Chapter 8
Comprehensive Modeling of Occupational Diseases Using Digital Twins: An IoT-Based Approach

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ABSTRACT

This chapter focuses on the application and beneficial effects of digital twins in the field of occupational disease prevention and treatment. Taking the IoT approach as an example, this chapter introduces how to use both factory site data and worker physiological data to build digital twins and provide personalized prevention and treatment models through AI-driven data analysis. The practical applicability and advantages of this technology are illustrated in the case study on noise-induced hearing loss (NIHL) in a foundry setting. By integrating environmental noise monitoring with individual health data, digital twins generate precise and personalized representations of the correlation between noise exposure and hearing health. This method improves the health and safety of workers by enhancing the accuracy and efficacy of risk assessments, resulting in more targeted and efficient interventions.

DOI: 10.4018/979-8-3373-0538-7.ch008

INTRODUCTION

The global burden of occupational diseases poses a substantial challenge to economic productivity and public health. Traditional methods of managing these diseases have primarily relied on reactive approaches, which emphasize post-event data analysis. This implies that preventative measures are frequently implemented only after incidents have occurred, which can lead to a delayed response and potentially more severe consequences. Although these traditional methods (including epidemiological studies and workplace inspections) are valuable, firstly, epidemiology often focuses on post-analysis and has a certain degree of lag, while workplace inspections are prone to formalism, especially when the data cannot be collected online.

In order to achieve effective modeling of occupational health and safety, a comprehensive approach is necessary, which extends beyond the mere collection of worker health data. Although traditional worker-centric models are significant, they frequently fail to consider the broader context of the work environment. If a model focuses only on the characteristics and behaviors of individual workers and ignores the key role of factory-specific risk factors, such as the factory's organizational structure, environmental conditions, production processes, and specific equipment scenarios, then such a model may not fully understand the current risks, resulting in ineffective interventions and inaccurate assessments.

Figure 1. Future healthcare (Linax Technologies Ltd., 2022)