

# Artificial Intelligence supported P&ID-development

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## Motivation



- P&ID is the most important document of a plant
- Creating and maintaining P&IDs is a very time-consuming task

## Smart Engineering of P&IDs via Artificial Intelligence

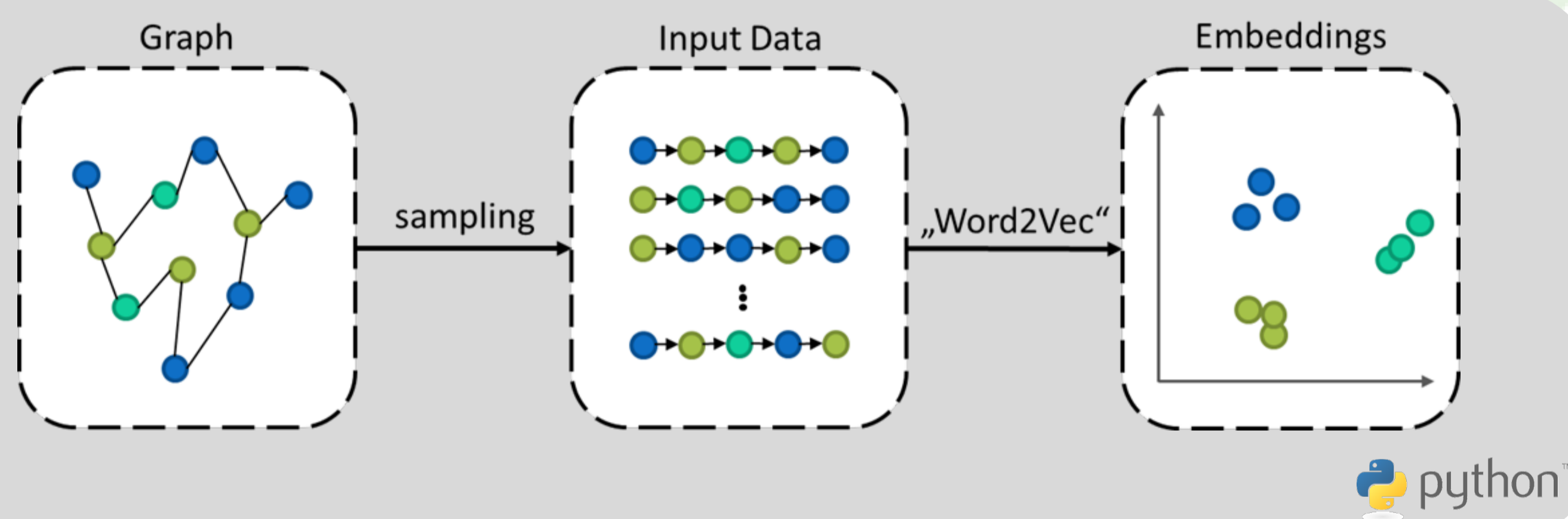
- Reuse patterns and design decisions based on previous projects
- Predict the next element(s) in the drawing
- Analyze consistency of existing P&IDs
- Continued learning based on design decisions



## Node2Vec<sup>[1]</sup>

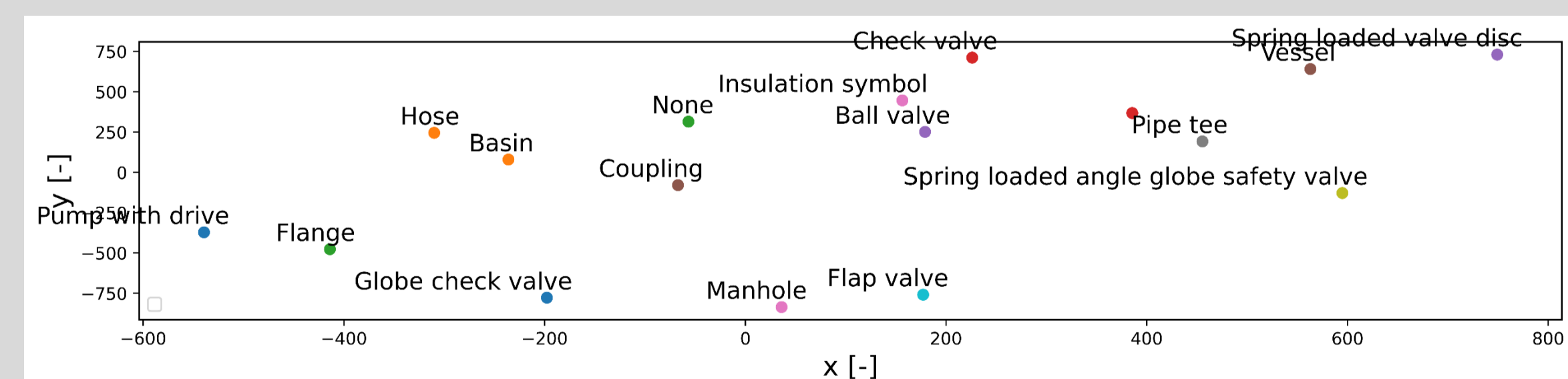
Vectorization of words can also be used for graphs using the Node2Vec<sup>[1]</sup> method.

- 1) Randomized transformation of graphs into sentences (sampling)
  - Random biased walk (max. walk length, walk parameters)
- 2) Representation of the graph in vector space by using Word2Vec<sup>[2]</sup>



## Conclusion

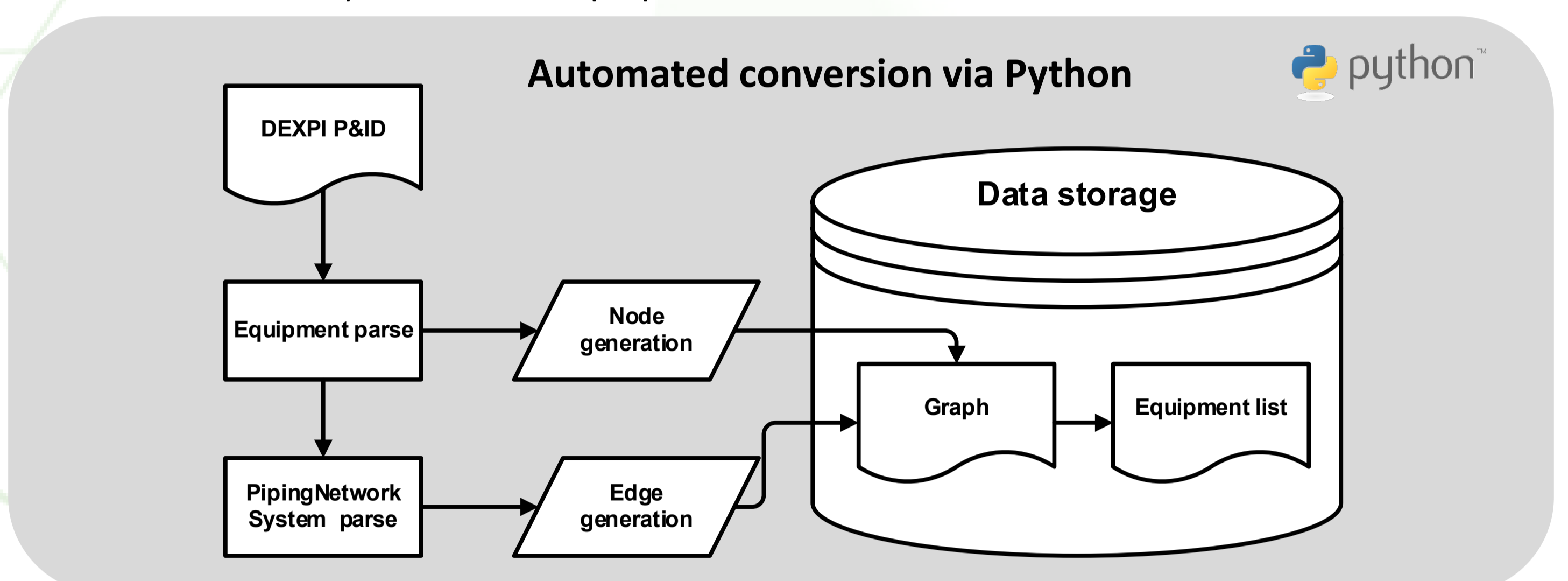
- Extraction of graphs from P&IDs (DEXPI) and representation via vector relations
  - First approaches show potential
  - Forecast of next equipments



- Training with 30 to 40 real P&IDs from the industry
- Currently, DEXPI files still contain many inconsistent designations that interfere with training

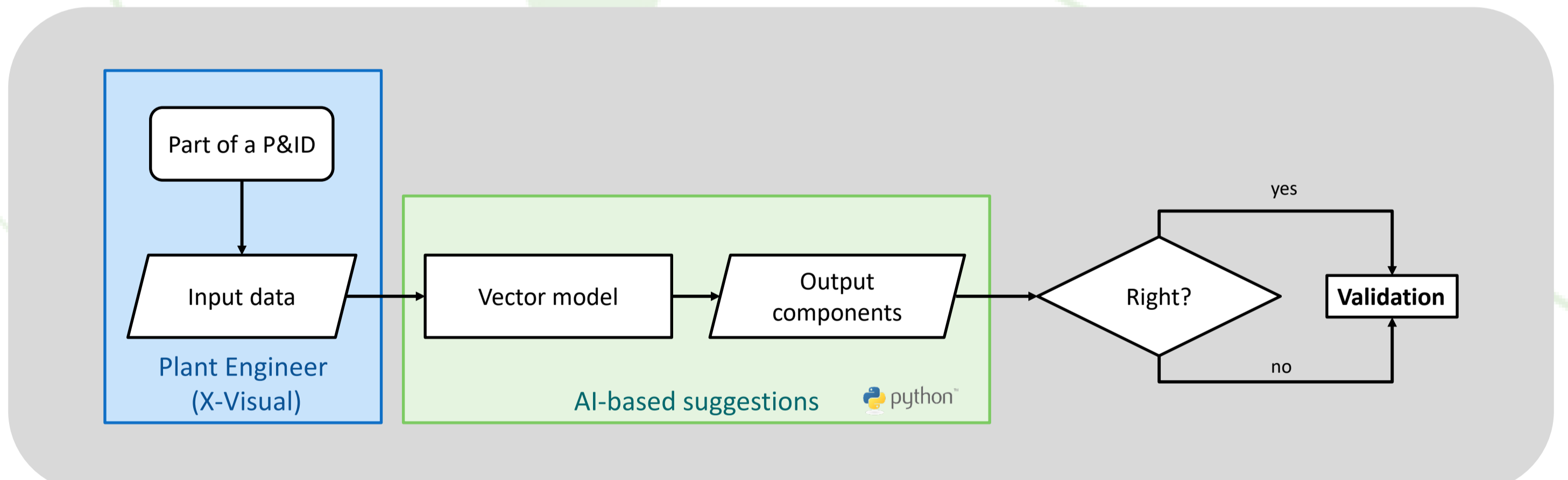
## DEXPI-to-graph

- Parsing of Nodes (Equipment / PipingComponent)
- Parsing of Edges (PipingNetworkSystem)
- Saving in data storage for further application
  - Graph
  - Equipment list



## Future: Forecast & Implementation

- Future implementation of the model into the P&ID-Software Plant Engineer (X-Visual Technologies GmbH)
- AI-based suggestions of shapes and connections based on the vector representation
- User feedback to validate the performance of the model



## Outlook

- Implementation of process instrumentation and control loops
- Consideration of recycles and bypasses
- Detection of equipment assemblies by analysis of subgraphs
- Integration in the P&ID-Software Plant Engineer (X-Visual Technologies GmbH)
  - AI-based drop-down menu for smarter drawing of P&IDs
  - Consistency check of the drawing in real time

[1] A. Grover et al., node2vec: Scalable feature learning for networks, 2016

[2] Mikolov et al., Efficient Estimation of Word Representations in Vector Space, 2013

### Contact