

UNIVERSITI TEKNOLOGI MARA

**DEVELOPMENT OF AN EXPERT SYSTEM FOR
SHEET-METAL-FORMING DIE
MANUFACTURING METHODOLOGIES TO
SUPPORT AN EXTENDED DESIGN TEAM**

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ABSTRACT

In an ever competitive business and manufacturing environment, artificial intelligence (AI) and expert system (ES) play a crucial role in assisting an enterprise to make effective and reliable decisions. This research addresses this issue with the design and development of the architecture of a sheet-metal-forming die manufacturing expert system (DMES) using an up-to-date object-oriented technology (OOT). The DMES method is proposed to improve performance of sheet-metal forming manufacturing activities through the application of concurrent engineering (CE) within an enterprise and collaborative teamwork (CT) amongst industry partners. The knowledge acquisition (KA) of current issues and newfound ideas for improvement on CE and CT is through interviews and discussions with the industry experts. Other specific knowledge is acquired through technical references, resource manuals and on-site data collection. Based on research works by Bugtai and Young (1998) and Zhao, Cheung and Young (1999), the knowledge on die manufacturing is modelled into three components of manufacturing capabilities, namely resource-, process- and strategy-related capabilities (*Resource*, *Process* and *Strategy* respectively). The *Resource* focuses on the DMES's physical elements of tool making machines and sheet-metal forming or press machines within an enterprise and industry partners. *Process* is the action or sequence of actions. *Strategy* is the restrictions imposed upon the use of manufacturing resources and processes.

With this DMES architecture, OOT is used to model the DMES in a simpler and structured form of objects representing the real sheet-metal forming technology environment. Its knowledge representation (KR) through the database and programming components of the OOT then follow suits to complete the design and development of the DMES. Two critical areas considered in case study implementation of the DMES are machining a die component and mass production a sheet-metal product. The DMES obtains information on the die or die component, evaluates its manufacturing capabilities and proposes best possible machining technologies to manufacture the die component and the forming or press machines to mass produce the product. Other case studies include outputs on important information to assist design teams (DTs) decision makers and operational level personnel on machine details, recommended machining parameters and costing. These major contributions of this research work represent the DMES that emulates the best of plural human experts, proving its capability as an ES that is reliable, fast and consistent in providing solutions to an enterprise and its industry partners. This research shows that the DMES is capable of promoting CE and CT, which are the trademarks for higher productivity and output performance. It provides alternative solutions to meet internal and external requirements of an enterprise. Overall, this approach will reduce organisation cost and hence products and services can be competitively priced to meet customer requirements.

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This topic has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree be subjected to the disciplinary rules and regulations of the Universiti Teknologi MARA.

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