

## Flexible Assembly Systems through Workplace-Sharing and Time-Sharing Human-Machine Cooperation – PISA

<sup>1</sup>DR. ROLF BERNHARDT, <sup>2</sup>DR. KLAUS SCHRÖER, <sup>1</sup>PROF. DR. JÖRG KRÜGER

<sup>1</sup>Fraunhofer Institute for Production Systems and Design Technology (IPK), <sup>2</sup>Volkswagen AG

Abstract:

The growing number of product variants, smaller lot sizes, accelerated time to market and shorter life-cycles of products have led to increasing demands on assembly equipment and concepts. They must realise high flexibility with respect to variants, low-cost adaptability of products and quick amortisation within a sustainable equipment concept. In order to master these challenges, innovative approaches and technologies are required. The performance of existing automation techniques is often insufficient. As a solution to this problem, hybrid, i.e. human-integrated, approaches are proposed. The idea is to combine human flexibility, intelligence and skills with the advantages of sophisticated technical systems. Such systems should help the human worker instead of replacing him. Intelligent assist systems (IAS) offer a rational, advanced method for the assembly of complex products on demand and at significantly reduced cost. Since today neither the technology nor the tools for planning and management of IAS are available, the aim of the project is their prototypical development, based on use-cases. One breakthrough of this project shall be to fill the gap between manual and automated assembly by introducing novel IAS technology and providing planning and integration tools in order to make this new technology applicable. A second breakthrough shall lie in the re-configurability of assembly systems and the reusability of assembly equipment. On the one hand this is related to a modular structure of assembly systems including standard hardware and software interfaces of assembly equipment. On the other hand, methods and tools are needed for reconfiguration planning, re-programming, life-cycle and equipment management. A skilled and motivated workforce still serves as the most capable and reliable resource for the flexible assembly. Recent studies have demonstrated that flexibility can be improved by combining the benefits of human capabilities with sophisticated automation equipment in so-called hybrid flexible automation systems, providing a rational advanced concept for producing high-tech products with growing complexity at significantly reduced cost. However, a reliable technological basis for hybrid systems does not yet exist, and the performance of existing flexible automation techniques (e.g., industrial robots) is quite limited in their ability to cooperate with and assist the human worker. Therefore, the prime objective of the Integrated European Project entitled “PISA” is to establish a new generation of modular flexible assembly methodology by developing concepts, formal methods, standards and safety frameworks, tools and technologies to allow integration and cooperation between human workers and highly flexible devices and equipment in a qualitatively new and efficient manner.

