

Chapter 9

Die Casting Process Using Automated Machine Learning

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ABSTRACT

Castings that are near to net forms are made using the extremely complex manufacturing technique known as die casting. Despite the method's lengthy history—more than a century—a system engineering method for characterizing it as well as the information that each cycle of die casting can create has not yet been completed. Instead, a tiny subset of knowledge deemed to be essential for die castings has attracted the attention of industry and academia. The majority of the research that has been published on artificial intelligence in die casting has a specific focus, which restricts its usefulness and efficacy in an industrial casting. This study will examine the die casting process through the perspective of systems design and show practical uses of machine learning. In terms of technical definition and how people interact with the system, the die casting process satisfies the criteria for complex systems. The die casting system is an adaptive, self-organizing network structure, according to the technical definition.

INTRODUCTION

Die casting, often known as die-casting, is a very difficult industrial process. Die casting is made up of several systems that control mechanical, thermal and hydraulic
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processes to produce castings that are almost net-like (Andresen, 2005). The design, configuration and administration of these systems have a bearing on casting quality and machine performance. For process management and optimisation, the die casting industry formerly only used a tiny percentage of the system data (Blondheim, 2020).

According to the North American Die Casting Association (NADCA), sales of aluminium die casting will reach \$8 billion in 2019. This is more than 80% of the \$9.67 billion estimate provided by the American Foundry Society (AFS) (Folk, 2019, pp-16-19) for all aluminium castings. The average internal scrap rate for components manufactured by the industry's existing control and optimisation processes is 8%, and equipment utilisation is 68% (NADCA, 2014).

Die casting has a variety of expostulations as it transitions from traditional data collecting to slice- bite analytics on vast information sets. One of the first expostulations is the introductory understanding of how blights are produced and the bracket of expiring enterprises. Collecting, analysing, storing, and utilizing voluminous quantities of data is grueling . also, a lot of trouble must go into expiring serialisation and traceability across the force chain. also, artistic hurdles must be beat for the use and relinquishment of daedal logical approaches. (Wuest et al., 2016, pp.23-45)(Baier et al., 2019. p.16) (Sun et al., 2020) (Landry et al .,2018) (Blondheim, Jr, 2018,2020)

From a system engineering perspective, die casting will generate orders of magnitude more data than it does at the moment. Each cycle in the company would now store thousands of data points instead of the hundreds that used to exist (Blondheim, 2020). For anyone tasked with optimising the die casting process, this abundance of data becomes daunting. In order to understand the data needed to address practical challenges for the die casting system, a framework for data creation is required. Machine learning is needed to analyse, optimise, and manage the pace and volume of data created by the die casting system.

Die Casting Basics

Metal castings with almost flawless shapes are produced using the HPDC manufacturing method, often in large numbers. Liquid metal is poured into a mould that can be used repeatedly at high pressures and speeds. A structure that typically weighs under 20 pounds and has traditionally been made by die casting is required to generate data. Castings weighting 40 pounds or more are used more frequently in the industry as a result of recent technological advancements, growing demand for massive block engines (Alvarez, 2020), and architectural die cast components (North American Die Casting Association, 2009). High-level die casting process phases are shown in Table 1.

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