Defects in industrial production, such as imprecise assembly in car manufacturing (see Figure 1), may lead to production downtime at the cost of up to 1 Mill. Euro per hour. Therefore, it is crucial to find causes of defects fast to mitigate this risk.

Important effects depend on causes that come from (1) production processes, (2) the production system that automates the processes, and (3) the production environment. This project aims at annotating knowledge on risk for selected effects to a cause-effect graph that links relevant effects to typical causes as a foundation for deriving a smart checklist to find the selected effects fast and at low cost.

The performance of production processes, such as 4-color printing, depends on correct contributions by a cyber-physical production system (CPPS) that automates these processes. Figure 2 illustrates a 4-color printing process as a sequence of printing and drying process steps using different colors. The product quality Color Clarity depends on the process performance that in turn depends on functions that the production resources, such as printers and their components, provide. Figure 2 shows an example...
cause-effect network, as red lines, starting from the effect Color Clarity, and leading to potential causes with a Drive or a Dryer (annotated with a letter C in a blue circle).

Figure 2: 4-color printing process with risk analysis regarding the risky effect Color Clarity.

Goal of this project is to develop a web-based application for facilitating risk analysis: (1) collecting risk analysis data from several sources as a knowledge graph; (2) annotating a cause-effect path; and (3) providing the cause-effect knowledge graph via a graph database as a foundation for advanced functions, such as deriving a smart checklist or adding evidence from designing or using the production system.

This topic is provided and supervised in cooperation with our industrial/academic partner TU Wien Pilot Factory.
Tasks
- Detailed requirements analysis for risk and issue analysis functions.
- Design of a web-based application based on the MDRE Platform, a front-end platform that provides functions on graph manipulation for connected models to efficiently collect several views on the system into a common graph.
- Selection of graph databases based on the risk analysis requirements.
- Prototype implementation and evaluation of risk and issue analysis functions.
- Design and implementation of benchmarks for risk and issue analysis queries.
- Empirical evaluation of measurement data regarding criteria for the strengths and limitations of the graph databases.

Expertise
For this topic a set of skills is recommended (at least two are mandatory).
- Java programming skills
- Graph database skills, e.g., Neo4J/Cypher.
- Data modeling
- Empirical evaluation, e.g. case study, pre/post comparison.

References
