UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

BOTTOM UP COST ESTIMATION MODEL FOR PROJECT MANAGEMENT IN SEMICONDUCTOR INDUSTRY

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DEDICATION

To my beloved families:

My Wife, My Father, My Mother, My Brother and My Sister

ABSTRACT

Cost estimation is a process of estimating and forecasting the total cost required of executing the engineering activities from project initiation till project completion. In semiconductor manufacturing industry, project managers encountered several obstacles with regards to cost estimation. There are no proper guidance, no standardization and no project budget breakdown overview on the cost estimation. Consequently, these have incurred no consistency in project cost estimation among project managers, poor cost management and mitigation plan shown by project managers with regards to high percentage difference between the actual and estimate (plan) which is more than 20 percent. Hence, there is a need to develop a systematic framework or a proposed approach for cost estimation in order to help and support the project managers which handling the package assembly project in INN Company, Malacca. This research proposes a methodology that uses bottom up approach via Activity Based Costing (ABC) to estimate a project cost with five key cost elements using Excel-based cost estimator. The package assembly projects that are being discussed and analyzed are projects complexity of 1, 2 and 3. The cost model is validated with the historical data while the testing data are validated with the actual data. Mean absolute percentage error (MAPE) is calculated to measure the forecast accuracy. With the full implementation of the established cost model, it helps the company to achieve 7 percent of MAPE in 2015 as compared to 13 percent (2014) and 16 percent (2013). The outcome of the cost model is satisfactory as the MAPE of 7% is obtained as compared to an industrial target of 10%. It is recommended that thorough studies and analysis could be studied to understand greater details of cost element. Web Portal is the recommended tool for the cost estimation in future as it is a collection of webpages that support multiple web browsers.

ABSTRAK

Anggaran kos model adalah satu proses untuk menganggar dan mengira jumlah kos yang diperlukan untuk melaksanakan aktiviti-aktiviti kejuruteraan dari permulaan projek sehingga selesai projek. Dalam industri semikonductor, pengurus projek menghadapi beberapa halangan dari segi kos anggaran. Antaranya ialah tiada bimbingan yang betul, tiada piawaian. Oleh itu, tidak ada konsisten dalam membuat anggaran kos projek di kalangan pengurus projek, pengurusan yang lemah dan rancangan yang tidak rapi ditunjukkan oleh pengurus projek apabila berlaku sisihan yang ketara di antara anggaran kos pelan dan kos sebenar, iaitu melebihi 20 percent. Dengan itu, ada perlunya untuk merangka pendekatan sistematik untuk membantu pengurus projek yang mengendali projek pemasangan pakej dalam industri semikonduktor di INN Company, Melaka. Kajian ini mencadangkan satu kaedah yang menggunakan pendekatan bawah ke atas melalui kos berlandaskan aktiviti dan teknik untuk menganggar kos projek dengan sumber pemasangan (kos buruh) sebagai parameter utama menggunakan Excel. Projek pemasangan yang akan dibincangkan dan dianalisa adalah projek kelas 1, 2, dan 3. Anggaran kos model is disahkan dengan data-data yang diperolehi daripada project-project dulu dan keputusan ujian pula disahkan dengan data-data yang sebanar. MAPE dikira untuk menguji ketepatan kos anggaran. Dengan anggaran kos model ini, MAPE yang dicapai di tahun 2015 adalah 7%, 2014 (13%) dan 13% (2013). Keputusan daripada kos anggaran model itu memuaskan kerana piawaian peratus perbezaan antara anggaran dan sebear adalah 10% dalam sektor perindustrian. Adalah disarankan untuk mengaji lebih teliti dalam element-element kos dan Web Portal digalakkan pada masa akan datang keran ia boleh menggabungkan beberapa jenis rangkaiwan web dalam penanggaran kos.

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ABC	- Activity Based Costing
AOC	- Annual Operating Cost
CAD	- Computer aided design
CAM	- Computer aided manufacturing
CBO	- Cost Breakdown Overview
CC	- Complexity Class
CP	- Capital Purchase
DoE	- Design of Experiment
EMWG	- Economic Modelling Workshop Group
ESFC	- Engineering Sample Forecast
FMEA	- Failure Mode Effect Analysis
GR&R	- Gage repeatability and reproducibility
HTOL	- High Temperature Operating Life
HTS	-High Temperature Stress
MSDS	- Material and Safety Data Sheet
MSP	- Mark, Scan, Pack
M & O	- Maintenance and Operation
MOTI	- Ministry of Transportation and Infrastructure
NDA	- Non Disclosure Agreement

PMBOK	- Project Management Body of Knowledge
Q Plan	- Qualification Plan
RoHS	- Restriction of Hazardous Substance
ROM	- Rough of Magnitude
SAT	- Scanning Acoustic Tomography
SEM	- Scanning Electron Microscopy
SME	- Subject Matter Expert
THB	- Temperature, and Humidity Bias
TC	- Temperature Cycling
TCM	- Total Cost Management
VRFC	- Volume Rolling Forecast
WBS	- Work Breakdown Structure
WSDOT	- Washington State of Department Transportation

CHAPTER 1

INTRODUCTION

1.1 Background of Study

A lot of effort is required for a company to have innovative products especially during the development stage (Chwastyk and Kolosowski, 2013). The automotive sector is also not exempted from the global market place, the companies have to be innovative in various areas, including cost, functionality, design, manufacturing, and quality (R.Roy et al., 2011). The establishment of any proposed innovative ideas, frameworks or any systems launching are major challenges for a company. Any projects have its uncertainties and risks where systematic tools and methods are significantly important to ensure project success. Attaining company's objective and achieving project success is largely relying on the effective implementation of the deployment process in a company. This research paper shows an approach to estimate the total cost of the package assembly project in semiconductor manufacturing industry. The intention is to help project managers in providing quality project cost estimation within the stipulated time. Not only that, cost estimation is crucial in decision making process. If the project cost is underestimated, authorization of a new project could waste the limited resource and jeopardize the expected contribution and credibility of a project manager. In contrast, if it is overestimated, a new project could be refrained which may beneficial to the organization.

Cost engineering is the engineering practice related to the management of project cost, involving tasks such as planning, cost estimating, cost controlling and monitoring, cost managing so that the project can be completed within the approved budget (Roy and Griggs, 2004). The cost engineer seeks optimum balance according to project triangle, which is cost, time requirement, project scope trade off with quality requirement in the middle.

Cost estimating is the process of developing an approximation of the monetary resources required to complete the project activities or work-packages. There are many methods and techniques in cost estimating, such as using expert judgment, analogous estimating, parametric estimation, bottom-up estimating, three-point estimating and activity based estimating (PMI, 2013). Cost estimates include the identification and consideration of costing alternatives to kick off and complete the project. Cost trade-offs and risks should be taken into consideration to achieve optimal costs for the project. According to Ramasubbu and Balan (2010), their research has shown that project cost estimate is always a challenge, time-consuming which took longer time to accomplish, unavoidable cost overruns and schedule slips due to poor cost estimates may delay of overall project progress.

1.2 Problem Statement

In actual scenario, project managers encountered several obstacles and problems related to project cost estimation in semiconductor package assembly manufacturing industry. This research work is based on the actual case occurred in INN Company, located in Malacca.

There are no proper guidelines, no standardization and no project budget breakdown overview on project budget estimation in 2013. The first common problem encountered is no proper guideline which resulted in no consistency on project budget estimation thus created big gap or deviation (more than 10%) and variation in terms of comparison between actual versus test estimate (forecast) which can be illustrated in Figure 1.1 for different project complexity in 2013. In semiconductor industry particularly, project complexity plays an utmost role in determining how much the project budget is. Without proper guidelines, project managers have no visibilities comparing projects by projects, having difficulties on decision making whether to buy or make, to start a project in in-house's assembly site or in subcontractor's site.

In INN Company for example, no standardization can be seen, ranging from small-scale design of experiment (DoE), engineering evaluation or engineering assessment up to a single project level. This common dilemma caused the project cost estimation calculated without standardized work breakdown structure (WBS) by the project managers. As a consequence, issue like no transparency throughout the entire project cost estimation among the requestor, the project manager as an executor and stakeholders of the project occurred. Thus, when the project is executing based on this lacking-structure practice, resource management and effective prioritization became big challenge for the project managers in the scenario of resource constraints.

Lastly, project managers always have the difficulties to explain the project budget or cost breakdown overview (CBO) during project decision meeting. The lacking of comprehensive work breakdown structure has not only resulted in poor project execution quality but also unclear relationship among project cost, project scope, quality requirement, timeline. Subsequently, project managers were taking longer time in preparing the project cost estimation which may not be accurate and meet the expectation of the requestor or sponsor.

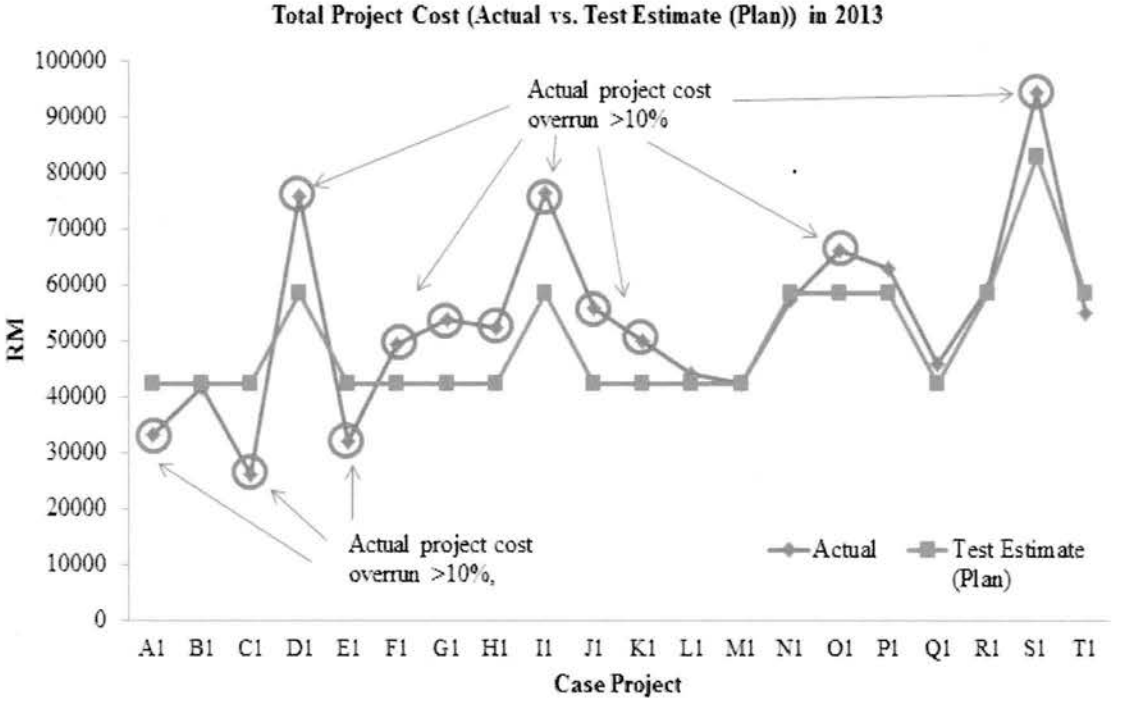

Figure 1.1: Actual Project Cost versus Test Estimate in 2013