Chapter 5

# Considerations of the Mental Workload in Socio-Technical Systems in the Manufacturing Industry:
## A Literature Review

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## ABSTRACT

*As cognitive tasks have displaced physical tasks in today's manufacturing industry, this sector can demand high levels of mental workload from workers. In certain situations, there is a high cognitive load, which affects operators reducing their attention to the task and causing them mental fatigue and distractions, resulting in errors that generate economic costs or even injuries to workers. This literature review aims to provide a comprehensive understanding the use of mental workload in the manufacturing sector. The methodology consisted of conducting a search in four databases. In the search, a combination of keywords was used, classifying each journal according to the mental workload evaluation means, the type of evaluation, and the area of application. Articles not focusing on the manufacturing area were discarded. Of the total of 3839 articles found, 12 have been selected. Regarding the methods used for mental load assessment, the analytic techniques were found to be the most frequently used.*

## INTRODUCTION

Currently, due to industries' growing automation, this sector's modern socio-technical systems feature great complexity (González Munõz & Gutiérrez, 2006). Despite such automation, there are still tasks in industry where people are necessary and even indispensable (Autor, 2015). For example, whenever automation has been viable, simple tasks which previously required several workers with a low level of qualification have turned into complex tasks requiring fewer workers with a higher level of knowledge, that is, with complex cognitive skills that involve decision making, improvisation, handling of information, and failure diagnosis, among others (Beaudry, Green, & Sand, 2013), so as to complement the automated systems. On the other hand, there are also tasks that have not been automatized successfully, but where, ironically, the level of complexity has increased (Mital & Pennathur, 2004). This has occurred in tasks that require people's mental abilities, or in cognitive tasks such as those mentioned above, which cause workers' mental load to tend to increase and exceed their capacities and limitations to perform their work efficiently and safely. On the other hand, a low workload level is also undesirable as it can cause workers to fall into complacency (González Munõz & Gutiérrez, 2006) and to generate errors derived from distractions or lack of attention.

Based on the foregoing, it can be said that mental workload evaluation is a key point in research and, in general, in all those activities that seek higher levels of comfort, satisfaction, efficiency and safety in the workplace (Rubio, Díaz, Martín, & Puente, 2004).

Therefore, the main objective of this work is to determine the state of the art of the assessment and consideration of mental workload into modern socio-technical systems of the manufacturing industry by means of a systematic literature review. Additional objectives of this work are to analyze important characteristics of actual available mental workload evaluation and assessment techniques such as training time, administration time, tools needed, advantages and disadvantages, among others. Also, once some selection criteria are established among the articles found, the most frequently used and widely applied techniques must be identified. Finally, to offer recommendations about the pertinence of the use and evaluation of mental workload in the manufacturing environment and operations is convenient to propose future research trends.

## BACKGROUND

Whenever any type of work is done, the body undergoes two types of loads: a physical one and a mental one. The physical load is constituted by the biomechanical, physiological and caloric requirements that the worker's body demands, while the mental load refers to the cognitive processing requirements necessary for good performance at work (González Munõz & Gutiérrez, 2006) although currently there is no consensus as to which factors are most closely associated with mental load (Rubio, Díaz, & Martín, 2001).

### Mental Workload Evaluation and Assessment

There are different techniques for evaluating mental work load. According to various authors (Dalmau & Ferrer, 2004; González Munõz & Gutiérrez, 2006; Stanton, Hedge, Brookhuis, Salas, & Hendrick, 2004; Stanton, Salmon, & Rafferty, 2013; Young, Brookhuis, Wickens, & Hancock, 2015), these techniques can be grouped into:

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