps to Eliminate, Reduce, Isolate, and Control risks
Apply Lean Concepts

- **Flow (Auto Activation linking Islands of Activity)**
  - Visual workflow scheduling
    - see early finishes/delays at a glance
  - Simplified coordination/Pull Systems
    - In built system recovery/contingency planning;
    - Rapid feedback and response on quality issues;
    - Improved use and care of equipment/technology.

- **Flexibility to make only what is needed**
  - It has to be right first time
    - You need
      - the right mix of skills to make it happen;
      - Routine standardised practices that are easy to do right, difficult to do wrong;
      - Work place/work flow organisation.

- **Focussed improvement to reduce activities which do not add value (customers would not miss):**
  - Transport, Inventory, Movement, Waiting, Over processing, Over productions, Defects (TIM WOOD)
**Documentation Formats to Encourage Creativity**

- **Define**
  - Concept
  - High Level Design

- **Design**
  - Detailed Design
  - Pre fab Construction

- **Refine**
  - Install
  - Commission Test

- **Improve**
  - Stabilise
  - Optimise

- **Select vendor**
- Tease out weaknesses
- Enhance value
- Record Decisions

- **Coordinate resources**
- Develop new skills
- Achieve flawless operation

- **Refine new skills**
- Stabilise performance
- Achieve business benefits
- Strive for optimum conditions

- **Sketches**
- Layouts
- Milestone plans
- Scale Models
- Simple simulation
- Design standards
- Outline ways of working

- **Detailed Layouts**
- Larger Models
- More detailed drawings
- Checklists
- Testing/Analysis
- Quality plan
- Task lists
- Detailed ways of working
- Risk Assessment
- QA of Manufacture

- **Work plans**
- QA installation
- Best practice development
- Training plans
- Test reports
- Problem resolution

- **Cross shift learning**
- Technical manuals
- Problem resolution
**Title** Conveying Systems  
**Version/Date** 1.0 draft 11.11.12  
**By** 

**Reason for preparing the standard**  
To define how to design conveying systems to be able to handle a range of full pack configurations effectively. 

**Scope of the application**  
1. The standard applies to handling of multi packs of cans between the packing machines and palletiser.  
2. The standard outlines design principles to be applied at and prior to EEM step 2 Basic Engineering.  
3. This standard will be developed into a measure of conveyor system effectiveness to guide the assessment of conveying system options. (Design effectiveness is a function of conveying system length and complexity) 

**Design and method of use**  

**Design Principles**  
Intrinsic reliability is a function of conveying system length and complexity. See below for basis for optimum assessment.  

5 = simple, short, level conveying systems and intrinsic pack alignment  

Operability is enhanced by assuring alignment and reducing changeover complexity and contamination risk.  

5 = no-touch changeover, conveyor system should maintain alignment of packs without the need for additional guide rails. This reduces contact and the risk of can damage/leaking cans.  

Below are guidelines for optimum (score of 5) conveying gaps, distance and complexity.

**Conveyor Gaps and Distance**  
Conveyor gap/dead plate span Pack side edge length  
Conveying gap should be no more than 40% of the smallest pack side edge length.  

Avoid using long runs of conveyors these have more joins. The impact each join on alignment is cumulative. Long conveyors need more guide rails and maintenance.

**Optimum Conveying Systems**  
Packs will maintain their alignment on a conveyor system unless acted upon by other forces. The optimum conveying system requires no additional alignment between process steps. This reduces risk of can damage/leaking cans, changeover time, capital and maintenance costs.  

**Conveyor and Pack Alignment**  
Specify conveyor horizontal and vertical alignment parameters.  

**Avoid Complex Conveying Options**  
Inclines reduce traction. Gaps should be less than 25% of the smallest pack side edge length.  

Directional changes should be avoided where possible as this results in 2 gaps and requires additional alignment guides/pack contact.

**Sketches and Diagrams**  
- Simple illustrations to describe and encourage exploration of options  
- Use models to understand what you don’t know  
- Develop outline ways of working and Day in the life of activities to explore tacit knowledge  
- Use working assumptions to guide decision making. Test decision sensitivity if needed  
- Capture lessons learned as design standards
Documents to Record Insights Gained

Allocate accountabilities for specification/delivery

1. Allocate features to processes by level of importance, all scores add up to 10

<table>
<thead>
<tr>
<th>Action</th>
<th>Feature</th>
<th>Basic</th>
<th>Perf 1</th>
<th>Perf 2</th>
<th>Perf 3</th>
<th>Perf 4</th>
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<td>Proc QA Mains Ops Purch</td>
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<td>3</td>
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<td>Predictable Life</td>
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<td>2</td>
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<td>3</td>
<td>1</td>
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<td>8</td>
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<th>KiLink</th>
<th>Parameter/Part</th>
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<td>1</td>
<td>Raw Material Quality 2 1 1 1</td>
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<td>3</td>
<td>3</td>
<td>1</td>
<td>Dust Control 2 1 2 2</td>
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<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Cutting 3 1 1 1</td>
</tr>
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<td>2</td>
<td>3</td>
<td>2</td>
<td>Start up routine 3 1 2 3 2</td>
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<td>2</td>
<td>3</td>
<td>3</td>
<td>Steady state routine 3 2 5 3 3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>1</td>
<td>Close down routine 2 1 1 1</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>10</td>
<td>Total 10 10 10 10 10</td>
</tr>
</tbody>
</table>

Identify which parameters have most impact on quality defects

Identify parameter control points

Allocate accountabilities for specification/delivery
Assure Project Discipline: Stage Gate Review

Goals

- Confirm progress made from the last review
  - Red status: Issues which have a significant impact on future project success. Stage gate cannot be passed without resolving this issue.
  - Amber status: Issues with a known route to resolution which are unlikely to have significant impact on the delivery of project goals or working assumptions made based on experience but in need of confirmation. These items must be completed prior to the next stage gate review.
  - Green status: Issues which have been resolved satisfactorily.

- Develop plan for actions to deliver next stage gate
  - Amber status issues
  - Check list Items to be checked, examined or dealt with prior to the next stage gate

![Diagram showing project stages]

Deciding what to do
Making it happen
### EEM Road Map Overview Eden Valley Line 4

#### Define

**Step 1: Concept Development**
1. To develop a preferred concept
   - Task: Mobilise concept
   - Task: Select preferred concept
   - Task: Create concept specification
   - Task: Develop project plan
   - SG Review: 0

**Step 2: High Level Design**
2. To develop a funding application and vendor short list
   - Task: Mobilise HLD
   - Task: Select concept delivery approach
   - Task: Define HLD specification
   - Task: Develop project plan
   - SG Review: 21/11/2014

#### Design

**Step 3: Detailed Design**
3. To select a preferred vendor, detailed specification and installation plan
   - Task: Procure
   - Task: Equipment detailed design
   - Task: Freeze specification
   - Task: Detailed activity planning
   - SG Review: 20/03/2015

**Step 4: Pre Fab Procurement**
4. To manufacture equipment and prepare site for installation
   - Task: Mobilise PFP
   - Task: Operations change management
   - Task: Organise installation and commissioning
   - Task: Deliver QA Plan
   - SG Review: 20/11/2015

#### Refine

**Step 5 Installation**
5. To install equipment, finalise micro layout and prepare glide path to flawless operation
   - Task: Mobilise installation
   - Task: Install
   - Task: Pre commission
   - Task: Installation coordination
   - SG Review: 15/01/2016

**Step 6 Commissioning**
6. To deliver flawless operation on production day 1
   - Task: Mobilise Commissioning
   - Task: Commission
   - Task: Flawless Operation delivery
   - Task: Commissioning coordination
   - SG Review: 18/02/2016

#### Improve

**Step 7 Stabilise**
7. To establish normal conditions without special support
   - Task: Mobilise team
   - Task: Stabilise "Normal" conditions
   - Task: Technical stability
   - Task: Coordinate handover
   - SG Review: 24/06/2026

### Case Study Example

- **Task**: Improve the efficiency of the installation process.
- **Goal**: Reduce installation time by 20%.
- **Task**: Conduct a pilot project in a similar setting.
- **Goal**: Gather data and feedback.
- **Task**: Analyse the results.
- **Goal**: Implement improvements and monitor the outcome.
EEM Define Steps: Getting the Right Design

1. Mobilise Concept
   - Understand Operational Reality
   - Clarify project scope
   - Evaluate Options

2. Select preferred concept
   - Flawless Operation risks
   - Document concept
   - LCC forecast and Targets

3. Create Concept Specification
   - Define business case

4. Develop Project Plan
   - Concept Stage Gate
   - Project Manage
   - HLD Stage Gate
   - HLD Specification
   - Risk Assessment 1
   - LCC Update

- Milestones
- Resources
- Timing

- Risk Assessment
- LCC Update
- Specification

- Define Design
- Refine
- Improve
- Concept
- High Level Design
- Detailed Design
- Prefab Construction
- Install
- Commission
- Test
- Stabilise
- Optimise

- Confirm Concept
- Document Options
- Vendor RFQ
### EEM Site Level Master Plan

<table>
<thead>
<tr>
<th>How is this changing</th>
<th>Challenges</th>
<th>Equipment Management Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commercial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Customer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Expectations</td>
<td></td>
<td>Capacity for future demand</td>
</tr>
<tr>
<td>• New products and services</td>
<td>Incremental product development, new products and services for growth</td>
<td>Robust supply chain</td>
</tr>
<tr>
<td>• LCC Management</td>
<td></td>
<td>Supply chain for global operations</td>
</tr>
<tr>
<td>• Main contributors (4M)</td>
<td></td>
<td>Flexible to potential market shifts</td>
</tr>
<tr>
<td>• Technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>High level of resource recycling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flexible to financial risks (e.g. vendor)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Easily scalable to 400% or to 25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Access to high added value markets</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Operability</td>
<td></td>
<td>One touch operation for height, position, number colour etc</td>
</tr>
<tr>
<td>• OEE losses</td>
<td></td>
<td>Flexible to volume risk</td>
</tr>
<tr>
<td>• Lead time/flow/flexibility</td>
<td></td>
<td>Flexible to labour skill levels</td>
</tr>
<tr>
<td>• Maintainability</td>
<td></td>
<td></td>
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<tr>
<td>• Predictable component life</td>
<td></td>
<td>Inbuilt problem diagnostic</td>
</tr>
<tr>
<td>• Defect prevention</td>
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<td>Self correcting/auto adjust</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Predictable component life</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Easily overhauled, fit and forget</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Reliability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Increase precision</td>
<td></td>
<td>High MTBI</td>
</tr>
<tr>
<td>• Automation</td>
<td></td>
<td>Stable machine cycle time</td>
</tr>
<tr>
<td>• New technology/materials</td>
<td></td>
<td>Easy to measure</td>
</tr>
<tr>
<td>• Safety</td>
<td></td>
<td>Flexible to material variability</td>
</tr>
<tr>
<td>• Ease of compliance</td>
<td></td>
<td>Foolproof/failsafe operation</td>
</tr>
<tr>
<td>• New legislation</td>
<td></td>
<td>High level of resource recycling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uses sustainable resources</td>
</tr>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Case Study Example**

**Example**

- Improved control, lower grade materials
- Capturing lessons learned
- Adapting plant to new products, improving technical competence
- High MTBI
- Stable machine cycle time
- Easy to measure
- Flexible to material variability

- Inbuilt problem diagnostic
- Self correcting/auto adjust
- Predictable component life
- Easily overhauled, fit and forget

- Safety
- Ease of compliance
- New legislation

- Increased legislation and controls. Higher environmental expectations
- Safe, environmental practices with minimum impact on performance
- Improved sustainability
- Foolproof/failsafe operation
- High level of resource recycling
- Uses sustainable resources
“Day In the Life Of” (DILO) Simulation

Participants with defined roles /target areas
- Intrinsic Reliability
- Intrinsic Safety
- Ease of use
- Ease of Maintenance
- Product/Service Quality
- Product/Service Profitability

PHYSICAL REPRESENTATION OF REALITY/SCALE

Design Feedback/Concerns
Checklist Development
Life cycle cost Innovation

The outcome may include low cost or no cost improvement opportunities which are outside of the Capex project scope. This is part of the EEM scope.

Day in the Life list 1
Production:
- Start up
- Performance
- Close Down

Day in the Life list 2
Problem solving
- Availability
- Performance
- Quality Losses

Week in the Life list 2
- Maintenance:
  - Daily Checks
  - Running Checks
  - Routine servicing

Month in the Life list 3:
- Maintenance:
  - Daily Checks
  - Running Checks
  - Routine servicing

Experience / Tacit knowledge
## Stage Gate Checklists

### Design Checklist

<table>
<thead>
<tr>
<th>Owner</th>
<th>Date</th>
<th>Equipment/Area</th>
<th>Weakness/Issue</th>
<th>Target</th>
<th>Milestone</th>
<th>Notes (In Design y/n/ completed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eng</td>
<td>24-Nov</td>
<td>Packaging</td>
<td>Define cost, quantity and size</td>
<td>Rel</td>
<td>3. DD</td>
<td></td>
</tr>
<tr>
<td>Eng</td>
<td>24-Nov</td>
<td>End of line ops</td>
<td>Basis of preferred layout/operation</td>
<td>SE, Rel</td>
<td>3. DD</td>
<td></td>
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<tr>
<td>Eng</td>
<td>24-Nov</td>
<td>Packing station</td>
<td>Carton on demand detailed spec</td>
<td>Op, LCC</td>
<td>3. DD</td>
<td></td>
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<tr>
<td>Eng</td>
<td>24-Nov</td>
<td>Training</td>
<td>Operator skills required/manual production</td>
<td>Rel, Se</td>
<td>3. DD</td>
<td></td>
</tr>
<tr>
<td>Eng</td>
<td>24-Nov</td>
<td>Ease of use</td>
<td>Specification/measurement</td>
<td>Op</td>
<td>3. DD</td>
<td></td>
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<tr>
<td>Eng</td>
<td>24-Nov</td>
<td>Change over</td>
<td>Standards for freqency/speed</td>
<td>LCC</td>
<td>3. DD</td>
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<td>Ops</td>
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<td>Standardise machine components</td>
<td>LCC</td>
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<td>Ops</td>
<td>24-Nov</td>
<td>Best practice dev</td>
<td>Cleaning and asset care design</td>
<td>Mnt</td>
<td>3. DD</td>
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<td>Ops</td>
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<td>Training schedule development</td>
<td>LCC</td>
<td>3. DD</td>
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<td>Storage</td>
<td>For outs</td>
<td>Op</td>
<td>3. DD</td>
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<tr>
<td>Ops</td>
<td>24-Nov</td>
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<td>For service spares e.g vacuum cups</td>
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<td>Heating cost/timer setting</td>
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<td>Ops</td>
<td>24-Nov</td>
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<td>Start up procedure (refined/visual aids)</td>
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<td>Set up procedure (refined/visual aids)</td>
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<td>Asset care development (Provisional)</td>
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# Setting EEM Targets

## Commercial

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<th>3. Acceptable</th>
<th>5. Optimum</th>
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<tr>
<td>Rework levels</td>
<td>Less than 1 pallet worth of rework cases per shift</td>
<td>No rework</td>
</tr>
<tr>
<td>Handbailing off line during tape change</td>
<td>No handbailing off the line</td>
<td></td>
</tr>
<tr>
<td>2 rejects from the case closer per run</td>
<td>2 rejects per 24 hour period</td>
<td></td>
</tr>
<tr>
<td>Waste</td>
<td>Less than 1 pallet of empty or part filled cases at the end of a run</td>
<td>2 part filled cases at the end of a run</td>
</tr>
<tr>
<td>Handbailing off the line during tape change</td>
<td>No handbailing off the line</td>
<td></td>
</tr>
<tr>
<td>2 rejects per 24 hour period</td>
<td>2 rejects from the case closer per run</td>
<td></td>
</tr>
<tr>
<td>Outer carton</td>
<td>Half current levels of damaged cases</td>
<td>1/20th of current levels</td>
</tr>
<tr>
<td></td>
<td>2 part filled cases at the end of a run</td>
<td>1/20th of current levels</td>
</tr>
</tbody>
</table>

## Operations

<table>
<thead>
<tr>
<th></th>
<th>3. Acceptable</th>
<th>5. Optimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set up procedure</td>
<td>Set up machine in less than 20 minutes</td>
<td>Set up in 10 minutes or less</td>
</tr>
<tr>
<td>Standard set up across shifts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training manual/process</td>
<td>Visual management and checklist support</td>
<td>Self start and visual management confirmation</td>
</tr>
<tr>
<td></td>
<td>Easy to clean at end of run</td>
<td>Easy to keep clean when running, no routine major clean required</td>
</tr>
<tr>
<td>Countermeasures to Common Problems</td>
<td>Develop best practice for response to list of common problems e.g end of line jam ups</td>
<td>Auto recovery following likely problems</td>
</tr>
<tr>
<td>Access</td>
<td>Floor level access to packing station (gate vs stairs) without removing boxes</td>
<td>Direct access</td>
</tr>
<tr>
<td>Reject carton (case closer)</td>
<td>Ease of access to carton</td>
<td>Self eject/auto reset</td>
</tr>
<tr>
<td>Spare parts</td>
<td>Line side spares for frequent spares e.g. vacuum tips</td>
<td>Early warning condition checks and single touch replacement capability</td>
</tr>
<tr>
<td>Material Storage</td>
<td>Storage for current and next outer carton size</td>
<td></td>
</tr>
<tr>
<td>Component Standards</td>
<td>Agreed list of standard parts for service kits</td>
<td>Agreed list of standard parts for overhaul items</td>
</tr>
</tbody>
</table>

## Engineering

<table>
<thead>
<tr>
<th></th>
<th>3. Acceptable</th>
<th>5. Optimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging</td>
<td>Agreed spec to test against for this project</td>
<td>Formal standards which are easy to apply to multiple projects</td>
</tr>
<tr>
<td>Machine selection</td>
<td>Agreed basis for selection of a preferred option for this project</td>
<td>Formal standards which are easy to apply to multiple projects</td>
</tr>
<tr>
<td>Carton buffering</td>
<td>7 Minutes buffering</td>
<td>Reject conveyor/loop?</td>
</tr>
<tr>
<td>Sensors</td>
<td>Guarded to avoid damage when releasing jams</td>
<td>No sensor?</td>
</tr>
<tr>
<td>Jam reset</td>
<td>Machine can be cleared easily following a jam</td>
<td>Automatic reset to start of cycle following jam</td>
</tr>
<tr>
<td>Specification</td>
<td>Agreed measures for ease of use etc</td>
<td>Formal standards which are easy to apply to multiple projects</td>
</tr>
<tr>
<td></td>
<td>Agreed specification for change over frequency and speed for this project</td>
<td>Formal standards which are easy to apply to multiple projects</td>
</tr>
</tbody>
</table>
Targeting Performance Gains

- Major Clean
- Routine servicing
- Set up and adjustment
- Routine Cleaning
- Jams
- Defect prevention
- Belt utilisation
- Rework

Index

Total time: 118
- Planned downtime: 10
- Planned time: 100
- Availability losses: 39
- Available time: 61
- Speed losses: 24
- Operating time: 37
- Rework and Scrap: 6
- Total productive time (OEE): 31
- Total Improvement: 65
- Potential OEE: +110%
Maintenance and Defect Prevention Gains Include Low Equipment Life Cycle Costs

Capital costs are only part of the picture....

The Goal of EEM is to Minimise Life Cycle Cost
1. Right first time output is 83%, 17% of the line capacity is wasted on bad quality.

2. An estimated 50% of defective parts are reworked at 1/3 of process speed to feed the pieces properly. This loses another 15-20% of line capacity.

   **Target improvement 25%-30% increase in capacity**

3. Poor material from upstream processes causes downtime due to lack of material. This accounts for 10% of availability.

   **Target availability improvement from downstream processes 5%**
Action Map

- **Outcome**
- **Goal**
- **Strategies**
  - **Actions**
    - **Assumptions**
  - **Actions**
    - **Assumptions**
  - **Actions**
    - **Assumptions**

What will success deliver?

What do we need to achieve to be successful?

What will we do to achieve the goal?

What actions will will support the strategy?

What are the fundamental parts of the solution?
Auto Palletiser Project @ 8 May 2014

<table>
<thead>
<tr>
<th>Design Assessment</th>
<th>Now</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>1.8</td>
<td>3</td>
</tr>
<tr>
<td>LCC</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Operability</td>
<td>1.6</td>
<td>3</td>
</tr>
<tr>
<td>Maintainability</td>
<td>1.6</td>
<td>3</td>
</tr>
<tr>
<td>Reliability</td>
<td>1.2</td>
<td>3</td>
</tr>
<tr>
<td>Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>1.6</td>
<td>3</td>
</tr>
</tbody>
</table>

(1= limited, 3= acceptable, 5 = Excellent)

**A. Outcome**
99% Efficiency, Green for lean on go live

**B. Goal**

**C. Strategies**
- Compliance
- Commissioning plan
- Maintenance Plan
- Finalise Design
- Skill Development

**D. Actions**
- WIP Management
- Ramp up
- Documentation
- Layout
- 8. Bar Code
- FDS
- Skills Training Process
- Procedure Design
- Resource Release

**E. Issues to be resolved**
- Case Presentation
- Maintenance Tasks /Role
- Commissioning plan
- Existing Equipment
- Ramp up
- Maintenance Plan
- Finalise Design
- Skill Development
## Action Map Workstream Summary

<table>
<thead>
<tr>
<th>Workstream</th>
<th>Aim</th>
<th>EEM Team</th>
<th>Planned Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Compliance</td>
<td>100% compliance for all internal specifications or in outs to Autopalletiser</td>
<td>Commercial</td>
<td>Perform gap analysis vs. case quality doc, Agree case quality doc/spec, Quality/FLM Review and sign off</td>
</tr>
<tr>
<td>2. Maintenance</td>
<td>Reliable safe plant</td>
<td>Operations</td>
<td>FMECA study, Assessed parts holding, MP2 condition monitoring, maintenance tasks and follow up review process, Training plan defined, Training plan delivered and competencies confirmed</td>
</tr>
<tr>
<td>3. Commissioning</td>
<td>Develop a plan to prove it works</td>
<td>Technical</td>
<td>Identify a preferred commissioning approach, Mobilise team, Carry out test and communicate updates, Day 1 production success</td>
</tr>
<tr>
<td>4. Finalise design</td>
<td>Deliver URS KPI's</td>
<td>Technical</td>
<td>Team vision, Draft FDS, Final FDS, Tested software, Installed signed off software</td>
</tr>
<tr>
<td>4.1 Layout</td>
<td>Best use of space</td>
<td>Operations</td>
<td>List of activities, List of tools, info etc, Preferred option selected (and why), Work station specification agreed, Approve layout</td>
</tr>
<tr>
<td>5. Skill Development</td>
<td>Develop competencies of Auto P operation team, support shift tech and line MT's</td>
<td>Operations</td>
<td>List of procedures (SOP, SWP, CSWP), Refine procedures, Defined TNA and Gap analysis for roles and skills, Carry out training and confirm competencies</td>
</tr>
</tbody>
</table>
Evaluate, Select and Refine Preferred Option

- Weaknesses/problems/priorities
- Technical Handbook
  - MP Data
  - Option Shortlist
    - Subjective analysis
  - Objective Testing
    - Mock ups
    - Simulation
    - Select/Refine Specification
    - Risk Assessment/Foolproofing
    - Visual Indicators for Early Problem Detection/Normal conditions
    - Standardisation Policy
  - Update Best Practice Design Book
- Section Header
Long List to Short List Evaluation

- **Function**: Loading containers

- **Short List Logic**: Assess location issues first, then method of loading
Long List Review Benefits/Outcomes

- Encourages the conditions for Innovation
- Structures the decision making process
- Reduces the risk of missing attractive opportunities
- Documents working assumptions and the basis for converging towards a preferred option:
  - These working assumptions can be tested/confirmed as part of project governance/stage gate review
- More time can be spent evaluating and developing the most viable options
- Future team members can be quickly brought up to speed about the basis for past decisions
Subjective Analysis: Case Closing with Glue or Tape?

1. Preliminary qualitative assessment identified the double tape head as the preferred option.
   (Using a 1 to 5 scale where 1 is poor, 3 is acceptable and 5 optimum solutions)

<table>
<thead>
<tr>
<th>Description</th>
<th>Safety</th>
<th>Reliability</th>
<th>Operability</th>
<th>Maintainability</th>
<th>Customer</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Glue</td>
<td>2.5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2.5</td>
<td>20</td>
</tr>
<tr>
<td>2 Single tape head</td>
<td>3.5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>19.5</td>
</tr>
<tr>
<td>3 Multiple tape head</td>
<td>3.5</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

This assessment identified that both tape and glue options provided benefits
Tape was considered safer, easier to maintain, a better pack presentation to the customer and also cost less

Glue was considered to have higher reliability and require less intervention

To be robust, the assumptions on which this preliminary assessment was made had to be confirmed. These were tested using a line study and analysis of available data.
Objective Testing: Case Closing with Glue or Tape?

2. Following a line study and evaluation of maintenance data
   a. On some products, the mean time between intervention at the tape packing station is less than 2 minutes;
   b. Discussions with marketing revealed that customers are likely to want to move to shelf ready packaging which will only be possible with Glue closures.
   c. A suitable, proven double tape head solution could not be sourced

Following the above analysis, the assessment was revised. Glue and the Double Tape head options were very close. Glue was selected as the preferred option because it provided more flexibility for future packaging configurations.

<table>
<thead>
<tr>
<th>Description</th>
<th>Safety</th>
<th>Reliability</th>
<th>Operability</th>
<th>Maintainability</th>
<th>Customer</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Glue</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>2 Single tape head</td>
<td>3.5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>19.5</td>
</tr>
<tr>
<td>3 Multiple tape head</td>
<td>3.5</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

The design brief for the Glue option was amended to include design actions to improve safety, maintainability and cost performance to as close as possible to that achieved by the tape option.
Specify Design Modules Structure

Make Criticality and the Main Contributors to Life Cycle Costs Visible

- **Process Step Criticality**
  - **Function A** criticality (M)
    - Component B1 criticality (l)
  - **Function B** criticality (H)
    - Component B2 criticality (h)
  - **Function C** criticality (L)
    - Component B3 criticality (l)
  - **Function D** criticality (L)

Prioritise by Criticality and Life Cycle Cost Contribution

**Key**
- High LCC
- Medium LCC
- Low LCC
Getting the Right Design

- Be aware of the shop floor operating conditions for volume production. Codify these as standards to support the design process.

- Configure design modules and perform structured high level design reviews to capture weak ideas and added value opportunities.
  - Use this to identify preferred vendor strengths and weaknesses.

- Use objective testing to evaluate options and understand the strengths and weaknesses.

- Use DILO and simulation activities to raise understanding of cause/effect and latent design weaknesses.
EEM Define Steps: Getting the Right Design

1. Mobilise Concept
   - Understand Operational Reality
   - Clarify project scope
   - Evaluate Options

2. Select preferred concept
   - Flawless Operation risks
   - Document concept

3. Create Concept Specification
   - Define business case
   - LCC forecast and Targets

4. Develop Project Plan
   - Concept Stage Gate

---

1. Mobilise HLD
   - Design
   - Confirm concept
   - Evaluate Delivery Options
   - Vendor RFQ

2. Select concept delivery approach
   - Define Design Modules

3. Create HLD Specification
   - Document HLD
   - Risk Assessment 1
   - LCC Update
   - Specification

4. Develop Project Plan
   - Project Manage
   - HLD Stage Gate
   - Milestones Resources, Timing
   - Fund Application
Collaborating with Vendors

What we need

What we can get
Define Vendor Assessment Profile

Apply a multi factor scale and assess each vendor against

1 = Weak
3 = Acceptable
5 = Excellent

Which supplier would you rather work with?
## Vendor EEM Questions

<table>
<thead>
<tr>
<th>Code</th>
<th>Standard</th>
<th>Scope</th>
<th>Module</th>
<th>Weakness / Issue</th>
<th>3. Acceptable Standard</th>
<th>Question</th>
<th>Answer (Yes, No, N/A)</th>
<th>Degree to which you comply (1-5)</th>
<th>Details of where standard is not met, or deemed not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe 1</td>
<td>Safety</td>
<td>Access, weight handling, oven belt cleaning</td>
<td>General</td>
<td>Risk of injury</td>
<td>No heavy lifting. Ergonomics considered, lifting equipment identified for maintenance.</td>
<td>Does your design support good ergonomic practises as set out in the acceptable standard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rel 1</td>
<td>Changeover</td>
<td>SMED</td>
<td>Mould change over time, low hopper alarms, auto splice, auto check, accumulation lane changes</td>
<td>General</td>
<td>Minimise the need for intervention</td>
<td>Minimum manual activity, no tools required.</td>
<td>Does your design support minimal changeover activity without the need for tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rel 2</td>
<td>Materials</td>
<td>Material quantities and reconciliation, blower auto change, confirmation of materials</td>
<td>General</td>
<td>Reduce risk of human error and admin needed to maintain traceability of materials</td>
<td>Counters at key points to capture material usage/rejects</td>
<td>Does your design include counters for good and scrap materials at each production step. Is it easy to capture and archive this information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rel 3</td>
<td>CIP</td>
<td>Sanitisation and utilities</td>
<td>General</td>
<td>Minimise build up of contaminants, reduce</td>
<td>Optimised CIP time and frequency to achieve zero micro failures,</td>
<td>Does your design include optimised CIP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rel 4</td>
<td>Work Place Organisation</td>
<td>Energy efficiency, storage, wash facilities, networking, mods to existing lines, tracking label production, CIPsplit, guide rail adjustment, operator levels</td>
<td>General</td>
<td>Minimise movement, allow at least 30 minutes between intervention</td>
<td>Formal layout with clearly defined work space change parts, communications, quality checks and materials integrated with other lines</td>
<td>Does your layout include recommended space requirements for the items set out in the acceptable standard</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Summary

| Intrinsic Safety | 0.00 | 0.00 | 0.00 | Created |
| Intrinsic Reliability | 0.00 | 0.00 |
| Operability | 0.00 | 0.00 | | Sent to vendors |
| Maintainability | 0.00 | | | Response from vendor |
| Customer Value | 0.00 | 0.00 | | Evaluated |
| Life Cycle Cost | 0.00 | | | Closed |

<table>
<thead>
<tr>
<th>EEM Standard</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe 1 Safety</td>
<td>Does your design support good ergonomic practises as set out in the acceptable standard</td>
</tr>
<tr>
<td>Rel 1 Changeover</td>
<td>Does your design support minimal changeover activity without the need for tools</td>
</tr>
<tr>
<td>Rel 2 Materials</td>
<td>Does your design include counters for good and scrap materials at each production step. Is it easy to capture and archive this information</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eval</th>
<th>Weight</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>
Detailed Design Process

- Decisions made at the earliest steps of the project have the biggest impact on Life Cycle Costs (LCC)

- Use Detailed Design Module Reviews
  - identify the main contributors to LCC
  - Explore options to
    - Reduce life cycle costs
    - Increase project value
    - Flush out latent design weaknesses
  - Gain an insight into the route to flawless operation
Working With Vendors on Detailed Design

**Preparation**

- **Life Cycle Cost Data**
- **MP Data**
- **Design Module Definition and P&EEM timetable**
- **Improvement Targets**
- **Provisional ways of working**
- **Work flow Layout and specification**

**Workshop 1** to confirm understanding of spec/standards, tease out latent design weaknesses, improvement ideas

**Checklist 2: Confirm Design**

**Checklist 3: Confirm Installation plans**

**Workshop 2** Confirm design meets standards

**Provide additional guidance to Design team as necessary**
1. What is Maintenance Prevention (MP)

- ... and why is it important

This maintainer has had to crawl under G17 Lacquering Line to replace this roller friction pad
Normal and Optimum Conditions

**Normal Conditions**
- Equipment Condition Standards
- Asset Care Regime
- Operating Best Practice
- Training
- Component Modification

**Optimum Conditions**
- Pre-emptive control of defect source
- Visual Control, ease of detection

1. Sudden Failures
2. Chronic Losses

Equipment Effectiveness vs. Usage/Time
Best Practice Asset Care

Prevent Deterioration

Look, feel listen inspection, Lubricate Clean, Adjust, Minor repairs and Record data

Measure Deterioration

Monitoring, Prediction, diagnose and plan maintenance

Restore and Repair

Preventive maintenance, Periodic Repairs Correct causes of breakdowns

The route map to zero breakdowns
Best Practice Operations

Start up

Steady state

Close down
Understanding Deterioration

- **Natural**
  - Normal wear out

- **Accelerated**
  - Neglect
  - Consequential damage
  - Dirt and dust in moving parts
  - Incorrect operation

Reduce the causes of accelerated deterioration to:
- Stabilise and extend component life.
- Set the foundation of zero breakdowns
Getting to Root Cause

- Why did the cog wear out rapidly
  Because the chain was loose and out of alignment
- Why? Because it had stretched and not been adjusted
- Why? Because the condition of the chain was not monitored
- Why? Because the chain could not easily be inspected
- Why? Because the importance of the adjustment was not recognised
- Why? Because there are no formalised asset care standards

**Action required**

Short term: Replace the cog
Long term: Establish an adequate standard of asset care
Improving Maintainability

Pre start check of chain tension

Setting for plunger gauge

Schematic shown with guard removed

Visual check of adjustment limits to avoid over stretching chain
Reducing Contamination

Dirt brought in during transit

Dust falling from beams, cranes, hoists, vents

Scattering of dust from the process

Contamination brought in on the work piece or tooling

Sweat from hands, blowing out swarf etc

Floor dust raised by movement/cleaning

Dirt and dust in getting into moving parts accelerates wear
Preventing Quality Defects

Defects

Variation from optimum performance

- Human error
- Equipment condition
- Tooling/Process Imperfections
- Variation in environment

Stable Asset Condition

Raising of Process Standards
Paint Line intervention points

Out feeder
- Lifting table
- Conveyors
- Positioning & tracking
- Not optimized function

Spraying box
- Roller cleaning unit
- Line control system
- Paint system (pumps, valves, nozzles, piping etc)

Buffer
- Stops & sync. problems

Flash-off
- Synchronization problem with spray box and drier

Extraction system
- Frequent blockages
- Poor extraction

Brush sanding mach
- Problem with different speed of pcs in machine
- Alignment of pcs
Defect Prevention: Reducing Errors

1. Methods
   1. Easy to establish reference planes
   2. Easy to clamp
   3. Easy to position in fixtures
   4. Tends to stay centred

2. Materials
   1. Resists damage
   2. Rarely forms burrs
   3. Easy to machine
   4. Easy to measure

3. Machinery
   1. No scattering of swarf or dust
   2. Easy to remove swarf or dust
   3. Easy to start up, change over, run and close down
   4. Minimal cleaning required

4. Manpower
   1. Easy to distinguish from other products or components
   2. Easy to assemble
   3. Easy to automate

- Mark red/green limits on indicators for
  - Roller pressure,
  - Scraper pressure
  - Pump pressure
Maintenance Prevention Principles

- Break out of equipment centred design and adopt a human-machine approach

- Stabilise and extend component life (MTBF)
  - Reduce the causes of accelerated wear
  - Accurately predict component life

- Improve Maintainability and MTTR
  - Access
  - Early problem detection
  - Routine servicing

- Improve quality maintenance (MTBI)
  - Control of tooling
  - Critical to quality components
  - Optimum conditions

Outcome: Reduction in Equipment Life Cycle Costs
Mastering New Competencies

1. Develop the road map to develop core, intermediate and specialist competencies as part of the detailed design activity planning activity.

2. Operational methods

3. Operations Organisation
   1. Workplace information, Work Planning/Scheduling, Recording and reporting, Cost control, Stock management, operations organisation.

4. Maintenance methods
   1. Maintenance prevention, Best practice evolution (PDCA), Inspection, Spare parts, Machine manuals, Service Level Agreements, Maintenance organisation.

5. Maintenance Organisation
   1. Technical information, PM Planning/Scheduling, Recording and reporting, Cost control, Lubrication and spares control.

As soon as each design module is completed, begin work on the road map to develop internal Core, Intermediate and Specialist competencies for the new operation.
Categorise Mechanisms (Case Study)

- **Positional Controls**
  - Pneumatics
  - Sensors/Cameras
  - Guides/Brushes
  - Chain/Pushers

- **In/Outfeed Stations**
  - Belts
  - Pick/Place

- **Material Movement**
  - Stitch
  - Laminate

- **Process**
  - Assembly
  - Cutting/Imprint
  - Print/Glue Applicators

- **Contamination control**
  - Paper/Dust
  - Ink/Glue

- **Drives**
  - Mechanical
  - Electrical

- **Lubrication**
  - Oil
  - Grease

- **Product Inspection**
  - Manual
  - In process
Categorise Skill Profile Per Shift and Work Group

Lean Maintenance: Traditional Skills Plus
Focussed improvement

Best practice Operations

Asset Care

Coach
Intermediate
Foundation/Core

Advisory
Specialist

Direct

Coach
Intermediate
Foundation/Core

Advisory
Specialist

Direct

Coach
Inspection
Routine Checks

Advisory
Servicing

Direct

Competence needed by all line personnel
Competence within each line team
Competence needed within each shift team

Outer Ring Production Team Leader and Maintenance Engineer
**Single Point Lesson - Example**

<table>
<thead>
<tr>
<th>SPL NO.</th>
<th>TASK</th>
<th>How to...</th>
<th>M201 Milling Machine</th>
<th>DATE:</th>
<th>VERSION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td></td>
<td></td>
<td>Start up best practice operation</td>
<td>14.03.01</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>MAIN STEPS (who, what, why, where, when)</th>
<th>KEY POINTS TO DEMONSTRATE</th>
<th>VISUAL AID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Check power on at compressor</td>
<td>Where power isolated and warning light</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>2.</td>
<td>Check oil levels and air pressure</td>
<td>Location and confirmation</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>3.</td>
<td>Check coolant return hoses are in drip tray</td>
<td>Remove and replace coolant drip tray</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>4.</td>
<td>Check coolant</td>
<td>Switch on – check flow/direction and switch off.</td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>5.</td>
<td>Check tools on shadow board</td>
<td></td>
<td><img src="image" alt="Diagram" /></td>
</tr>
<tr>
<td>6.</td>
<td>Report non conformance</td>
<td></td>
<td><img src="image" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**COMPETENCY STATUS**

- After 2 supervised start-ups
- After 1 week of full operation
- After 1 month of full operation

**AUTHORIZATION:**

- Authorised instructor
- Team Lead
## Define Skills Provision Policy

### Training time required

<table>
<thead>
<tr>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Frequent</em></td>
<td><em>Infrequent</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency of skill used</th>
<th>Internal training programme/facilities</th>
<th>Periodic refresher/Single point lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Frequent</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Infrequent</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Job Requirement for new hires
- Potential sub contract role
# Coordinate Training and Competency Assessment

**Training Matrix**

<table>
<thead>
<tr>
<th>Name</th>
<th>SPL1 Daily Cleaning</th>
<th>SPL2 Hydraulic Care</th>
<th>SPL3 Slide bed care</th>
<th>SPL4 Greasing</th>
<th>SPL5 Lubrication types</th>
<th>SPL6 Lubrication checks</th>
<th>SPL7 Temperature checks</th>
<th>SPL8 Coater weekly clean</th>
<th>SPL9 Pit clean out</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Mike Traynor</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>2 George Wear</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>3 Mark Hogan</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>4 Jane Crowther</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>5 Darren Field</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**Date opened**: 20/01/2009  
**Date closed**:  

**Company**: Long meadow  
**Asset/Shift**: Injection Moulding  
**Campaign**: Basic Asset care  
**Page**: 1 of 1

- **Aware**  
- **Understands**  
- **Competent**
Problem Prevention Working Methods

- Refine operations and maintenance best practice as part of commissioning

- Finalise visual management specification and micro layout level
  - Visual workplace, layout/signage
  - Visual indicators/Normal Conditions
  - Colour coding
  - Visual Management

- Carry out training and skill development cascade to deploy core skills and structure the development of team intermediate and specialist competency skills inventories.
Developing the Forward Plan

- **Define the Scope**: Use action mapping to agree what needs the tasks and accountabilities to achieve flawless operation from day 1.

- **Planning the plan**: Use milestone planning to explore risks, develop sequencing, identify the critical path and support top level progress reporting/risk management.

- **Work Structuring**: Design detailed work packets to a standard time interval to support work load balancing, management of site resources, progress reporting and quality assurance.

- **Progress Management**: Establish standard progress management routines for each work package covering
  - Preparation
  - Safety management
  - Reporting, review and action
  - Feedback/lessons learned
Installation Work Structuring

Level

1. Plant
   (Prep, Assembly Packaging etc)

2. Process
   (Silo, Mixing, etc)

3. Module

4. Function

5. Work package

Responsibility for work
Performance Measures
Resource Estimate
Cost elements
Budget
Schedule
Scope of Work
Installation Risk Assessment Management Plan

- Review each work packet and assess risks
- Create Health & safety plan
  - Work permit procedure (hot work, confined area’s height)
  - Power supply / scaffolding / lifting / transport
  - Emergency procedure
  - Safety training required
- Assign work area coordinator
- Define Toolbox meeting schedule
1. The Pre Fab Procurement step includes witnessed inspection and problem prevention activities.

2. Review vendor quality plans to confirm inspection criteria for:
   1. Manufacture of equipment prior to installation on site.
   2. Installation plans, quality assurance milestones and inspection criteria during installation.

3. Update action plan and allocation of tasks.

4. Track formal sign off of witnessed inspection protocol on completion of tests.

Use standard templates for items below as applicable:

<table>
<thead>
<tr>
<th>Factory Acceptance Testing</th>
<th>Applicable</th>
<th>Allocated to</th>
<th>Report Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equipment/Installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Material and specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Welding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pickling and passivating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Painting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Fixtures and fasteners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Insulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Scope of delivery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Testing and inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Data sheets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Documentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Transport</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Modifications and Inspections</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Installation testing**

Checks/tests to assure:

1. Construction site safety
2. Equipment performance targets can be met.
3. Best Practice Routines are developed and trained in.
4. Flawless operation can be achieved.

This template provides a format for coordinating the development of working methods, organisational and skill development needs for the new operation.
Getting the Design Right

- Collaborate with vendors to improve design effectiveness
- Include maintenance prevention and defect prevention as part of detailed design process
- Structure the process to master new competencies
  - Categorise core, intermediate and specialist competencies
  - Identify gaps, assess options for provision
- Develop quality plans to assure manufacture, installation and commissioning of design modules
EEM Refine Steps: Delivering Flawless Operation


- Induct new team members
- Refine BPR and layout
- Flawless Op readiness review
- Hand over
- Installation complete?

Control Plan Achievement

Day 1 Readiness Review

Installation complete?

Project Manage


- Issue capture and resolution
- Flawless Op Glide Path
- Transfer and Acceptance
- Core Skill Development
- Document Management

Control Plan Achievement

Document Management

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Installation Management

- **Preparation**
  - Make arrangements for materials and equipment
  - Provide scaffolding, lighting, power, positioning/lifting equipment where they are needed
  - Install temporary piping for purging/cleaning
  - Organise waste disposal routes
  - Statutory inspections

- **Safety Management**
  - Carry out risk assessment
  - Review and amend safety policy/briefing as appropriate
  - Organise safety patrols, safety partners and daily accident prevention activities
  - Arrange resources to carry out safety inspections of contractor equipment
  - Provide safety training/induction facilities

- **Reporting**
  - Daily/weekly progress, delays, resource usage vs. budget for each work package, progress against quality plan milestones;
  - Record resources used and potential for improvement
  - Record safety patrols, incidents and action taken
  - Work completion/start up report planned vs. actual, problems opportunities;
  - Post installation report, pre planning for next project
Managing Underpinning Systems

Operations
- Daily Schedule
  - Coordinate work packet
  - Call off materials
- Inspection
  - Work completion
- Close Down / Clean out
  - Return Plant and Equipment

LRM/Work Planning
- Week 1 and 6 Schedule
  - Inbound Logistics
- Late Changes
  - Customer Sign off
- Await QC release
- Delays

Logistics
- Check availability
  - Allocate Teams
- Job Planning
  - Record Costs
- Invoicing
  - RM Invoices
  - Document Management

Project Administration
- Credit Check
  - Receive Order
- Contract Management
  - Accuracy
- Tender Management
  - Project Completion

Case study Example
- Delays
- Late Changes
- Accuracy
Toyota Visual Project Management Processes
Project Visualisation: Oobeya Room

- Planning, Design, Production and Sales & Marketing
- Only Green & Red
- Issue Board
  - Potential
  - Real
  - Finish
  - Record
  - Design
  - Engineering
  - Finance

Issues for management decisions
Commissioning Management

- **Effective organisation**
  - Induction of team members,
  - Cross functional teams located together
  - Formal roles and test/handover protocols
  - Central storage of paper documentation
  - Appropriate IT system support

- **Extensive and integrated planning**
  - Single cross functional planning process
  - Milestone plans supported by detailed work packet activity planning and critical path analysis
  - Visual scheduling to show early completions, delays, next steps at a glance

- **Good communications**
  - Daily meeting: progress, delays, defect management, query resolution, defect recording, next steps.
  - Single point of contact, regular honest 1 page progress reports

- **Contingency planning**
  - Risk assessment and what to do if things go awry
  - Raise understanding of process chemistry
  - Time to practice critical drills, handover protocols and safety and recovery routines

- **Problem solving**
  - Be prepared to stop and take stock
  - Apply structured documented problem solving process
  - Document lessons learned (Equipment and project process)

- **Systems for assuring progress quality and controlling changes**
  - Test/audit results
  - Change approval and documentation update
Flawless Operation

- Flawless operation means no sporadic failures and stable operation

- To achieve that we need to manage the glide path to establish
  - Equipment condition standards
    - Tested past infant mortality failure mode
    - Functional profile confirmed
  - Asset care regime
    - Start up checks, running checks, servicing standard practices in place
  - Operating best practice
    - Standard practices for start up, steady state, close down/clean out
  - Competency
    - Core competencies in place
    - Intermediate and specialist support in place
    - Skills transfer/competency development road map in place.

After application of EEM

![Diagram showing efficiency over time](image)
KPI: Measurement of Vertical Start Up

Vertical Start up % = \( \frac{\text{Actual start up time}}{\text{Planned (vertical) start up}} \times 100\% \)

<table>
<thead>
<tr>
<th>Project</th>
<th>Example</th>
<th>Vertical Start up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single B or C machine</td>
<td>Laser coder, fermentation tank Air compressor</td>
<td>&lt;1 day</td>
</tr>
<tr>
<td>Single A machine</td>
<td>Labeller, mash filter</td>
<td>&lt;1 week</td>
</tr>
<tr>
<td>Full Line</td>
<td>Packaging line, Brew house, Power Distribution</td>
<td>&lt;1 month</td>
</tr>
<tr>
<td>Complete Brewery</td>
<td>Brewery</td>
<td>&lt; 1 year</td>
</tr>
</tbody>
</table>

Graph showing installation completion with 90% of specification performance achieved and planned vs actual time.
Commissioning Process

Input

Output

Design Engineering Test Production Delivery

Work

Process Flow and Accountability Map

Accountability Map

<table>
<thead>
<tr>
<th>Process Flow</th>
<th>Standard Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td>M S</td>
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<tr>
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<td>M S</td>
</tr>
</tbody>
</table>

Check Sheet
Improve Steps: Delivering Stable Operation

1. Mobilise Route to Optimum Conditions
   - Design
   - Mobilise Team
   - Induct new team members

2. Stabilise Normal Conditions
   - Development & Management
   - Transfer Operational Roles
   - Design
   - Specify Design
   - Develop intermediate and specialist skills

3. Technical Stability
   - Performance analysis and tracking
   - Define Optimum Conditions
   - Specification

4. Coordinate Handover
   - Update Documentation
   - Project Manage
   - Control Plan Achievement
   - Plan steps to Optimum Conditions

Site Acceptance

Table:
- Concept
- High Level Design
- Detailed Design
- Pre Fab Construction
- Install
- Completion Test
- Stabilise
- Optimise

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Update Documentation

- Technical data
  - Catalogues, patents, journals
  - Technical literature
  - Design reviews, debugging reports, test reports
  - Equipment capacity data, market requirements
- Criticality data
  - Safety, Reliability, Maintainability and Operability data
  - Assessment of weak components
- Reliability maintenance information
  - Condition appraisal reports and action lists
  - OEE data and analysis of hidden losses
  - MTBF analysis and repairs
- Operations MP Data
  - Inspection and servicing routines
  - Operating manuals
  - Failures and defects
  - Equipment surveys (e.g. capacity/energy)
  - Problem prevention and improvement actions
  - MTBF/MTTR/MTBI analysis
  - Corrective maintenance
- Safety action reports
  - Accident reports
  - Situation reports
  - Safety improvements

- Best Practice Design Books
  - Stage gate checklists
  - Drawing check dates
  - Common parts lists
  - Standards
    - EEM Design standards
    - CAD automated design
    - Standard drawings
- Processes and Procedures
  - Standard Operating Sheets
  - Asset care
  - Process control parameters

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Key Learning Points

- Extensive integrated planning in detail
  - Single plan, include contingency plans and understand the critical path

- Structure the assurance process to capture and resolve latent weaknesses and control engineering change as a routine activity.

- Set out the glide path to flawless operation
  - Manage the development of new competencies as part of the installation and commissioning process
  - Be prepared to stop and take stock if progress is not as expected

- Capture lessons learned in best practice design books including:
  - Stepwise evolution of operational design;
  - Updated standards and processes
  - Relevant company team and vendor knowledge
**EEM Diagnostic Profile**

**Model Answer**

1. Improve sign off process (Sometimes impractical)
2. Improve visibility of snagging issues and test runs. Use to refine best practice
3. Widen scope of design brief to allow input from project team
4. Formalise vendor QA review/witnessed testing
5. HLD/funding sign off acceptable
6. Formalise steps to tease out design weaknesses and increase project value

<table>
<thead>
<tr>
<th>EEM Step</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Concept</td>
<td>2.50</td>
</tr>
<tr>
<td>B High level design</td>
<td>3.00</td>
</tr>
<tr>
<td>C Detailed design</td>
<td>2.50</td>
</tr>
<tr>
<td><strong>Sub Total Planning</strong></td>
<td><strong>8.00</strong></td>
</tr>
<tr>
<td>D Pre fab procurement</td>
<td>2.50</td>
</tr>
<tr>
<td>E Install</td>
<td>2.50</td>
</tr>
<tr>
<td>F Commission/test</td>
<td>2.00</td>
</tr>
<tr>
<td><strong>Sub Total Implementation</strong></td>
<td><strong>7.00</strong></td>
</tr>
</tbody>
</table>
Interpreting Priorities for Action

Diagnostic Score

<table>
<thead>
<tr>
<th>EEM Step</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Concept</td>
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<td>2.00</td>
</tr>
<tr>
<td>Sub Total Implementation</td>
<td>7.00</td>
</tr>
</tbody>
</table>

OK but could be improved:
Steps 1 and 2 focus on getting the right design

Poor Discipline:
Steps 3 and 4 focus on getting the design right

Informal Processes:
Steps 5 and 6 focus on delivering flawless operation
Steps 7 and 8 focus on delivering year on year performance improvement

Deciding what to do: Define Design Refine Improve

EEM Step Totals
A Concept 2.50
B High level design 3.00
C Detailed design 2.50
Sub Total Planning 8.00
D Pre fab procurement 2.50
E Install 2.50
F Commission/test 2.00
Sub Total Implementation 7.00
# Early Equipment Management Implementation Milestones

<table>
<thead>
<tr>
<th>Step</th>
<th>Pilot Project</th>
<th>Roll out</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. EEM Readiness Review</td>
<td>Review existing design process and select initial projects and personnel</td>
<td>Involve key personnel in leading their first early management project. Define cross project improvement targets</td>
<td>Use case studies as part of the induction process for new team members and project sponsors. All new projects use EEM</td>
</tr>
<tr>
<td>2. Mobilise EEM Project</td>
<td>Mobilise initial project team(s), develop initial project standards and checklists.</td>
<td>Launch teams and facilitate cross project learning to support delivery of flawless operation from day 1.</td>
<td>Develop EEM facilitators skills to reduce project delivery times.</td>
</tr>
<tr>
<td>3. Learn through doing</td>
<td>Use practical project to enhance current capital delivery process.</td>
<td>Focussed improvement teams resolve chronic losses and structure knowledge base. Apply knowledge learned through each EEM milestone plan step.</td>
<td>All new product development projects carried out using EEM principles and techniques to deliver flawless operation from day 1 with less resources.</td>
</tr>
<tr>
<td>4. Develop site level competencies</td>
<td>Site level core and stage gate team development, capture of lessons learned and stage gate review process.</td>
<td>Establish site level EEM master plans and deploy. Reviews as part of business planning process.</td>
<td>Reinforce ways of working, record and apply focussed improvement outputs to update EEM standards</td>
</tr>
</tbody>
</table>
Action Planning

- Benefits
- Concerns
- Next Steps
Early Equipment Management Key Learning Points

- EEM improves design effectiveness and delivery of Flawless Operation from production day one through the use of cross functional teams, clear processes to capture issues early and stage gate governance to prevent them passing onto later stages.

- EEM Activities concern:
  - Getting the Right Design
    - Systematic assessment and selection of options
    - Encourage creativity and innovation
  - Getting the Design Right
    - Capture and develop ideas, assess risks and communicate effectively
    - Collaborate to tease out latent design weaknesses and reduce life cycle costs
  - Managing the route to flawless operation
    - Clear plans, resources, timings and key decision points;
    - Project organisation and accountabilities and collate support plans;
    - Measure progress to business goals, coordinate next steps and actions to deal with road blocks.

- EEM Implementation
  - Identify performance gaps
  - Use pilot project(s) to enhance current ways of working and deploy new roles/accountabilities
  - Develop site level EEM master plans and best practice design books to support the targeting of design weaknesses.