

Solve a Real Problem - Step #1 Identify the Problem

I want to know where I need to focus my attention first. In this case I'm using a reliability analysis technique called "Failure Terminated Test" which looks at a time period up to the last failure of this equipment item. I simply selected a date period to look at, the reliability analysis method to use and the group of machines to analyze. Then I pressed "OK". That's it!

OK, I have this grid of information; so what. What am I supposed to do with it? Look at column #3. Find the "Increasing Failure Rate" entries.

These entries coincide with the machine in column #1. We really want decreasing or constant failure rates so we should look at these closer. Look at column #4 the mean (average) time between failures (MTBF) is also very important. We want this number to be as large as possible. Larger MTBF means greater reliability.

| Machines | Slope | Failure Rate | Mean Time Between Failures (Hours) |
|------------------------------------|---------|-------------------------|------------------------------------|
| 400 Cooler Discharge Conveyor #4 | 0 | Insufficient Data | 0 |
| 255 Cooler #3 | 1.0298 | Increasing Failure Rate | 566.538803723008 |
| 310 Donut Cutter #1 | 13.3838 | Increasing Failure Rate | 5.11457719540155E+37 |
| 272 Fryer #1 | 0.8236 | Decreasing Failure Rate | 70.8378870936222 |
| 281 Product Switches Horiz/Vert #2 | -0.7596 | Decreasing Failure Rate | 1.55585730757829E-03 |
| 255 Cooler #2 | -2.6212 | Decreasing Failure Rate | 1.52546504132887E-09 |

Machine Reliability Analysis - 272 Fryer #1

1 - Select a Date Period to Analyze

Days Before Today: 720

From: 3 / 19 / 1999 To: 8 / 4 / 2000

From Period: To Period

Days Before Date: 11 / 11 / 1999

Where Plant is: AnyTown Expected Production Hours: 10

Analysis Method: Serial Data Analysis - AMSAA Failure Terminated Multiple Machines (determine if failure rate for all machi

Machine: 272 Fryer #1

Area: Donut Cooler/Make Up

Use Excel: Category Field Value Field Use Excel OK Cancel

Serial Data Analysis - AMSAA Failure Terminated Multiple Machines (determine if failure rate for all machines in an area are increasing($\beta > 1$) or decreasing($\beta < 1$) between

OK Access Level : Administrat | Left mouse-click to select machine. Right mouse-click for more data analysis options.

Solve a Real Problem - Step #2a Examine the Problem

OK I have two machines to look at. Which one should I work on first? Here is where some judgement may be needed. I realize there is no computer program in the world that's going to replace my good judgement!

Well it looks like this 272 Fryer #1 is costing me \$0.8992 per hour for maintenance related costs during the selected time period. If I want, I can convert 'cost/hour' to 'cost /anything'. I like this flexibility! For now cost/hour works.

Now I need to look at the cost of the 255 Cooler #3 and compare it this machine's cost to own.

Breakdown Maintenance Labor Hours

| Machine Reliability | Cost of Machine | Causes of Failures | PM Assignments | Skill Matching | Extra Data | |
|---------------------|-----------------|--------------------|------------------------|----------------|------------------|-----------|
| | Time to Repair | Impact to Schedule | Preventive Maintenance | Work Orders | Spare Parts Used | Totals |
| Total Cost | \$240.70 | \$253.55 | \$47.10 | \$103.62 | \$1781.00 | \$2425.97 |
| Cost/Calendar Day | \$ 4.776 | \$ 5.031 | \$ 0.935 | \$ 2.056 | \$3.5337 | \$4.8135 |
| Cost/Hour | \$ 0.892 | \$ 0.940 | \$ 0.175 | \$ 0.384 | \$ 6.601 | \$ 8.992 |

Manufacturing Lost Labor Hours or Opportunity Cost.

Overall cost/hour

Analyze and Improve - 272 Fryer #1

Display: Time to Repair Impact to Schedule Preventive Maintenance Work Orders Spare Parts Used

Conversion Factors

Create Delete Hour Inquire

OK Access Level : Administratc Analyze to own cost machine.

Solve a Real Problem - Step #2b Examine the Problem

This machine is costing \$0.1995/hour to operate. Does this mean I should focus on the other machine first since it's costing more per day?

The answer is no; not necessarily. I know that many factors could influence this decision. But so far it looks like the 272 Fryer #1 might be my first target for improvement. I think I'll dig deeper into the 272 Fryer #1.

In order to improve the 272 Fryer #1 I must first identify the primary source of the issues that I have some control over.

| | Time to Repair | Impact to Schedule | Preventive Maintenance | Work Orders | Spare Parts Used | Totals |
|-------------------|----------------|--------------------|------------------------|-------------|------------------|-----------|
| Total Cost | \$80.50 | \$93.35 | \$129.52 | \$178.98 | \$56.25 | \$538.60 |
| Cost/Calendar Day | \$1.1597 | \$1.1852 | \$1.2570 | \$1.3551 | \$1.1116 | \$1.10686 |
| Cost/Hour | \$0.0298 | \$0.0346 | \$0.0480 | \$0.0663 | \$0.0208 | \$0.1995 |

Breakdown Maintenance Labor Hours

Manufacturing Lost Labor Hours or Opportunity Cost

Overall cost/hour

Analyze and Improve - 255 Cooler #3

Display: Time to Repair Impact to Schedule Preventive Maintenance Work Orders Spare Parts Used

Conversion Factors

Create Delete Hour Inquire

OK Access Level : Administratrc | Include work order labor hours expense for this machine during selected time period.

Solve a Real Problem - Step #3 Identify the Cause(s)

What is causing the 272 Fryer #1 to fail and what can I do about it? Four times this machine has failed due to 'Out of Time'. During the selected time period the MTBF for this cause is 70.94 hours but the MTBF for 'Improper Set-Up of Equipment' has a 39.33 MTBF indicating that this failure cause recently has happened with greater regularity even though 'Out of Time' has more failure instances overall. This is possible because MTBF has been calculated on each breakdown cause independently of the other breakdown causes for this machine. On the first tab of this screen 'Machine Reliability' MTBF and failure rate was calculated on the machine not each breakdown cause for this machine. I'll talk to the production superintendent regarding the 'Improper Set Up of Equipment' by manufacturing personnel then I'll attack the 'Out of Time' problem since I may have control over this.

Notice the MTBF for '100 Out of Time' is 70.94 days. The interval for 'Check/Tighten Set Screws' is 90 days. Perhaps we should shorten this interval and add more tasks.

| Cause | Assigned Task | MTBF (Days) | Interval | Count | Time Down | Sum of Impact | Wage Expense |
|---------------------------------|--|-------------------|----------|-------|-----------|---------------|--------------|
| 100 Out of Time | 00214 Check/Tighten Set Screws | 70.9446233258033 | 90 | 4 | 369 | \$320.42 | |
| 400 Improper Set-Up of Equipmen | | 39.3340158483134 | | 2 | 160 | \$555.73 | |
| 00118 Ingredient Bridged | | Insufficient Data | | 1 | 35 | \$30.39 | |
| 601 Foreign Object in Machine | | Insufficient Data | | 1 | 10 | \$8.68 | |
| 201 Circuit Breaker Tripped | 00108 Check For Excessive Amp Draw | Insufficient Data | 60 | 1 | 10 | \$8.68 | |
| | 00107 Check/Tighten Electrical Connections | Insufficient Data | 60 | 1 | 10 | \$8.68 | |

This task has been 'Mapped' (associated) to the breakdown cause '100 Out of Time'. There may be other tasks on this machine's PM list.

Task to cause mapping is a way of associating a breakdown cause with a task that may prevent the reoccurrence of that breakdown cause. MaintSmart makes this process simple and fast too!

Analyze and Improve - 272 Fryer #1

General Statistics Causes vs PM Tasks

OK Access Level: Administrator Click on any screen object for instructions on it's use. Press F1 for additional help.

Solve a Real Problem - Step #4 Take Corrective Action

By right mouse-clicking I brought up a menu that allows me to add and map tasks to the breakdown cause '100 Out of Time' as a way of correcting this problem. I have changed the interval for Check/Tighten Set Screws. I have also added two more tasks that in my expert judgement will help prevent future failures based on this breakdown cause. This took me approximately two minutes and the PM list is automatically updated with these new items.

I plan to monitor this machine by spending 5 minutes or so every month. If additional action is needed I'll use the same procedure. On the next page I'll summarize this entire problem solving process and present it to my boss as an action plan for improving the performance of this equipment item. I'm sure he'll be very pleased. I won't tell him it only took 8 minutes!

This interval was changed from 90 days to a more appropriate 60 days

| Cause | Assigned Task | MTBF (Days) | Interval | Count | Time Down | Sum of Impact Time | Wage Expense |
|----------------------------------|--|-------------------|----------|-------|-----------|--------------------|--------------|
| 100 Out of Time | 00214 Check/Tighten Set Screws | 70.9446233258033 | 60 | 4 | | 369 | \$320.42 |
| | 00207 Check/Tension Timing Belt(s) | 70.9446233258033 | 60 | 4 | | 369 | \$320.42 |
| | 00203 Check/Repair Belt Rollers and Shafts | 70.9446233258033 | 60 | 4 | | 369 | \$320.42 |
| 400 Improper Set-Up of Equipment | | 39.3340158483134 | | 2 | | 160 | \$555.73 |
| 00118 Ingredient Bridged | | Insufficient Data | | 1 | | 35 | \$30.39 |
| 601 Foreign Object in Machine | | Insufficient Data | | 1 | | 10 | \$8.68 |
| 201 Circuit Breaker Tripped | 00418 Check For Excessive Amp Draw | Insufficient Data | 60 | 1 | | 10 | \$8.68 |
| | 00407 Check/Tighten Electrical Connections | Insufficient Data | 60 | 1 | | 10 | \$8.68 |

These tasks were added to prevent the breakdown cause '100 Out of Time'

Analyze and Improve - 272 Fryer #1

General Statistics Causes vs PM Tasks

OK Access Level : Administrator Show statistics for each specific cause of down time for this machine.

Solve a Real Problem - Summary

- I identified problems with the 272 Fryer #1 and the 255 Cooler #3.
- After examining details regarding both machines I decided to attack the 272 Fryer #1 problem first.
- The heavy-hitter regarding MTBF (mean (average) time between failure) had to do with machine operator set up errors. Maintenance had been called to correct a problem caused by human error. In some cases maintenance may be able to help with a remedy to this issue. In this case I passed the information on to the machine operator's superior with a recommendation for training for this individual.
- The next biggest problem was the fryer getting out of time. I have some control here. Loose set screws are a problem contributing to this failure and are being tightened but not often enough. I shortened the interval for this task to head off future failures.
- I used my expert knowledge to conclude that additional tasks should be applied to this issue.
- I don't want to place an excessive workload on the person maintaining this machine so I think I'll look at the PM task list for this individual and see if there are tasks that may not need to be done as often or at all. **This reliability analysis can be used to remove tasks too. Wow, I think I deserve a raise!**

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