

Predictive maintenance for Aerospace Product Manufacturing

Prof. Ernesto Damiani

(CINI, Italy, TOREADOR Principal Investigator)

Mrs Marianna Lezzi

(Università del Salento, Italy, TOREADOR Aerospace Pilot analyst)

RESEARCH LAB



CORE Lab, www.core-lab.it

Università del Salento

Agenda

- Toredor project
 - Concept, Objectives, Partners
- Aerospace Product Manufacturing Pilot Case
 - Industrial scenario & Toredor solution
 - Predictive maintenance analysis
 - Root cause analysis
 - Fault detection analysis
 - Basic requirements

Toreador Project

- The **TOREADOR – TrustwOrthy model awaRE Analytics Data PlatfORm** project is aimed at overcoming some major hurdles that until now have prevented many **European companies** from reaping the full benefits of **Big Data Analytics (BDA)**
- Covering key **areas** of the EU marketplace



Toreador Concept

- TOREADOR follows a **Model-based Big Data Analytics-as-a-Service (MBDAaaS)** approach, providing models of the entire Big Data analysis process and of its artefacts
 - **Declarative Models:** Service goals of Big Data Pipeline
 - **Procedural Models:** How BDA should achieve the objectives
 - **Deployment Models:** How the BDA process should work
- TOREADOR will deliver an **architectural framework** and a set of components for **model-driven** set-up and management of **Big Data analytics** processes
- **TOREADOR MBDAaaS** driving costs of Big Data analytics well within reach of EU organizations (including SMEs) that do not have either in-house Big Data expertise or budget for expensive data consultancy

Toreador Objectives

Provide **declarative models** supporting enhanced **Big Data Analytics**

Support Model-based Big Data Analytics-as-a-Service via **automatic provisioning** and configuration of computational resources

Support integration and deployment of **different analytics** and **security technologies**

Provide **continuous monitoring** and management of analytics lifecycle and data security and privacy

Deploy **pilot scenarios** on **real in-production scenarios**

Provide clearance of **legal aspects** involving all TOREADOR operations

Toreador Partners

- The **consortium** partners come from five different EU member states
- The constitution of the consortium also reflects a well-balanced mix of skills in **five key areas** for the objectives of the project, namely research, technology providers, industrial applications, end users, and stakeholders

Partner	Country
• Consorzio Interuniversitario Nazionale Per L'informatica (CINI)	Italy
• Engineering - Ingegneria Informatica Spa (ENG)	Italy
• SAP Se (SAP)	Germany
• The City University (CITY)	UK
• Lightsource Renewables Energy LTD (LIGHT)	UK
• Taiger Spain SI (TAIGER)	Spain
• ATOS Spain SA (ATOS)	France
• BIRD & BIRD LLP (B&B)	Belgium
• Distretto Tecnologico Aerospaziale S.C.A R.L. (DTA-Unisalento)	Italy
• JOT Internet Media Espana SL (JOT)	Spain

Aerospace Product Manufacturing Pilot Case



- One of Toreador pilot cases is referred to the manufacturing context of **an Aviation** business of a DTA member, which designs, manufactures and maintains components and systems for civil and military aviation.
- The **PILOT GAOL** is to carry out **predictive analytics** during the manufacturing process in order to detect **product anomalies** and **machine faults**



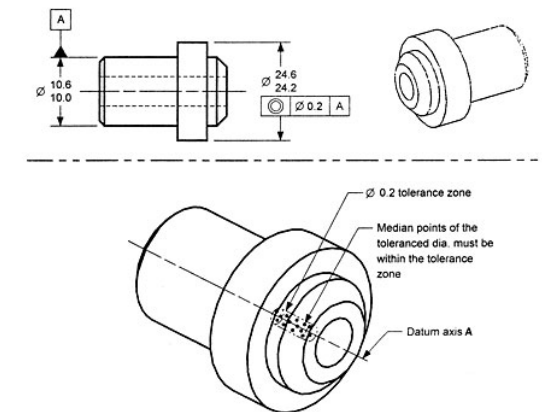
Toreador solution for aeronautical pilot

- The **TOREADOR** project aims to develop a **platform** able to:
 - **Collect** all industrial data sets
 - **Process** them with advanced analytics tools to generate meaningful information
 - **Provide useful insight** to the factory management

- Three **use cases** are defined:
 1. **Predictive maintenance analysis in the manufacturing process** to predict potential anomalies on products
 2. **Root cause analysis in the inspection phase** to find the root cause that has generated the anomaly
 3. **Fault detection analysis** to predict machine faults before the quality of the product can be jeopardised

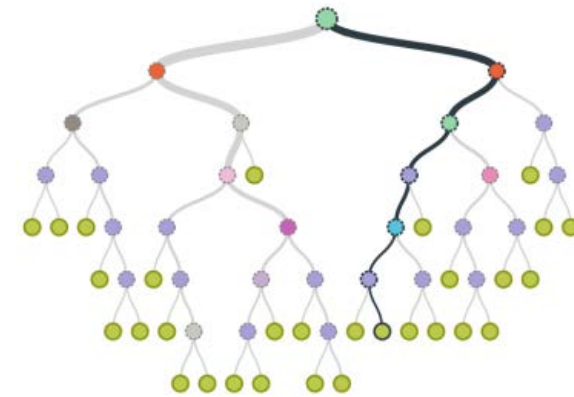
Predictive maintenance analysis

- The Toreador platform can manage **heterogeneous data** from various **measuring devices** (sensors) installed on machines
- **GOALS:**
 - **Monitor the work in progress** (e.g. compute *out-of-tolerance events* in the currently manufactured product)
 - **Forecast and communicate** pre-emptively **anomalies** expected in the next steps of the work cycle.



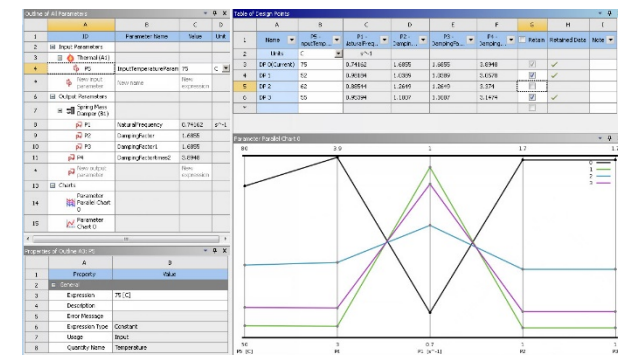
Root cause analysis

- The Toreador platform allows to **identify correlations** between the **working transactions** generated during steps of the work cycle and **inspection results**
- **GOAL:**
 - **Identify the production steps** which mainly influence the **conformity** of the final product
- Knowledge discovered with the **root cause analysis** can be used either to modify or to reject the current product



Fault detection analysis

- The Toreador platform can **monitor machines performance**, in order to predict the **time** of a possible **fault occurrence**, as well as pinpoint the **type of failure** and its **location**
- **GOAL:**
 - **Predict machinery faults** before the work cycle and the quality of the product may be jeopardized
- Fault detection inspects the **discrepancy** between the **actual value of machines working parameters** and the **expected values** by applying a predicting model



Basic requirements

- Study of the **manufacturing cell**:
 - **Processes** executed (turning and chamfering operations, heat treatments, ..)
 - **Machines** in the workcycle (working parameters, thresholds, connected tools, ..)
 - **Products** realized (dimensional, mechanical, physical-chemical and technological properties)

- **Data analysis** (according to Big Data approach: Velocity, Volume, Variety, Value) coming from all different sources

- Definition of **requirements**:
 - **System** to address the analytic needs
 - **Architecture** of the Platform-as-a-Service to build the industrial application
 - **Visualization** to let users interact with analysis results

THANKS FOR YOUR ATTENTION

Marianna Lezzi

marianna.lezzi@unisalento.it