Chapter 13
A Multi Attribute Selection of Mobile Robot using AHP/M-GRA Technique
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ABSTACT

Today's highly competitive environment and volatile market conditions at national and international level are forcing the manufacturing concerns and its management to adopt the advance automated material handling equipment like mobile robots in a flexible manufacturing system (FMS) to meet the customers' demand regarding quality and variety of product at minimal cost. Selection of a robot is one of the most difficult problems in today's manufacturing environment. The problem has become more challenging due to increasing specifications and complexity of the robot. The main aim of this paper is to develop and implement an integrated methodology based on AHP (Analytical Hierarchy Process) and M-GRA (Modified Grey Relational Analysis) for the selection of a mobile robot for material handling in FMS environment. In this methodology, AHP technique has been used to assign the relative importance between mobile robot selection attributes and M-GRA technique is applied to determine mobile robot selection utility index. The proposed AHP/M – GRA technique is more suitable for the decision making in the presence of vagueness. The methodology is illustrated by means of an example. The ranking and evaluation of this process will provide a good guidance to the decision maker/user to select the appropriate material handling equipment on the basis of attributes. This is the novel effort in the area of robot selection.

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1. INTRODUCTION

In modern manufacturing scenario companies are facing competition in technology at international level. Due to the rapid growth in technology, shortened product life cycles and high quality expectation by the customers at lower price has become quite difficult to survive for manufacturing industries without using advance manufacturing techniques (AMTs) in combination with advanced material handling systems for developing countries. Intermittent competitive prices of products at global level are forcing the manufacturing organisations under great pressure. This pressure is more intense in the case of developing countries (Raj et al., 2007). According to Tompkins (2010) Material handling (MH) is an activity which is used to provide the right amount of the right material at the right place, at the right time, in the right sequence, in the right location and at the right cost. Selection of material handling equipments plays an important role in enhancing the productivity of the plant (Onut et al., 2009). Beamon (1998) has also advocated that the appropriate material handling equipment selection can be used to meet the industry's requirements. Material handling is a very complex and tedious task for the decision makers. Because an effective material handling equipment significantly improves the competitiveness of a product through the reduction of handling cost, enhances the production process, increases production and system flexibility, increases efficiency of material flow, improves facility utilization, reduction in manpower and decreases manufacturing lead time. Material handling equipment have been classified into main groups of automatic material handling equipment like, computer based conveyors, automated guided vehicles (AGVs), cranes, automatic part feeder, industrial trucks, storage and retrieval systems, rotary table and industrial robots (Kulak 2005). Now a day's robots are available with different capabilities and specifications and can be programmed to keep the constant speed of a predetermined quality when performing task repetitively (Kumar and Garg, 2010). Robots are also capable in doing work with difficult and tedious work environment. The use of robots can enhance the productivity if use properly. The selection of robot is a challenging task in real manufacturing environment. To overcome this difficulty, advanced features and facilities are incorporated in advance robots like Advance mobile robots. Manufacturing environment, product variety and its design, production system and its cost are the same important considerations in selection of robots (Chakraborty et al., 2015). A selection of mobile robot does not depend on cost only but also depends on various attributes like flexibility, automation, load carrying capacity its working efficiency with safety. Therefore, selection and justification of mobile robot system is a multi-attribute decision-making problem. In order to address this issue of effective evaluation and justification of mobile robot, a systematic and logical scientific method or mathematical tool is needed to guide the decision makers towards an appropriate decision in the presence of multiple and conflict criteria. So, the main objective of the present research work is to propose an integrated AHP/M-GRA as a multi-criteria decision making method for the selection of mobile robot. The proposed methodology has been illustrated with the help of an example.

The remainder of the paper is organized as follows. Literature review on material handling equipment selection and its attributes in FMS environment is presented in section 2. An overview of AHP method is given in section 3. Section 4 presents M-GRA technique in detail with its procedural steps. Under proposed methodology various steps of the AHP/M-GRA technique for selection of mobile robot are summarised in Section 5. This is followed by an example in section 6. A sensitivity analysis of AHP/M-GRA technique is carried out in Section 7. The conclusion of the paper is given in Section 8. Managerial implication of the present research work is discussed in section 9. At last, limitations of present work and directions for future research work are presented in section 10.

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