Design for Maintainability

Presentation
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Agenda:

Design for Maintainability

Section: Design for Affordability

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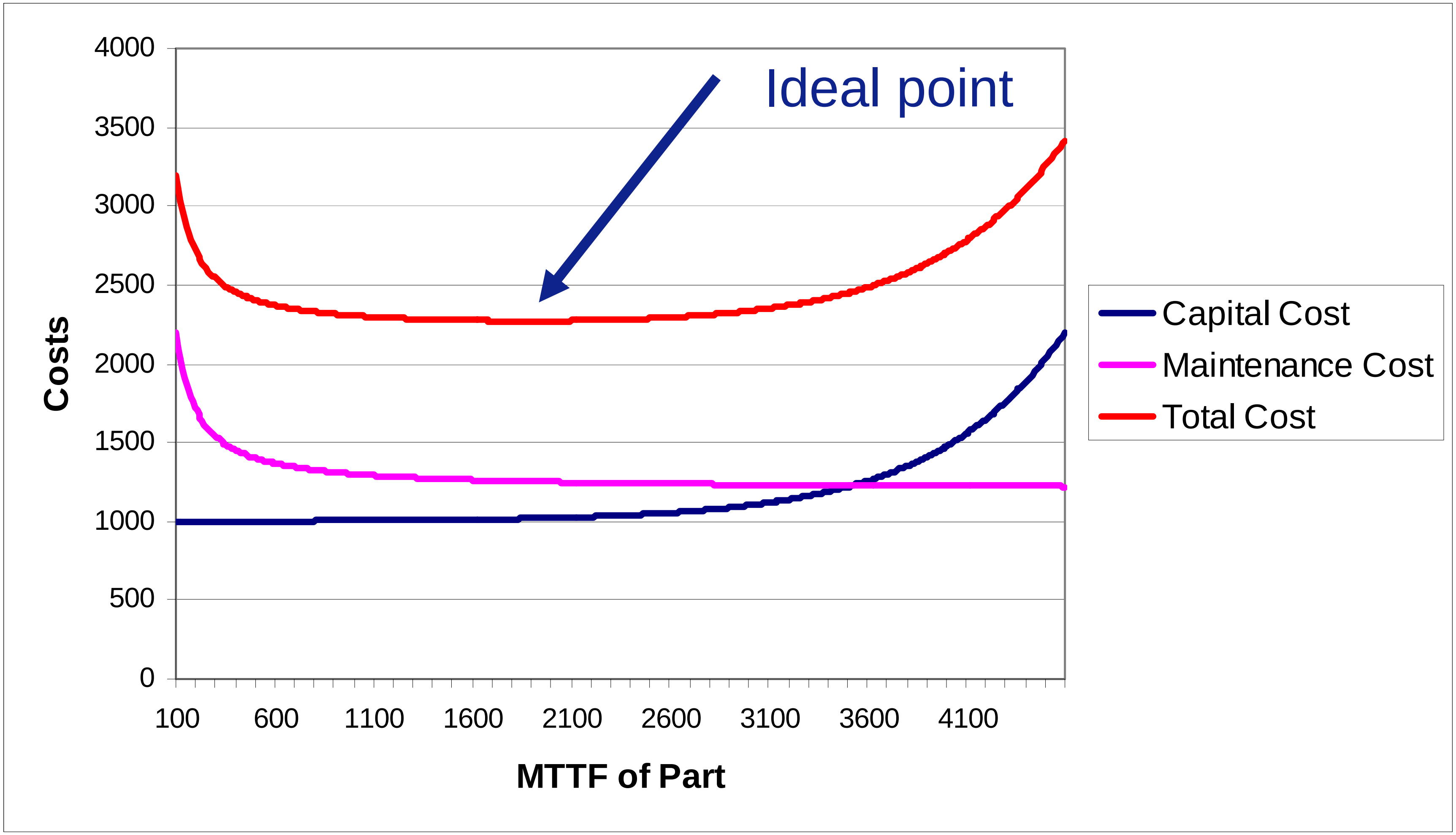
What is Design for Maintainability?

- Design:
  - Transformation of an idea into a product, process or service that meets both the designer's requirements and end user's needs.

- Maintainability:
  - The degree to which the design can be maintained (or repaired) easily, economically and efficiently.
  - Maintainability is a *characteristic* of design, whereas maintenance is the *result* of design
  - Design Parameter

Total Cost of Ownership



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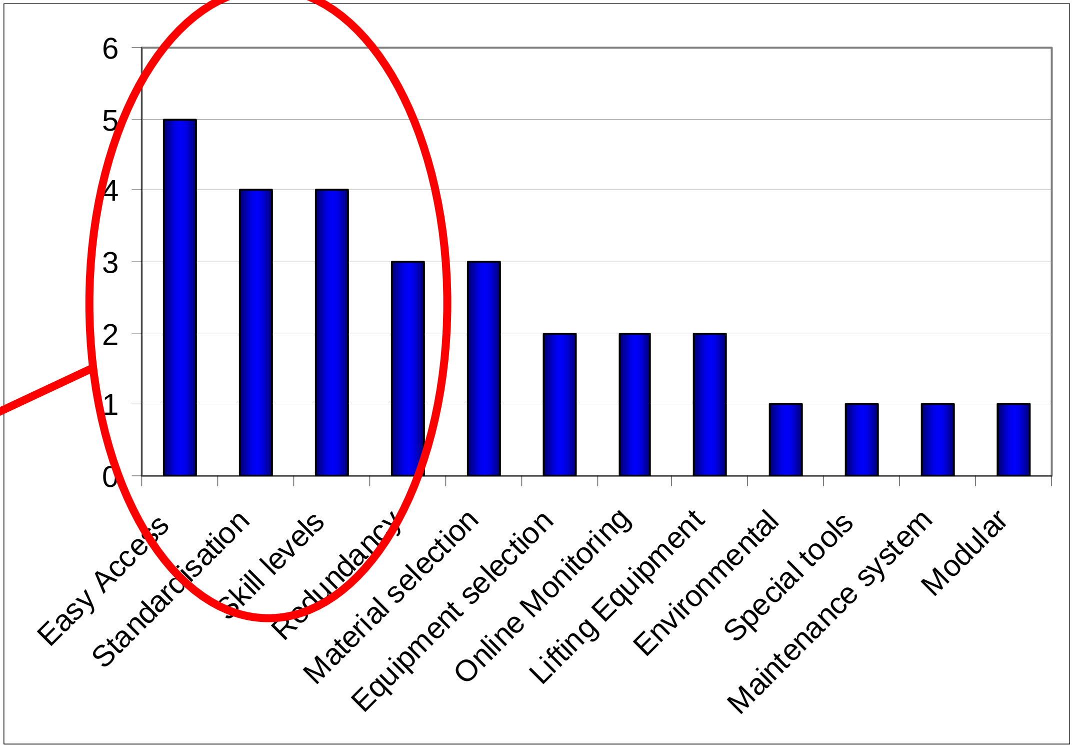
Design for Maintainability

Section: Design for Affordability

01 What is Design for Availability?
02 Plant Engineer Perspective
03 Why the time component?
04 Practical Examples
05 Design Strategy

Plant Engineer Survey

- Surveyed 5 plant engineers within Lonmin Platinum
- Open ended – “What would be your requests/dream i.t.o. maintainability?”
- Four most typically encountered requests were:
  1. Make equipment accessible
  2. Make equipment accessible
  3. Make equipment accessible
  4. Everything else



Time Component

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Why the time component?

$$A_i = \frac{MTBF}{(MTBF + MTTR)}$$

A_i = Inherent Availability

MTBF = Mean Time Before Failure

MTTR = Mean Time to Repair

- Only looks at failures
- Largest availability value that can be observed

$$A_0 = \frac{MTBM}{(MTBM + MDT)}$$

A_0 = Operational Availability

MTBM = Mean Time Before Maintenance

MDT = Mean Down Time

- Includes all corrective & preventative actions (not only failures)
- Includes all downtime including delays (not only repair)
- $A_0 < A_i$ due to "things going wrong"

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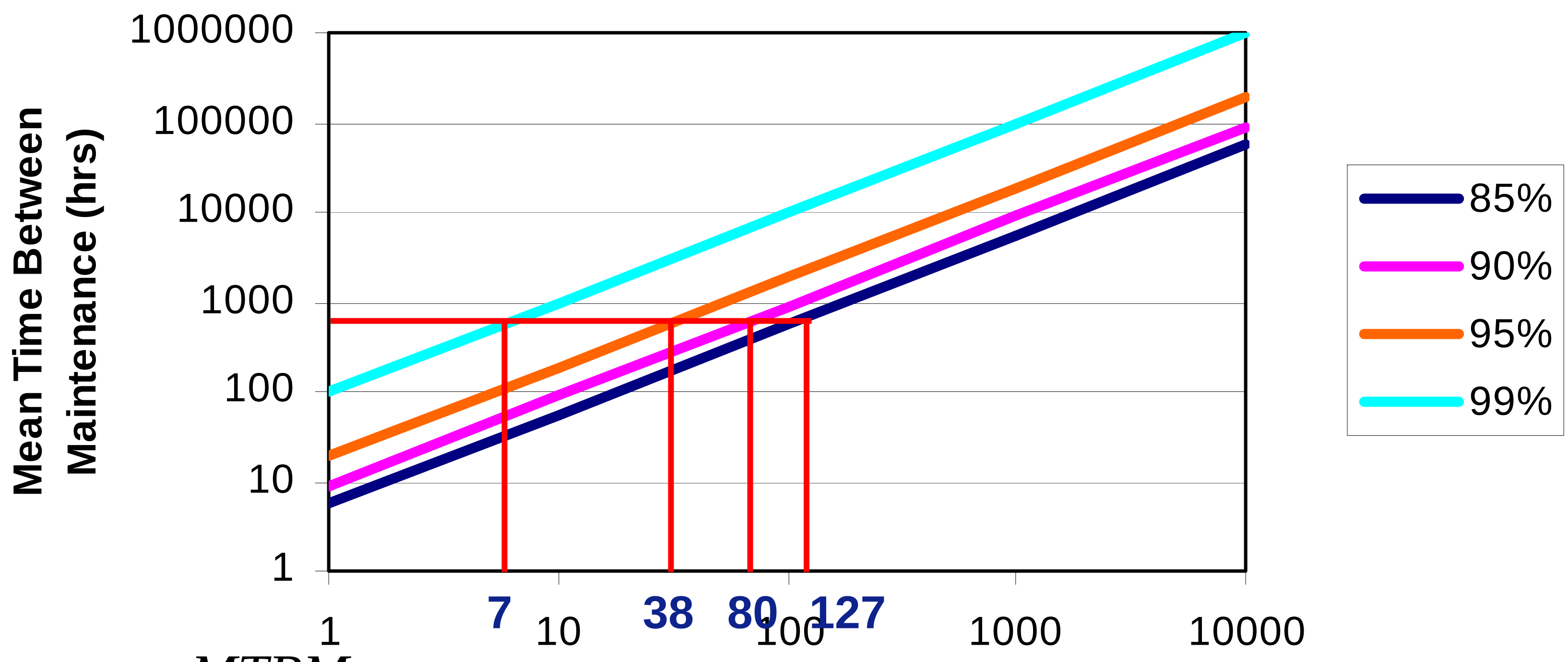
Availability Relationships



$$A_0 = \frac{MTBM}{(MTBM + MDT)}$$

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EPC concentrator

- Commissioned in Oct 2002 as part of Opencast project
- Situated adjacent to EPL plant
- Brits – North West Province
- 120 000 tpm MF2 circuit
- Highly automated
- Standby pumps
- Dedicated pipelines

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Example: Accessibility

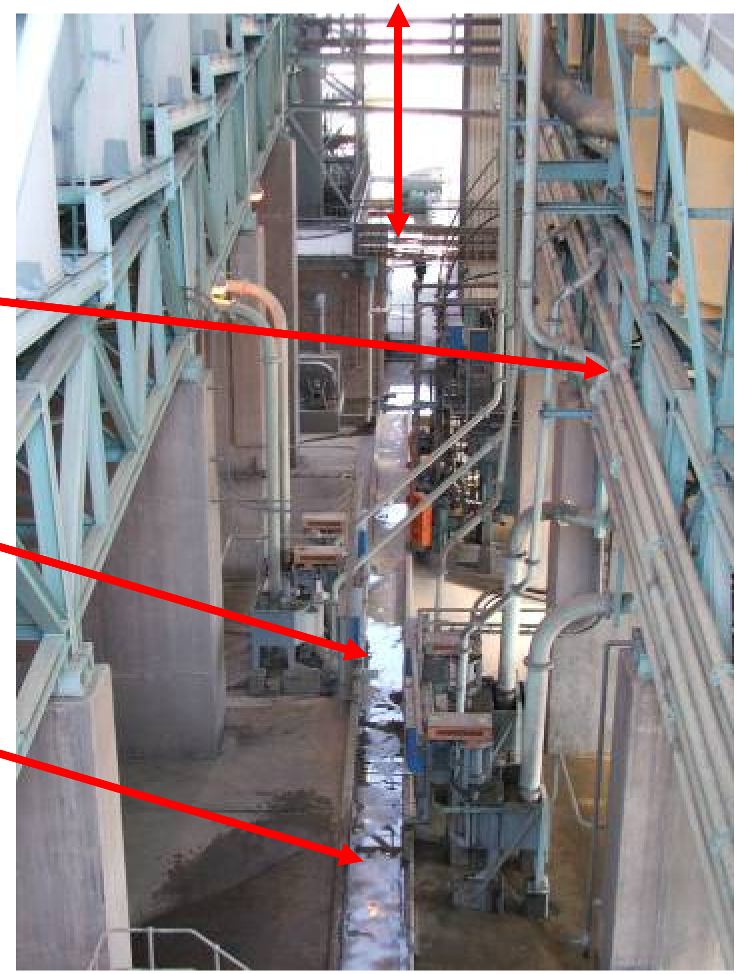
Permanent Trolley

Dedicated pipe routes

Pumps accessible

Walkway

Overhead crane travel



Examples: Pumps

“Pig tails”

Self tensioning motor bases

Non-parallel flanges

Spillage direction

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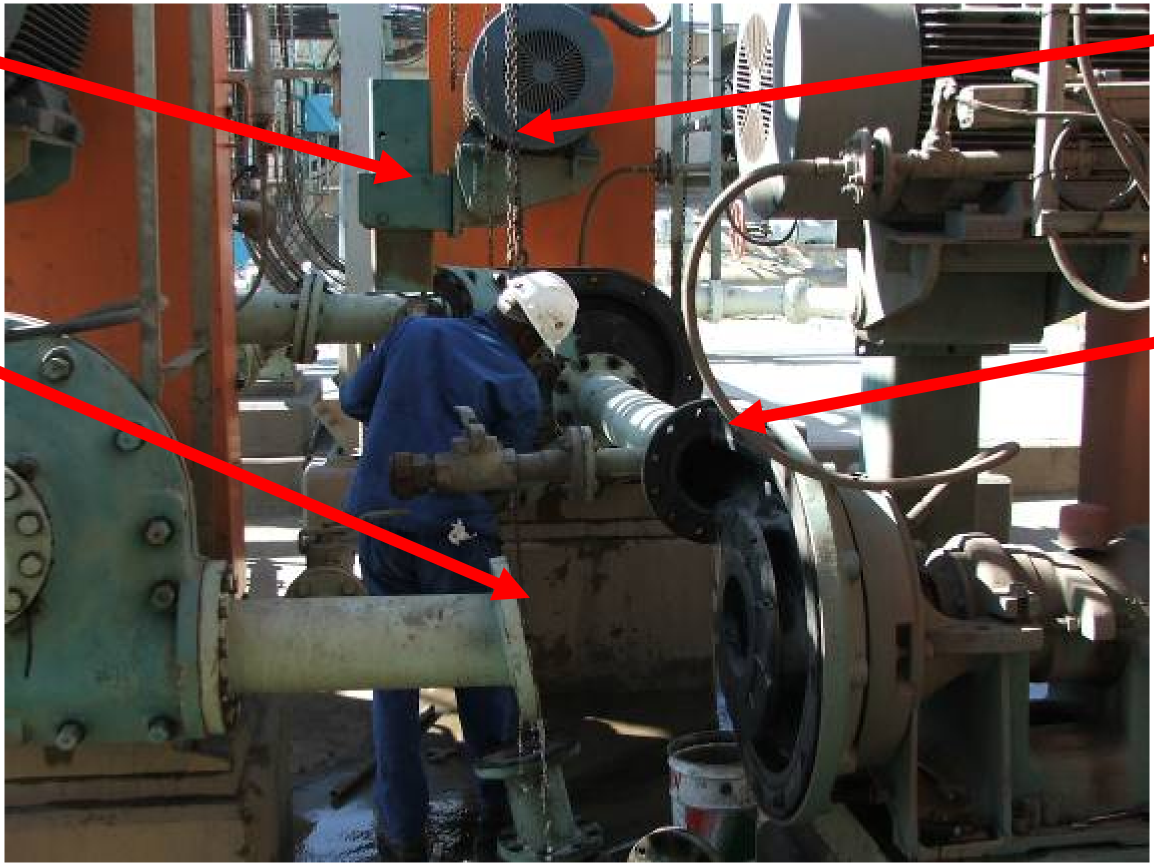
Examples: Pumps

Motorbase dropped

Overhead crane



Non-parallel flanges

Flexible Gland pipe

Example: Pumps

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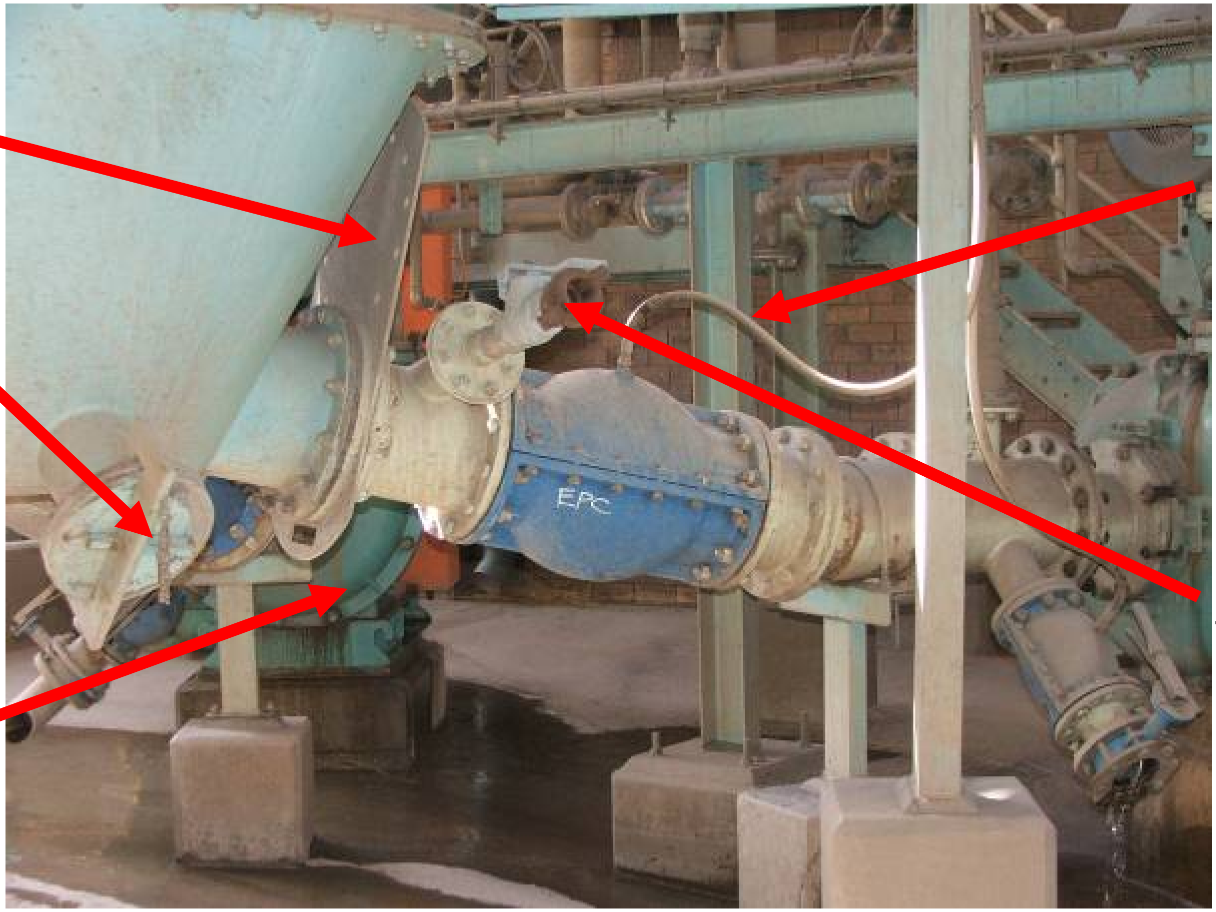
Isolation plate

Knock-off flange with chain

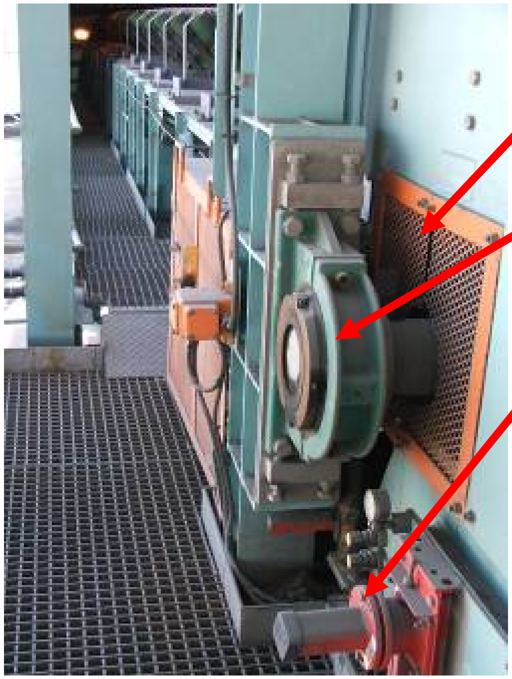
Standby pump



Air operated valves

Manual flush points

Example: Conveyors



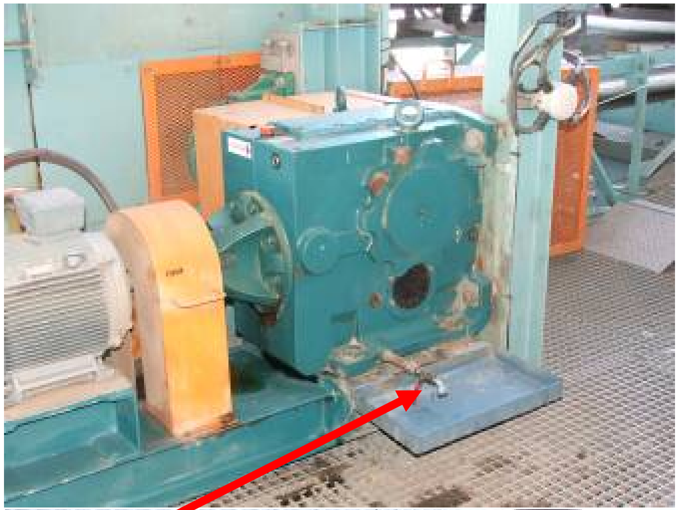
Split guards

Split bearings

External Scraper adjustment

Oil spillage handling

Return Idler removal



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Example: Standardisation

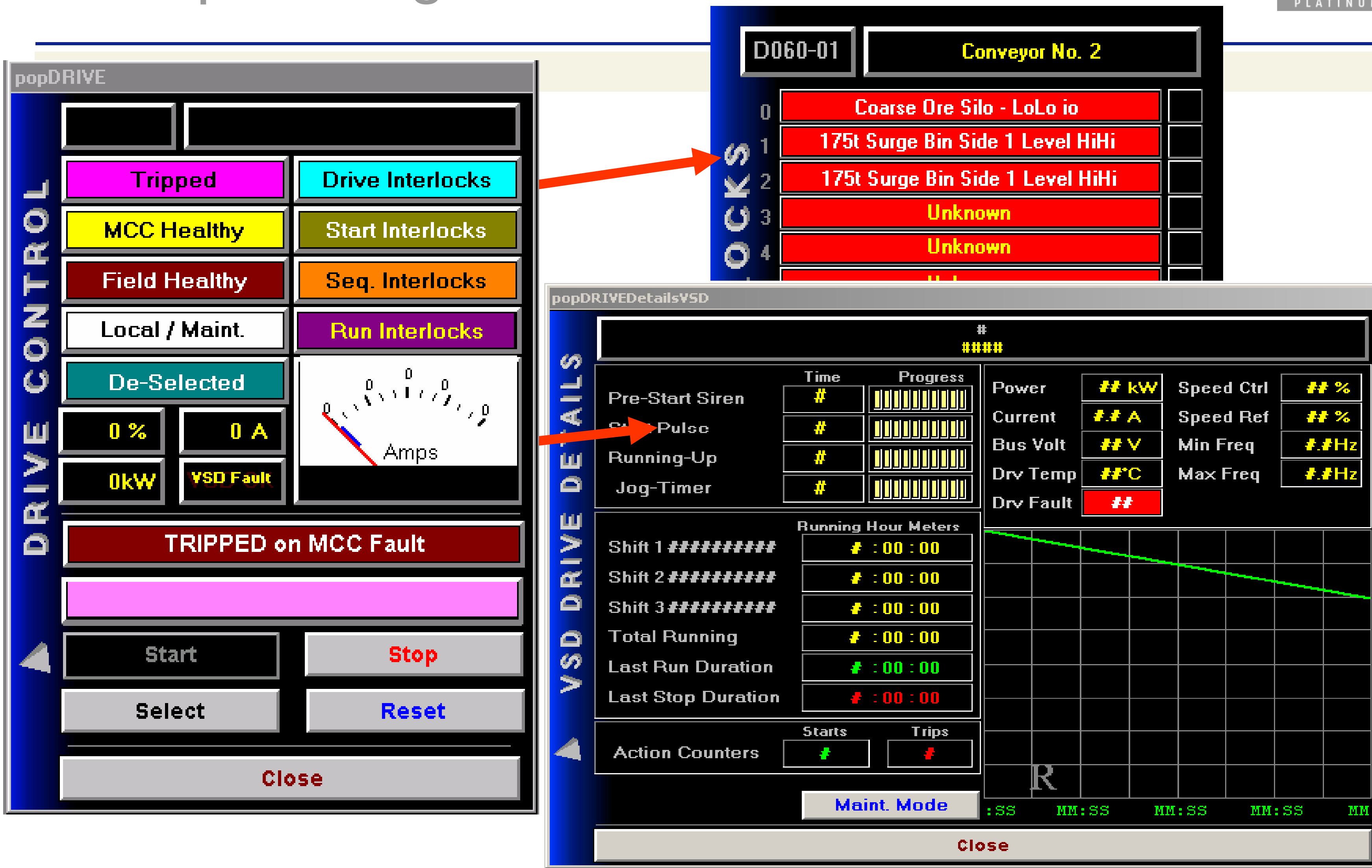
Example: Environmental & ergonomics

Crane access

Spill Pan

Example: Instrumentation access

Example: Diagnostics



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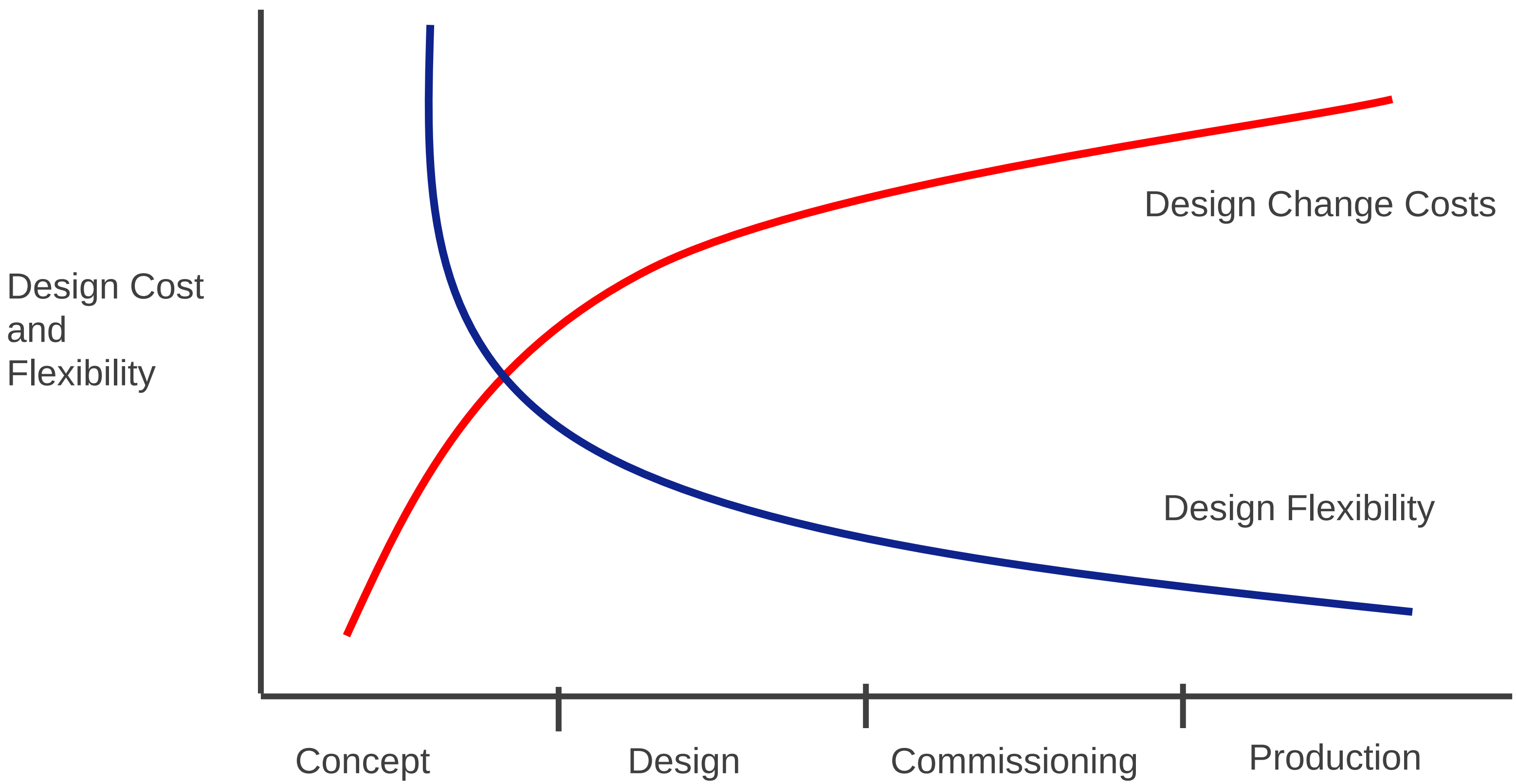
Design Phase vs Change Cost & Flexibility



Design Strategy (Conclusions)

- Maintainability is a design parameter
- Not expensive if considered early in the design process
- Failure can be very expensive
  - Safety
  - Retrofits
  - Emergency repairs
  - Operation disruptions
  - “Cutting torch” maintenance

- Design engineer to review project goals & strategies with operational team prior to design sign-off
- Use 3D design packages where possible & review with maintenance team
- Invest time with design & installation specifications and get sign-off
- Be flexible during construction with maintenance team on site