



DIAM Program – Desktop and Tablet

Application to investigate and mitigate problems in Nuclear Power Plants

Henri Sjöberg 10th Nov 2021



Thanks





- Toni Haapasalo
- Leo Siipola



Paul Smeekes



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- Description of DIAM project
 - Previous work
 - Terms
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Background

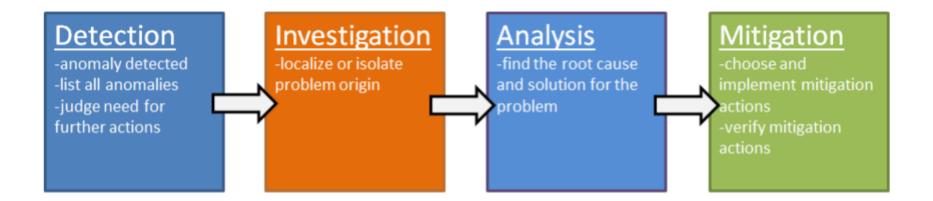


- Energiforsk Vibrations R&D program
- Participants from Nordic NPP operators
- Idea for DIAM matrix tool by Paul Smeekes from TVO
 - Systematical problem solving approach
 - Increase and Transfer knowledge
- Master's thesis and research projects developing the matrices
 - Pipe vibration Mikko Merikoski
 - Turbine and generator vibrations Rainer Nordmann
 - DIAM-matrices for EDG vibrations Antti Kangasperko



Responsibilities





Responsible party:

Power plant personnel

Manufacturer / consultant service



Matrices in Excel



4	Α	В	С	D	Е	F	G	Н	1	J	K	L	М	N	0 1	P (Q F	2	S	T U	J	/ W	/ X	Y	Z	AA	AB	AC A	D A	E A	FA	G Al	H A	A	AL	AM	AN	Α	0	AP
1				Anomalies detectable by sensors						Anomalies detectable by human senses										Anomaly location																				
2																		Т															<	Ма	rk here	"x" if no	t used	in the	e plan	t
3					х																												<	Ма	rk here	"x" if de	etected	ı		
4		Detection	Anomaly / symptom description	Vibration amplitude has changed	Vibration frequencies have changed	Boost pressure monitoring	Cylinder pressure monitoring	Electric power monitoring		_							Amplitude modulating noise				Crack	Wear dust or wear marks	Component fail		engine + mounted components	nerator + mounted components	Turbochargers	Baseframe	Silling Control	Bearing nousing	Print Property	Not applicable or uncertain	Common	Severity	of probabilities, if no blanks	Relative probabilities	ness & Severity weighted probability		ness	
5		Phenomenon / Cause of vibration	Section	6.1.1.1	6.1.1.2	6.1.1.3	6.1.1.4	6.1.1.5	6.1.1.6	6.1.1.7		6.1.1.8	6.1.1.9	6.1.1.10	6.1.1.11	6.1.1.12	6.1.1.13	0.1.1.14	6.1.1.15	6.1.1.16	611.1.1	6.1.1.19	6 1 1 20	6.1.1.21	Diesel	Gen									Product o	Relative p	Commonness		Commonness	Severity
6		Mass forces	4.1.1							0	0		1	2		2	C)	4		4 2	2 2	. 3	4	5	4	5	5 5	5	3 4	- 5	1	. 5	2	0					
7		Gas forces	4.1.2							0	4			3	5	3	C)	5	2	5 3	3	4	5	5	4	5	5 5	5	3 4	- 5	1	. 5	3	0					
8	Diesel engine	Crankshaft torsional critical speed	4.1.5	2	2				2	0	0	2	1	3	2	5	C)	2	3	5 2	2 4	5	1	4	1	0	1 4	1	1	1	. 1	. 1	5	2	3 %	2 9	%	1%	5 %
9	<u>e</u>	Misfiring	4.1.7	4	5	5	5	4	5	1	5	1	1	3	2	3	3 5	5	5		2	3	4	4	5	3	5	5 5	5	1	5	1	. 3	2	5	8 %	5 5 9	%	8 %	5 %
10	je.	Diesel knock	4.1.8	1	2	1	4	1	2	1	3	3		2		1	4	1		3		2	1	. 1	3		2	2	2		1	. 1	1	2	2	3 %	19	%	1%	2 %
11		Piston slap	4.1.9	2	2				1	0	0	5	3	1		5	3	3	4	4		5		1	4	1	1	1 2	2	1	1	. 1	. 2	1	2	3 %	19	%	2 %	1 %
12		Governor hunting	4.1.11	3	4	2	1	2	5	0	1		3	1	3	2	5 3	3	3			4	1	. 3	5	3	5	3 5	5	1	2	1	. 2	4	4	6 %	6 9	%	4 %	8 %
13	•	Magnetic forces	4.2.1							0	0		3	1	3		2 ()		4	3 1	l 1	. 1	. 2	2	5	0	3 2	2	3	2	1	. 5	1	0					
14		Static eccentricity	4.2.3	3	1			3		3	0	2	3	1	1		3 ()	1	2 4	1	2	3	1	3	5	3	4 3	3 4	1	3	1	. 3	4	1	2 %	2 9	%	2 %	2 %
15	>	Dynamic eccentricity	4.2.4	4	1			3		3	0	3	3	1	1		3 ()	1	2	2	2	2	3	3	5	3	3 2	2	5	3	1	2	3	1	2 %	19	%	1%	2 %



Integrated Desktop and Tablet Application



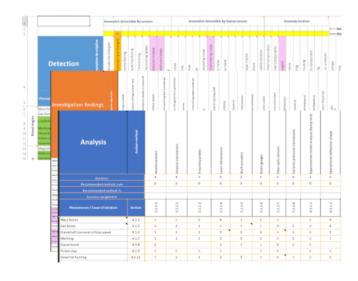
	Excel	Application
Data Storage / Database	Anarchy	Organized
Maintainability	Fragmented	Robust
User Guidance	None/Manual	Active
Visible Information	All	Significant only
Workflow	Simple	Flexible
Use of Historic Data	Difficult	Easy
User	Expert	Expert & Inspector

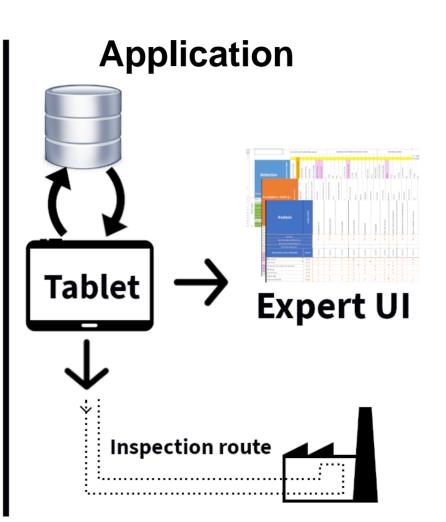


Excel vs Application



Excel







Hardware



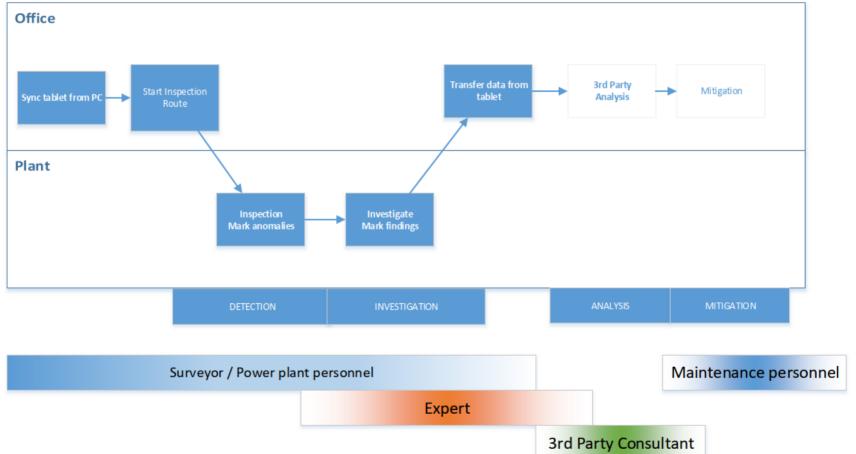
- Dell Tablet
 - 2-in-1
 - Can act as tablet or laptop
 - Standalone
 - Connectivity





Application Workflow













Thank you

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