

**The Impact of Using CAD/CAM Technology on the
Performance of Mould & Die Manufacturing
Industry in Sri Lanka**

By

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MBA Program

Year 2014

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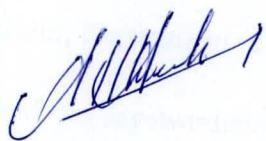
By

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**A research submitted to the University of Sri
Jayewardenepura in partial fulfillment of the requirements
for the Degree of Master of Business Administration**

DECLARATION

I, Alankara Arachchige Shantha Prasanna Jayasinghe declare that this research report is my own, unaided work, unless otherwise referenced or acknowledged . This research was carried out under the supervision of Dr. K.M.S.D. Kulathunga and it is being submitted in fulfillment of the requirement for the Degree of Master of Business Administration in the University of Sri Jayewardenepura Sri Lanka . It has not been submitted before for any degree or examination in any other University.



A.A.S.P Jayasinghe

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LIST OF ABBRIVIATIONS

AGV	Automatic Guided Vehicle
AMT	Advanced Manufacturing Technology
AS/RS	Automatic Storage / Retrieval System
BOM	Bill Of Material
CAD	Computer-aided design
CAD/CAM	Computer-aided design / Computer-aided manufacturing
CAE	Computer-aided engineering
CAPP	Computer-aided part programming.
CEO	Chief Executive Officer
CFA	Confirmatory Factor Analysis
CIM	Computer Integrated Manufacturing
CM	Cellular Manufacturing
CNC	Computer Numerically Controlled
CRM	Customer Relationship Management
DFMA	Design For Manufacture and Assembly
E-commerce	Electronic commerce
ERP	Enterprise Resource Planning
FMC	Flexible Manufacturing Cell
FMS	Flexible Manufacturing System
JIT	Just-in-Time
MCFMS	Multi-Cell Flexible Manufacturing System
MD	Managing Director
MES	Manufacturing Execution System
MMF	Multi-Machine Flexible Manufacturing System
MPS	Master Production Scheduling
MRP	Material Requirements Planning
MRPII	Manufacturing Resource Planning
SCM	Supply Chain Management
SEM	Structural Equation Modeling
SFM	Single Flexible Machine
TQM	Total Quality Management
WIM	Web-Integrated Manufacturing

AKNOWLEDGEMENTS

I wish to express my gratitude and appreciation to my supervisor Dr. K.M.S.D. Kulathunga for providing me with helpful suggestions and assisting me in many circumstances during the time of study. I would also like to express my sincere gratitude to our MBA program coordinator - Dr. P. Janak Kumara for his support and understanding with kind encouragement. Also I wish to thank Mr. Janaka Mangala-senior lecturer, University of Moratuwa for reviewing my survey instrument prior to collection of Data .

My special thanks to national engineering research and development centre (NERD) management and the board of directors for assisting me in carrying out my research work to meet the requirement of my MBA program doing. Also my thanks to Sri Lanka die and mould makers association (SLMDA) for providing me with the necessary Information and Support.

Finally, my deepest appreciation goes to my wife, son - Pubudu, daughter -Senali and family members for inspiring and encouraging me at various stages of the MBA and tolerating miss of company.

A B S T R A C T

Today, computer-aided design (CAD) and computer-aided manufacturing (CAM) technologies are seen as important technologies especially in the manufacturing sector. These technologies are very much relevant to the die and mould manufacturing industry too. However there is little evidence to show any positive impact of CAD/CAM technologies to the die and mould manufacturing industry. This is very much true in the Sri Lankan context. Therefore, this research is aimed at examining the impact of CAD/CAM technologies on the performance of die and mould manufacturing industry in Sri Lanka.

Based on the literature review, a conceptual framework was developed to depict the relationship between CAD/CAM technologies and organizational performance. Consequently two hypotheses were developed. Further, a structured questionnaire was developed, based on the past literature and it was sent to all 40 companies operating in the die and mould manufacturing industry in Sri Lanka. 35 of them responded to the questionnaire.

Data collected was analyzed using frequency analysis, descriptive statistics, correlations and multiple regression. It could be observed that 34.3% of the companies have been operating for more than 15 years, 57.2% of the companies have a workforce of 10-20 people and 45.7 % of the companies are having annual turnover between Rs.1-5 million.

The correlation analysis showed that a positive and significant relationship exists between use of CAD / CAM technologies and the organizational performance. Hence the two hypotheses were accepted. Further multiple regression analysis proved that the conceptual model was statistically fit.

CHAPTER 1

INTRODUCTION

1.1 Background

The use of Advanced Manufacturing Technology(AMT) in Sri Lankan die and mould manufacturing industry was started around late 90's, and in fact these manufacturing technologies were comprehensively applied in the few international firms operating in free trade zones (FTZ). The transfer of technologies has not been properly trickled down to local manufacturing industry (Mould manufacturing) as the means of technology transfer was taking place through the knowledge and hard skills gained by the engineers and operators who worked in those factories. Advanced manufacturing technology related to mould manufacturing, specially in Sri Lankan context is primarily CAD (Computer-aided design) and CAM(Computer-aided manufacturing)technology, CNC(Computer numerically controlled) technology, CIM (Computer integrated manufacture). Also an extended part of CAD/CAM is coupled with CNC machinery, computer aided analysis and simulation, 3D modeling, CNC part program generation etc.

However in early year 2000, a few Sri Lankan firms opted to purchase CNC machines and assisted CAD/CAM technologies for use in their manufacturing process mainly run by conventional type manufacturing machines. This transformation has boosted the local manufacturing industry, specially mould manufacturing industry which needs accurate and reliable machinery for produce quality moulds, and by the year 2010 almost all the major manufacturing facilities were equipped with the latest state of the art CAD /CAM technology. Even with the introduction of the machinery and local adaptation of the equipment, the rate of growth expected by the industry was not met, and return on investments on those machinery were questioned.

At present there is a problem in the manufacturing industry where they purchase these expensive high end machinery/ equipment for manufacturing, whether the expected outputs are achieved. This research work basically plans to study the effect of CAD/ CAM on mould manufacturing industry and investigate whether the expected output has been realized by the said technology.

The following section will briefly provide the details of the dimensions of CAD/CAM and the dimensions of organizational performance and their respective relationships.

1.1.1 Computer-aided design (CAD)

With the introduction of CAD (Computer-aided design) to the mould manufacturing industry in Sri Lanka, it was visible that the productivity of the design process has improved many folds, early companies who were reluctant to produce complicated parts were then entered the field with easy access. At the early stages, manufacturing companies were using AutoCAD for their design work, this was basically 2D drafting package and has very limited capacity for 3D modeling but with the help of AutoCAD companies were managed to speed up their design process and streamline it.

This was a big step for the people who used hand sketches for mould design and people who used conventional drawing board for mould design, since the mould design is a very complicated process and often needed rework and modification where conventional methods hardly had had any option other than redraw or erase. Hence the introduction of CAD packages (Even AutoCAD) has made very significant improvement in local mould manufacturing companies. With the introduction of more advanced CAD packages like Pro Engineer, UniGraphics ,I DEAS the flexibility and capabilities of mould design has dramatically improved . The 3D modeling and engineering analysis contain in this CAD packages has in turn improve the creativity of designers and competitiveness in product design. Mould design is basically comprised of few steps with the help of CAD. CAD Software comprised of article drawing, mould design, core and cavity design, mould analysis, mould drawing / assembly part drawings capabilities.

1.1.2 Computer-aided manufacturing (CAM)

With the introduction of CAM (Computer-aided manufacturing) the conventional type manufacturing has taken a big boost, the introduction of various CNC machines has increased their production capability and productivity but integration of CAM software with CNC has improve the manufacturing capabilities of companies in many folds. Initially CNC machines were programmed manually by CNC operators which took long time and depend largely on the experience of the machine operators, and this had become a problem to the senior managers as they have no control over the machine operators in planning their manufacturing activities, but with the introduction of CAM package this task is made very easy by automatically generating the part program, even the design engineer himself could generate the part program which are necessary for machining the mould cavities and other complicated components .

Introduction of CAM packages has largely integrated the design process and manufacturing processes, many organizations have employed CAD/CAM engineers for the design and manufacturing activities of their respective companies. This has increased the flexibility of the process and improved the manufacturing standards. CAM related activities to mould manufacturing would be CAM Software, automatic generation of tool paths, Generate part programs for CNC machines, calculation of machining time, manufacturing of mould bases, manufacturing of mould core and cavity. In the CNC machine on their control panel it displays the simulations of tool paths generated through CAM software. This will help the programmer or the designer to optimize the tool paths and plan the tooling required for the process. This will also help in process planning activities.

1.1.2 CNC technology

Even though CNC technology is rather new to Sri Lanka, it is more than 5 decades old, CNC stands for Computer Numerical Control. The movements of a conventional machine is controlled by manual means, through wheels and leavers but in the case of CNC machines the movements are controlled through servo motors by a computer.