ISO/IEC JTC 1 SC 42 Artificial Intelligence – Working Group 4

Use Case Submission Form

The quality of use case submissions will be evaluated for inclusion in the Working Group's Technical Report based the application area, relevant AI technologies, credible reference sources (see References section), and the following characteristics:

— Data Focus & Learning: Use cases for AI system which utilizes Machine Learning, and those that use a fixed *a priori* knowledge base.

— Level of Autonomy: Use cases demonstrating several degrees (dependent, autonomous, human/critic in the loop, etc.) of AI system autonomy.

— Verifiability & Transparency: Use cases demonstrating several types and levels of verifiability and transparency, including approaches for explainable AI, accountability, etc.

— Impact: Use cases demonstrating the impact of AI systems to society, environment, etc.

— Architecture: Use cases demonstrating several architectural paradigms for AI systems (e.g., cloud, distributed AI, crowdsourcing, swarm intelligence, etc.)

1. General

ID	(leave blank, for internal use)	
Use case name	Machine learning driven approach to identify the weak spots in the manufacturing of the circuit breakers.	
Application domain	Manufacturing	
Deployment model	Prototype	
Status	On-premise system	
Scope[1]	Detecting the issues in manufacturing process that leads to early failures of the circuit breakers through the data mining of the manufacturing process.	
Objective(s)[2]	To generate actionable intelligence to improve the manufacturing process of circuit breakers through mining of manufacturing related data.	
Narrative	Short description (not more than 150 words)	An approach was developed that can mine the manufacturing data of circuit breakers through multiple machine learning algorithms. The approach could successfully identify the weak spots in the manufacturing where failure rate jumped from 0.2% to 7% (35 fold more probability of failure) and hence candidates for improvement in the manufacturing process.

[1] The scope defines the intended area of applicability, limits, and audience.
[2] The intention of the system; what is to be accomplished?; who/what will benefit?.

	Complete description	High voltage circuit breakers are critical component of an electric circuit and it has a normal lifespan of 30-40 years. However, due to various reasons few circuit breakers fail within 0-5 years of operation. As a manufacturer of these circuit breakers, lots of data related to manufacturing aspects are present with the manufacturer. Such data has information about production lot size, material of production, design voltages for sub-components, heater voltages, date of failure etc. In general data related to 49 variables are captured for close to 56000 circuit breakers over a lifespan of several years. The manufacturer is interested to know if there are any weak spots in the manufacturing process which leads to higher failure rates. Circuit breakers can fail not only due to manufacturing defects but also due to wrong operation of the circuit breaker in the field e.g. applying voltages higher than design values. However, operational data of the circuit breakers was not available with the manufacturer. Therefore, the key challenge of this project was knowledge discovery with partial data set using machine learning algorithms. The data scientists applied various machine learning algorithms such as decision tree, random forest, support vector machine, Naïve Bayes classifier, logistic regression and neural network and compared the results of one algorithm verses the other algorithm. Through multiple numerical experimentations on data selection and algorithm hyper parameter tuning, the data scientist team selected the best algorithms and deduced the key weak spots in the manufacturing that are generally associated with high failure rates. In conclusion, the work provided a set of 5 actionable rules, where the failure rates jumped drastically from 0.2% to 7% leading to 35-fold higher chance of failure.		
Stakeholders[3]	Manufacturer of HV circuit breakers			
Stakeholders' assets, values[4]	Reliable and safe power supply to customers			
System's threats & vulnerabilities[5]	Incorrect use of AI/ML			
Key performance indicators (KPIs)	ID	Name	Description	Reference to mentioned use case objectives
	1	Ratio of ML discovered failure	What combination of manufacturing	Actionable intelligence to

[3] Stakeholder are those that can affect or be affected by the AI system in the scenario; e.g., organizations, customers, 3rd parties, end users, community, environment, negative influencers, bad actors, etc.

[4] Stakeholders' assets and values that are at stake with potential risk of being compromised by the AI system deployment – e.g., competitiveness, reputation, trustworthiness, fair treatment, safety, privacy, stability, etc.

[5] Threats and vulnerabilities can compromise the assets and values above - e.g., different sources of bias, incorrect AI system use, new security threats, challenges to accountability, new privacy threats (hidden patterns), etc.

		rate to nominal failure rate	processes/decisions leads to higher failure rates compared to nominal failure rate	improve the manufacturing process of HV circuit breakers
AI features	Task(s)	Classification		
	Method(s)[6]	Decision trees, SVM, ANN, Logistic Regression, Random Forest and Naïve Bayes		
	Hardware[7]	64 GB RAM Windows server		
	Topology[8]	NA		
	Terms and concepts used[9]	Classification, Actionable Rules, HV Circuit breakers		
Standardization opportunities/ requirements	Standardization of data representation models comprising of both manufacturing related data and end-use related data.			
Challenges and issues	Discovering actionable insight with partial data set and managing bias in ML models due to limited number of failed cases			
Societal Concerns[10]	Description	Safe and reliable power delivery		
	SDGs[11] to be achieved	Industry, Innovation, and Infrastructure		

[6] AI method(s)/framework(s) used in development.
[7] Hardware system used in development and deployment.
[8] Topology of the deployment network architecture.
[9] Terms and concepts used here should be consistent with those defined by Working Group 1 (AWI 22989 and AWI 23053) or to be recommended for inclusion.
[10] To be inserted.
[11] The Sustainable Development Goals (SDGs), also known as the Global Goals, are a collection of 17 global goals set by the United Nations General Assembly. SDGs are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.
URL: http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

References

References						
No.	Type	Reference	Status	Impact on use case	Originator/organization	Link
1	Conference	Kumar, S., K., Jamkhandi, A., G., and Gugaliya, J., K., Achieving Manufacturing Excellence through Data Driven Decisions, IEEE International Conference on Industrial Technology, Melbourne Australia PP 1267-1273	Presented in Feb 2019	Use case taken from this reference	ABB	Yet to be published