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# Evaluation of the effect of product demand uncertainty on manufacturing system selection

Ana Vafadar[a,*], Majid Tolouei-Rad[a], Kevin Hayward[a]

[a]*ECU Western Australia, Perth and WA 6027*

**Abstract**

The use of advanced manufacturing systems is widespread; however, manufacturers frequently face difficult decisions when it comes to selecting the most appropriate system. Uncertainty regarding product demand makes this process more difficult, as many factors are influencing simultaneously. This paper focuses on analyzing the demand uncertainty on the performance of modular drilling manufacturing systems versus other alternatives and evaluating the uncertainty's impacts on the final decision. To do so, a model is suggested and the effect of demand uncertainty on the output is investigated. Three automotive components of varying complexity are used to examine the approach for making reliable decisions.


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*Keywords:* Manufacturing system selection; Modular manufacturing system; Decision-making; Uncertainty; Product demand

## 1. Introduction

Manufacturing industries have to adapt quickly to current production challenges such as new production requirements and rapid market changes [2]. To cope with these requirements and stay competitive, new manufacturing systems with advanced technology that effectively responds to market changes are required. Modular

* Corresponding author.
*E-mail address:* avafadar@our.ecu.edu.au


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manufacturing systems are a relatively new technology designed based on current and future market requirements which are leading economic production solutions for drilling-related operations [3]. These systems do not have a rigid bulky structure and consist of several components such as machining and sliding units, support columns, rotary or sliding indexing table, and other accessories (Fig 1). Their modular character allows these machines to manufacture similar products by rearranging their components. Proper utilization of such machines can significantly increase the productivity and profitability of industries. However, an appropriate analysis is required to justify modular manufacturing system utilization versus other available alternatives.

In a competitive environment, one of the key decisions a manufacturing industry has to make is selecting the most appropriate manufacturing system from a wide range of alternatives. Improper selection of a manufacturing system has an effect on productivity and a manufacturer's capabilities and may cause different problems, such as decreasing the profitability and productivity of the facility [4]. Indeed, selecting a new manufacturing system is a difficult decision- making process which requires advanced engineering knowledge and expertise [5]. To make a proper decision, many factors and a large amount of information need to be evaluated [6]. Besides, today manufacturers face uncertainty of product demand which does not have forecast patterns [7, 8]. Accordingly, the process of selection a new manufacturing system becomes more difficult as demand variation influences many factors simultaneously. Samvedi, et al. [6] found that the selection of the appropriate manufacturing system is an important initial investment decision for industries which influences the profitability of the facility. Accordingly, a reliable decision should be made before make an investment in the production method.

Cost analysis is a fundamental criteria in manufacturing decisions [4]. Several research publications have applied cost analysis in various engineering disciplines such as manufacturing system selection [4, 9, 10], the automotive industry [11], and the molds and dies industries [12] . Hazir, et al. [13] believe that the number of researchers who use cost analysis in the manufacturing field is increasing. Cost analysis provides important information about a manufacturing system selection process. However, one of the challenges for companies which use cost analyses is product demand uncertainty which may influence the manufacturing system performance and consequently the final decision on utilizing a manufacturing system at the preliminary stages. Moreover, the evaluation of investment decisions becomes more complicated when the estimation of input parameters are made in the presence of uncertainty [14]. Accordingly, in order to make a robust decision, an additional analysis is required to investigate product demand uncertainty and its effects on the cost model output.

For studies concerning the evaluation of future or unpredicted situations, uncertainty analysis (UA) is utilized to determine the range of possible outputs which are the result of imprecise input parameters [15]. Essentially, sensitivity analysis (SA) defined as an extension of an uncertainty analysis which is applied to analyze the contribution of estimated uncertainty ranges in the output resultsof a model [15, 16].

Fig. 1. Modular drilling manufacturing system