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## Decision support systems in the metal casting industry: An academic review of research articles<sup>★</sup>

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### Abstract

This article offers a complete review of the research articles that are related to the application of decision support and intelligent system with specific reference to metal/dry casting. Data was obtained from 89 articles that were published from 2000 to 2015 in 47 journals. The articles are categorized based upon three different categories based on numbers of impressions, material poured and pressure application. They are further classified into 10 subsections. A widespread list of journal articles is identified in this present study that provides relevant information/references for both practitioners and researchers on the application of decision support and intelligent systems to various stages of metal/die casting. In light of the developed classification framework, we identify gaps in extending the use of the decision support and artificial intelligent systems in the industry and suggest potential and applicable research areas for further consideration in this subject area.

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*Keywords:* metal casting; decision support system; die casting; artificial intelligence system

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## 1. Introduction

Metal casting is considered as a 7000-year-old technology which offers a large range of routes in order to produce the components with a range of sizes, shapes, quantities, quality and metal requirements (Akarte et al., 1999). Metal casting is the simplest process in which mostly gives a direct routing to the shape of the product and it gives least expensive. The process of metal casting requires a mould cavity with the desired shape and metal that is molten is poured over the mould cavity. The main objective of the metal casting is produced beneficial implements for the human consumption and also for the beautiful work of art. From the ancient art casting, it is clear that modern industrial casting has their production which has significant skill and technological skill. In the ancient times learned and traditional skill has been used for the ages and experiences in order to produce acceptable casting.

The quality of the metal casting is affected by a number of parameters which are found at the different process stages. For example, defects that may result from improper parameters of the moulding and core sand include pinholes due to the presence of hydrogen, sand deformation, gas fractures, and shape imperfections. Defects that may result from improper construction or improper assembly of the pattern and moulds are fractures, shape imperfections, sand presence, is runs, cracks, gas presence, surface defects, mechanical damage, knob, flash, mismatch, pushing up, warping. Gases tend to dissolve in the liquid steel at all stages of the production of castings, i.e. during melting in the furnace, during tapping, during pouring of moulds, and even after pouring of the moulds before complete solidification of the casting. Therefore, reducing or eliminating casting defects such as blowholes, voids in the cast structure, pinholes, non-metallic presence or porosity, and scaling on the surface of casting requires strict control of the whole process of melting and casting. The control of charge and compliance with the technological regime during melting of alloys in a furnace for casting are particularly important in the absence of vacuum treatment of liquid metal (in an induction furnace or ladle). Possible defects caused by incorrect melting include is runs, slag presence, tears (caused by excessively high temperature), gas presence, incorrect chemical composition, and pinholes (Wilk-Kołodziejczyk et al., 2014).

The systematic review of the designer and robust in a way for evaluating the options that are available for identifying the best. The process selection is a manufacturing task in order to choose a method to transform the materials in to the one or more processes. The process considered to be more economical, and they are subjected for the meeting of technical constraints (Dieter, 1991). The manufacturing and material processing is a selection process problem in which multi-attribute decision-making problem. The decision is made during the preliminary design of an environment that is uncertain in the parameters, relationship and requirements. Material and process selection (MPS) occurs before the beginning of design for manufacturing (DFM) (Karthik et al., 2003). The study indicates that the product cost is around 5% of the total product cost, and the design is made of the stage effect of the product cost (Chen and Feng, 2000).

This study, therefore, aims to provide a systematic and inclusive evaluation of research articles in order to gain insights into the applications of decision support in the metal casting system. It also aims to develop a classification

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