Option #2: Factory Machines Faults Detection

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**Option #2: Factory Machines Faults Detection**

# General

## Project Description

The system shall provide a secure and scalable solution with an easy-to-use user interface, capable of receiving and furnishing real-time data from sensors on assembly lines to detect machine flaws, predict machine down times, and guide equipment usages for the factory line of an automobile parts manufacturer.

### Background

The automobile parts manufacturer produces auto parts for eight different automobile manufacturers, including Ford, Toyota, and Chevy. The manufacturer receives orders online continuously, in no predictable timeframe, in amounts varying from 10,000 parts to 800,000 parts. The assembly line produces 5,000 parts per day. Five assembly line machines make up the factory line. Development begins at the first machine and continues down the factory line before ending at the fifth machine. During daily operations, parts become unusable due to wear and tear and improper usage.

### Purpose

The purposes of the Factory Requirements Document (FRD) is to present the stakeholder requirement needs for the system completely, accurately, and unambiguously in a technology-independent manner. The information is captured and written by the Business Analyst during the Analysis phase of the project. Business language is used to capture the requirements here within. This document serves as the definitive specification of the user requirements. The FRD is the primary input to the design and development phases and the primary specification for User Acceptance.

### Assumptions and Constraints

The following constraints have been identified:

* Time constraint: The final draft of the FRD shall be completed by Sunday, February 9, 2020 at 11:59 P.M.
* Resource constraint: Limited staff and technical equipment availability.
* Scope constraint: The scope encompasses shop floor sensor data from five assembly line machines.
* Cost constraint: The cost is based on the monetary value acquired from all departments.

The following assumptions have been made:

* Resource Assumption: Adequate staff are available to define the vision, scope, develop, design, and test the project.
* Cost Assumption: Cost project analysis will be conducted to determine the project approval process and oversight levels.
* Budget Assumptions: Project will not exceed approved budget amount.
* Scope assumption: Scope does not change. Should the scope change, the project will follow a change control approval process.
* Time Schedule Assumption: The final draft of the FRD will be completed by Sunday, Februray 9, 2020 11:59 p.m.
* Implementation Assumption: The implementation strategy being used is based on

### Interfaces to External Systems

Name the applications with which the program must interface:

* Amazon Web Services (AWS)

## Points of Contact

List the names, titles, and roles of the major participants in the project. At a minimum, list the following:

* Tim Smith- Project manager
* Scott Miner – Business Analyst
* Mark Hanson – Developer
* Robert Davis – Solutions Architect

## Document References

Key documents needed as supporting references are displayed below:

* Business Requirement Document (BRD)
* Technical Requirement Document (TSD)

# FUNCTIONAL REQUIREMENTS

The core functionality of the application will allow automobile manufactures (Ford, Toyota, Chevy, etc.) to place orders in varying amounts ranging from 10,000 parts to 800,000 parts.

## Data Requirements

Alexopoulos et al. (2016) propose a BI architecture for the factory environment comprising several layers: (a) sensor data retrieval, (b) pre-processing, (c) data storage/management, and (d) application. A factory that produces washing machines (WMs) implemented this architecture in one of its assembly lines. The factory was able to improve the quality of finished results and reduce errors by 30% in a single workstation and by 10% in the overall sub-line by increasing data quality, availability, and accuracy.

## Functional Process Requirements

The application must receive orders online of varying ranges (10,000 parts – 800,000 parts) and produce 5,000 parts per day. Wireless sensors create an environment where machines and non-moving parts are connected and monitored (Hochmuth, 2005). Five different machines are interconnected on an assembly line. The system has the capability to pinpoint part failures, electrical or overheating issues, why the line has stopped, and scheduled service reports.

# OPERATIONAL REQUIREMENTS

Hochmuch (2005) describes how factories use sensor technology to measure factors (e.g., machine vibrations, heat) to predict when a machine might fail or require service. A mesh network allows a factory to connect any device to any device, using the most optimal path, bypassing the need to tie all data back to only a few wireless access points. Such an architecture can save a factory 10% to 20% on production costs. Jiahao Wang et al. (2010) describe how RFID technology provides a wireless means to track moving objects for flexible manufacturing lines by using RFID readers as detecting sensors, leading to improvements in object accuracy tracking and reductions in costs.

## Security

Morariu et al. (2018) describe how a policy-based mechanism can be used to introduce real-time PKIs using Certification Authorities (CAs) to generate instantaneous secure socket communication. Additionally, a document level encryption and signing mechanism shall be used to encrypt all messages between intelligent sensors, shop floor resources and different components.

## Audit Trail

In the applications audit trail, we shall record the following:

* Number of transactions per day
* Number of orders per part
* Number of parts produced per day
* Avg. processing time per station
* Total processing time

## Data Currency

The data needs to be real-time. Farooq (2013) describe how real-time data warehousing is used to provide operational BI. Oliver (2013) writes that with real-time data warehousing, it takes 1ms to capture a data event, 100ms to transform a data event, and 100ms to update a Cloud-based data warehouse.

## Reliability

The system shall recover from errors and failures in the interfaces.

## Recoverability

Backups are performed nightly and automatically via AWS.

## System Availability

The system will be available online 24 hours each day, 365 days a year, with the exclusion of scheduled and pre-notified system maintenance downtimes. AWS will ensure system resources are adequate for on-time report generation. Additionally, AWS will ensure all hosting and maintenance updates are not performed during peak operation hours.

## Fault Tolerance

There are no fault tolerant requirements.

## Performance

The system requires real-time performance.

## Capacity

The system anticipates the daily input of orders between 10,000 parts and 800,000 parts. The assembly line shall produce 5,000 parts each day.

## Data Retention

The data shall be retained in the DW for 10 years.

# REQUIREMENTS TRACE ABILITY MATRIX

|  |  |
| --- | --- |
| **ID #** |  |
| **Requirement Type** |  |
| **Statement** |  |
| **Source/Date** |  |
| **Priority** |  |
| **Business Rule #** |  |
| **Backward** |  |
| **Use Case Source** |  |
| **Test Case Source** |  |

# Glossary

AWS – Amazon Web Services

DW – Data Warehouse

PKI – Public Key Infrastructure

RFID – Radio Frequency Identification

References

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