

Dissertation title:

**Product Life Cycle Analytics
Unstructured Data Analytics for Smarter Manufacturing**

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This thesis investigates the analytics potential of unstructured text data around the product life cycle of industrially manufactured products and the IT approaches needed to handle such data, especially in view of current developments towards a fourth Industrial Revolution. The main example throughout this thesis is product quality data from the automotive industry. The overarching research goal is the creation of a framework providing means to integrate and analyze structured and unstructured data across the product life cycle of an industrially manufactured product. Several sub-goals are to be fulfilled by this framework:

- (1) Data analytics tasks which are currently carried out manually and involve the processing of unstructured data are to be supported through partial automation with the help of unstructured data analytics.
- (2) Novel value-added analytics tasks using unstructured data from across the product life cycle are to be enabled.
- (3) With the help of analytics and data integration, the human worker is to be integrated better into an increasingly flexible production environment as it arises during the fourth Industrial Revolution.

To address these goals, the concept Product Life Cycle Analytics (PLCA) is developed for the purpose of integrating and analyzing structured and unstructured data from the entire product life cycle. An architectural framework for implementing this concept is provided. Within this framework, several application scenarios from the area of automotive quality data, especially aftersales part quality, are prototypically implemented or tested as proofs of concept. They address mainly the first two research goals: A prototype is implemented for supporting the classification of damaged car parts in aftersales through the automatic analysis of text reports from several sources (research goal 1). Several novel analytics scenarios using unstructured sources from several life cycle phases are tested for feasibility (research goal 2). For example, the discovery of error causes in the development of a new vehicle series can be supported through analytics on diagnostic data from the aftersales phase of the preceding model.

The thesis also investigates the re-use and maintenance of structured domain-specific enterprise internal knowledge which is necessary for text analytics in the context of the overall analytics framework.

To address research goal 3, PLCA and the associated architecture are used as a foundation for developing the concept and prototype of a Social Factory

which optimally integrates human workers as flexible problem solvers with the help of a strong data integration and analytics infrastructure.