

R&D Digital Solutions

Overview

Data Science & Data
Engineering

Process Optimization
and Operations
Research

Chemometric
Modelling

Process Control and
Modelling



As the Digital Solutions Team at
Tüpraş R&D,

*«We develop integrated and cognitive
solutions to enhance efficiency and
profitability while ensuring **safe,**
sustainable, and **responsible**
production.»*



Our Strategy Pillars

- ✓ Environment
- ✓ Efficiency
- ✓ Safety
- ✓ People
- ✓ Cost

R&D Digital Solutions

Products & Technologies



Digital Twins & Predictive Maintenance



Industrial AI and ML Solutions



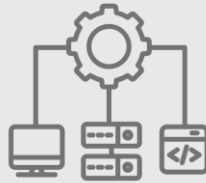
Decision Support & Agentic Development



Optimization



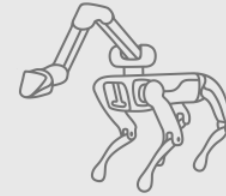
General Automated Monitoring and Reporting



Integrated Infrastructure & MLOps



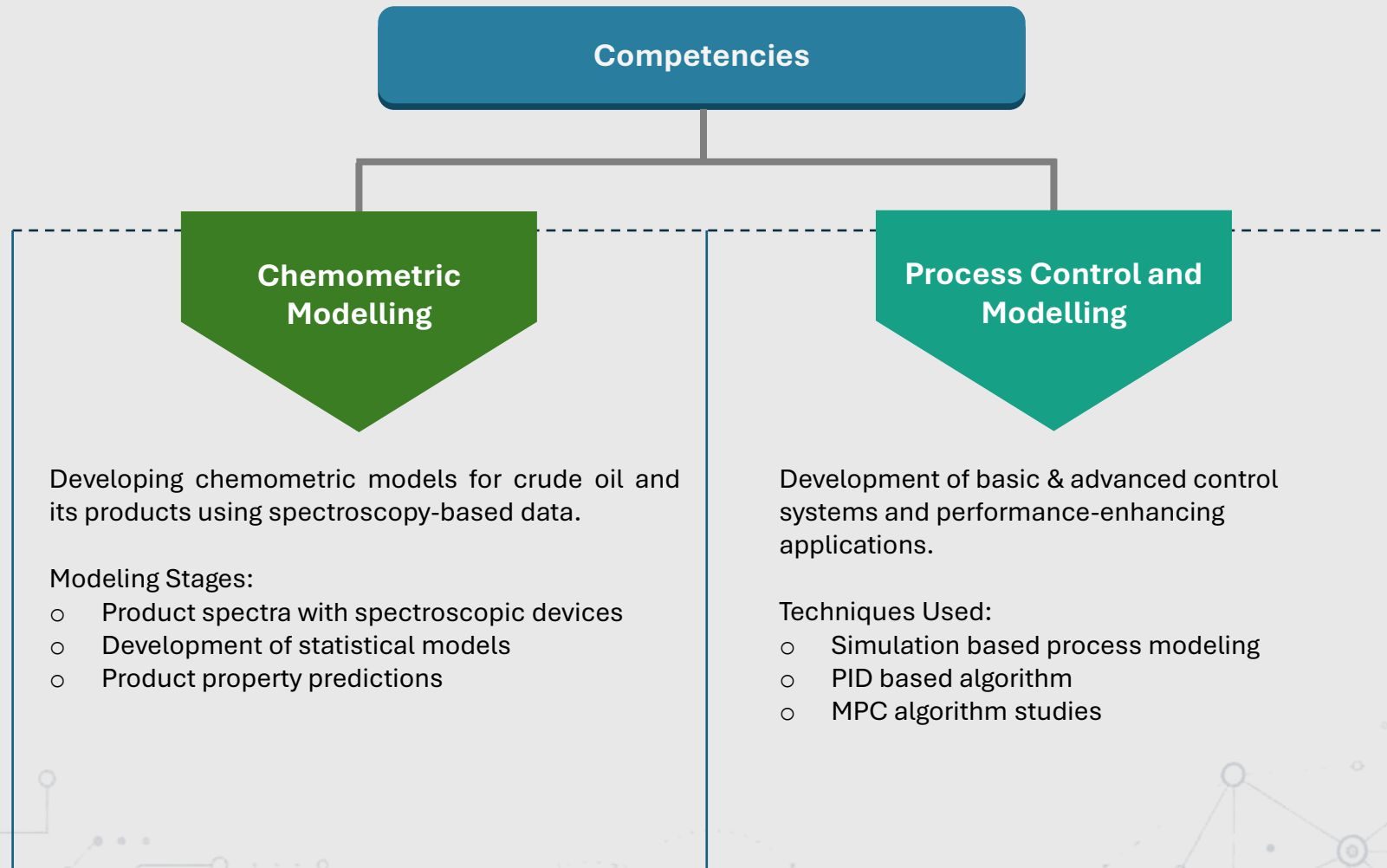
Sensors and Soft Sensors



Deployment of Commercial Robotic Solutions

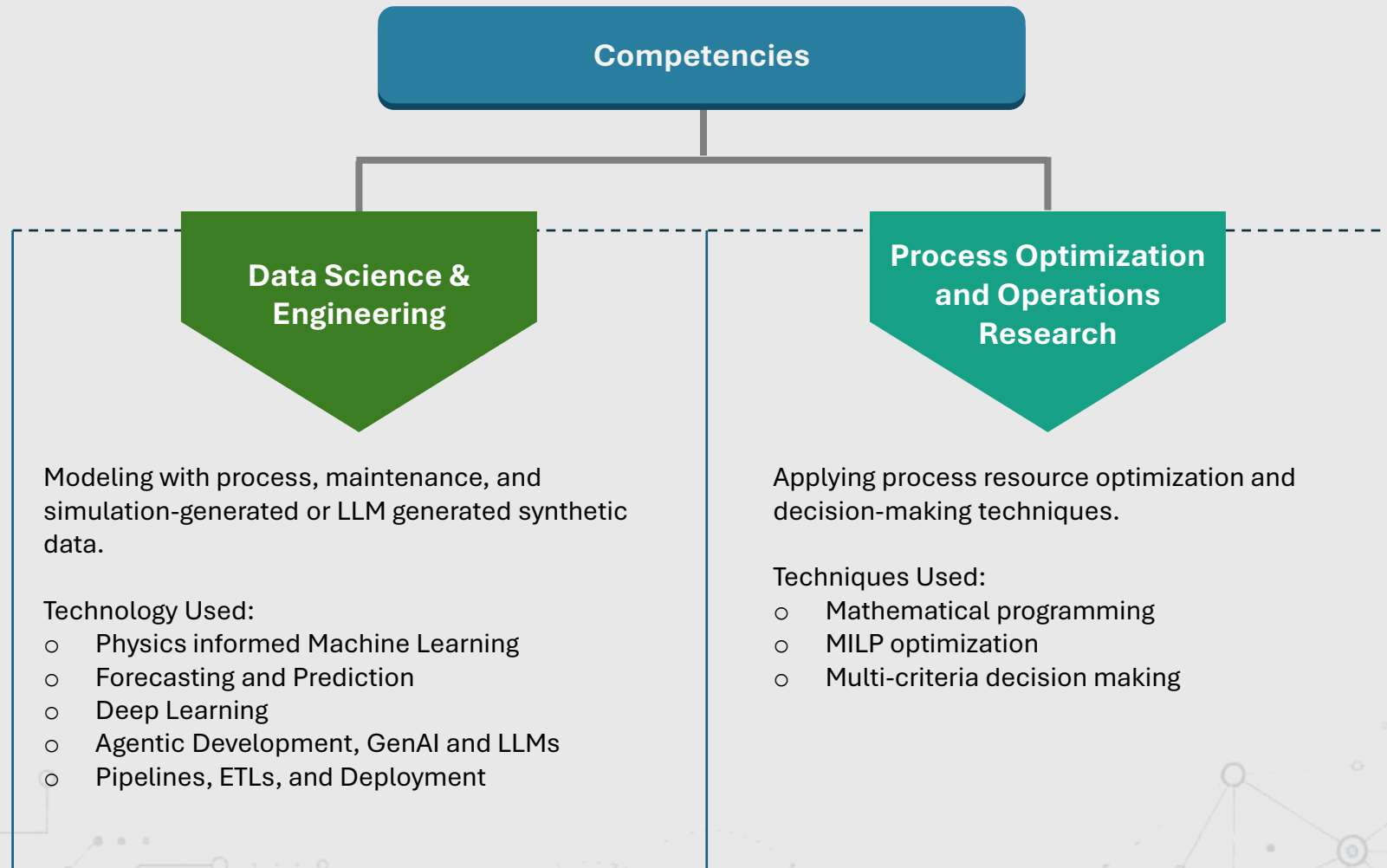
R&D Digital Solutions

Research Fields



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Research Fields



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Publications

~30 peer-reviewed papers, conference contributions and theses (2016–2026) spanning all four research fields.

Data Science & Engineering

- Physics-informed neural network modelling of an industrial wastewater treatment unit
- Deep-learning soft sensors: suspended solids and dissolved-oxygen forecasting
- Machine learning for sustainable energy, biochar and biofuel production
- Venues: Computer Aided Chemical Engineering, IFAC-PapersOnLine, Chemical Communications, Fuel

Process Optimization & Operations Research

- Optimization of scheduling of crude oil operations
- Exergy analysis of a vacuum distillation unit
- Optimization of the LPG pool of a refinery and feedback fault diagnosis using machine-learning based soft sensors
- Venues: Chemical Engineering and Processing, Computer Aided Chemical Engineering, Electrical, Computer and Energy Technologies

Process Control & Modelling

- Self-optimizing control applied to a real heat exchanger network
- Control-loop performance monitoring via disturbance characterization
- Spectral envelope method for multi-cause diagnosis with industrial data
- Real-time feedforward decision support and sulphur recovery unit modelling
- Venues: IFAC-PapersOnLine, Computer Aided Chemical Engineering, International Journal of Petroleum Research

Chemometric Modelling

- Machine-learning assisted optimization of an industrial visbreaker plant
- FTIR-based quality prediction and monitoring of gasoline in blending
- Hydrocarbon composition of naphtha and properties of CDU products
- ATR-FTIR classification and oxide-thickness determination methods
- Venues: Light Metals, Food Chemistry, SSRN, academic theses

R&D Digital Solutions

EU Funded R&D Projects

25 European Union funded R&D projects – 18 completed and 7 on-going – delivered with international consortia.

On-going Projects (7)

- **FuelUp**, **ICO2NIC** and **SunFusion** – sustainable fuels, CO₂ valorisation and solar-driven processes
- **FLEXIndustries** and **IS2H4C** – industrial flexibility and symbiosis hubs for circularity
- **HERMES** and **Eastern Lights** – hydrogen purification and regional clean-energy collaboration
- Focus: decarbonisation, energy flexibility and circular refinery operations

Completed – Digitalisation & Efficiency

- **FUDIPO** and **FACTLOG** – process diagnostics, digital twins and cognitive plant models
- **CitInES** and **Indus3Es** – energy system modelling and industrial waste-heat upgrading
- **safeAST** and **iPerm** – asset integrity, inspection and safety technologies

Completed – Carbon, Catalysis & Circularity

- **BiZeolCat**, **CO2MOS** and **MOF4AIR** – catalytic conversion and CO₂ capture routes
- **MACBETH** and **BAMBOO** – membrane reactors and energy-intensive process efficiency
- **CORALIS** and **EBIO** – industrial symbiosis and bio-based value chains

Completed – Water, Materials & Monitoring

- **AquaSPICE** and **INTEGROIL** – water reuse and treatment in refinery operations
- **Hydroptics** and **EPC-EqTech** – advanced optical sensing and monitoring technologies
- **ACHIEF** – high-performance materials and solutions for energy-intensive industries

R&D Digital Solutions

Where We Fit in the Consortium

Refinery-scale demonstration scenarios and digital work packages we can lead or contribute to as a consortium partner.

Demonstration Scenarios We Provide

- **Industrial pilot site** – real refinery units (CDU, hydroprocessing, WWTP, utilities) as validation environments
- **Data-rich use cases** – historian, laboratory, spectroscopic and maintenance data for model training and testing
- **Human-in-the-loop trials** – operator-facing decision support tested in day-to-day operations
- Focus: TRL 4–7 validation in a real energy-intensive industrial setting

Work Packages We Can Lead

- **Industrial AI & digital twins** – physics-informed models, soft sensors and predictive maintenance
- **Optimization & decision support** – MILP, scheduling, energy and product-pool optimization, agentic assistants
- **Data infrastructure & MLOps** – pipelines, deployment and monitoring of models in production

Work Packages We Contribute To

- **Demonstration & validation** – site preparation, KPI definition, measurement campaigns and result assessment
- **Process control & modelling** – advanced control, simulation and performance monitoring of demo units
- **Exploitation & dissemination** – industrial replication potential, publications and standardisation input

What We Bring as a Partner

- **Proven track record** – 25 EU funded projects delivered with international consortia since 2016
- **In-house product suite** – optimization, chemometrics, soft sensors, monitoring and agentic solutions
- **Multidisciplinary team** – data science, process engineering, control and operations research expertise