Future trends in Management and Operation of Assembly Systems: From customized assembly systems to cyber-physical systems

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1 Introduction

Some of the most influential management concepts have their origin in the organization of assembly systems: from Henry Ford's assembly lines and the concept of mass production, to the more recent Toyota production systems and the principles of lean manufacturing. Currently, assembly systems experience dramatic changes imposed by altering market conditions and profound shifts in existing technologies. Mass customization is one of the important current trends. Modern markets demand customized products at low cost that feature, e.g., short product life cycles, short time to market, and high reliability of deliveries. The ability to offer customized products at prices comparable to that of standard products is defined as *mass customization* (Davis 1987, Pine 1993). Mass customization requires rethinking of the processes along the whole supply chain, but the need for change is especially pronounced in design and management of assembly systems. Theoretical analysis and mathematical models have become essential as never before to address the challenges of mass customization that can be summarized in the following two points:

- Assembly processes should become more *flexible, adaptable, and agile* to cope with increased product variety and market volatility. This requirement concerns equipment, personnel, organization of production, and decision processes. For instance, product customization shifts product tagging, i.e. assignment of a particular workpiece to a specific customer order, earlier into the production process (Zipkin 2001). As a