



hyperiongroup



Access to HPC Resources by Greek SMEs Info Day EuroCC@Greece

13th March 2024

Cutting-Edge Online
Process Analysis AI Technology
for Polymer Production

HYPPOS

Hyperion Predictive Production Online Software



Co-funded by
the European Union





HYPERION GROUP

Who we are: A Privately held, globally operating technology and engineering group formed in 1993. Hyperion gained world class market reputation and global clientele. Hyperion provides engineering advisory and consulting services, and implements advanced industrial IT solutions in the hydrocarbons, chemicals and power generation industries.

Resource and Identity: Core team of professionals, many with postgraduate qualifications and considerable industrial experience. Extensive network of associate engineers and consultants that increase the ability to meet capacity, domain and specialized expertise constraints.



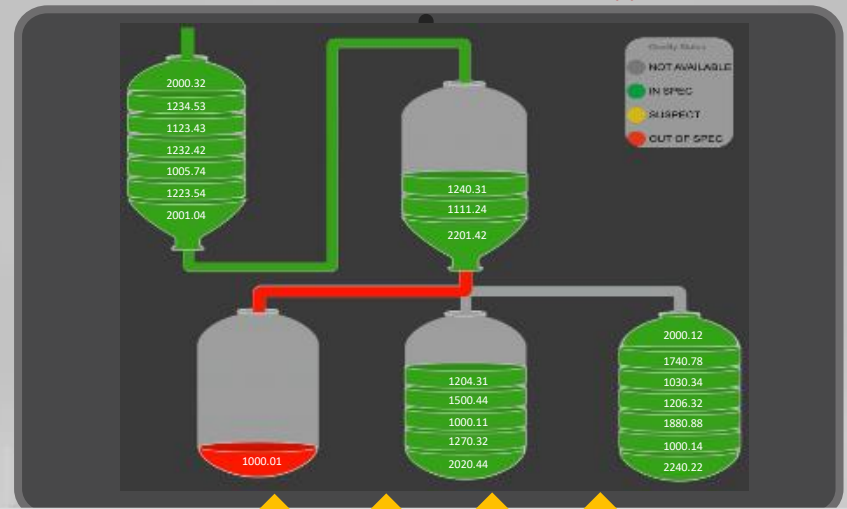
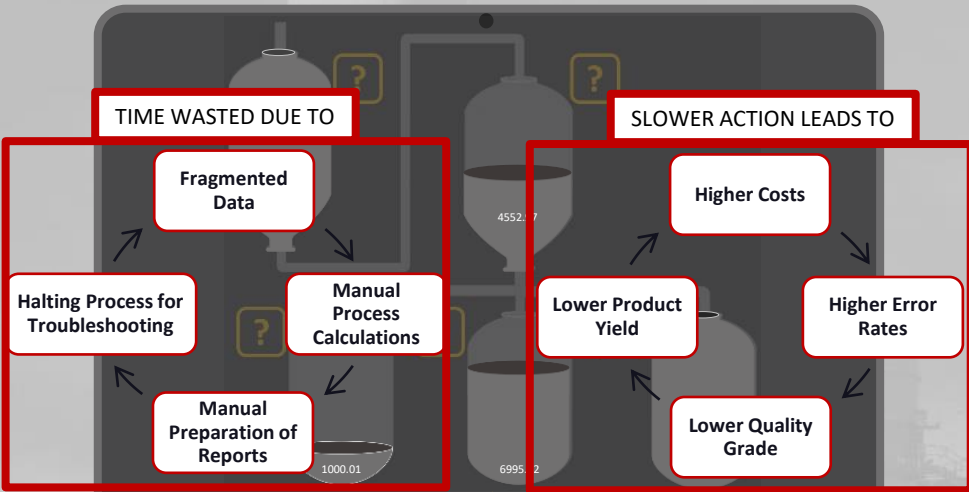
More than 500 projects in 51 countries

HYPPOS Predictive Production Online Software



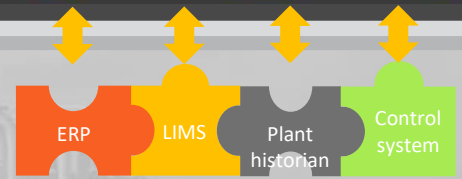
Challenges in manufacturing operations: **limited visibility & control of product quality**

With the HYPPOS all-in-one decision support tool



Solution **HYPPOS**

Hyperion Predictive Production Online Software

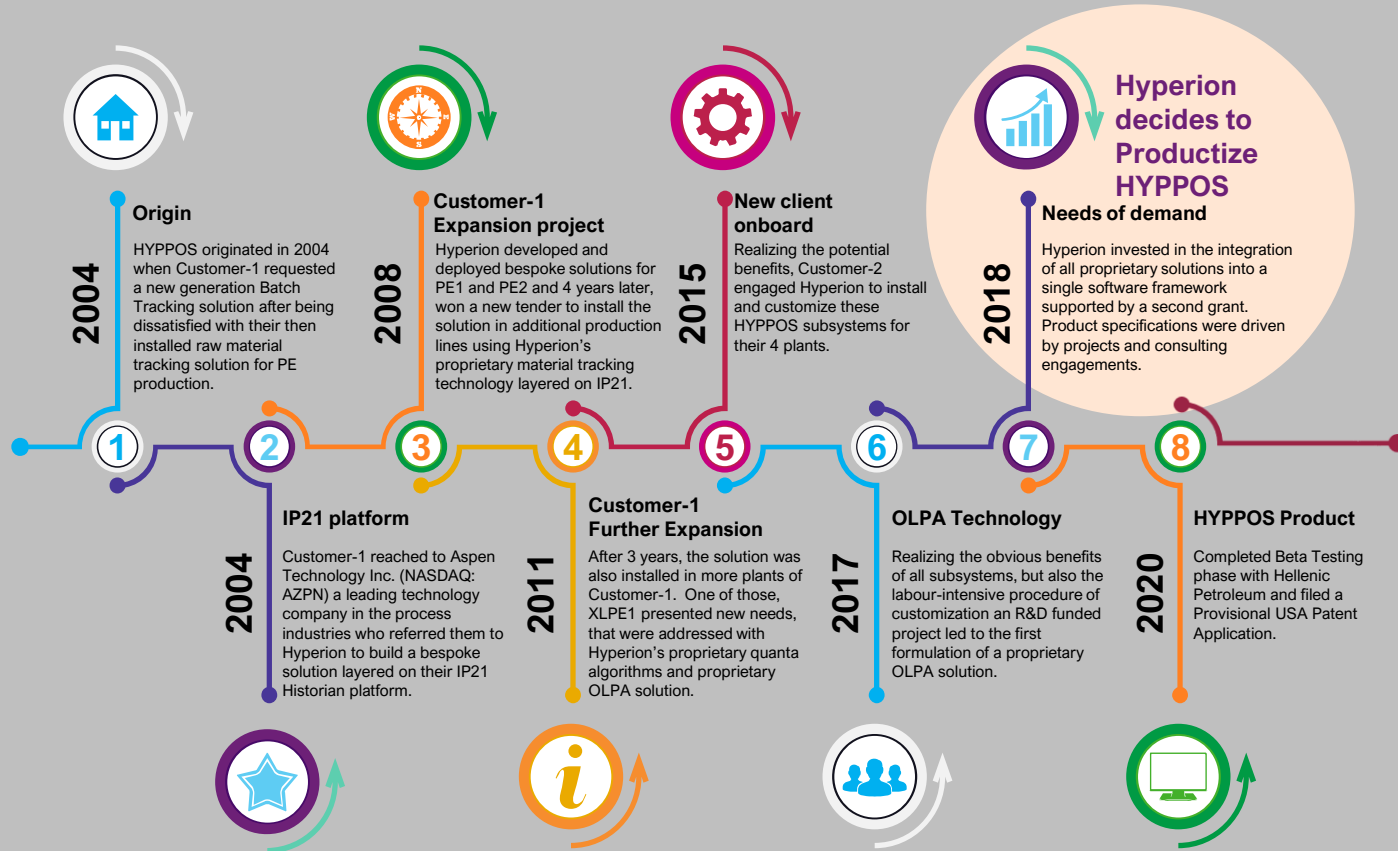


> Real-time information
 > Predictive alerts
 > Actionable feedback

Operators can take action during manufacturing to keep in-spec:

- product quality and
- other KPIs

History behind the creation of HYPPOS



HYPPOS Recognition & Awards

Recognised **three times** with the **Seal of Excellence** by the European Innovation Council under the Horizon 2020 evaluation process for **EU Horizon 2020 SME Instrument Phase 2** [JUN 2019 (880334), FEB 2019 (859141), JUN 2018 (830173)]



Programme	Proposal Number	Proposal Acronym	Partners	Total Budget	Public Funding Intensity	Start Date	End Date
Support of Business Innovation (Cyprus MECI)	No. 8.1.12.13.3.3.48	OLPA	-	€326,753	€196.052	10/2015	04/2017
Hyperion Systems Engineering Ltd.	-	HYPPOS	-	€500,000	€0	05/2017	10/2018
Horizon 2020 2 nd Opportunity	OPPORTUNITY/0916/SM E-II/0005	HYPPOS	-	€1,141,200	€700,000	10/2018	10/2020
EuroCC		HYPPOS-ML Smart Sensors	CYI	-	-	8/2021	8/2021
Research in Enterprises (Bridge Programs)	ENTERPRISES/0521/0175	EMBED-AI	CYI	€314,300	€199,780	06/2022	06/2023

Total Investment to date € 2,282,253 (US\$ 2,456,366)



Bespoke Installations *without AI*

- Since 2004 application prototypes are in operation on 15 polymer plants at customer sites delivering daily benefits.
- 3 new bespoke solutions are contracted for 2023/2024.

Current production lines			
Cust. 1 (Phase 1)	Cust. 1 (Phase 2)	Cust. 1 (Phase 3)	Cust. 2
PE1 – 320.000 t/y	PE3 – 540.000 t/y	PE4 – 540.000 t/y	PP – 350.000 t/y
PE2 – 280.000 t/y	PP1 – 400.000 t/y	PE5 – 540.000 t/y	HDPE – 400.000 t/y
	PP2 – 400.000 t/y	PP3 – 480.000 t/y	LDPE – 300.000 t/y
		PP4 – 480.000 t/y	PC – 260.000 t/y
		XLPE1 – 80.000 t/y	
		LDPE1 – 350.000 t/y	



HYPPOS First Product Installation *with AI*

The Hellenic Petroleum Polypropylene plant in Thessaloniki (PP – 240,000 t/y) is the HYPPOS Launch Partner:

- Beta test successfully completed May to June 2020
- Since July 2020 HYPPOS is connected to the real-time plant data management systems collecting data from the PP production line, to track product batches in real time and produce the associated reports.

Objective:

To increase the benefits achieved through the online operation of **HYPPOS**, specifically via **quality predictions** in real-time.

Challenge:

To overcome **lack of installed instrumentation** we developed appropriate Machine Learning (ML) based algorithms to implement **soft-sensors**.

Methods:

Using the soft-sensors to enhance the **predictive power** of solutions by identifying off-spec material in real-time **without the need for specialized online analyzers** (instrumentation).

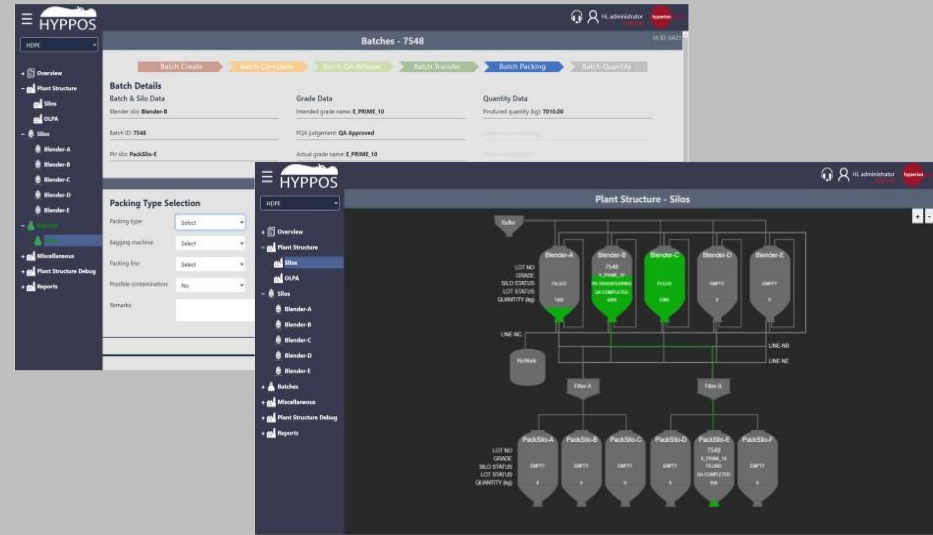


Project implemented under the programme of social cohesion “THALIA 2021-2027” co-funded by the European Union, through Research and Innovation Foundation.

General Profile of the Embed-AI Project



- **Project Title:** Embedding AI/ML Predictive Technology in HYPPOS v1.0 first commercial release
- **Starting Date:** 01-Jun-2022
- **End Date:** 30-Jun-2023
- **Project Duration:** 12 months
- **Total Budget:** € 314.300
- **Requested Funding:** € 199.780
- **Co-funded by the European Union**
- **Host Organisation:** Hyperion Systems Engineering
- **Partner:** The Cyprus Institute (CyI)
- **Spin-offs:** Hyperion Process Manufacturing Global Solutions Ltd.



The project is implemented under the programme of social cohesion "THALIA 2021-2027" co-funded by the European Union, through Research and Innovation Foundation.

Cyclone Supercomputer at the Cyprus Institute

The cluster used for the project through the production and preparatory application process

- **17 40-core** compute nodes
- **16 40-core** compute nodes and 4 NVidia V100 GPUs each
- 2 20-core sockets with Intel Xeon Gold 6248
- 192 GB memory per node
- 135 TB NVMe Storage
- 3.2 PB Shared Disk Storage
- HDR 100 Node-to-Node interconnect
- Rocky Linux 8.6



<https://hpcf.cyi.ac.cy/>

Evaluation Metrics for the Prediction of Melt Flow Rate (MFR)

- Clean and transform the polymer production plant data to make it ready to be used by the ML model
- Produce descriptive statistics, plots and metrics
- Perform exploration of the dataset to select the appropriate features with the highest predictive power
- Develop the ML models to predict the material quality
- Evaluate the best performing ML models
- Embed the 2 best performing ML models in HYPPOS

Model	Dataset	Pearson	M.A.P.E.	M.A.E.	R.M.S.E
Linear	Train	0.988	0.165	0.791	1.176
Linear	Test	0.946	0.31	1.246	2.12
Polynomial	Train	0.992	0.127	0.65	0.998
Polynomial	Test	0.967	0.234	0.907	1.598
XGBoost	Train	1	0	0.001	0.002
XGBoost	Test	0.983	0.075	0.585	1.462
ANNBN	Train	0.999	0.054	0.26	0.35
ANNBN	Test	0.418	0.277	1.838	12.939
Random Forests	Train	1	0.005	0.032	0.08
Random Forests	Test	0.97	0.071	0.548	1.555

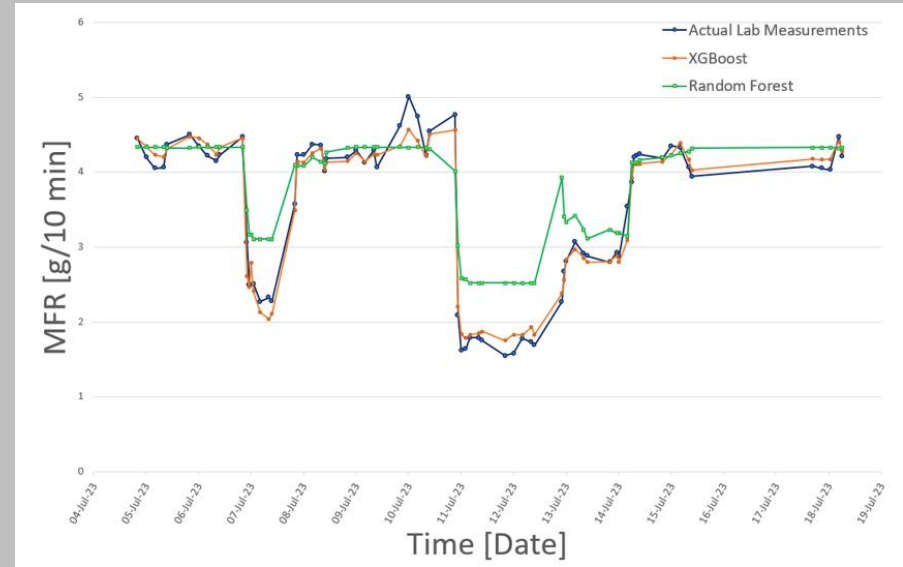
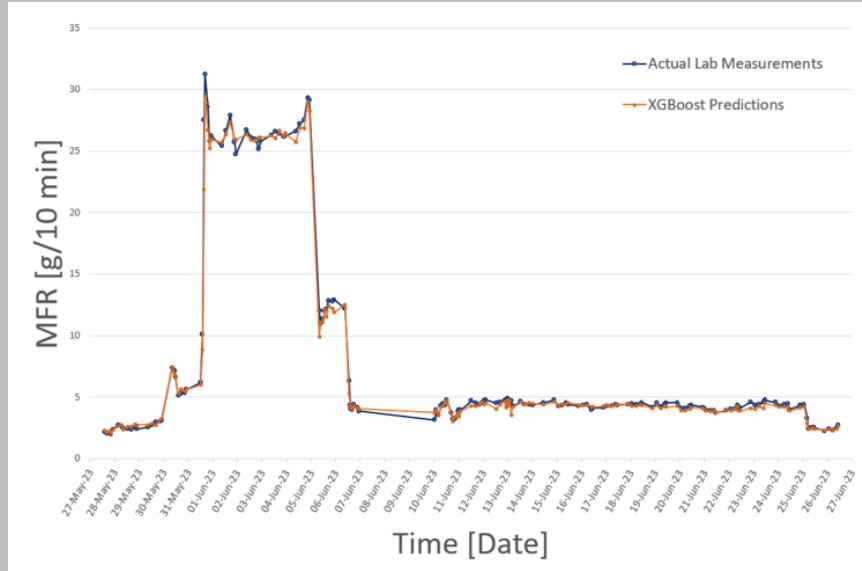
Testing at Real Production/Operational Environment



- Historical data of **plant measurements of 3 years** from **HELLENiQ ENERGY polypropylene plant** in Thessaloniki were used for training and testing the ML model.
- ML models were implemented for predicting the **Melt-Flow-Rate (MFR)** in polymers production.
- **MFR** is one of the **most critical quality parameters** in polymers manufacturing



MFR Predictions



➤ **XGBoost** model produces less noise and more accurate results than Random Forest.

Project Achievements: Feedback from HELLENiQ ENERGY

- More than 90% of the predicted data points fall within 10% of the measured value.
- The average errors across all MFR ranges are below 9%.
- Trends in transitions from low to high MFRs and vice-versa seem to be captured quite accurately.

Polypropylene Production Manager



The HELLENiQ ENERGY Polypropylene Plant is ready to adopt HYPPOS-AI for production use to provide MFR visibility and prediction and welcome any new collaboration to further improve the accuracy of the ML model



Thank You



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<https://goo.gl/maps/GzAfjUYXy8q3h9j68>

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