Production Optimization with Industrie 4.0

Bachelorarbeit

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vorgelegt von

Name: Bandrabur Vorname: Jon

[redacted]

Prüfer: Prof. Dr. nat. Michael H. Breitner

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Table of Contents

List of Figures

List of Tables

List of Abbreviations

B2B: Business to Business

CM: Corrective Maintenance

CPS: Cyber Physical Systems

IoT: Internet of Things

M2M: Machine to Machine

PM: Preventive Maintenance

WS: Workstation

1 Introduction

1.1 Motivation and relevance

Germany is one of the primary locations for manufacturing. Considering not only big manufacturing companies like BMW, Volkswagen or Daimler, but also Airbus, Lufthansa and the Port of Hamburg can be seen as such, in cooperating not logistic schemes but the importance of efficiency drives those Industries.

With three industrial revolutions, that happened to be mainly within the 20th century, all changes focused on the automation of production systems, the fourth industrial revolution now is within the making. The main goal hereby was to eliminate failures, and increase the output of production. Regardless, the product produced, the objective was to increase the output. The first three industrial revolutions focused on producing one equal good with less input, automation lead to mass production of one good. This leading to all people buying the same good. Consequently, manufacturing systems and industries had no need to adapt to different products.

The automation process firstly considered just the assembly line, which made human beings work the same task all day. By this monotonous work scale effects were generated, which increased production as well decreased health for all labour. Later control systems were introduced, and also the importance of information management increased. Within Industrie 4.0 the aspect of smart factories was introduced, which implemented communicating systems and objects. These systems not only know which type of job should be produced for which customer, furthermore it can detect every element needed to produce the good at the end.

One of the main reasons for the impact of Industrie 4.0 was the connection of the physical world with the virtual world. As the importance of information has increased within the past years, the linkage of information and the physical production is provided within Industrie 4.0. The possibility of a production system, which is able to detect the type of job, which it produced at the moment, as well as the type of job following on that are stunning, imaging that before production only produced one good per assembly line. Also the impact of information and so called cyber physical systems are tremendous, as maintaining activities can be made preventively and furthermore, could be limited as the state of each workstation is known ex-ante.

As these kind of information systems are linked to the physical world and are not only increasing the information flows, but increases transparency and communication

5 Conclusion and Further Outlook

The results created through this paper are theoretical assumptions to generated the optimal use of Industrie 4.0 components within production. Hereby focussing on the output maximization, which in this case, was the production of WS 5. The results of the theoretical analysis were that the predictive maintenance would have more impact than a WS knowing service times of the WS around itself.

Many assumptions were made, to simplify both the model, and the simulation. Only one job was observed, which disregarded the flexibility characteristic, which nowadays is necessary to stay competitive as a manufacturer. Simultaneously ignoring the adapting time of a WS to another. To have more significant results for manufacturing businesses this aspect needs to be researched in combination with preventive maintenance.

Another aspect that should be taken into account is the research regarding merging and splitting streams of production. Nowadays, manufacturing systems are less aligned as an assembly line, because it limits or even eliminated the opportunity to produce different products. These days diversity is as important as efficiency. Therefore, future research should combine these two aspects, and try to find optimal ways, to increase flexibility as well as staying efficient in production.

Since this work is only based on a theoretical model, future research should generate data from realistic production systems prior to the implementation of Industrie 4.0. Subsequently, the results should be compared with each other since the differences could differ from the outcome of this theoretical approach.

The results arising from this theoretical model have a strong impact on the throughput and final production results. Two approaches from the field of M2M communication were introduced. Observed first was the M2M communication, considering the service time, which was known by a previous WS. This approach increased the production, but at the same time increased utilization, which as a total does not seem to be efficient. The introduction of predictive maintenance methods proved to be an efficient approach that resulted in an almost perfect outcome. The throughput was almost maximised. Missing only one job, which has not been done by now. Moreover, the CT of a job within the system decreased, to almost the sum of all service times. This leading to an efficient production system.

Consequently, to organise production systems efficient, the breakdown times, or occurrence of breakdowns should be minimised, which results in the almost maximum output, considering an assembly line, with one kind of job.

Appendix A

In appendix A all results that are tested for the Base Model will be found within the tables below. Also all values that were entered are presented for every Workstation as well as Arrival streams.