

The Mold Cost Estimation Calculator for Plastic Injection Mold Manufacturing

Massila Kamalrudin, Sharmini Mohan, Liew Pay Jun, Rosmiza Wahida Abdullah
*Faculty of Information and Communication Technology,
Universiti Teknikal Malaysia Melaka (UTeM),
Locked Bag 1200, Ayer Keroh, 75450 Melaka.*
*massila@utem.edu.my, minishar_29@yahoo.com.my, payjun@utem.edu.my,
rosmiza@utem.edu.my*

Abstract

This paper presents a research about the software system to calculate cost estimation in plastic injection mould manufacturing which is named as mold cost estimation calculator (MCEC). The objectives for MCEC is to optimize the cost estimation problems in plastic injection mould, assists industrial practitioner in estimating budget for manufacturing and assists for teaching purposes. There are three target users for this project that is industrial practitioner, lecturers and students. MCEC is developed using JavaScript programming language which each embedding of JavaScript within a particular environment provides the means to interact with that environment. All users may use this software easily even those who are not expert in injection molding because this software are user friendly.

1. Introduction

Plastic injection molding is one of the most popular manufacturing processes for making thermoplastic products where consists of various components such as mould plate, mould standard parts and auxiliary components. Mould cost estimations made during the concept design stage itself because it will help in identifying acceptable part and mould configurations before actual investment in the mould is made. The mould cost can be divided into two major categories which is first is cost of the prefabricated mould base consisting of the required plates, pillars and guide bushing. The second category is cavity and core fabrication costs [1]. Many commercial programs are available for estimating the cost of injection molded

thermoplastic parts. Some are quite good, but their target audience is more often than not injection molders, not part designers [2]. Cost estimators must enable an estimator to recognize unique design conditions and estimate the cost of the project's activities and corresponding resources and generate and maintain an integrated cost model based on the estimators' rationale [3]. Besides that, calculate the costs for mould are depending on the material and resource cost implications of the mould.

2. Literature Review

There is available software for estimating costs for injection mould parts that written for *cost estimators* [2]. Although these programs help them to estimate the cost, they do not serve those designers who want to understand the relationships between part cost and tooling or part design. According to Douglas (1998), a barrel contains heated plastic that is injected into a closed mold that contains a machined, reverse image of the desired product. The plastic injection mould is allowed to cool and solidify in the cavity. Then, the mold is opened and the product is ejected.

Based on Chan et al. (2003), Computerized Quotation System for Injection Mould Manufacturing (CQSIM) is one of many software systems that available in market nowadays. The system is established with Microsoft Access and its programming language is Visual Basic for application. The Visual Basic application program calculate input data with predefine data from the database and save the calculated data into the corresponding result data table. The user must input data in this system such as mould base, ejector pin, cooling line and machining method to mould makers. Users choose a suitable operation from the menu for the desired tasks. The results can be obtained within a minute

of calculation. Second is Gumstix computer is a tiny single board computer which is an inexpensive and high-performance miniaturized platform to estimate the manufacturing cost of molded parts. It consists of a knowledge-base, knowledge processing units and server service unit for user interactions, all of which are implemented on the Gumstix computer. Gumstix is an independent computer only connected to the host through the USB port. The host computer is used as a power supplied as well as a communication gateway [7].

Third is Quicksight Mold Estimator developed as a Microsoft Excel spreadsheet, is a program for generating injection molding part and mould cost estimated from simple inputs. Cost estimates are based fundamentally on volumes. The colour and star coding combine to make it easy to get started with Quicksight Mold Estimator. One can choose a generic thermoplastic in the volume and material panel and this automatically inputs a density value [8].

3. Method

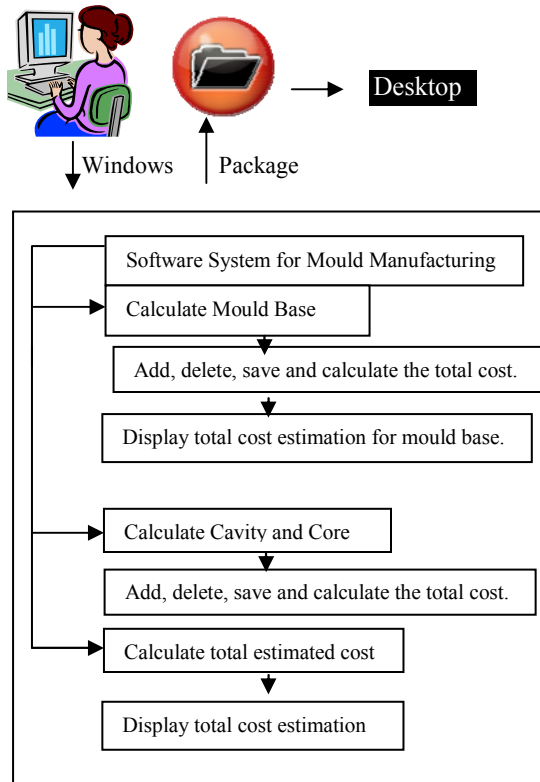


Figure 1: System Architecture

MCEC is developed through windows by the developer. Developer will use JavaScript as a

programming language and Microsoft Access as a database for the system. This software system divided into three parts which is first is to calculate mould base, second is to calculate cavity and core and finally is to calculate total estimated cost for one mould. After the system finish developed through windows, developer will do packaging on the developed system to be installed in desktop. From the system, user can calculate estimated cost for mould base and cavity and core to get the total estimated cost for one mould. There are save button for user save all the information that used to calculate on mould.

a) Engine

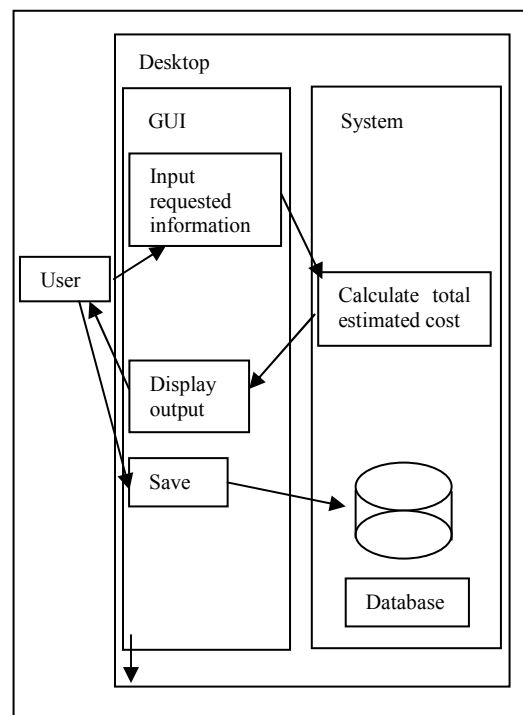


Figure 2: Calculator Engine Architecture

Figure 2 above illustrate the architecture about the flow of the engine of MCEC. Firstly, the user should input the required information before the system calculates the total estimated cost for one mould. After the system calculates the cost estimation for one mould, the result will be shown on the screen through the GUI of the system. The user can save all the information into the database by clicking the save button on the GUI interface of the system.

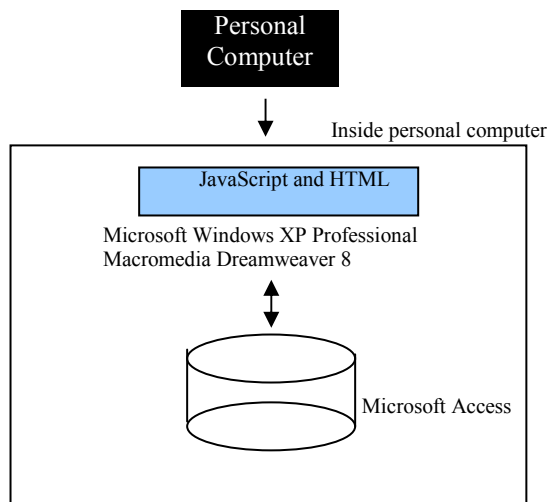


Figure 3: The Software Development Environment Setup Architecture

This section describes the steps required to compile and link engine programs. The main steps are:

- (i) Step 1 – Write Main Application
The main application of this system is written in JavaScript and HTML programming language. Usually HTML programming language is used to design the system while JavaScript are used to run the function in the system.
- (ii) Step 2 – Save Data in Database
Setup the link to the database in the application. The database for this cost estimation for mould manufacturing system is Microsoft Access. All the data from application will be saved in the database. Ms Access is chosen because this system does not involve huge amount of data.
- (iii) Step 3 – Test the System
The system is ready to be use by the user. Testing is held between developer and users. Main users are academics, students and practitioners.

JavaScript (client-side scripting) and HTML programming language are used to code the cost estimation of mould manufacturing system. A sophisticated language like JavaScript and HTML, a programmers can create programs or systems that input and output information in a variety of ways. JavaScript is a scripting language most often used for client-side web development. It is a dynamic, weakly typed, prototype-based language with first-class functions. JavaScript was influenced by many languages and was designed to have similar look to Java but easier for non-programmers to work with. The language is best known for its use in websites

but also used to enable scripting access to objects embedded in other applications [10].

The client-side validation for JavaScript can speed up in loading forms because form fields can be checked on the fly both during the user’s changes and when the user submits. Besides that, the user can be immediately notified of a problem before the data is returned to the server. Below is the example of java script codes that are used in order to calculate mold;

Table 1: Example of mould base calculation

```
//declare the function for mould base calculation
function calculate()
{
  VarA=
  parseFloat(document.getElementById("Surface_Area").value);
  VarB= parseFloat(document.getElementById("Thickness").value);

  document.getElementById("TotalCost").value=formula(A,B);
}

//declare the function for mould base calculation
function formula(A,B)
{
  var C = Math.abs(1000+(0.45*(A*Math.pow(B,0.4))));
  x=C.toFixed(2);
  return x;
}
```

Table 2: Example of cavity and core calculation

```
//declare the function for cavity and core (manufacturing ejector
system)

function calculateEjecSys()
{
  varD=
  parseFloat(document.getElementById("ProPartArea").value);
  document.getElementById("ManuEjecPin").value=for
mulaEjecSys(D);
}

//declare calculation for cavity and core (manufacturing ejector
system)
function formulaEjecSys(D)
{
  var E=Math.abs(2.5 * Math.pow(D,0.5));
  x=E.toFixed(2);
  return x;}
}
```

Table 3: Example of total cost estimation for one mould

```
//declare calculation for total mould cost
function formulaTotalMouldCost()
{
  varP=
  Math.abs(document.getElementById("TotalCost").value)+Math.ab
s(document.getElementById("EstimateCC").value);
  x=P.toFixed(2);
  return x;
}
```

4. Discussion and Results

Based on the engine, a prototype of a mold cost estimation system is built. The system acts as a calculator which provides fast and accurate results. The users also can retrieve back the data through the database that provided. Figure 4, Figure 5 and Figure 6 are the example of the interface of the prototype.

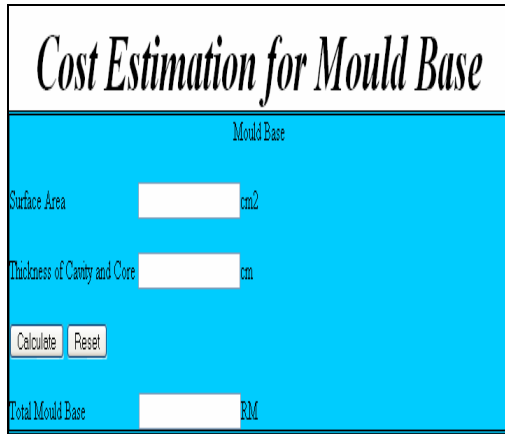


Figure 4: Mould Base Calculation

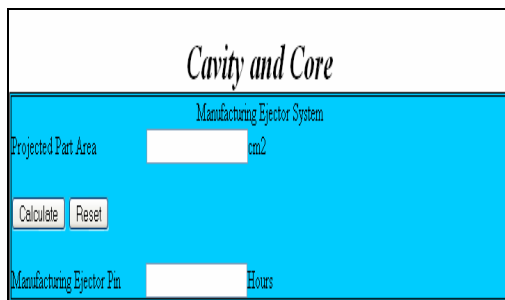


Figure 5: Cavity and Core Calculation

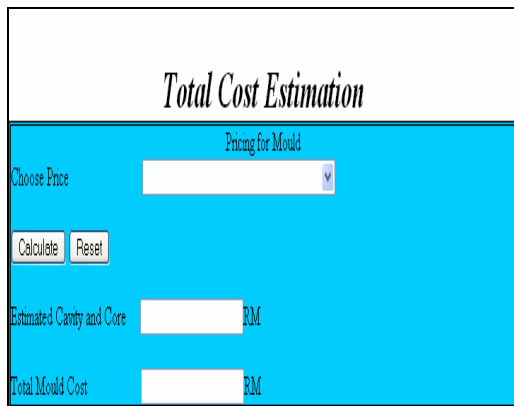


Figure 6: Total Cost Estimation Calculation

5. Conclusions

In conclusion, the performance of the MCEC is measured in the next phase in order to prove its accuracy, efficiency and reliability. This evaluation results will be discussed in the coming phase of the research.

6. References

- [1] Boothroyd, G., Dewhurst, P. and Knight, W. (2002). "Product Design for Manufacture and Assembly." Marcel Dekker Inc. New York
- [2] Wichmann, M.W., Boyer, T.D. and Broglia, T.J. "A Simple Plastic Part Cost Estimator Using Microsoft Excel." DuPont Engineering Polymers. 611-615.
- [3] French, S.S., Fischer, M., Kunz, J. and Paulson, B. (2003). "A Generic Feature-Driven Activity-Based Cost Estimation Process." Advance Engineering Informatics 17. 23-39.
- [4] Bryce, D.M. (1998). "Plastic Injection Molding: Mold Design and Construction Fundamentals." Volume III. Dearborn, Michigan: Society of Manufacturing Engineers.
- [5] Chan, S.F., Law, C.K. and Chan, K.K. (2003). "Computerised Price Quoting System for Injection Mould Manufacturing." Journal of Materials Processing Technology 139. 212-218.
- [6] Ko, K.H., Pochiraju, K. and Manoochchri, S. (2007). "An Embedded System for Knowledge-Based Cost Evaluation of Molded Parts." Knowledge-Based Systems 20. 291-299.
- [7] Maier, C. (2005). "Quicksight – Quick estimate." Journal of Business 11.
- [8] Horwat, W. "JavaScript 2.0: Evolving a Language for Evolving Systems."
- [9] Chin, K.S. and Wong, T.N. (1996). "Developing a Knowledge-Based Injection Mould Cost Estimation System by Decision Tables." Advanced Manufacturing Technology 11. 353-364.