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Ingenuity for life

A diagnostic & corrective action system based on deep learning & natural language processing

Dr. Giuseppe Fabio Ceschini, Siemens Power Generation Services
Dr. Thomas Hubauer, Siemens Corporate Technology

Distributed Generation, Power Services Division: we monitor the range of Power, Oil & Gas and Industrial rotating equipment in 79 countries …

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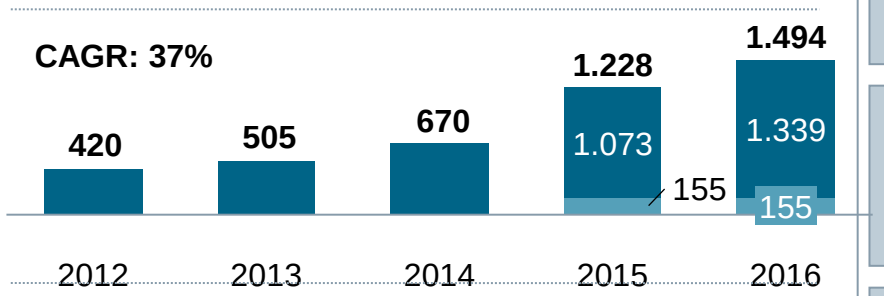
… to identify a potential problem before it impacts operation!

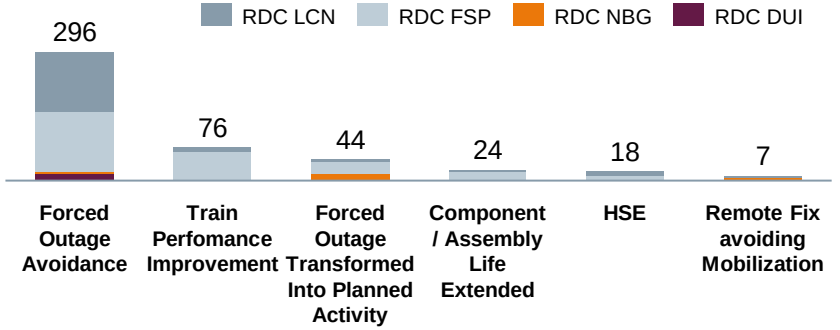
LTP coverage[1)] ~90%

Units under daily monitoring >350

 # number of units connected



Value for the customer (exemplary)



Installed fleet (units)

- >450 customers,
- >990 trains,
- >1,400 units

Setup

- 5 Remote Diagnostic Centers: Finspong, Lincoln, Warwick[2)], Nurnberg, Hengelo[3)]

Regionali-zation

- RSP operational
- Russia: Training ongoing
- Setup for China proposed

Industry Split (%)

- ~28% Industrial
- ~30% Power
- ~42% Oil and Gas

Combining the operational excellence of our customer with the in-depth OEM engineering knowledge we aim for maximizing the availability and reliability of our customer's installed base

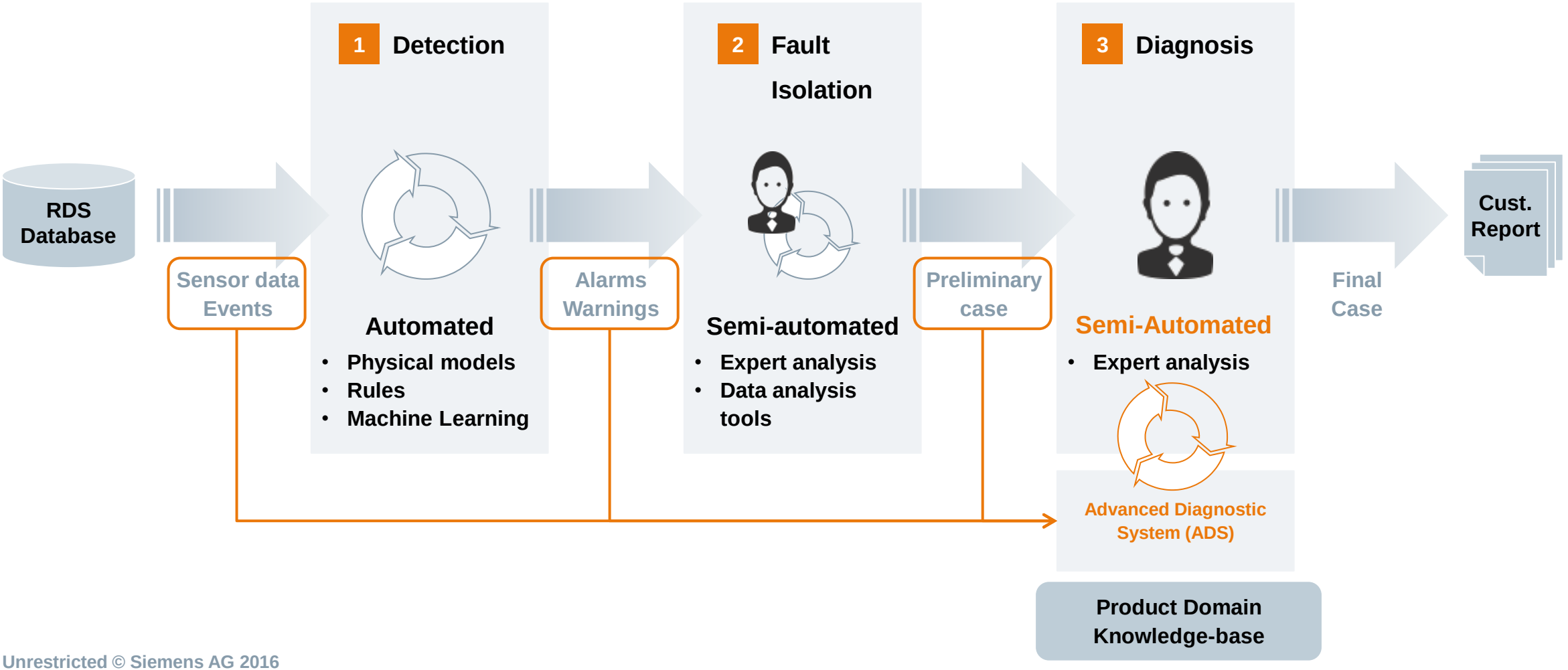
1) Level 2 and level 3 2) Integration on-going 3) D-R Integration started with HOU/DBG

SGT, MGT, IST & CMP AGT

Business Needs

- A huge organic growth of the Connected Fleet requires to enhance the capacity of our Remote Diagnostic Centers (RDCs) in every Product Competency Center
- Each Diagnostic Engineer will need to increase his capability to daily monitor his assigned units from 25 to at least 30, across the steps of:
  - Automatic Detection (assisted by on-line software)
  - Fault Isolation (also based on human-based experience)
  - Diagnosis and Short Term Recommendations to customers
- OEM‘s Product Domain know-how needs to be stored and easily accessible in libraries of homogeneous reference cases, that will have to be Retrievable, and Reusable or Revisable
- Those reference cases will become the knowledge basis for merging the Design Engineering approach with the Operational Troubleshooting mindset, which is typically a System Engineering mindset characterized by a „Cross-Discipline“ approach.
- Both Service Engineering (supporting LTPs and Maintenance Optimisation) and New Equipment Engineering (for continuous Product Optimisation and RCA process) will get benefit from this Advanced Diagnostic System (ADS). Regions will be better integrated in the Technical Community.

The “Advanced Diagnostic System” integrates easily with the Remote Diagnostic Service processes



ADS supports the diagnostic engineer by suggesting similar historic cases based on machine and text data

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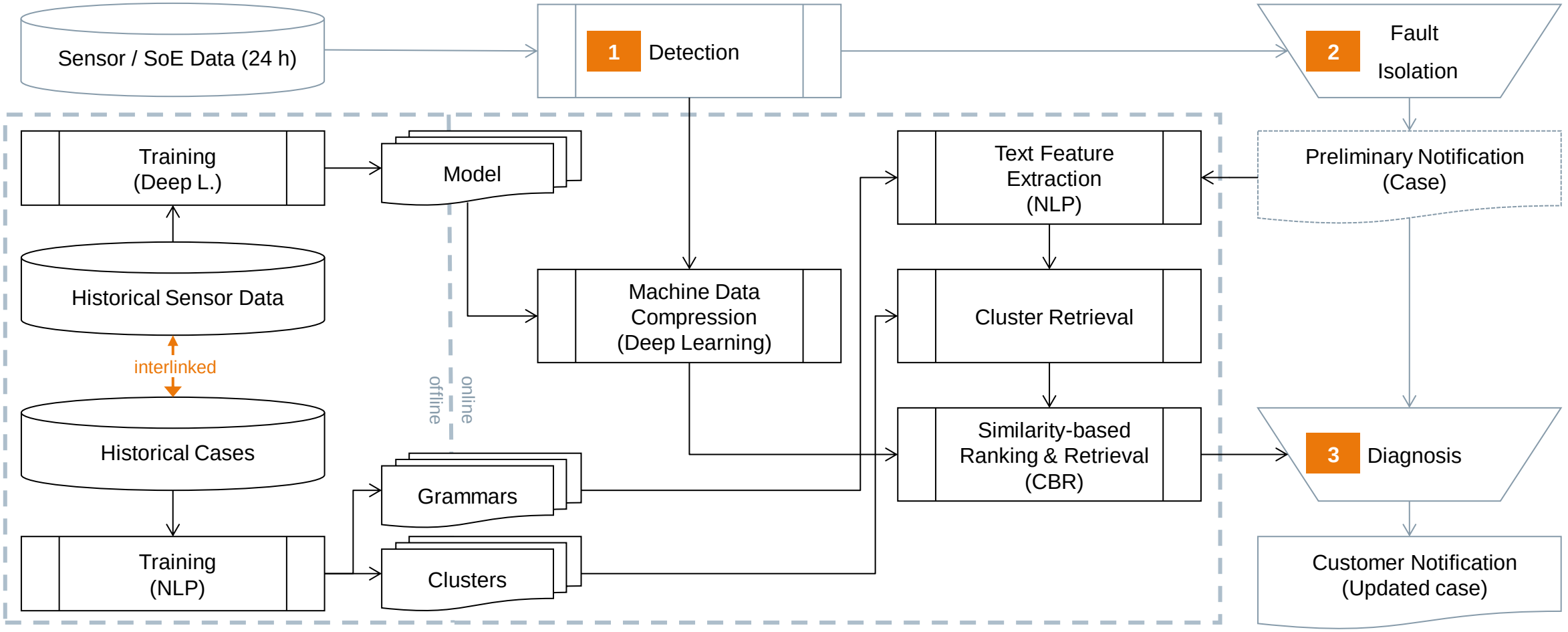
Solution overview



Deep neural networks are used to compress windows of sensor and event data into concise feature vectors

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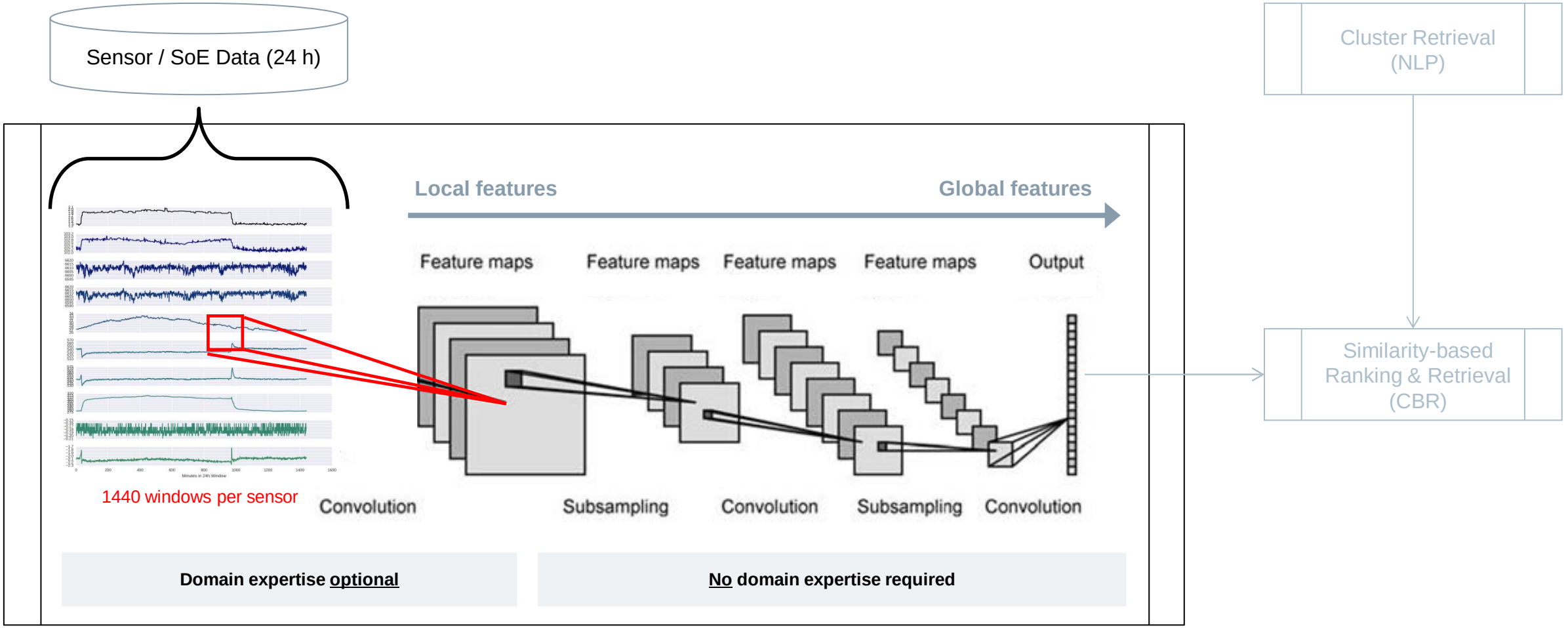
A closer look at Machine Data Compression



Natural Language processing uses grammars and domain-specific lexica to extract features from natural language tickets, and cluster them

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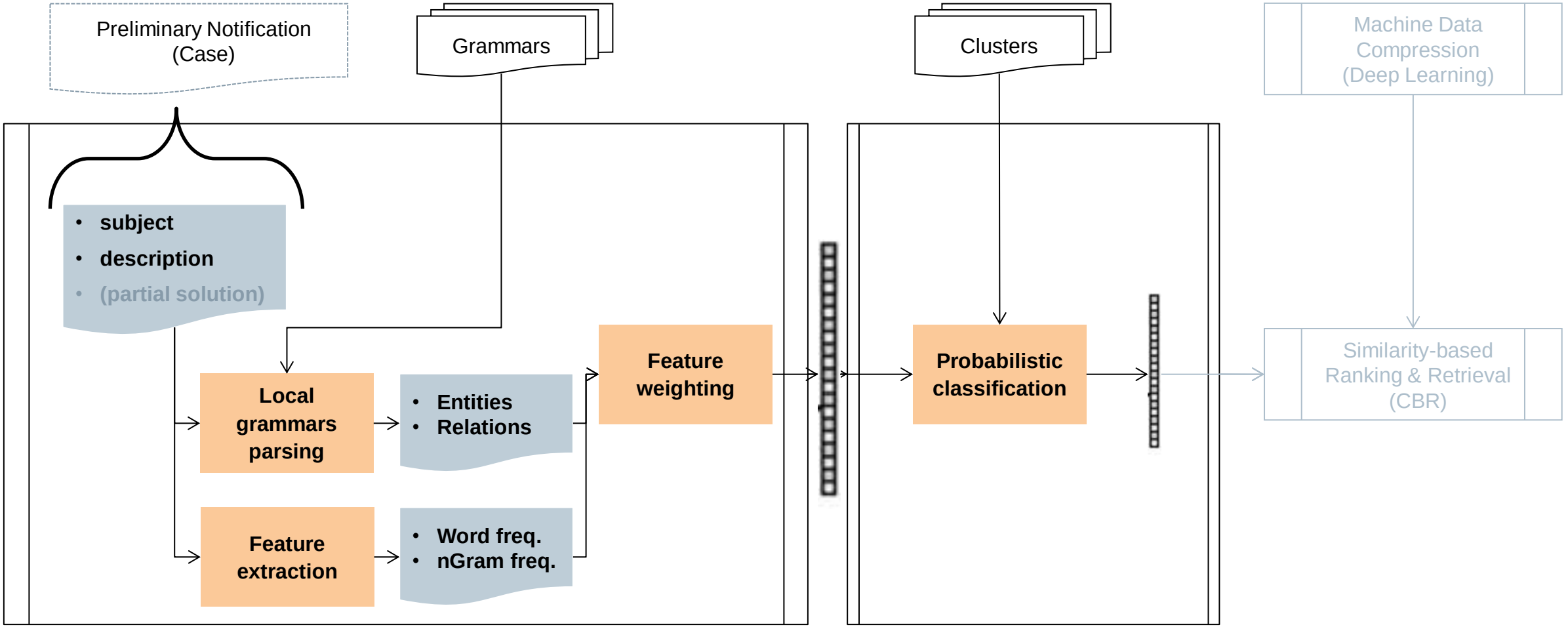
A closer look at Text Feature Extraction (NLP) and Cluster Retrieval



The solution is already deployed using a loosely coupled approach and caching for maximum flexibility and performance

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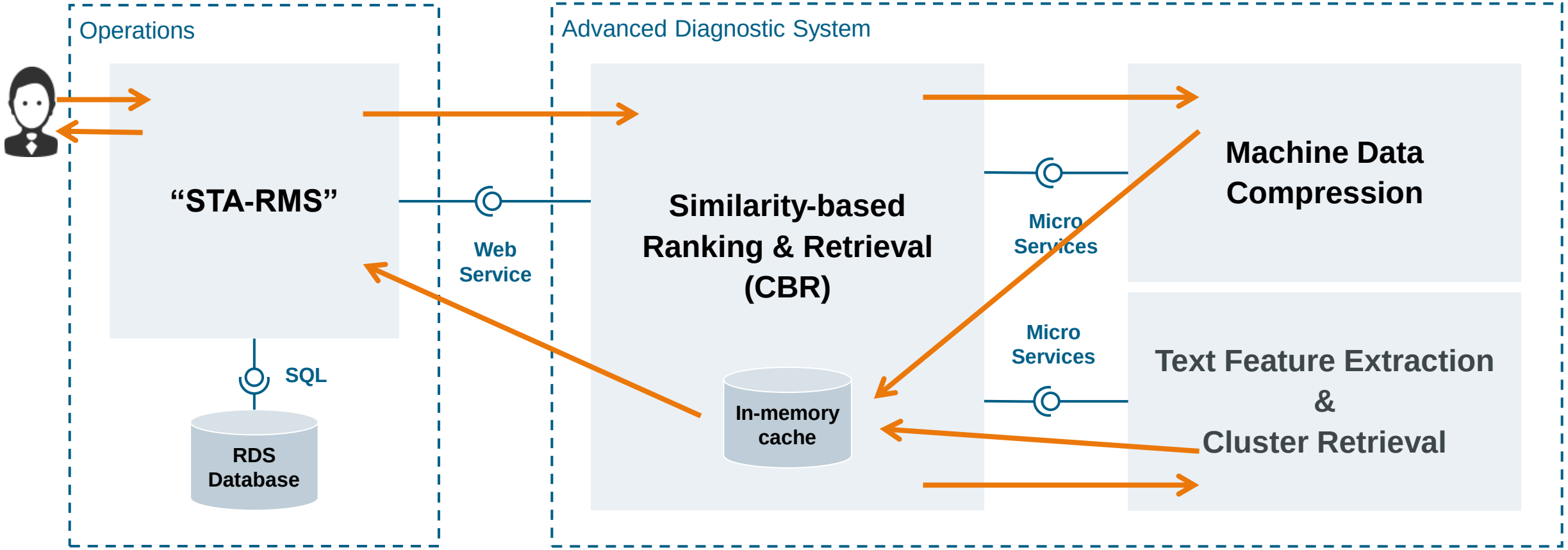
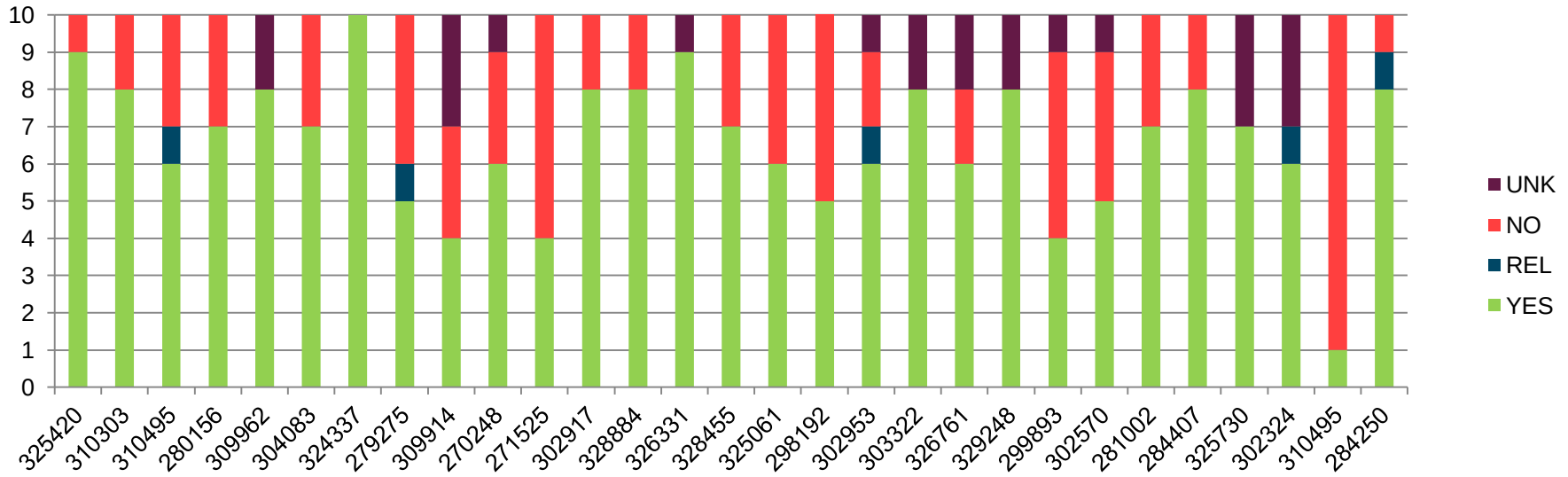
Deployment architecture



A first evaluation with experts shows promising results

Initial evaluation results

For **29 randomly** selected test cases**,** the expert was shown the **top 10 answers** only and asked to judge their helpfulness…



Success rate (29 test cases)	1 or more	2 or more	3 or more	5 or more	7 or more
YES	100% (29)	97% (28)	97% (28)	86% (25)	52% (15)
YES + REL	100% (29)	97% (28)	97% (28)	86% (25)	59% (17)

Advanced Diagnostic System, a continuous Improve Process

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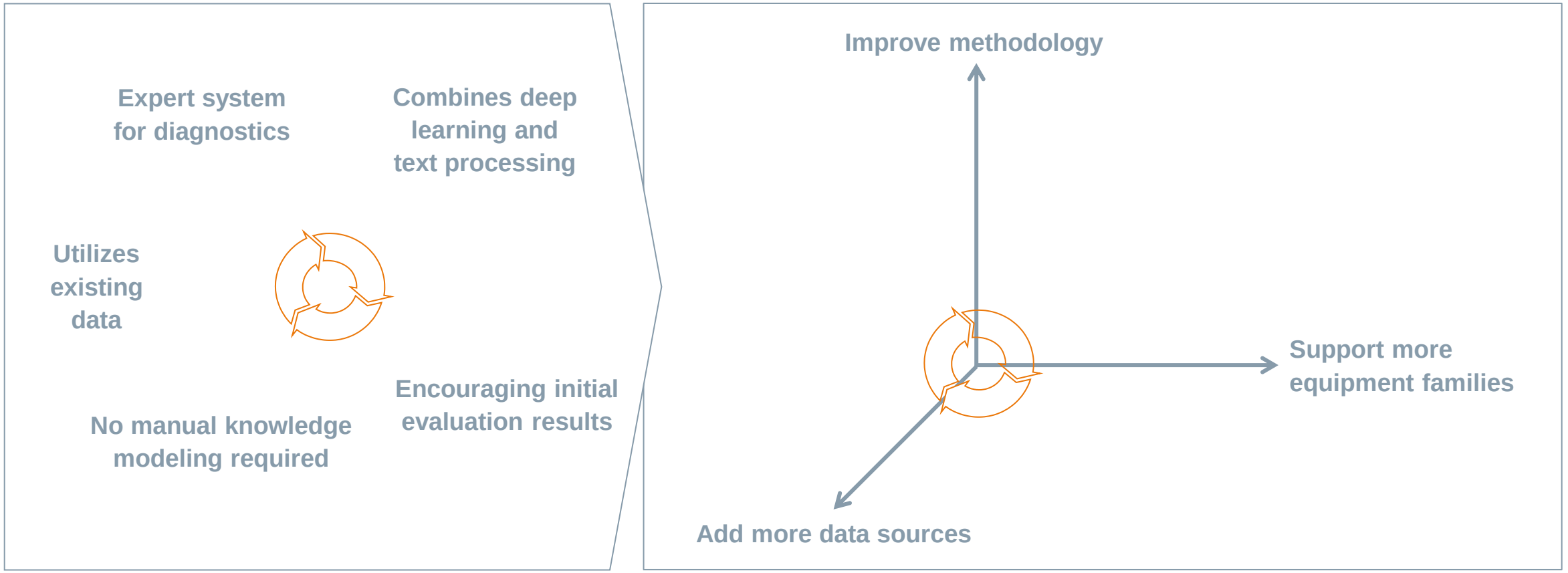
Conclusion and Outlook



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Thank you for your attention!

giuseppe.ceschini@siemens.com

thomas.hubauer@siemens.com

Any Questions