SUCCESS STORY

Pro2Future
Products and Production Systems of the Future

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Centre K1

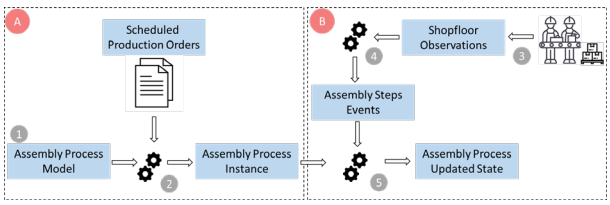
Type of project: A2PS,
2 Years, multi-firm

PRIVACY-RESPECTING MONITORING OF MANUAL ASSEMBLY LINES

SUPPORTING THE DETECTION OF DEVIATIONS, OPTIMIZATION POTENTIAL, AND JUST IN TIME REPLANNING WITHOUT EXPOSING WORKERS

As manufacturing companies move towards producing highly customizable products in small lot sizes, assembly workers remain an integral part of production systems. However, with workers in the loop, it is necessary to monitor the production process for timely detection of deviations and timely provisioning of worker assistance.

Direct monitoring of human activities raises legal and ethical issues. Legal regulations and union policies often limit the use of sensors such as cameras for direct observations of human activities. Therefore, assembly progress tracking needs a different approach relying only on indirect observations such as part picking or tool usage. Monitoring human assembly work, however, is highly challenging. To overcome minor disturbances in production, workers tend to rely on their tacit knowledge to apply various optimization techniques (team collaboration on complex tasks, tasks reordering, preparing steps for upcoming orders ahead of time etc.). These subtle optimizations make monitoring more difficult, as even with perfect observations available, these would not match the expected process.



Monitoring of Assembly processes require detailed model of each assembly process instance combined with partial observations from the shop floor.

Federal Ministry
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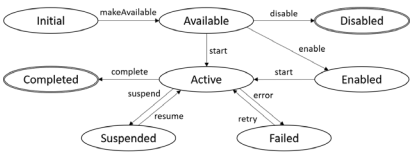
The research approach conducted jointly by the research and industry partners builds on a combination of multiple models: an assembly process model describing the optimal order of assembly steps; a constraint model describing which step dependencies cannot be physically violated; and a runtime model describing which steps could be worked on, should be worked on, are worked on, and are completed.



Assembly step progress model

Relying only on partial observations (note, that not all assembly steps involve parts picked or trackable tools) requires heuristics (rules of thumb) that need to be validated on real data.

Impact and effects

Evaluated with real observations from the assembly floor of our industry partner Wacker Neuson, we could demonstrate that accurate assembly step durations and assembly process progress is possible based only on indirect worker observations and maintaining a workers privacy. Specifically, using only part picking events, our approach is able to predict step completion times for key steps accurately within 1,12% of the assembly tact time.

The approach requires merely standard sensory infrastructure on the assembly floor such as weight-sensitive part boxes or pick-by-light systems. Process progress information is provided back in near real-time via a cloud-based solution hosted by Fabasoft.

Fabasoft Cloud-based Process Deviation Feedback Interface

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- Profactor GmbH, Austria
- Wacker Neuson Beteiligungs Gmbh, Austria
- Fabasoft Austria, GmbH, Austria

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