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APLICADA À INDÚSTRIA
DO PETRÓLEO

Digital Twins as a Platform For Artificial Intelligence in the Petroleum Supply Chain

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The SIRIUS Centre

Eight years' financing from RCN
14 Industrial Partners (11 in 2017)
5 Leading Academic Institutions
Centre for Research-Based Innovation
Funding for 20 Ph.D. students
Innovation through prototypes and pilots
50 affiliated researchers

equinor
Schlumberger
SAP
IBM
DNV·GL
EVRY
Dolphin
NUMASCALE BIGGER DATA ANALYTICS
KADME Knowledge and data management expertise
OSIsoft.
aibel
TechnipFMC
computas
AkerSolutions

UiO : University of Oslo
simula
SINTEF
NTNU Norwegian University of Science and Technology
UNIVERSITY OF OXFORD DEPARTMENT OF COMPUTER SCIENCE

Research programs build a foundation for …

Analysis of Complex Systems

Ontology Engineering

Semantic Integration

Data Science

Scalable Computing

Industrial Digital Transformation

… Beacons addressing industry challenges

Geological Assistant

Integrated Digital Planning

Subsurface Data Access & Analytics

Digital Twins

Digital Field & Reservoir Management

Digital Field Development

Personalized Medicine

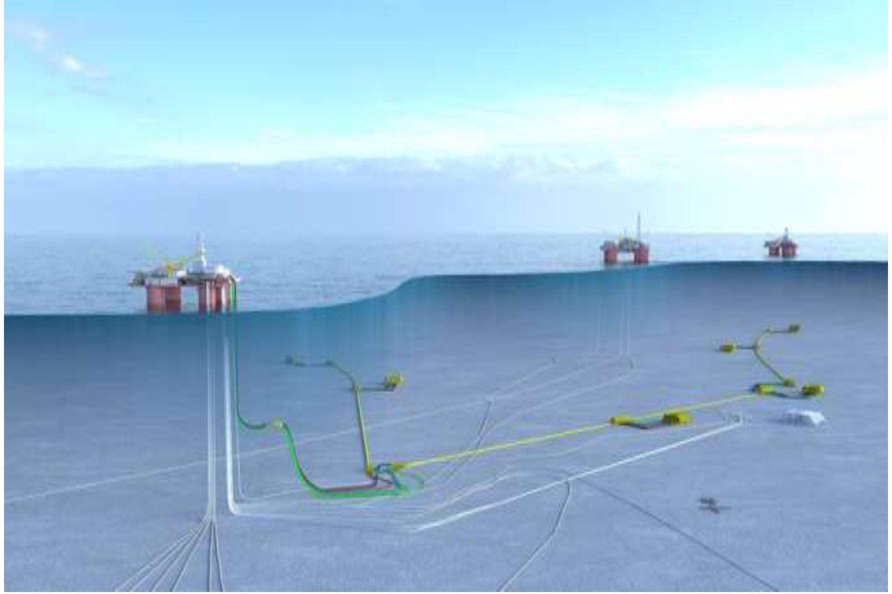
Environmental Applications

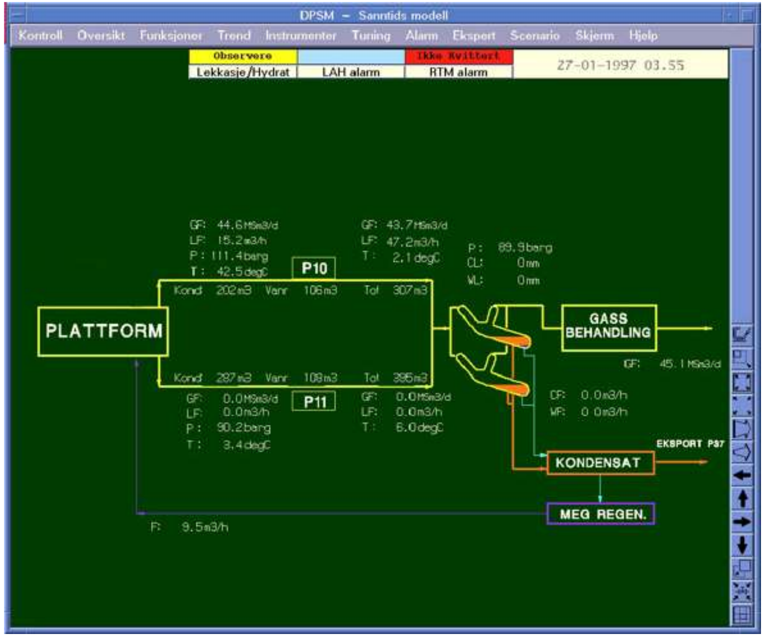
What is a digital twin?

"An integrated multi-physics, multi-scale, probabilistic simulation of an as-built system, … that uses the best available models, sensor information, and input data to mirror and predict activities/performance over the life of its corresponding physical twin."

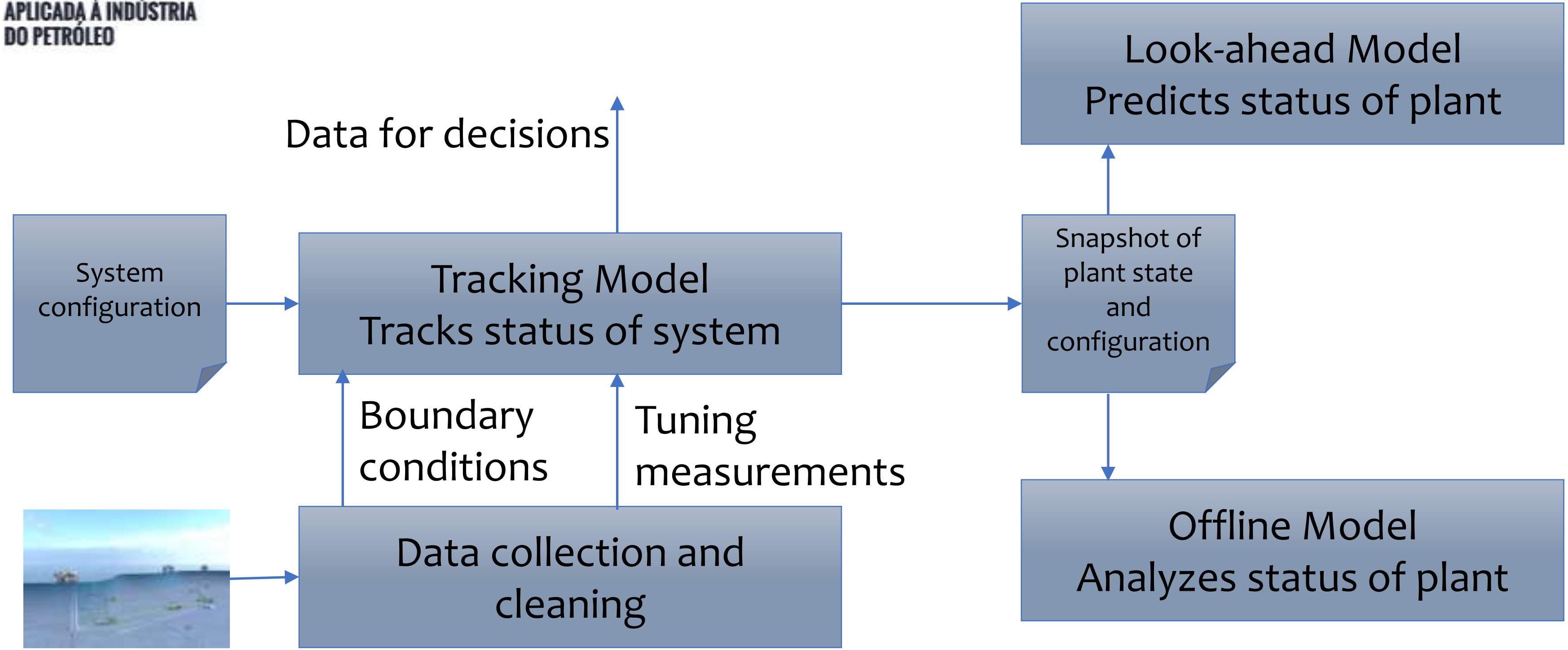
www.dau.mil/glossary/pages/3386.aspx

A digital twin success story: on-line flow assurance

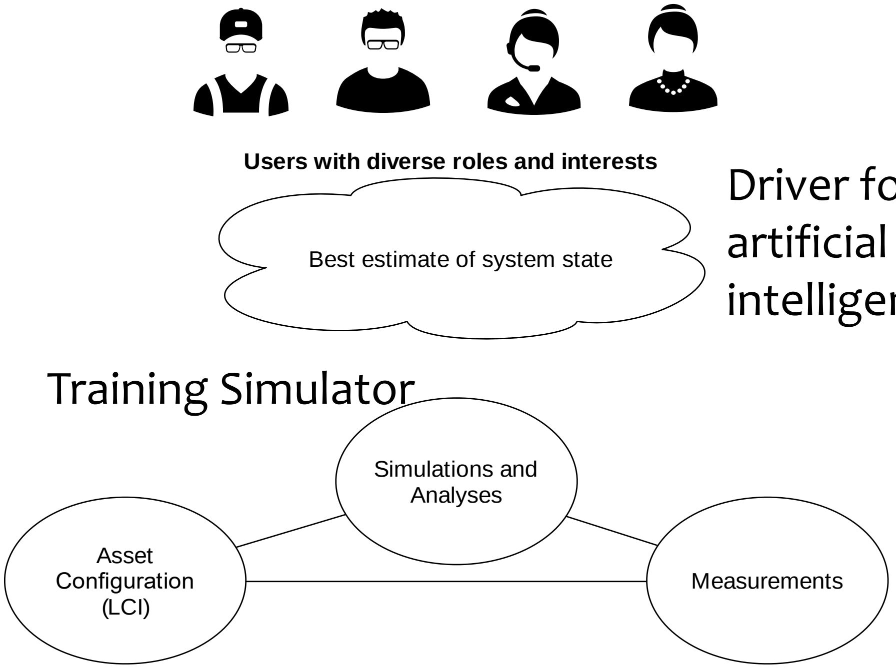




How a simulation digital twin works



A conceptual framework for twins



Driver for artificial intelligence!

Training Simulator

3D viewer

Glorified SCADA

Current and planned twin applications

- Established practice
  - Flow assurance twins
  - High-quality visualization of operational data with 3-D model of facility
- Commercial but novel
  - On-line top-side operations simulators for prediction and data reconciliation
  - Structural and other special-purpose twins
- Future
  - Whole field twin: reservoir, flow assurance and top-side in interaction
  - Integrated twin along asset lifecycle and product lifecycle

Today’s twins are bogged down in virtual paper!

Demands

from regulators

from company

from partners

Operating procedures

Operations and optimization

Design rules

Requirements

Digital twin

As built

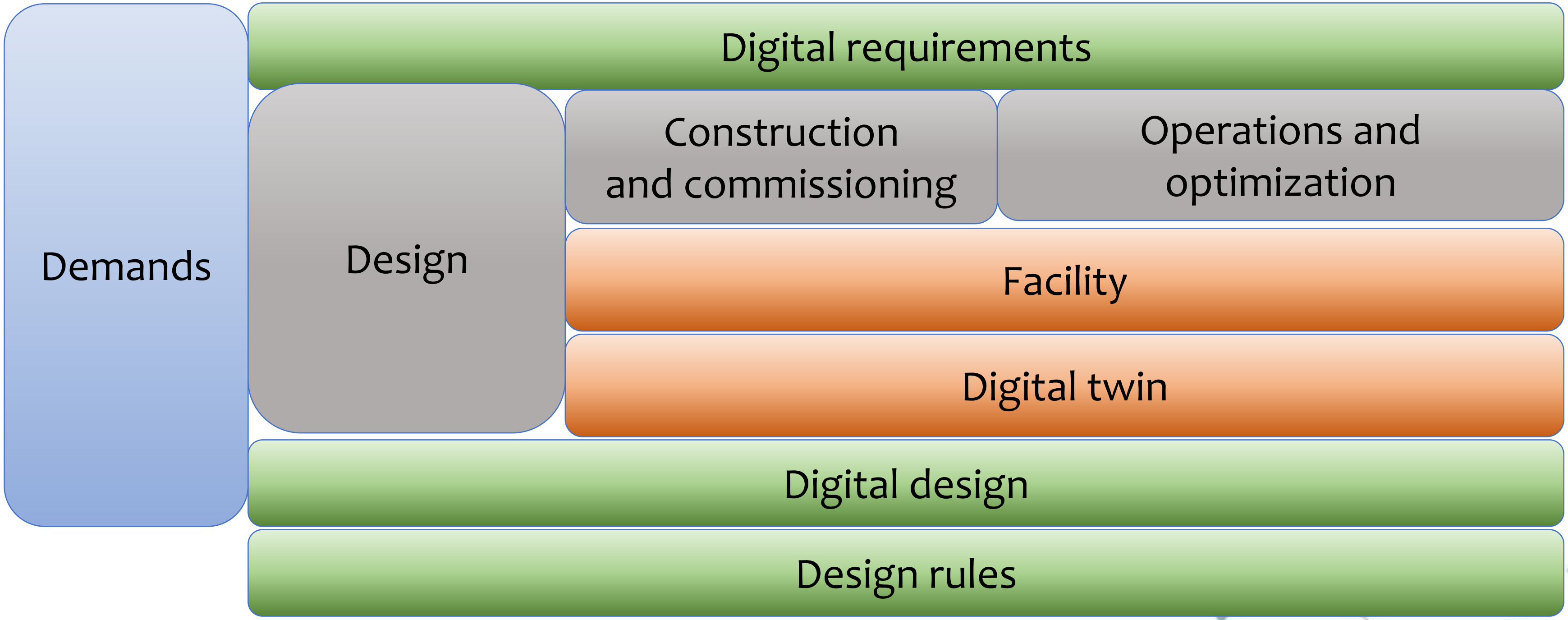
Design

Construction and commissioning

Facility

Design basis

A vision for digital twins in 2024



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What would this mean for a complex offshore field (such as Libra)?

Integration

Maintenance

Business models, security and confidentiality

Work practices

Scope

Usability

Computational power: edge and cloud

Neutral data format

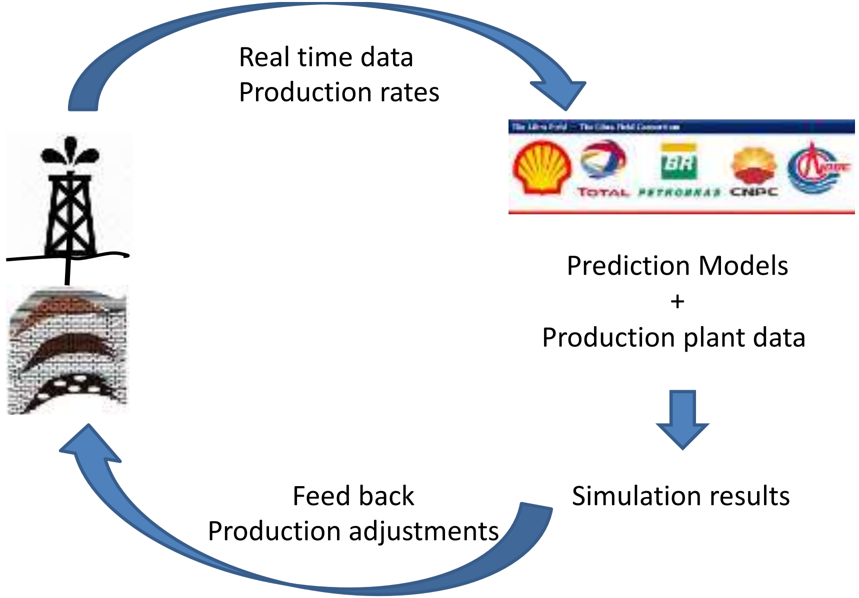
Uncertainty, validation and data science

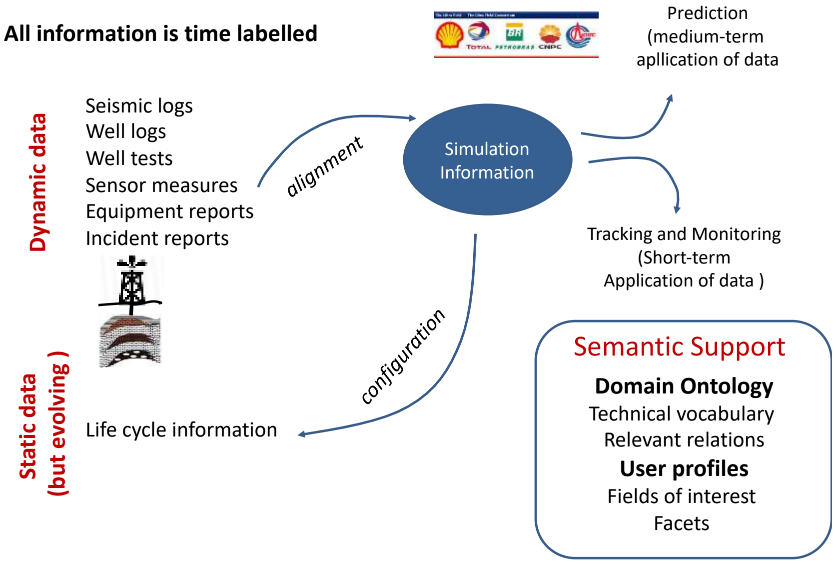
PeTWIN: Whole-field digital twins for production optimization and management

Petromaks/FINEP Project: 2020-2023

28M kr project sponsored by Research Council of Norway, FINEP, Equinor, Shell and Petrobras

The problems to be addressed

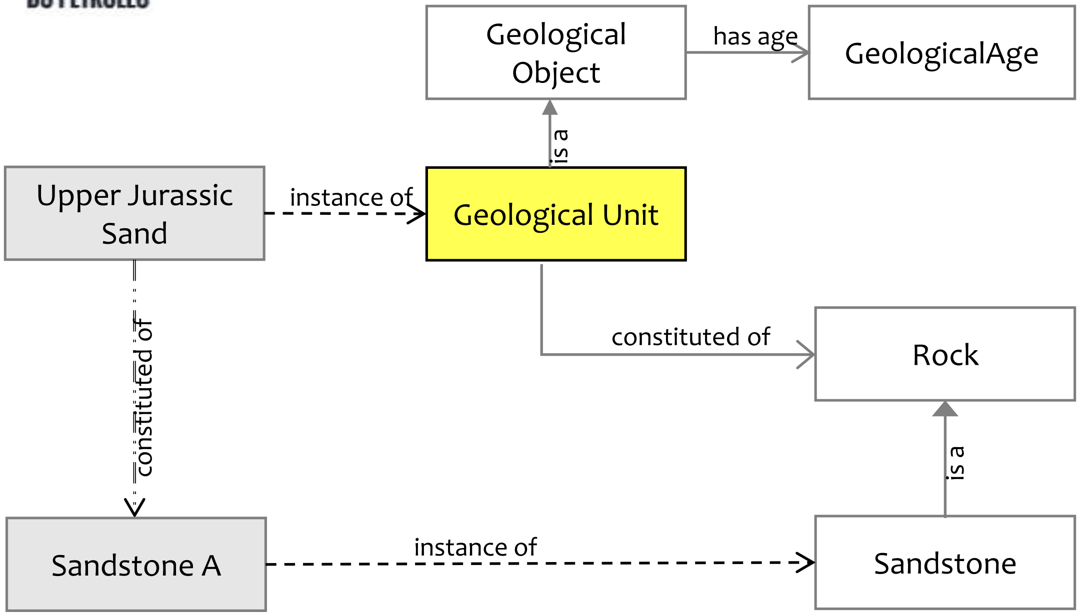


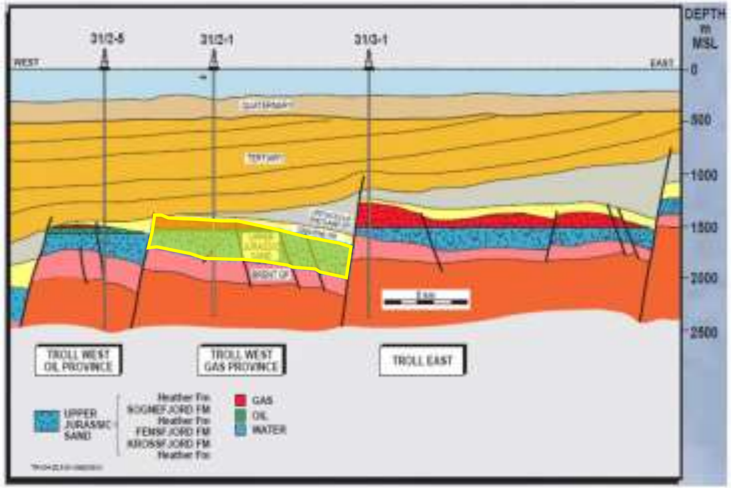


Impact

From…	To…
Unclear and hyped	Robust, research-based best practice
Point-to-point, ad-hoc integration	Model-driven integration
Multiple applications in silos	Integrated applications
Vendor lock-in	Standards-based interoperability
Ad-hoc and manual change control	Lifecycle model for change control
Data science and machine learning is hard to scale	DSML is automated and supported by models
Semantic models are hard to build	Engineers and geologists can build models
Separate user interfaces	Standard, semantic user interfaces
Integration in a data lake	Data is kept where it is most useful
On-site deployment	Best possible deployment
Small-scale academic projects	Realistic oil and gas systems.

Building on Conceptual Models





Structural cross section and distribution of hydrocarbons through Troll Field
(Johnsen et. al., 1995).

What we will deliver

- Common semantic models of subsurface, facilities and lifecycle that can be used for data integration and governance.
- Prototype tools for:
  - Integrating and maintaining digital twins
  - Building and maintaining semantic models
  - Visualizing and analysing data in the twin.
- Demonstration and minimum viable product on company examples.
- The book about oil and gas digital twins.

Acknowledgements

The SIRIUS partner companies.

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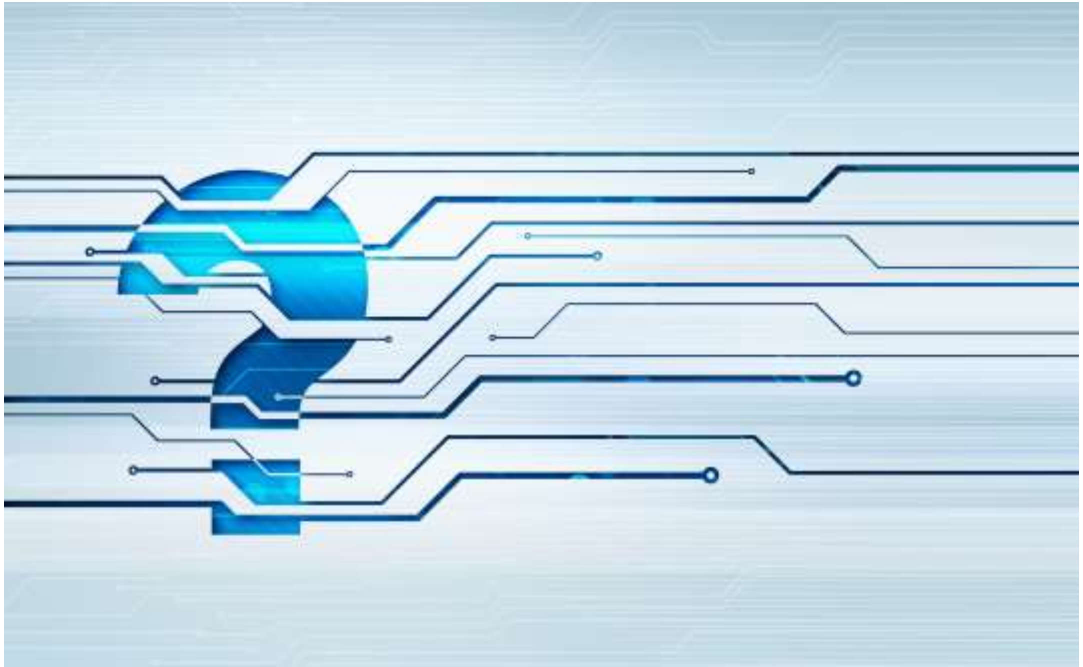
Brazilian Agencies

CAPES CNPq



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