



DELIVERABLE 4.3

Model-Based Control Modules

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¹ **Types.** **R:** Document, report (excluding the periodic and final reports); **DEM:** Demonstrator, pilot, prototype, plan designs; **DEC:** Websites, patents filing, press & media actions, videos, etc.; **OTHER:** Software, technical diagram, etc.

² **Dissemination levels.** **PU:** Public, fully open, e.g. web; **CO:** Confidential, restricted under conditions set out in Model Grant Agreement; **CI:** Classified, information as referred to in Commission Decision 2001/844/EC.

Executive Summary

This deliverable describes how the STREAM-OD system have been implemented in the three use cases considered in the project. The STREAM-OD system is comprehensive of an optimization module, a recalibration module, a cloud database and a graphical user interface (GUI) and, for all three use cases, a general view of the implementation layout and a detailed view of the layout for each module are presented.

First, three different options for the implementation of the system in a general industrial process are presented, namely:

- Optimization and Recalibration in cloud: all process parameters are saved in the STREAM-OD cloud database and, from here, are accessed by the optimization and recalibration module, to provide the optimal control strategy to the production line.
- Optimization offline and Recalibration in cloud: In order to avoid any issue related to a possible internet connection malfunctioning, the optimization module, used for real time control of the process, is transferred in the line, directly connected to the line database / server.
- Optimization and recalibration offline: In case it is not possible to have a stable and continuous connection with the industrial process database, both the optimization and recalibration module can be moved offline, directly implemented in the line.

Following this general section, specific details on the system implementation for the three use case are provided. Particularly, strategies developed for each use case are next summarized:

- Seals pilot case, SP: Both optimization and recalibration module are implemented in cloud, connected to the cloud database. Being SP pilot case a continuous manufacturing process, the optimization module is used to predict and anticipate errors in the output product and to compute the optimal control signal to minimize error before it is even measured at the end of the line. The GUI is a web app accessible online and connected to the cloud database. A virtual dynamic representation of the real plant has been created to simulate the process behaviour and test the system performances; the implementation layout is presented for both real and virtual tests implementation.
- Bearings pilot case, FERSA: Two different machines are considered in the FERSA use case, NOVA 9 and NOVA11, and three different control strategies have been implemented. The optimization module runs offline in FERSA server, while there is no need for the recalibration module. The first control strategy is related to the implementation of the ROM in-line, to correct the measurement performed on cones which are affected by the parts temperature and can lead to evaluation error. The second strategy deals with the control of NOVA 9 machine, making use of a Data Driven Model that can predict the machine outputs from its inputs and process parameters and provide suggestions on control strategies to minimize errors. The third strategy refers to the control of NOVA 11 machine, where a set of rules have been implemented to automatically adjust the machine behaviour based on the measured error.
- Booster pilot case, ZF: Due to security issues, both the optimization and recalibration module run offline, directly implemented in ZF assembly line. Process data are then imported manually on the cloud database, with no possibility for a continuous stream of data. The optimization module is used to determine the optimal Lap Gap that provide the desired Jump-In in the assembled booster, while the Recalibration module is run periodically to compensate for any unmodeled parameter that might affect ROM predictions precision.