# Ontology Explorer: An Ontology-Based Visual Analytics System for Exploring Time Series Data in Oil and Gas

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## SUMMARY

Well-founded ontologies are a powerful tool to make apparent the semantics of the data that supports the decision-making process in surveillance environments.

Optimizing oil and gas production requires the right-time analysis of a large amount of data produced by several distinct data providers that adopt their conventions and formats.

The main contributions of this work are:
- Ontology Explorer, a new Visual Analytics system that leverages the concept of Ontologies in the interactive exploration of time series in digital twins.
- A case study that demonstrates an application of the Ontology Explorer in the oil and gas digital twins.

## REQUIREMENTS & ARCHITECTURE

R1. Display the time series associated with sensor data as line graphs, supporting individual plots, or composed plots that allow comparisons;
R2. Allow the user to define temporal filters to narrow the analysis to specific periods (months, days, and hours);
R3. Display the taxonomy of the ontology, allowing the user to hide, expand and inspect certain paths from the root of the taxonomy;
R4. Support a text query from the user that highlights in the taxonomy the class nodes that match the input query, summarizing at each node the count of children nodes returned by the query;
R5. Support selection of class nodes and inspection of their instances;
R6. Support navigation through semantically non-hierarchical associations such as components or properties;
R7. Support selection of one or more properties and the display of composed lineplots associated with the time series.
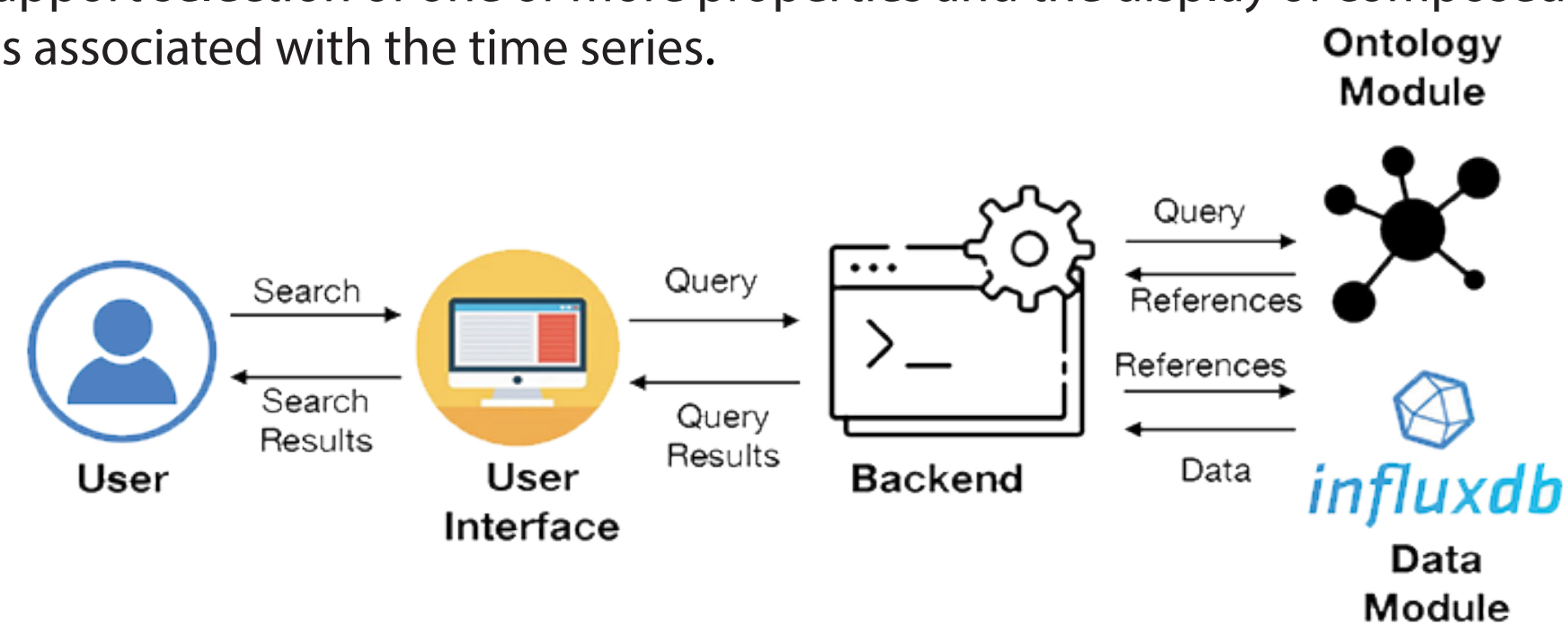


## CONCLUSIONS AND FUTURE WORK

- This work presents the Ontology Explorer, a visual analytics system for time series data in the oil and gas field, enhanced by the O3PO ontology to enable semantic interactive exploration of data.

- Leveraging the semantics of the domain, the tool allows users to filter data in terms that closely reflect the core business, relieving the extra burden of thinking about the way information is stored.

- Future work will focus on the ontological treatment of processes related to petroleum production (e.g., the event of injection loss), aiming to provide a similar semantic exploration of them. We plan to release a general version of the tool, allowing users to plug in their ontologies, provided they meet certain requirements, along with necessary documentation. Also, regarding the larger landscape of the PeTwin project (petwin.org), the prototype has been validated and is being installed for evaluation and improvement at the corporate partner while also being integrated with a data analytics & machine learning module.

## ONTOLOGY EXPLORER

### O3PO
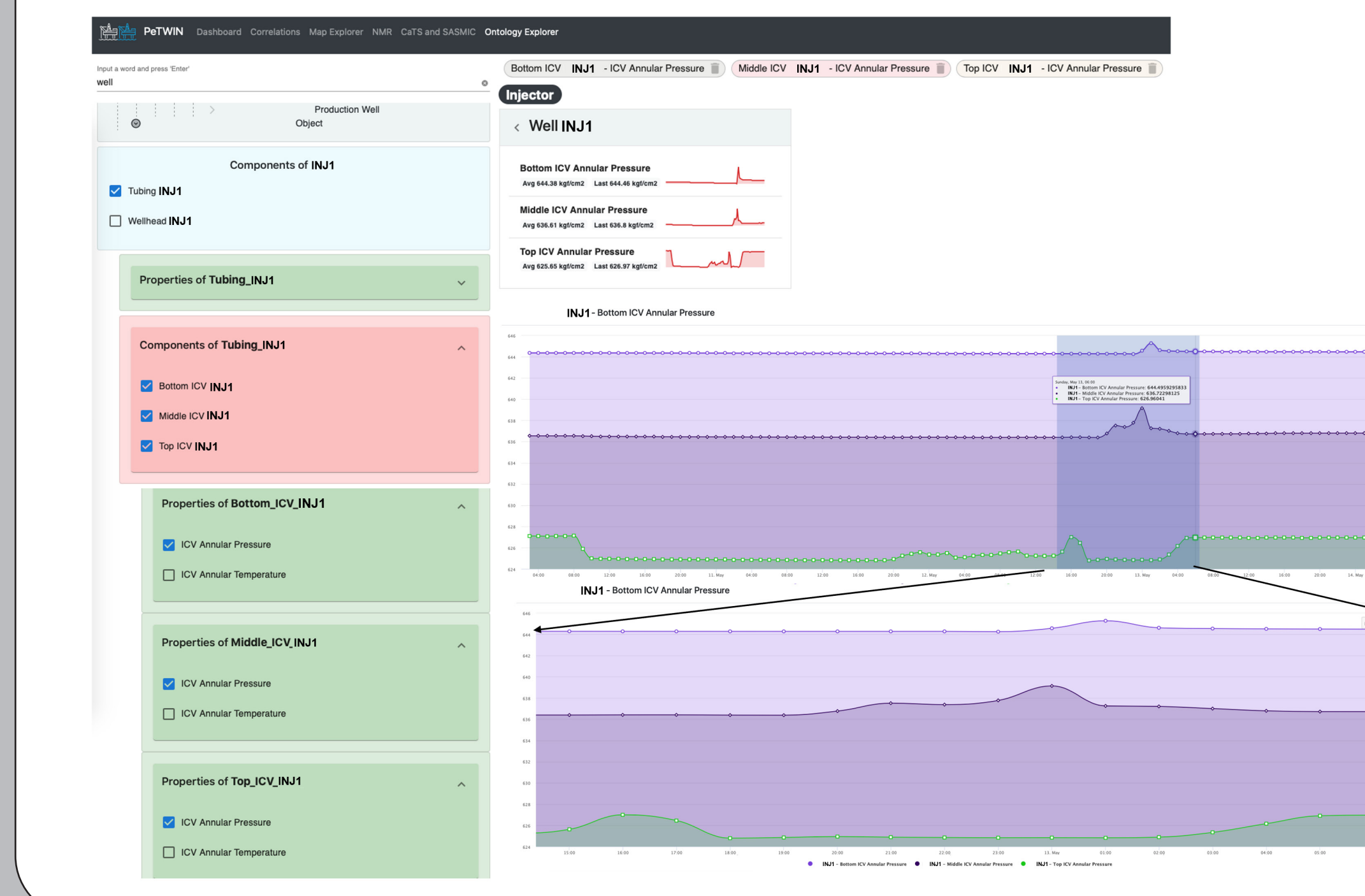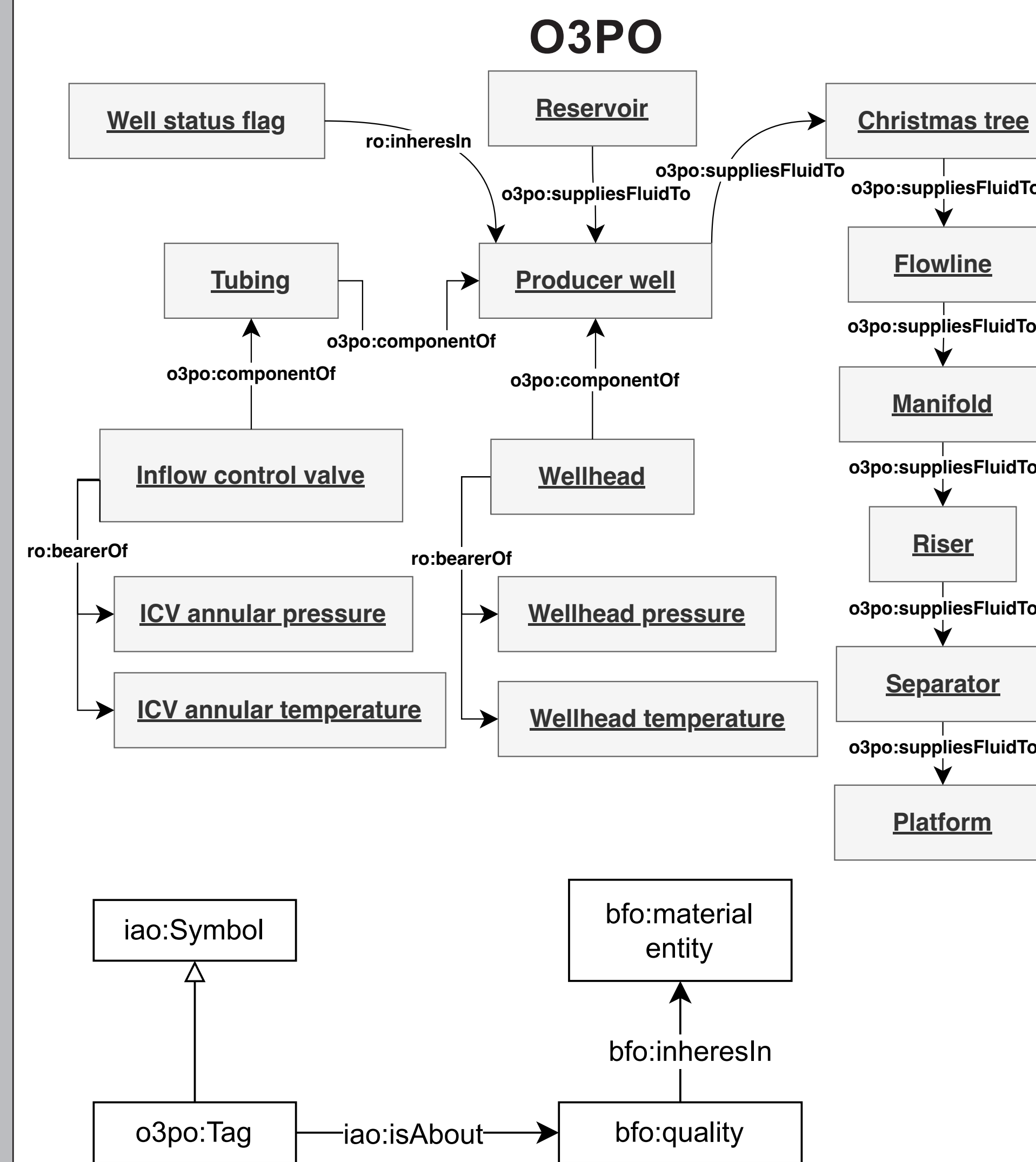


### Ontology Explorer



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2. Nicolau O. Santos, Mara Abel, Fabrício Henrique Rodrigues, and Daniela Schmidt. Towards an ontology of offshore petroleum production equipment. In Emilio M. Sanfilippo, Mohamed-Hedi Karray, Dimitrios Kyritsis, and Arkopaul Sarkar, editors, Proceedings of the 12th International Workshop on Formal Ontologies meet Industry (FOMI 2022) Co-located with workshops about the Industrial Ontology Foundry (IOF) and the European project OntoCommons (EU H2020 project), Tarbes, France, September 12-15, 2022, volume 3240 of CEUR Workshop Proceedings. CEUR-WS.org, 2022.

3. Nicolau Santos, Fabrício Rodrigues, Daniela Schmidt, Régis Romeu, Givanildo Nascimento and Mara Abel. O3PO: A Domain Ontology for Offshore Petroleum Production Plants. Available at SSRN: https://ssrn.com/abstract=4280151 or http://dx.doi.org/10.2139/ssrn.4280151.

## ACKNOWLEDGMENT