Design and Development of Plastic Injection Mould With Concurrent Engineering

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Design and Development of Plastic Injection Mould With Concurrent Engineering

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BY

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APPROVAL

This Projek Sarjana Muda (PSM) submitted to the senate of UTeM and has been as partial fulfillment of requirement for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design). The member of the supervisory committee is as follow:

....

En. Shajahan Bin Maidin
Faculty of Manufacturing Engineering

ABSTRACT

This Bachelor Degree project presents a study on design and development of plastic injection mould with concurrent engineering. The application of concurrent engineering process to the design of an injection process involves the simultaneous consideration of plastic product design, mould design, and injection molding machine selection, production scheduling and cost as early as possible in the design stage. The advantages of concurrent engineering are reducing the development cost and shorten the lead-time. Product can be market with short time and good quality. This project uses a product, which has been model with CAD software as a case study and will incorporate concurrent engineering methodology. Many of the design tasks were carried out in the parallel process. The product design has been tested with the CAD software like Mold Flow analysis and Structural Analysis. Then the shortest plastic injection time was found which 1.11 second is. Therefore short injection time can reduce the cycle time. Meanwhile, the mold cost can be reduced. The results of this project shows that the side injection location, shortest runner length 40mm, small runner diameter 4mm and high melted temperature 250 ºC can achieve the shortest plastic injection time. Thus, by using CAD software and the implementation of concurrent engineering improve the quality design of the plastic part and reduce the lead time, cost by reducing mold development time and enhance cooperation between the designers and manufactures.

ABSTRAK

Projek sarjana muda ini adalah bertujuan untuk mengkaji tentang mereka dan pembaguanan acuan plastik dengan penggunaan kejuruteraan serempak. Pengunaan kejuruteraan serampak ini melibatkan rekaan produk plastik, reakaan acuan, pilihan pengacuan suntikan mesin, jadual pembuatan serta kos pada peringkat lebih awal semungkinnya. Manfaat kejuruteraan adalah mengurangkan kos pengembangan dan memendekan masanya. Maka produk tersebut akan boleh dipasarkan dengan masa yang pendek dan berkualiti tinggi. Projek ini telah menggunakan satu produk plastik yang telah dijadikan model dengan CAD perisian sebagai kes pembelajaran. Metologi proses serampak juga diaplikasi dalam proses rekabentuk dan pembuatanacuan.Banyak kerja rekabentuk boleh dijalankan dalam process selari. Rekaan produk tersebut telah dikaji dengan CAD perisian seperti acuan analisa dan struktur analisa. Masa suntikan plastik yang terpendek telah dicari iaitu 1.11 saat. Oleh itu, masa suntikan yang pendek boleh mengurangkan kitaran masa. Pada masa sama kos acuan boleh dikurangkan juga. Keputusan dalam projek ini menunjukkan kedudukan suntikan pada tepi, panjang pelari yang pendek 40mm, diameter pelari yang kecil iaitu 4mm dan suhu pengcairan yang tinngi iaitu 250 ºC boleh menguranakan masa suntikan. Justeru itu, penggunaan CAD perisian dan aplikasian kejuruteraan serampak mampu mengubah kualiti rekaan plastik dan mengurangkan masa pengeluaran dengan mengurangkan masa pmbangunan meningkatakn kerjasama antara pereka dan pembuat acuan.

DEDICATION

My Parent

Who has always been there for me and always prays of me,

My young brother,

My friends

Who has support me.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

ABS	-	Acrylonitrile, Butadiene, Styrene
AC	-	Acetal
CAD	-	Computer-Aided Design
CAE	-	Computer Aided Engineering
CATIA	-	Computer Aided Three dimensional Interactive Application
CE	-	Concurrent Engineering
CMM	-	Coordinate-Measuring Machine
CNC	-	Computer Numerical Control
3DP	-	Three Dimensions Printing
EBM	-	Electron Beam Melting
FDM	-	Fused Deposition Modeling
LO M	-	Laminated Object Manufacturing
MJM	-	Multi Jet Modeling
NC	-	Numerical Control
RP	-	Rapid Prototyping
PET	-	Polyester
PC	-	Polycarbonate
PMMA	-	Polymethyl Methacrylate
PP	-	Polypropylene
PPS	-	Polyphenylene Sulfide
Pro/E	-	Pro/ENGINEER
PVC	-	Polyvinyl Chloride
SLA	-	Stereo Lithography
SLS	-	Selective Laser Sintering
STEP	-	Standard Template for Electronic Publishing
STL	-	Standard Template Library
V5	-	Version 5

CHAPTER 1

INTRODUCTION

1.1 Background

Concurrent engineering can improve product quality and reduce manufacturing cost, development time, and development cost. These reported improvements in manufacturing cost, development time, and development cost are primarily achieved through a combination of overlapping phases, cross-functional integration, and analytical tools [1]. With overlapping phases, firms are able to shorten development time and cost by improving the integration and tradeoffs between downstream and upstream activities. Cross-functional integration complements the overlapping of phases by providing the cross-functional communication necessary to perform different phases simultaneously [2]. Tools such as design for assembly, design for manufacturing, modular design, quality function deployment, computer-aided design (CAD), and Computer-aided manufacturing complement overlapping phases and cross-functional integration by helping firms simultaneously analyze a product from a variety of functional perspectives and thus make better tradeoffs between manufacturing costs, product performance, and product quality [2]. This project will use a part has been model with CAD software as a case study. It is anticipated that these concurrent tools will guide part designers and mold makers to decide the appropriate factors of design. Finally the core and cavity of the part can be produced with great consistency, accuracy, and with less time.

1.2 Objectives Of The Project

(a) To select a plastic product and to design the plastic injection mold according to mold design specifications factors and optimum aspects.
(b) To design and develop the plastic injection mold with the concurrent engineering.
(c) Design and develop plastic product by CAD software for an injection molding system that provides consistency and systematic analysis and design of the shape of molding components with efficiency and quality.
(d) To design core and cavity of plastic product with accuracy dimensions and suitable specifications.

1.3 Scope Of Project

(a) To create and design a plastic product.
(b) To analyze the optimum design parameters of mold and included costing.
(c) Utilization of CAD software in design and analysis.
(d) To create and design core and cavity for the plastic part.
(e) Utilization of rapid prototyping technology as a concurrent tool for mockup.
(f) Study efficiency of the implementation of concurrent engineering.

1.4 Problem Statements

Product development has changed from the traditional serial process of design, followed by manufacture, to a more organized concurrent process where design and manufacture are considered at a very early stage of design. The application of CE process to the design of an injection process involves the simultaneous consideration of plastic product design, mould design and injection molding machine selection, production scheduling and cost as early as possible in the design stage.

It realizes that injection moulds are expensive to design and fabricate which require skills and experience. Designers have their own approach to design an injection mould. Surely one of the most critical parameters to be considered in the design stage of the mould are the number of cavities, methods of injection, types of runners, methods of gating, methods of ejection, capacity and features of the injection molding machines. Mould cost, mould quality and cost of molded product need to be considered.

This project will use a name card box, which has been model with CAD software as a case study. It is anticipated that these tools can help designer and mould makers to develop good product with a better delivery and faster tooling with less time and money.

CHAPTER 2

LITERATURE REVIEW

2.1 Concurrent Engineering (CE)

According to CIM institute, Concurrent Engineering is defined as “the delivery of better, cheaper and faster products to market, by a lean way of working, using multidiscipline teams, right first time methods and parallel processing activities to consider continuously all constraints [3].

The term Concurrent Engineering or sometimes-called Simultaneous Engineering was originated in the USA in 1989 [3]. It is an approach to product development, which focuses on parallel (rather than sequential) interaction among various product lifecycle concerns. In other words, concurrent engineering is a systematic approach to the integrated, concurrent design of products and their elated processes, including manufacture and support. This approach is intended to cause developers, from the outset to consider all elements of the product life cycle from conception through disposal, including quality, cost schedule and user requirements [4].

2.1.1 Objectives of Concurrent Engineering

The objective of Concurrent Engineering is to improve the interactive work of different disciplines affecting a product. The following are the objectives of CE [4]:

(a) Minimize the product life cycle

Eliminate the redesign procedure.

(b) Decrease production cost

Results from the minimization of the product life cycle.

(c) Maximize product quality

Spending more time and money initially in the design cycle and ensuring that optimize the concept selection. The company can increase the prospect of delivering a quality product to customer.

(d) Teamwork

Human Resources are working together for a common product.

2.1.2 Concurrent Engineering Fundamental

There are lots of alternative definitions of concurrent engineering are, but this list is a fairly typical one. The increased role of manufacturing process design on product design decision, the formation of cross-functional teams to accomplish the development process, and the use of lead time as a source of competitive advantage are all part of it [5].

(a) Cross-functional teams

Often the method of accomplishing the integration of design with other functions is through the use of cross-functional teams. These teams may include people with expertise in production, marketing, finance, service or other relevant area, depending on the type of product.

(b) Customer Requirement

Another important functional barrier is the separation between the engineering designer and the customer. Under the same philosophy of removing the design-manufacturing barrier, the designer can become more responsive to customer desires and thereby create a more successful product. This is known as design marketing integration.

(c) Lead time

Lead-time has proved to be a significant facet of modern competition. By lessening the lead-time the firm is able to rapidly respond to market trends or to incorporate new technologies. A lessened lead-time creates a market advantage for those firms who are to produce products rapidly [5].

2.1.3 Principle of Concurrent Engineering (CE)

Traditionally, product development activities are carried out sequentially from one stage to another as illustrated in Figure 2.1.3.a. This approach is time consuming and not cost effective. Nowadays, because of advancement in technology and high competition, product life is getting shorter. This means that if a new product were to be introduced in market place, it has to be developed in fast track.

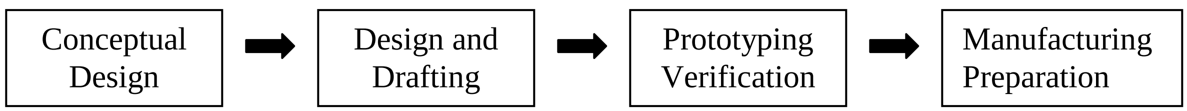

Figure 2.1.3.a: Traditional Way of Product Development [5]