Paris Session 2022

Case study about cost-Effectiveness of investment for sensors in existing substation equipment

Study Committee B3
PS 3.1

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Question and our contribution

Question PS3.1

- What are the benefits of digital solutions like IoT-sensors, machine learning, artificial intelligence, drones, robots etc. for substation life cycle from planning to maintenance? Which measures are necessary to increase the acceptance of intelligent IoT-based power equipment in substations ?

Answer

- We present a case study in which the benefit of introducing sensors to existing facilities was analyzed against the investment cost.
- As a result of the analysis, the break-even point occurs after 24 years from the installation of the sensor and the return on investment increases significantly after 30 years.

Expecting effects of sensor installation

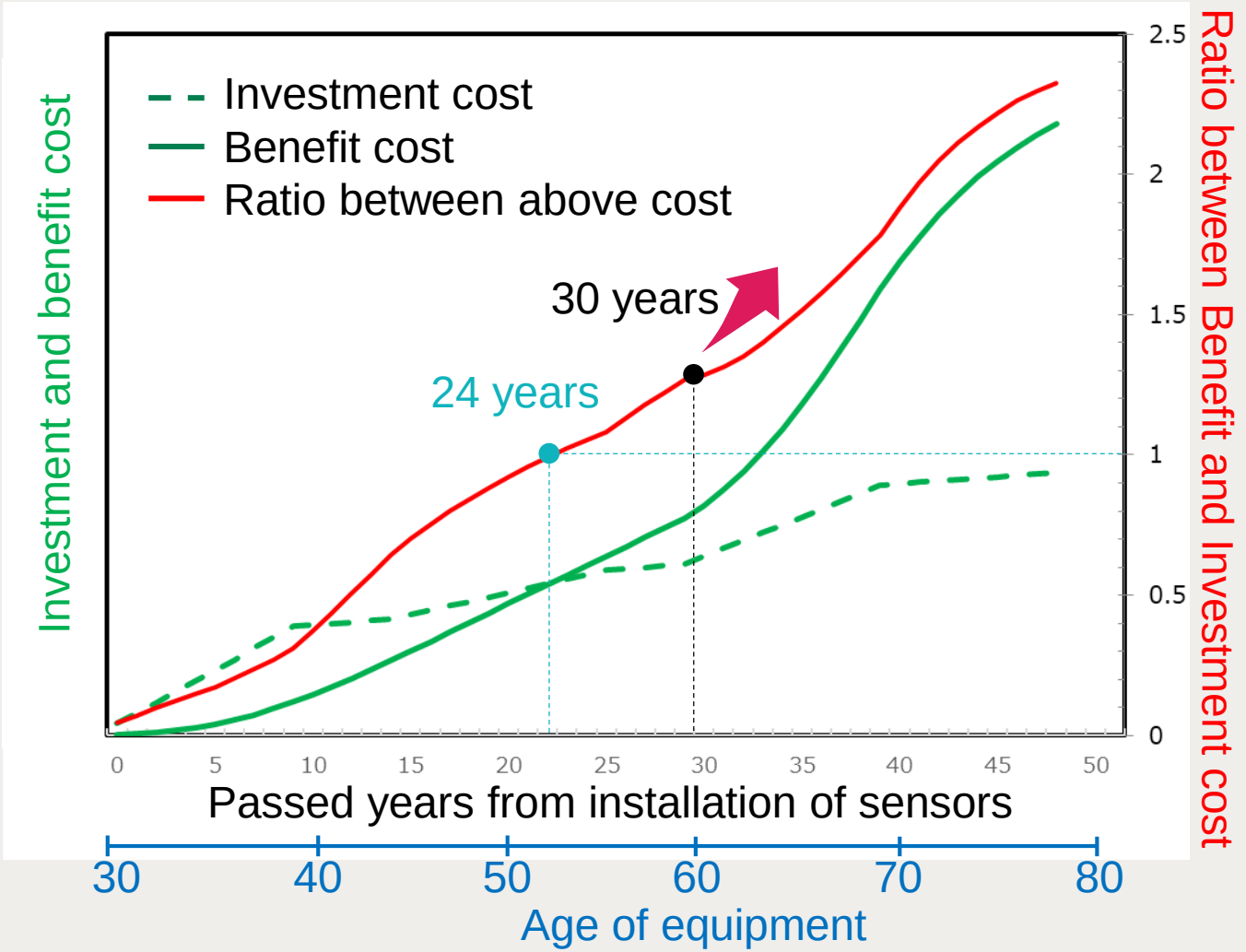
Equipment	Monitoring items	Sensor	Purpose		
			Degradation diagnosis	Life assessment	Efficiency of maintenance
GIS Overall	Gas pressure Slow leak	Gas pressure sensor Temperature sensor	✓		
GCB	Operating characteristics	DC clamp CT Travel sensor Auxiliary switch	✓	✓	✓
	Operation mechanism energy storage	DC/AC clamp CT Oil pressure sensor	✓	✓	
	Contact consumption	AC clamp CT	✓	✓	
DS/ES	Operating characteristics	DC clamp CT Operation check switch Temperature sensor	✓	✓	✓
OIT	Oil temperature	Temperature sensor	✓	✓	
	Oil level	Level sensor			✓
	Dissolved gas	Dissolved gas analysis unit	✓	✓	✓
Bushing	Partial discharge	PD sensor	✓	✓	
LTC	Driving torque	Torque sensor	✓	✓	✓

Cost-Effectiveness of investment based on estimation conditions

(Assumed Scenario)

- Mounting of sensors to equipment aged over 30 years
- Sensor repaired in 15 years, updated in 30 years
- Additional 10 years of service life prior to replacement (e.g., 60 to 70 years)
- Depreciation expense for 10 years included in the analysis
- Cost of data transmission is reflected
- Influence on societal benefits such as the avoidance of power outages is reflected

➢ The break-even point is 24 years from sensor installation and return on investment accelerates significantly after 30 years.



Conclusion and Future work

- A case study of the cost effectiveness for investment that introduces CBM sensors into existing facilities is presented.
- As a result of this analysis, the break-even point is 24 years from the installation of the sensors and the return on investment accelerates significantly after 30 years.
- In the future, the break-even point may occur even earlier by reduction of the investment cost via the use of general-purpose sensors and components to the greatest extent possible.

Thank you for you kindness.