

A quality/cost-based improvement approach for conceptual process planning

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Abstract. This paper proposes an approach to develop a quality/cost-based conceptual process planning (QC-CPP). This approach aims to determine key process resources with estimation of manufacturing cost, taking into account the risk cost associated to the process plan. It can serve as a useful methodology to support decision making during the initial planning stage of the product development cycle. Quality function deployment (QFD) method is used to select process alternatives by incorporating a capability function for process elements called a composite process capability index (CCP). The quality characteristics and the process elements in QFD method have been taken as input to complete process failure mode and effects analysis (FMEA) table. To estimate manufacturing cost, the proposed approach deploys activity-based costing (ABC) method. Then, an extended technique of classical FMEA method is employed to estimate the cost of all risks associated to studied process plan, this technique is called cost-based FMEA. For each combination of resources, cost-based FMEA proposes a set of recommended actions, estimates their cost and the risk cost. The output data gathered in this approach are used to perform decision guidelines for detailed process planning in order to improve product quality/cost ratio. A case study is presented to illustrate this approach.

Keywords: process planning, quality function deployment, failure mode and effects analysis, activity-based costing, decision-making

1 Introduction

Conceptual process planning (CPP) is an activity for designers to evaluate manufacturability and manufacturing cost in the early product development stage^[5]. The major manufacturing cost is determined in the early stage of product development. It is critical to be able to assess quality and cost as early as possible in the product development cycle. This paper proposes an approach to develop a quality/cost-based conceptual process planning (QCCPP). This approach uses the QFD (Quality Function Deployment) and FMEA (Failure Mode and Effects Analysis) tools to determine manufacturing processes and resources with appropriate process capability to produce product characteristics. It also uses the ABC (Activity-Based Costing) method to estimate manufacturing cost. Finally, a cost-based FMEA method is carried out to estimate failure and alternative actions cost.

QFD is a powerful tool for quality planning. It is a structured methodology to translate the desires of the customer into product design or engineering characteristics, and subsequently into parts characteristics, process plans, and production requirements associated with its manufacture. This is a four-phase process: product planning, parts deployment, process planning, and production planning^[8]. These four phases approach is accomplished by using a series of matrixes, called House Of Quality (HOQ), that guide the product team's activities by providing standard documentation during product and process development. Each phase has a matrix consisting of vertical columns of "Whats" and horizontal rows of "Hows". At each stage, the "Hows" are carried to the next phase as "Whats".

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