Motivation

Concurrent engineering’s benefits are well known
  » improvements in product quality, product cost, turnaround, time to market
Limitations of Existing Tools

- Tools for preliminary and conceptual design
  - usually support only the capture of design specs
  - inadequate for evaluating proposed designs
- CAD/CAM tools
  - generally useful only during detailed design, when most of the product cost has already been committed
- Development of DFM tools is impeded by
  - poor data integration between design and manufacturing facilities
  - lack of plant-specific data on process capabilities

Our Technical Goals

- Develop concurrent-engineering tools that are useful at all phases of product development

<table>
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<tr>
<th>Conceptual Design</th>
<th>Preliminary Design</th>
<th>Detailed Design</th>
<th>Manufacturing Planning</th>
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- Help designers and planners
  - keep track of alternative design and plan elements and constraints
  - combine elements into viable designs and plans
  - evaluate tradeoffs among alternative designs and plans
  - access external information sources
**Track Record**

- More than ten years experience
  - Process Planning, Concurrent Engineering, DFM
  - Systems Engineering and Information Integration
  - Facility Layout, Production Scheduling
  - Inventory and Distribution Systems, Supply Chain Management

- Sponsors and Partners
  - **Government**: DARPA, ONR, NIST, NSF, US Army TACOM, Wright Patterson AFB

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**EDAPS: Electromechanical Design and Planning System**

- **Vision**
  - integrated design and planning system for designing and planning the manufacture of microwave transmit/receive modules

- **Features**
  - Integrates commercial electronic and mechanical CAD packages
    - EESof (Hewlett Packard)
    - Microstation Modeler (Bentley Systems)
  - Integrates electronic and mechanical process planning
    - Hierarchical Task Network (HTN) planning techniques from AI
  - Plan-based design evaluation
EDAPS System Architecture

User Interface (Tcl/Tk)

- Circuit Schematic, Component Selection
- Substrate Design & 3-D Layout
- Process Planning & Plan Evaluation

EEsof
- AEL Routines
- Routines in C++

Microstation
- MDL Routines

HTN Planner (C++)

Product and Process Data Files

EXTRA: Expert T/R Module Analyst

- Vision
  » IPPD automation tool for electro-mechanical products
  » integrate product and process design phases into a single system environment
  » help designer with best overall decisions including manufacturing considerations

- Features
  » Integrates legacy, relational, object-oriented DB's enterprise-wide for product data management
  » Process representation and characterization for quality and cost assessment
  » Multi-objective optimization for trade-off analysis
HERMES: Heterogeneous Reasoning & Mediator System

- **Vision**
  - Intelligent interchange of diverse heterogeneous information
  - Integration at both the systems and semantic levels

- **Features**
  - Runs on a distributed platform across the Internet
  - Remote access to and integration of distributed heterogeneous database systems, other software systems
  - Integrates many commercial and third-party packages
    - DBASE, PARADOX, ObjectStore, Ingres, flat files, images, video, spatial databases, newswires, path planning systems, face recognition systems

IMACS: Interactive Manufacturability Analysis and Critiquing System

- **Vision**
  - Achieve DFM by evaluating manufacturability of CAD designs during the design phase

- **Features**
  - Domain: machined parts, 3-axis vertical machining center
  - Recognizes machining features automatically from the CAD model
  - Generates and evaluates alternative operation plans
  - Provides feedback about machining operations, setups, cost and time
How IMACS Works

Find All Machining Features
- examine part faces

Generate Plan
- operations, precedences, machining parameters

Evaluate Plan
- tolerances, surface finishes, cost, time

Manufacturability Evaluation
- based on best plan (if a plan exists)

OSPAM: Optimal Selection of Partners in Agile Manufacturing

- Vision
  » Design for manufacture by multi-enterprise partnerships
  » Optimal assignment of production tasks to partners

- Features
  » Retrieves similar designs already developed by partners
  » Detects infeasible design attributes
  » Evaluates design manufacturability with respect to production capabilities of potential partners
  » Forms optimal partner network
  » Performs all tasks early in the design cycle
An Analysis of Virtual Manufacturing

http://www.isr.umd.edu/Labs/CIM/virtual.html

Contents

» Our assessment of VM for Wright Patterson AFB
  – database of relevant research and applications
  – assessment and evaluation
  – future outlook

» Other related materials
  – publications related to VM
  – a copy of our Global Virtual Manufacturing ‘97 presentation