

1 Change Failure Rate

Starting from Slide 180 in the notes – What has changed - Cell D3 changed from 0.2 to 0.1.

	A	B	C	D	E	F	G	H	I	
1	MONITORING INTERVAL OPTIMISATION (Todd/Witt Method)								Results For	
2	Equipment Type & Failure Mode	Slide 108 - With changed failure rate							13/10/2007 15:17	
3	Condition Based Maint. Method									
4	Failure mode failure rate	(Failures/yr)	λ	0.1	Predictability Characteristics			MTBF (yr)	10.00	
5	Cost of an Unpredicted Failure	(\$/Failure)	CBdPF	\$5,000	% Problems Not Predicted by Method	FrtFNtPred	0%	Detects All Modes		
6	Cost of a Predicted Failure	(\$/Failure)	CPPrPF	\$800	Typical warning time(50% failed -Weeks)	MedWtW	10			
7	Monitoring Cost	(\$/Inspection)	CMPI	\$5	Short warning time (5% failed - Weeks)	ShtWtW	4	StDev(Wk)	3.6474	
8	Monitoring Cost Overheads	(\$/yr)	CPMPYr	\$200	Operate To Failure Cost Per Year		\$500	3%	%Go Early	
9	Shortest Response Time	(Weeks)	RTShortW	0.2	Minimum Cost to the Business Per Year		\$349	\$374		
10	Ineffective Inspections	% of	FrtIneffInsp	5%	Minimum Cost Monitoring Interval (Weeks)		5.00	3.00		
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Note MTBF (Mean Time Between Failure) cell I4. Operate to failure cost cell G8.

The shape of the plots remains relatively unchanged - Woops I cut cell J14 off – it says “week” i.e. 1 on the graph is 1 week. At a 3% go early figure program advises testing 3 weekly (unchanged) – with annual cost estimate only down about \$90.

2 Change Warning Time

Cells G6 and G7 changed as we now have a better condition monitoring method.

	A	B	C	D	E	F	G	H	I	
1	MONITORING INTERVAL OPTIMISATION (Todd/Witt Method)								Results For	
2	Equipment Type & Failure Mode	Slide 108 - With changed failure rate & Warning time							13/10/2007 15:40	
3	Condition Based Maint. Method									
4	Failure mode failure rate	(Failures/yr)	λ	0.1	Predictability Characteristics			MTBF (yr)	10.00	
5	Cost of an Unpredicted Failure	(\$/Failure)	CBdPF	\$5,000	% Problems Not Predicted by Method	FrtFNtPred	0%	Detects All Modes		
6	Cost of a Predicted Failure	(\$/Failure)	CPPrPF	\$800	Typical warning time(50% failed -Weeks)	MedWtW	40			
7	Monitoring Cost	(\$/Inspection)	CMPI	\$5	Short warning time (5% failed - Weeks)	ShtWtW	6	StDev(Wk)	20.6687	
8	Monitoring Cost Overheads	(\$/yr)	CPMPYr	\$200	Operate To Failure Cost Per Year		\$500	3%	%Go Early	
9	Shortest Response Time	(Weeks)	RTShortW	0.2	Minimum Cost to the Business Per Year		\$324	\$335		
10	Ineffective Inspections	% of	FrtIneffInsp	5%	Minimum Cost Monitoring Interval (Weeks)		15.00	7.00		
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Now we can relax inspection interval - see cell G10 & H10.

3 Now Failure Costs Changed

See cells **D5 & D6**

MONITORING INTERVAL OPTIMISATION (Todd/Witt Method)							Results For	
Slide 108 - With changed failure rate, Warning time & Fail Costs							13/10/2007 15:49	
Condition Based Maint. Method								
Failure mode failure rate	(Failures/yr)	A	0.1	Predictability Characteristics		MTBF (yr)		10.00
Cost of an Unpredicted Failure	(\$/Failure)	CBdPF	\$100,000	% Problems Not Predicted by Method	FrtFNotPred	0%	Detects All Modes	
Cost of a Predicted Failure	(\$/Failure)	CPdPF	\$8,000	Typical warning time(50% failed -Weeks)	MedWtW	40		
Monitoring Cost	(\$/Inspection)	CMPI	\$5	Short warning time (5% failed - Weeks)	ShtWtW	6	StDev(Wk)	20.6687
Monitoring Cost Overheads	(\$/yr)	CPMPYr	\$200	Operate To Failure Cost Per Year		\$10,000	3%	%Go Early
Shortest Response Time	(Weeks)	RTShortW	0.2	Minimum Cost to the Business Per Year		\$1,379	\$1,521	
Ineffective Inspections	% of	FrtIneffInsp	5%	Minimum Cost Monitoring Interval (Weeks)		4.00	1.00	

If it costs us so much for a breakdown we watch it like a hawk – weekly - cell H10.
 Operate to failure cost logical up at 10% of unpredicted failure cost per annum.
 Change to cost to business - cell H9 ~ \$1,500 up by a factor of 5.
 Total monitoring cost = $\$5 * 52 + 200 = \460 .
 Monitoring Return on Investment factor = $10,000 / 1,521 \sim$ a factor of 7 times.

4 Monitoring Costs

Cell D7 increased to \$25 per test.

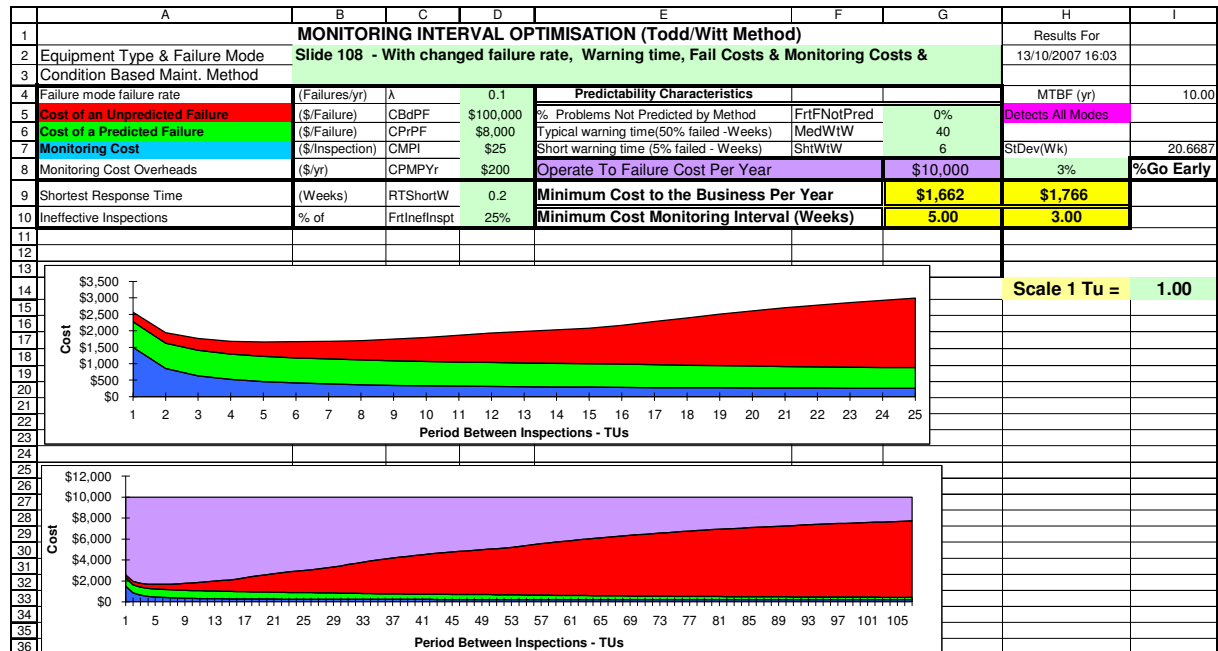
MONITORING INTERVAL OPTIMISATION (Todd/Witt Method)							Results For	
Slide 108 - With changed failure rate, Warning time, Fail Costs & Monitoring Costs							13/10/2007 15:58	
Condition Based Maint. Method								
Failure mode failure rate	(Failures/yr)	A	0.1	Predictability Characteristics		MTBF (yr)		10.00
Cost of an Unpredicted Failure	(\$/Failure)	CBdPF	\$100,000	% Problems Not Predicted by Method	FrtFNotPred	0%	Detects All Modes	
Cost of a Predicted Failure	(\$/Failure)	CPdPF	\$8,000	Typical warning time(50% failed -Weeks)	MedWtW	40		
Monitoring Cost	(\$/Inspection)	CMPI	\$25	Short warning time (5% failed - Weeks)	ShtWtW	6	StDev(Wk)	20.6687
Monitoring Cost Overheads	(\$/yr)	CPMPYr	\$200	Operate To Failure Cost Per Year		\$10,000	3%	%Go Early
Shortest Response Time	(Weeks)	RTShortW	0.2	Minimum Cost to the Business Per Year		\$1,560	\$1,639	
Ineffective Inspections	% of	FrtIneffInsp	5%	Minimum Cost Monitoring Interval (Weeks)		8.00	4.00	

Observe high resolution graph – 1-2 weeks end kicked up. So at 5 times the cost we will monitor less often (4 weekly) cell H10 and still get roughly the same benefit. Cost to Business pa up ~\$100 pa (\$1,639 - 1,521).
 Even if we stuck to 1 week monitoring benefit of CM still about a factor of 5 - see graph 10,000/2,000.

5 Ineffective Inspections

Cell D10 increased to 25% meaning on average every 4th test is ineffective.

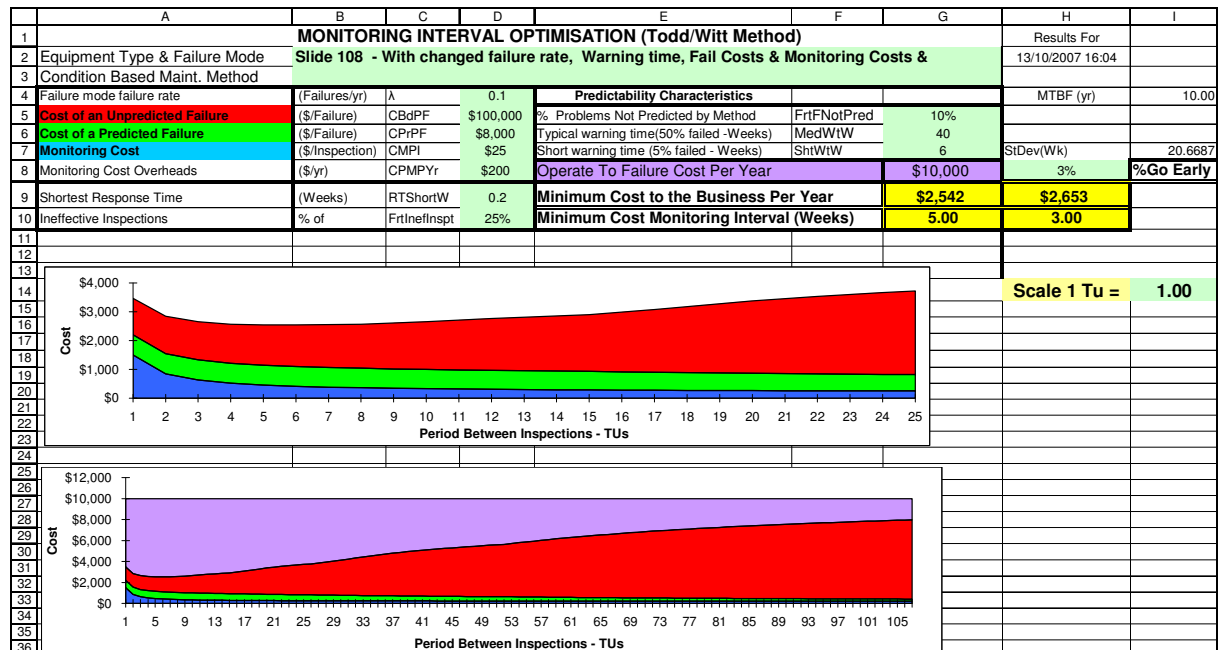
As a random effect not in a systematic fashion.



Test a bit more often - Cell H10

6 CM does not detect all Failure Types

Cell G5 changed to 10% indicating the CM method being studied only detects 90% of the failures. There is an undetected failure type, which gives of 10% of the failures that this method does not detect.



Cost to business up by \$900. Reduced ROI.

High resolution graph shows more colour red indicating greater expected cost due to Unpredicted Failure.

7 Change Failure Rate

An unacknowledged benefit of our CM has been that we pick problems early and our item actually lasts longer. So we change Cell D4 to 0.05 indicating we believe we have **doubled** the MTBF.

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1	MONITORING INTERVAL OPTIMISATION (Todd/Witt Method)								Results For	
2	Equipment Type & Failure Mode	Slide 108 - With changed failure rate, Warning time, Fail Costs & Monitoring Costs &							13/10/2007 16:07	
3	Condition Based Maint. Method									
4	Failure mode failure rate	(Failures/yr)	λ	0.05	Predictability Characteristics			MTBF (yr)	20.00	
5	Cost of an Unpredicted Failure	(\$/Failure)	CBdPF	\$100,000	% Problems Not Predicted by Method	FrtFNotPred	10%			
6	Cost of a Predicted Failure	(\$/Failure)	CPyPF	\$8,000	Typical warning time(50% failed - Weeks)	MedWW	40			
7	Monitoring Cost	(\$/inspection)	CMPI	\$25	Short warning time (5% failed - Weeks)	ShWW	6	StDev(Wk)	20.6687	
8	Monitoring Cost Overheads	(\$/yr)	CPMPYr	\$200	Operate To Failure Cost Per Year		\$5,000	3%	%Go Early	
9	Shortest Response Time	(Weeks)	RTShortW	0.2	Minimum Cost to the Business Per Year		\$1,462	\$1,547		
10	Ineffective Inspections	% of	FrtIneffInspt	25%	Minimum Cost Monitoring Interval (Weeks)		8.00	4.00		
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Looks **great big** savings.

Etc ... I need a **break** don't know about you.