

54th CIRP Conference on Manufacturing Systems

# Predictive analytics in quality assurance for assembly processes: lessons learned from a case study at an industry 4.0 demonstration cell

Peter Burggräff<sup>a</sup>, Johannes Wagner<sup>a</sup>, Benjamin Koke<sup>a</sup>, Fabian Steinberg<sup>a</sup>, Alejandro R. Pérez M.<sup>a</sup>, Lennart Schmallenbach<sup>a</sup>, Jochen Garcke<sup>b,c</sup>, Daniela Steffes-Lai<sup>b</sup>, Moritz Wolter<sup>b,d</sup>

<sup>a</sup>Chair of International Production Engineering and Management (IPEM), Universität Siegen, Paul-Bonatz-Straße 9-11, Siegen - 57076, Germany

<sup>b</sup>Fraunhofer Institute for Algorithms and Scientific Computing (SCAI), Schloss Birlinghoven 1, Sankt Augustin- 53757, Germany

<sup>c</sup>Institut für Numerische Simulation, Universität Bonn, Endenicher Allee 19b, 53115 Bonn

<sup>d</sup>Institut für Computer Science, Universität Bonn, Endenicher Allee 19a, 53115 Bonn

\* Corresponding author. Tel.: +49-271-740-4509; fax: +49-271-740-2630. E-mail address: [alejandroperez@uni-siegen.de](mailto:alejandroperez@uni-siegen.de)

## Abstract

Quality assurance (QA) is an important task in manufacturing to assess whether products meet their specifications. However, QA might be expensive, time-consuming, incomplete, or delayed. This paper presents a solution for predictive analytics in QA based on machine sensor values during production while employing machine-learning models based on logistic regression in a controlled environment. Furthermore, we present lessons learned while implementing this model, which helps to reduce complexity in further industrial applications. The paper's outcome proves that the developed model was able to predict product quality, as well as to identify the correlation between machine-status and faulty product occurrence.

© 2021 The Authors. Published by Elsevier B.V.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)  
Peer-review under responsibility of the scientific committee of the 54th CIRP Conference on Manufacturing System.

**Keywords:** Machine-Learning; Predictive Quality; Production; Quality Assurance; Logistic Regression

## 1. Introduction

## 2. Related Works

### 2.1. Quality check in production

### 2.2. Predictive analytics in production

## 3. The case industry 4.0 demonstration cell

## 4. Methods

### 4.1. Measurement

Support Vector Machine	95.0%
Multilinear Perceptron	95.0%
Random Forest	100%

Table 1. Method comparison for fault detection using the industry demo data test set.

### 4.2. Machine Learning

## 5. Experiments

### 5.1. Recording the data

### 5.2. Classifier optimization and testing

## 6. Conclusion

=====

## 7. Experiments

||||| HEAD

### 7.1. Lesson Learned

## 8. Conclusion