MANAGEMENT, PRODUCTION AND DESIGN

NO-STRESS MANUFACTURING

Funded By	Politecnico di TORINO Dipartimento DIGEP
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Context of the research activity	The research will analyze the main causes of stress in Manufacturing by the use of non-invasive biometric measures (such as Galvanic Skin Response, Hear-Rate, Eye-Tracking, etc.) and will propose solutions to reduce individuals' stress levels and the causes of work accidents. The research will study different uses cases for production (e.g., Lean/No-Lean/Smart manufacturing; production vs. assembly, high vs. low automation) and work tasks (e.g., direct labor/supervision/maintenance, etc.).
	In 2019, more than 3.000.000 work-related accidents occurred. They were often related to fortuitous and accidental events, often due to human error. These errors can be referred to workers' lack of rigour, distraction, etc., but psychologists suggest specific conditions and factors, such as stress, as the main causes. Even if, often they do not always result into direct accidents at work, they can occur into health problems with more general consequences on individuals and their social life. Moreover, estimates suggest that 55% of the total costs is due to lost earning, and that 17% and 10% is of medical and insurance costs, respectively. Safer workplaces reduce injury/illness costs by 20-40% and a workload-related absenteeism or human errors by 10% per year. Moreover, the latest manufacturing technologies has been affecting production lines, changing drastically daily routines and line operators' tasks, to the extent that not only they could introduce new elements of stress, but also seem, as the systems are highly automated, to emphasize the role of

Objectives	worker's tasks in production lines efficiency. Traditionally, the analysis of the physical, physiological, psychological and stress aspects that occur during work has been carried out through surveys and questionnaires that base their conclusions on the self-assessment of workers, non-objective data. Nowadays, though, new systems able to produce objective measures exist. The proposed approach is focused on biometric data by non-invasive tools (such as Galvanic Skin Response, Hear-Rate, Eye-Tracking, etc.). It gains objectivity, extending the current monitoring practices towards those subconscious processes, reasoning, emotional and cognitive load that occur while performing a task. Knowledge of such measures, protocols and the necessary equipment has been extensively explored in Engineering Design; in this research, it is crossed over Manufacturing and integrated with other technical knowledge of aid to manufacturing operations (e.g. physical assistance, motions) in order to provide a broader, more complete and systemic approach to workers' health. Initially, the research will integrate already tested technology for biometric measures aimed at studying cognitive load and stress at workplaces (TRL 6), with already commercialized tools for physical assistance. However, over time, the planned technology integration would imply including other types of workers and tasks, up to aiding the design of collaborative or digital technologies in Manufacturing. IMPACT: Research will build those competences that will be useful to design healthier manufacturing environments, constituting also the opportunity for optimizing production environment in term of efficiency. Less human errors in fact lead to less absences and/or downtime. As well as, on the long time, they will be able to link safety procedures, risk or efficiency assessments to the factors that affect workers' load and performances. Beyond less work accidents, society would get savings in public social safety. Future standards, norms and regulations for working environments could be designed differently, with a strong impact on social development, since improving workplaces means also increasing job attractiveness. RESEARCH PLAN: The research plan is structured as follows: 1. Literature Review: 2. Use-case definition, DOE and empirical protocol definition: the research group already has experience in biometric data collection, as well as it has contextual knowledge on manufacturing environments and production processes. However, the empirical protocols represent a contextualization of that knowledge in the use-case in term of approach and methodology, and operational practice for the collection and analysis of physical, physiological and psychological data. 3. Data Collection

	4. Data analysis, variables detection and identification of the main stress causes for workers' in Manufacturing. 5. Proposal of a set of solutions to improve workers' conditions and to create safer environments (at least in the use-cases), as well as to define optimized environments in terms of workers' production efficiency.

Skills and competencies for the development of the activity	The candidate should have competences about the collection and analysis of biometric data and neurophysiological signals. S/he should know the SoA of empirical tools and methods of research. S/he should have knowledge about industrial production environments, so to be able to position the research with respect to already conducted studies in Manufacturing. It would be preferred if the candidate would know the production techniques, pros/cons and the risks of the different production systems, so to know the working tasks involved.