Smart Manufacturing & Maintenance
Exploit the full potential of your data to boost manufacturing and maintenance!

The new industrial revolution is driven by the data collected via new-generation information and sensor technologies. This enables the optimization of a factory or a service-logistics network as a whole, instead of sub-optimizing business units and processes separately.

DSC/e
www.tue.nl/DSCe/RP/SMM
**Scope**

The new industrial revolution (Industry 4.0) is driven by new generation information and sensor technologies such as cloud computing, big data and data analytics, robotics and additive manufacturing. These technologies create the internet of things (IoT) in which objects (products, machines, factories, warehouses, customers) are all connected. The increased availability of massive amounts of sensor and manufacturing data that can be shared among the whole supply chain will enable integrated planning in industry to improve manufacturing and maintenance processes and to develop innovative products and services.

**Vision**

The digitizing industry bears the promise to improve and integrate manufacturing and maintenance planning, thus facilitating the optimization of a factory as a whole, instead of sub-optimizing business units and processes separately. Integrated planning will lead to higher and more flexible production capacity, more efficient maintenance, more reliable production lead times, and lower stock levels. To make this promise come true, the current way of making separate plans for manufacturing and maintenance based on ad-hoc collected data must change.

**Research challenges**

a) Development of data-collection and data-aggregation techniques to parameterize production, estimation, prediction and maintenance models.

b) Implementation of advanced prediction and estimation techniques (e.g. failures, wear out, demand).

c) Investigate simulation-based optimization techniques.

d) Creation of data-driven integrated prediction and optimization models.

e) Development of a data-driven decision-making framework at operational and tactical level to support integrated production planning and predictive maintenance.

f) Analysis of the value of integrated planning for the whole factory.

**Project examples**

**Daisy4Offshore, TKI WoZ**
To develop new algorithms for early failure detection to support maintenance of offshore wind turbines.

**Dynamerge, NWO**
Develop new models for emergency service logistics, dynamic planning at operational level, and network design with companies such as Philips, Brandweer Amsterdam, CWI.

**MANTIS, EU ECSEL**
Develop a predictive maintenance platform for smart manufacturing, fleet management, energy production and healthcare.

**Philips Data Science for health flagship**
A joint initiative by Philips and TU/e to create new methods and tools for the smart maintenance of healthcare imaging systems.

**ProSeLo Next, TKI Dinalog**
Creating new predictive maintenance approaches, service business models, and control towers with Marel, Océ, ASML, and Vanderlande.
Success stories

**ASML**
A software tool is developed for tactical and operational planning of spare parts that go through engineering changes. The tool uses data from multiple sources within ASML to improve the quality of the planning, which leads to less emergencies, and a reduction of the total workload for the planners.

**Marel Stork**
A sensor system has been developed to continuously monitor the condition of the chain of an overhead conveyor system in a poultry processing plant. This system is capable to accurately monitor and predict the chain length over time, enabling engineers to perform the right maintenance at the right point in time.

**Nexperia**
Advanced optimization algorithms have been developed to automate and improve the weekly scheduling of hundreds of production batches on assembly lines in Nexperia’s semi-conductor plants. Substantial capacity gain is shown to be feasible.

**NXP**
26 gigabytes of production data is translated into valuable information for maintenance managers and engineers. Based on a fluid-flow simulator, a software tool has been developed. Overall equipment efficiency has increased since implementation of the software.

**Philips Data Science for health flagship**
A data-driven approach was developed for the prediction of the useful remaining lifetime of critical components. This approach was implemented into a tool permitting the characterization of the criticality of a predictive alarm and facilitating proactive maintenance.

Scientific staff involved

**Core team**
- Prof. Geert-Jan van Houtum (RP leader)
  Smart maintenance
- Prof. Ivo Adan
  Smart manufacturing
- Dr. Alp Akçay
  Simulation-based optimization
- Dr. Alessandro Di Bucchianico
  Statistical process control, reliability theory, maintenance
- Dr. Mike Holenderski
  Machine learning
- Dr. Stella Kapodistria
  Data-Driven stochastic processes and optimization
- Dr. Ingrid Vliegen
  Project development officer

**Selection of other staff involved**
- Dr. Rob Basten
  Predictive maintenance, spare parts supply
- Dr. Joos Buijs
  Process mining, process modeling, process analysis
- Dr. Remco Dijkman
  Process optimization, data-driven logistics
- Dr. Simme Douwe Flapper
  Maintenance, re-manufacturing
- Dr. Tugce Martagan
  Stochastic modeling and optimization, manufacturing systems
- Prof. Mykola Pechenizkiy
  Predictive analytics, evolving data streams, handling concept drift, complex networks
- Dr. Sasha Pogromskiy
  Manufacturing networks, control systems
- Dr. Paulo Serra
  Bayesian statistics, time series analysis, recursive estimation
- Dr. Irene Vanderfeesten
  Workflow management, business process modelling, human aspects of information systems
- Dr Rik Eshuis
  data-driven process management

**Software**
ProM: An open source and extensible framework for process mining techniques, used to analyze processes and detect deviations. For more information see [www.promtools.org](http://www.promtools.org).