INNOVATIVE DIAGNOSTIC METHODS OF SUSTAINABLE MANAGEMENT OF GREEN ENERGIES

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THE ROLE OF TECHNICAL DIAGNOSTICS IN TECHNOLOGY MANAGEMENT

- The task of technical diagnostics
- The cost structure of operation of technical systems

Elements of working life costs

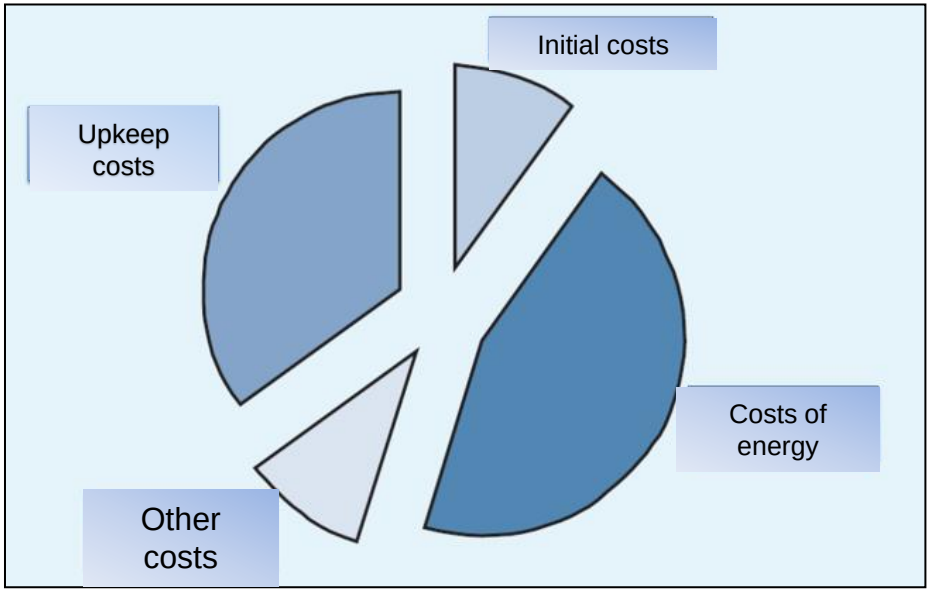
$LCC = C_{ic} + C_{in} + C_e + C_o + C_m + C_s + C_{env} + C_d$

where

C_{ic}: initial cost	C_m: cost of maintenance
C_{in}: installation, start-up cost	C_s: loss cost of malfunction
C_e: cost of energy	C_{env}: cost of environs
C_o: operational cost	C_d: decommissioning cost

Source: U.S. DOE 2001

The division of working life costs of a typical medium-sized industrial pump

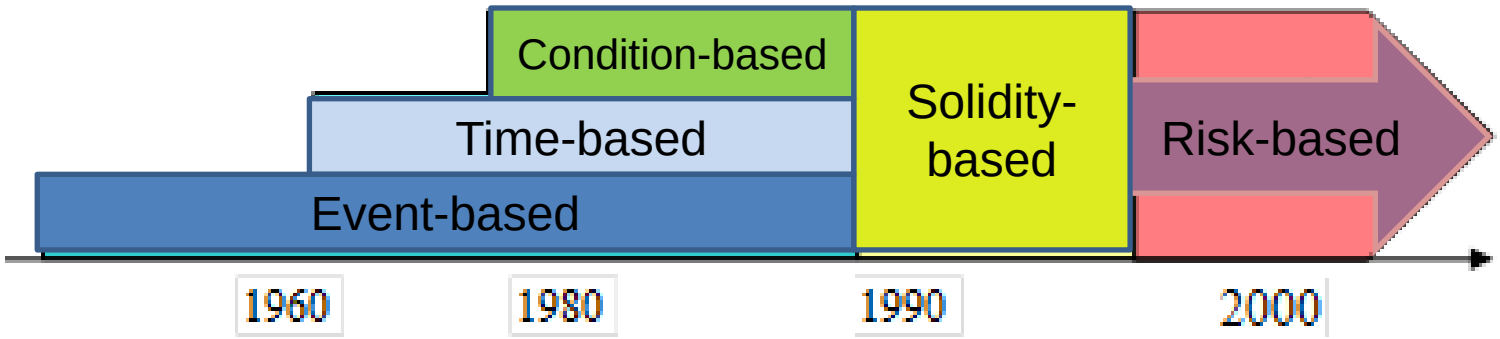


Source: U.S. DOE 2001

OPERATIONAL METHODS OF TECHNICAL SYSTEMS MANAGEMENT

1. Operational strategies of technical systems management
2. Operational systems of technical systems management

The change of principles of business organization



Source: KOCSIS 2014

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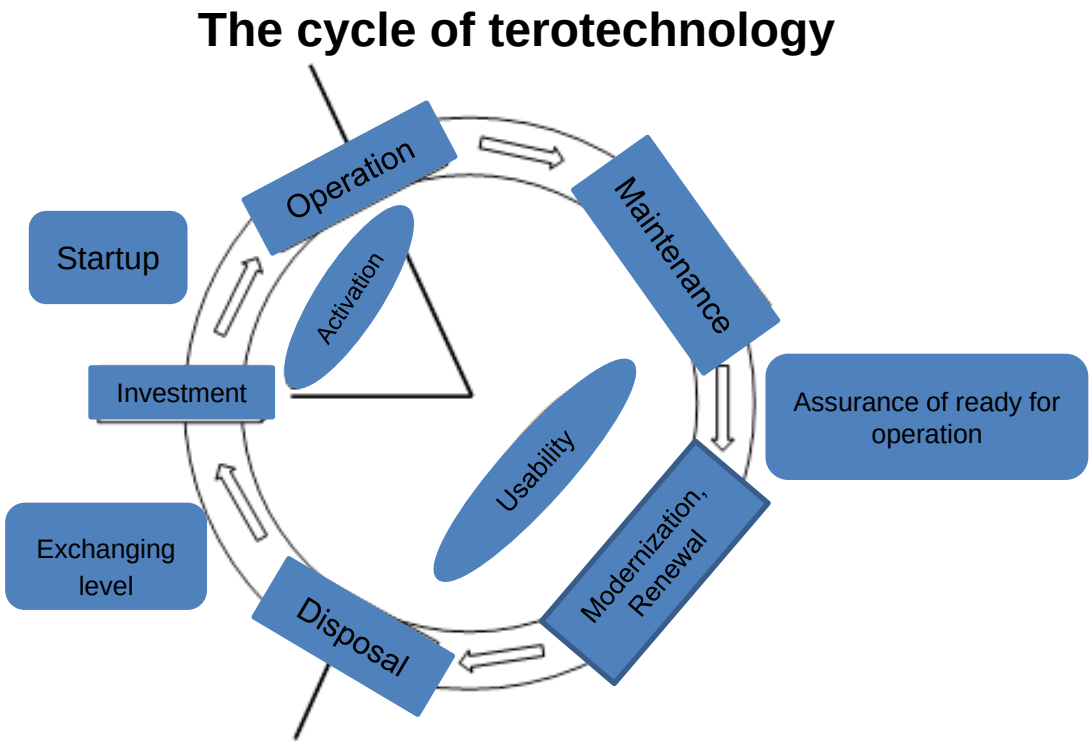


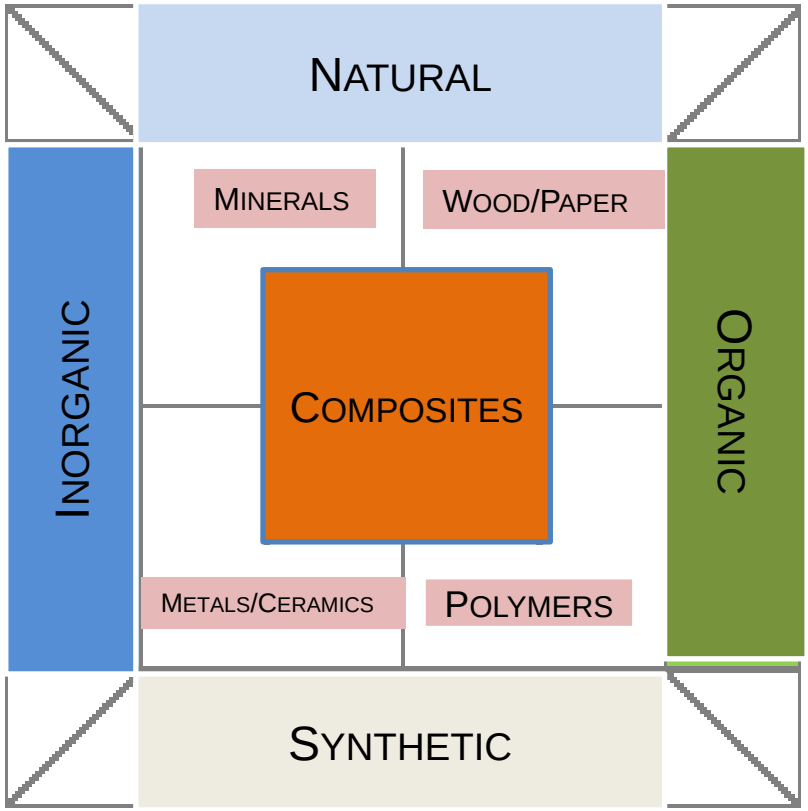
Source: KOCSIS 2014

THE FIELDS OF TECHNICAL DIAGNOSTICS

The fields of technical diagnostics

The eliminative aspects of applicable probative methods

The classification of materials according to their origins and features

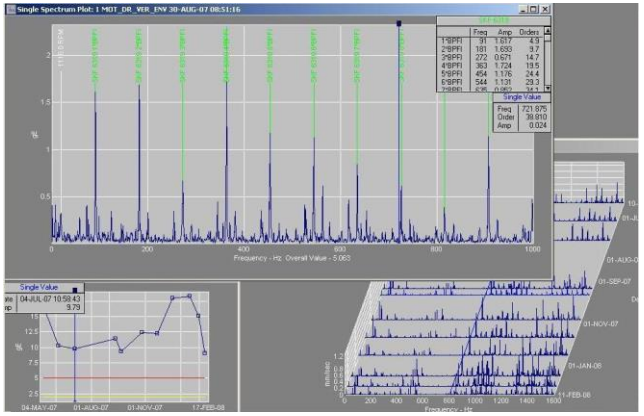


Source: CZICHOS 2009

THE METHODS OF TECHNICAL DIAGNOSTICS

- Oscillation diagnostics
- Technical acoustics

Analysis of oscillation



Forrás: http://www.ongroelektro.hu/feltolt/Image/motorok/diagnosztika.JPG

Oscillation diagnostic error detection with neural net on bearings

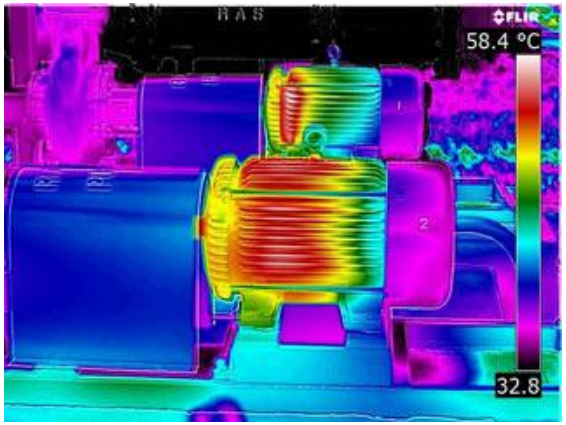
Type of error	Efficiency of naural net	Indications
Perfect status	-----	Fs, BPFO, BPFI the level of fault frequencies are low without circumscribed sidebands.
Laxity	92,3%	The amplitudo rates of Fs fault frequency are growing, and the sidebands appear.
Ring error	86,7%	The BPFI, BPFO fault frequencies, and the amplitude are growing on overtones.
Rolling element error	94,8 %	The signal amplitide is growing appearing on 2*BSF, BPFI, BPFO fault frequencies.

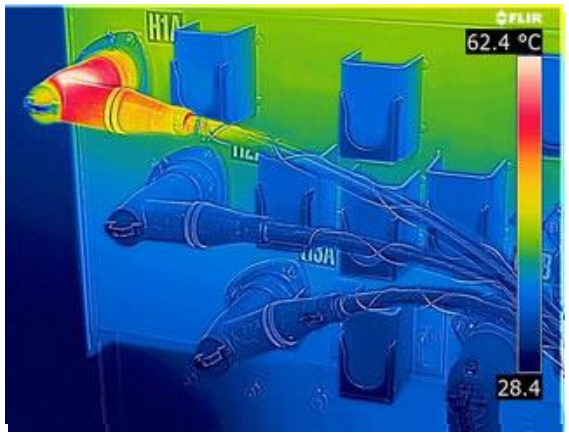
Source: DEÁK et al. 2014

THE METHODS OF TECHNICAL DIAGNOSTICS

- Thermography

Thermographic error detection at electical systems





Source: http://www.grimas.hu/hu/termografia/Lapok/FLIR_Systems_MSX_technologia.aspx

THE METHODS OF TECHNICAL DIAGNOSTICS

- Technical endoscopy and mechanical vision

Technical endoscopy and imaging

Source: Image reference 1.

Source: Image reference 1.

THE METHODS OF TECHNICAL DIAGNOSTICS

- Further non-destructive material testings: surface testing
  - Magnetic crack detection testing
  - Liquid penetrant testing
  - Eddy current testing
  - Heat exchanger testing

EVALUATION OF APPLICABILITY OF CERTAIN DIAGNOSTIC PROCEDURES I.

Tool	Method	Adequacy			Applicability			
		characteristic examined	characteristic measured	typical application	α	β	γ	all:
thermal imager	thermal imager	friction	temperature	BM, EG, EM, GT, K, SZ, V	5	5	5	5,0
testing-bench	force measurement	torque	braking force	BM, EG, EM, GT, K	3	4	5	4,0
manometer (blast-gauge)	digital	gas pressure (-changing)	voltage	BM, EM, GT, K, SZ, V	5	5	5	5,0
stroboscope	opto-electronic frequency measurement	(peripheral speed)	light pulse frequency	BM, EG, EM, GT, K, SZ, V	5	5	5	5,0
tachometer-dynamo	voltage measurement	(peripheral speed)	voltage	BM, EG, EM, GT, K, SZ, V	5	5	5	5,0

Note: BM: internal combustion engine, EG: electric generator, EM: electromotor, GT: gas-turbine, K: compressor, SZ: pump, V: ventilator;
α: practical applicability, β: compatibility, γ: usability in management

EVALUATION OF APPLICABILITY OF CERTAIN DIAGNOSTIC PROCEDURES II.

Tool	Method	Adequacy			Applicability			
		characteristic examined	characteristic measured	typical application	α	β	γ	all:
vibration meter	oscillation diagnostics	oscillation	oscillation acceleration	BM, EG, EM, GT, K, SZ, V	5	5	3	4,3
vibration meter	oscillation diagnostics	oscillation	oscillation velocity	BM, EG, EM, GT, K, SZ, V	5	5	3	4,3
vibration meter	oscillation diagnostics	oscillation	eddy current changing	BM, GT, K, SZ, V	5	5	3	4,3
multimeter	voltage measurement	voltage	voltage	EG, EM	5	5	5	5,0
multimeter	amperage measurement	amperage	amperage	EG, EM	5	5	5	5,0

Note: BM: internal combustion engine, EG: electric generator, EM: electromotor, GT: gas-turbine, K: compressor, SZ: pump, V: ventilator;
α: practical applicability, β: compatibility, γ: usability in management

EVALUATION OF APPLICABILITY OF CERTAIN DIAGNOSTIC PROCEDURES III.

Tool	Method	Adequacy			Applicability			
		characteristic examined	characteristic measured	typical application	α	β	γ	all:
ultrasonic flow-meter	flow rate measurement	gas-flow	pulse	BM, GT, K, V	4	5	5	4,7
ultrasonic flow-meter	flow rate measurement	liquid flow	pulse	K, SZ	4	5	5	4,7
ultrasonic flow-meter	flow rate measurement	fuel flow	pulse	BM, GT	4	5	5	4,7
manometer	digital	oil-pressure (-change)	voltage	BM, EG, GT, SZ, V	5	5	5	5,0
balance engine	(electric) performance measurement	power used	voltage, amperage	EG, EM, K, SZ, V	4	5	5	4,7
testing-brench+ tachometer	power and angular velocity measurement	power emitted	braking-force, angular velocity	BM, EG, EM, GT	3	4	5	4,0

Note: BM: internal combustion engine, EG: electric generator, EM: electromotor, GT: gas-turbine, K: compressor, SZ: pump, V: ventilator;
α: practical applicability, β: compatibility, γ: usability in management

CONCLUSIONS

- As the results based on literatures show, innovative technical diagnostic solutions can be found , and for the green technologies, as well, which can help to manage their operation in a sustainable way It is also true for the opertaional and maintenance **strategies of the organizations** operating a certain technology, which changed in the last decades from the error-based approach to the solidity and risk-based approach.

- **Wide range of diagnostic methods** can be used from the material testing based on sampling to the oscillation diagnostics, many performance features of the technical systems can be examined with them. The material features of structures and machines examined, and from practical aspect the management has the tools to select the applied technical diagnostics.

- It is recommended for the entrepreneurs, reserchers and decision-makers using and developing such technologies to take into account the tools of technical diagnostics in order to operate a certain technology in a sustainable manner, if needed with the help of experts, enterprises or knowledge centres. We would like to enable with the further **researches** the **spreading** of the innovative diagnostic methods of sustainable management of green technologies in our country,

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Sources of images:

- k1 http://www.grimas.hu/hu/termografia/Lapok/FLIR_Systems_MSX_technologia.aspx
- k2 http://shop.eurochrom.hu/pce-ve-500-video-endoszkop
- k3 http://www.karlstorzindustrial.com/products/techno-pack-t-video-borescope-documentation-system.html

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