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# Fault detection framework using neural networks for condition monitoring of high voltage equipment in power grids

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# Fault detection for condition monitoring of high voltage equipment

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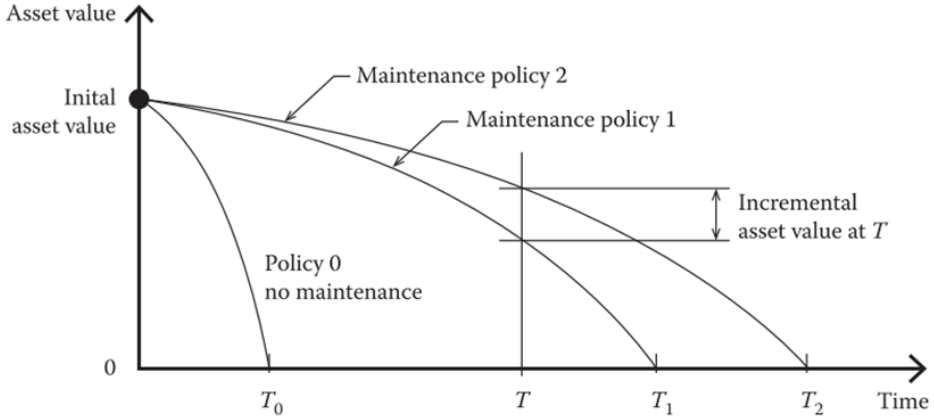
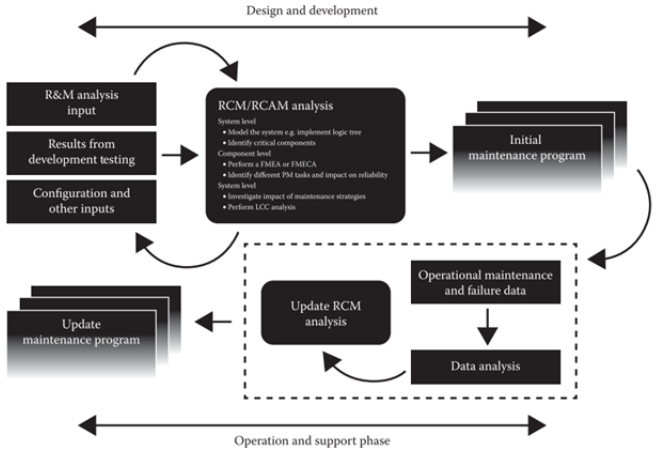
- Background & problems

- *Industrial Internet of things (IoT) development and digital asset management for electrical equipment;*
- *Data-driven condition monitoring to apply preventive maintenance to correct early degradation;*
- *Aware of current operating conditions and better planning before actual events.*




Lina Bertling Tjernberg, Infrastructure Asset Management with Power System Applications, CRC Press Taylor & Francis Group, Boca Raton, 2018.

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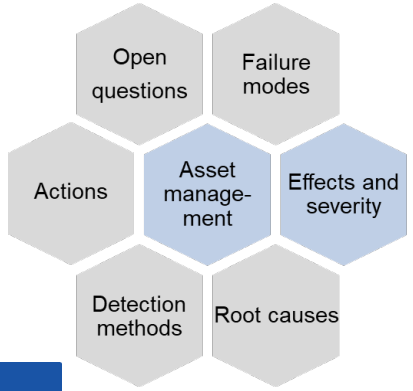
- Methods & results:

- *An expert interview is conducted to understand the asset management situation of power transformers;*
- *The questionnaire is listed based on IEC 60812 failure modes and effects analysis;*
- *The interviewees come from Hitachi Energy, Svenska kraftnät and Budapest University of Technology and Economics.*




| Failures | Root cause | Detection | Maintenance |
|---|---|---|---|
| • Major outages over seven days - CIGRE<br>• Minor faults:<br>- short circuit: weak insulation and creepage;<br>- tap changers failures due to mechanical reasons;<br>- bushing failures due to bad porcelain. | • FMEA as guidelines<br>• Long process<br>• Some scenarios:<br>- hot tanks: flux leakage;<br>- wet oil: bushing failures | • Acceptance tests: IEC & CIGRE standards;<br>• Online methods with sensors: hot spot, cooling control, gas, bushing, CoreTec®;<br>• Offline analysis and test (impedance, magnetic, etc.)<br>• Frequent follow-up after detect abnormal values | • Planned or condition-based maintenance with early online indications;<br>• Actions based on indications. |

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- Methods & results:
  - *An online operation dataset from ABB: [http://tec2.vbelnat.se/](http://tec2.vbelnat.se/)*
  - *unsupervised learning using autoencoders and semi-supervised learning using recurrent neural networks to model normal operations*
  - *Control charts as post-processing to trigger alarms towards operational risks.*