DEVOLVED MANUFACTURING: A Novel Approach and Implementation Methodology for Mass Customization with Application to Automotive Industry

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Objectives of the Project

The basic objectives of this research project are to:

• Identify and compare conventional/traditional models of modern manufacture
• Propose a new concept/philosophy of ‘devolved manufacturing’
• Build/develop prototype devolved manufacturing system(s) for mass-customization through e-manufacture.
• Realise the concept of devolved manufacturing for mass-customization through e-manufacture in a broader context.
Conventional Manufacture

Conventional *technical* model of manufacture

Conventional *economic* model of manufacture
e-Manufacturing

- Mass Production
- Long Pipeline
- Sales from Stock
- Sequential Processes
- Cost of Inventory
- Wait in Line

- Mass customisation
- Shrinking supply chain
- Make to order
- Simultaneous processes
- Capital working
- First available slot

Transformation by e-manufacturing

Source: *UK Manufacturing - we can make it better*, Manufacturing 2020 Foresight Report (URN 00/1380), 2000
Mass Customisation

Outcome of industrial revolution
Driven by production and cost needs

Concept developed in 1980’s
Increases product range by allowing customers to choose from range of options
Needs to be set up with care to avoid extra overheads associated with increased product variety

Ultimate goal of MC?
Rapid Manufacturing (RM)

1. The CAD model is sliced into layers

2. RM machine ‘creates’ model

3. Finished Object
End-user & Practitioner Surveys

Breakdown of Systems by Type

Rise in Annual Sales of RP/RM machines (000’s)

Number of Patents Issued for RP/RM Technology

Global RP/RM Installations
Devolved Manufacturing – (1)

- Current developments in e-manufacture are generally ‘factory-centric’
- Transport/logistics problems increasing (‘gridlock Europe’)
- New technologies are available or emerging
- New possibilities …
- Need to ‘Think outside the box’…
Devolved Manufacturing – (2)
Case One – CAL system

Typical Race Clutch Construction

Central Splines in Friction Plate Hub
Case One – CAL system

- System Menu
- Search Existing Products
- Input Spline Dimensions
- View 3D Model
- Send files for manufacture
- Test Mfg at Brunel
Case Two – wydiwyg.co.uk

Home page

Use mini-CAD program

Details

View model in 3D

Download mini-CAD program

Stage ONE

Stage TWO
Case Two – wydiwyg.co.uk

Stage THREE

Home Page
Upload CAD file
Make payment
Confirmation
Test part

Register
Find outlet
Outlet details
Case Three – Creatorium Portal

Stakeholders in the CREATORIUM Portal
Case Three – Creatorium Portal

CREATORIUM relationship with Cases One and Two
Discussion (1)

- Implementation key issues
- Start points and direction
- Organisational issues
- Technology adoption
- Strategies for DM
- Design, legal and ethical issues
- Control and management of a DM venture
Discussion (2)

– Broader e-manufacturing applications

- Web-based bearing design support systems
- Web-based manufacturing assembly simulation
- Web-based intelligent (CBR) selection of cutting tool inserts
- Modelling and simulation of the extended enterprise operations based on dynamic Petri nets
- Remote condition monitoring and control of manufacturing systems
- Creative design search engine
- RFID application for diamond cutting tools’ tooling service
Whole system simulations are produced by coupling all of the sub-system simulations based on Grid Computing
Web-based Intelligent (CBR) Selection System for Cutting Tool Inserts

A proposed system architecture...

Process Definition for ISO Turning application

Case-Based Reasoning System

Search for a known insert

Start a search

Please enter the reference of a known insert: ____________________

Validate
Modelling and Simulation of the Extended Enterprise Operations Based on Dynamic Petri Nets

EVENTS

ORGANISATION MODELS

PROCESS MODELS

RESOURCES

PRODUCTS

DATABASE

INTRANET / INTERNET

JAVA SIMULATION

REAL-TIME VISUALISATION

MANUFACTURING ENTERPRISE

INTERNET

CO-ORDINATOR

DESIGN

MANAGEMENT
Remote Condition Monitoring and Control of Manufacturing Systems
Creative Design Search Engine …
RFID Application for Diamond Cutting Tools’ Tooling Service

Tagged Cutting Tools \( T_1 \ldots T_N \)

Reader

Look up

Host System with Tool Database

Update

Geometric images
 Specification
 User information
 Resharpening records
 ……

Reading Successfully

Host system with Tool Database

Antenna

Geomatric images
 Specification
 User information
 Resharpening records
 ……

Diamond tools tracking and servicing support system
Selected ‘Milestone’ Publications (in e-manufacturing) from the AMEE Group

**Books:**

**Journal Papers:**
Conclusions

• Fulfilment of the project objectives
• Overall conclusions
• Future work
Thank you for listening …

Any Questions?