Manufacturing and Contract Service Networks: Composition, Optimization andTradeoff Analysis based on a Reusable Repository of Performance Models

Abstract— In this paper we report on the development of a software framework and system for composition, optimization and trade-off analysis of manufacturing and contract service networks based on a reusable repository of performance models. Performance models formally describe process feasibility constraints and metrics of interest, such as cost, throughput and CO_2 emissions, as a function of fixed and control parameters, such as equipment and contract properties and settings. The repository contains performance models for (1) unit manufacturing processes, (2) base contract services, and (3) a composite steady-state service network. The proposed framework allows process engineers to (1) hierarchically compose model instances of service networks, which can represent production cells, lines, factory facilities and supply chains, and (2) perform deterministic optimization based on mathematical programming and Pareto-optimal trade-off analysis. We case study the framework on a service network for a heat sink product which involves contract vendors and manufacturers, unit manufacturing process services including cutting/shearing and Computer Numerical Control (CNC) machining with milling and drilling steps, quality inspection, finishing and assembly.