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Standardizing the Analysis Process

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What We do

Physical Asset Management Solutions Analysis

- **A graded approach is utilized based on the project's structure system, and component (SSC) grade, potential for mission impact, and asset cost:**
  - Reliability Centered Maintenance (RCM) Analysis
  - Maintenance Task Analysis (MTA) – No FMEA component
  - Subject Matter Expert (SME) Review

What We do

- **RCM Analysis generates:**
  - Labor estimations
  - Spares estimations
  - Availability
  - Maintenance plan

- **Performed on:**
  - New systems
  - Restarting old equipment
  - Updating maintenance on equipment

Metrics

- **Original time estimate for a full RCM Analysis was 100hr + 1:1 (hour : # of components)**
- **Some systems contained up to 6,000 components while most were around 1,500**
  - Typical estimation was roughly 1,600 hours per system
- **New time estimate .33:1 (hour : # of components)**
  - Typical estimation is now roughly 500 hours per system
- **Average savings 1000 hours per system (25 weeks)**

Standardization

4 Primary improvements from standardization

- Standardize inputs/report provided to our customer regardless of which RE completed report
- Reduce of errors made during data entry
- Reduce manual data entry to allow RE to focus on the portion of the analysis that requires engineering experience and maintenance knowledge
- Greatly reduce time/cost to complete each analysis

Standardization

Created RCM Analysis walkthrough guide

- **Streamlines the training process for new hires and is a good reference document for employees**
  - Makes it easier for everyone on the team to keep up with new changes and stay standardized

Standardization

From inputting in AWB to Excel with a template

- **Template includes each column and sheet for easy AWB inputting**

- **Data Input Template allows for much easier troubleshooting of issues**
  - Before excel template any issues would have to be searched for individually in AWB software - much easier and faster to find issues in data when searching in excel

Standardization

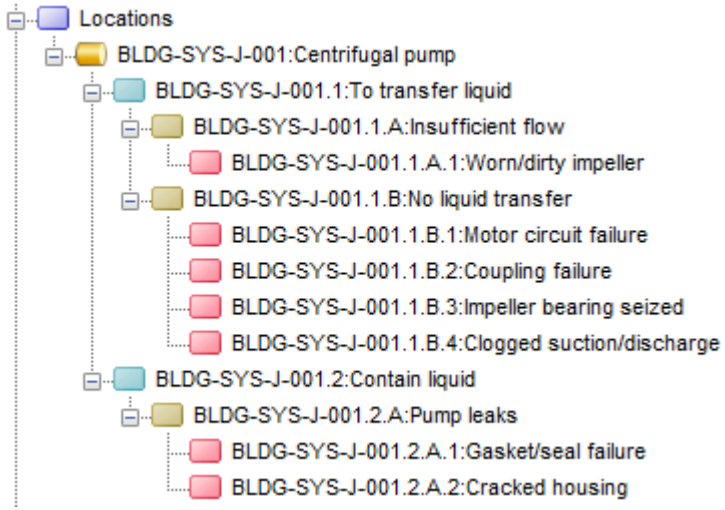
Failure Modes / Failure Data

Initial M-H: 1500
Final M-H: 750

- **Before: Manually entered data one by one into AWB**
- **After: Automated entry of bulk standardized data into Excel**
  - Estimated to reduce time by 50%
  - Automation works by cross referencing specific equipment types with a failure data template
  - Before accepted failure mode data it was up to the RE to enter the failure modes based on experience and memory of what had been used on previous RCM analysis - lots of opportunity for error + takes a very long time to continuously reference old analysis

How We Used To Do It

- **Build Function Locations in AWB**



Standardization

Failure Modes / Failure Data

- **The FLOC structure breaks the components down to a type**
  - Any pump = J
- **These must be specifics for the failure modes macro to cross reference**

Old	New	Description
J	BLOW	Blower
J	PUMPC	Centrifugal Pump
J	CAIRL	Circulation Airlift
J	PUMPD	Diaphragm Pump
J	EDCR	Eductor
J	PUMPF	Feed Pump
J	PUMPG	Gear Pump
J	PUMPM	Metering Pump
J	PUMPT	Transfer Pump
J	PUMPTB	Turbine Pump
J	PUMPV	Vacuum Pump
J	VSCRUB	Venturi Scrubber

How We Do It

- **All functions, functional failures, causes, MTBF, and corrective actions are generated from the failure database**
  - It builds the hierarchy to allow easy input into AWB

Id	Functions	Id	Functional Failures	Id	Causes of Failures	MTBF
BLDG-SYS-J-001.1	To transfer liquid	BLDG-SYS-J-001.1.A	Insufficient flow	BLDG-SYS-J-001.1.A.1	Worn/dirty impeller	241379.3
BLDG-SYS-J-001.2	Contain liquid	BLDG-SYS-J-001.1.B	No liquid transfer	BLDG-SYS-J-001.1.B.1	Motor circuit failure	241379.3
		BLDG-SYS-J-001.2.A	Pump leaks	BLDG-SYS-J-001.1.B.2	Coupling failure	241379.3
				BLDG-SYS-J-001.1.B.3	Impeller bearing seized	241379.3
				BLDG-SYS-J-001.1.B.4	Clogged suction/discharge	241379.3
				BLDG-SYS-J-001.2.A.1	Gasket/seal failure	241379.3
				BLDG-SYS-J-001.2.A.2	Cracked housing	241379.3

Standardization

Initial M-H: 750
Final M-H: 600

Labor

- **Before: Manually entered each labor code by Corrective Action (up to 20,000 lines)**
- **After: Macro Cross References Labor reference database (Typically fills in 75% of corrective actions)**
  - Estimated to reduce time by an additional 20%
  - Reduces potential errors in data entry
  - Allows RE to focus on labor tasks that require maintenance knowledge to figure out rather than just hours of data entry

How We Do It

- **The corrective actions are generated based on the causes, the task durations are automated as well**

Id	Causes of Failures	Corrective Action	TaskDuration	Labor
BLDG-SYS-J-001.1.A.1	Worn/dirty impeller	Replace Equipment	45.6	Millwright
BLDG-SYS-J-001.1.B.1	Motor circuit failure	Replace circuit	45.6	Electrician
BLDG-SYS-J-001.1.B.2	Coupling failure	Replace coupling	45.6	Millwright
BLDG-SYS-J-001.1.B.3	Impeller bearing seized	Replace bearing	45.6	Millwright
BLDG-SYS-J-001.1.B.4	Clogged suction/discharge	Clean/Repair clog	45.6	Millwright
BLDG-SYS-J-001.2.A.1	Gasket/seal failure	Replace gasket or seal	45.6	Pipefitter
BLDG-SYS-J-001.2.A.2	Cracked housing	Replace housing	45.6	Millwright

Standardization

Predictive Maintenance

Initial M-H: 600
Final M-H: 510

- **Before: Analyze each component to see if CBM technology applies**
- **After: Macro cross references with CBM reference database to limit the list of components that need analyzed to just the ones that could possibly need it**
  - Estimated to reduce time by an additional 15%
  - Another section where the template and macro improvements greatly reduces the chances of data input error

How We Do It

- **Scheduled tasks**
  - This is where manufacturer recommendations and industry best practices lead to manually entered PM's

Id	Causes of Failures	Scheduled Task	TaskDuration	Labor
BLDG-SYS-J-001.1.B.2	Worn/dirty impeller	Vibration Route	1	Millwright
BLDG-SYS-J-001.1.B.3	Motor circuit failure	Vibration Route	1	Millwright
BLDG-SYS-J-001.1.B.2	Worn/dirty impeller	Lubrication Route	1	Millwright
BLDG-SYS-J-001.1.B.3	Motor circuit failure	Lubrication Route	1	Millwright

Standardization

Spares

- **Before: No tracking on components that don't have model number**
- **After: Placeholders are used to track usage by FLOC so that we can still predict failures and spares needed**
  - Gives the customer a great plan of attack when doing spares planning and purchasing
    - Placeholders let customer know which spares to dig deeper into and find out enough details to purchase

How We Do It

- Generate spare parts list

Id	Causes of Failures	Spare	Spare Description
BLDG-SYS-J-001.1.A.1	Replace Equipment	PumpC1	Centrifugal Pump Replacement
BLDG-SYS-J-001.1.B.1	Replace circuit	PumpC1.1	Centrifugal Pump Circuit Replacement
BLDG-SYS-J-001.1.B.2	Replace coupling	PumpC1.2	Centrifugal Pump Coupling Replacement
BLDG-SYS-J-001.1.B.3	Replace bearing	PumpC1.3	Centrifugal Pump Bearing Replacement
BLDG-SYS-J-001.1.B.4	Clean/Repair clog		
BLDG-SYS-J-001.2.A.1	Replace gasket or seal	PumpC1.4	Centrifugal Pump Seal/gasket Replacement
BLDG-SYS-J-001.2.A.2	Replace housing	PumpC1.5	Centrifugal Pump Housing Replacement

Standardization

Report

- **Before: Different templates with different appendices for each project with major inconsistencies**
- **After: Similar templates for all projects so that all outputs are the same**
  - Greatly reduces grammatical and content errors.
  - Customers are generally new to our report and process so there is a good portion of the report that is explaining the process and assumptions.
  - Having a standardized explanation of our process and assumptions of the analysis reduces confusion as well as having to answer the same questions each time a report is provided.

Future Standardization

- Currently working on compiling a maintenance plan reference document per component type to try to standardize what maintenance is recommended for common components (will save time and allow outputs to be the same)
- Using the maintenance plan reference document, we will make a scheduled tasks (PM) cross reference guide in excel to automate part of those as well.

Questions?