Foods 2025 Conference
The 6th International Electronic Conference on Foods
Future Horizons in Foods and Sustainability
28–30 October 2025 | Online

“CANTINA 5.0”—Industry 5.0 Enters Winemaking Industry in Italy

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Introduction

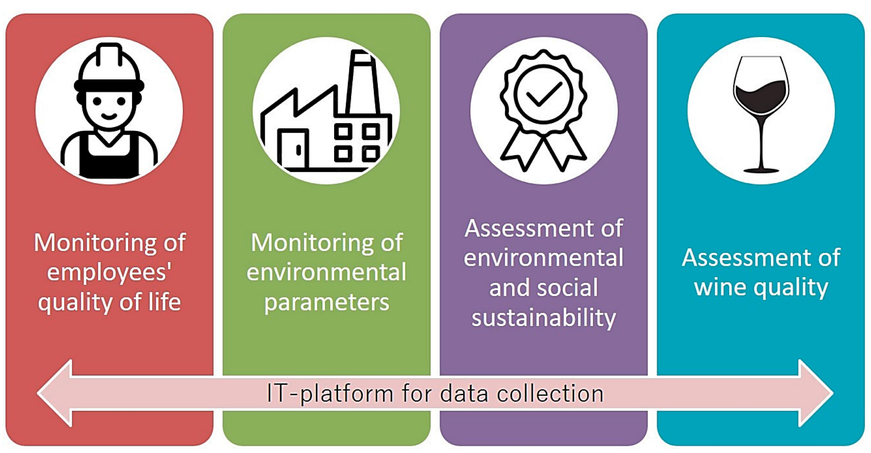
Compared to previous industrial revolutions, INDUSTRY 5.0 is defined as a new methodological approach, recently introduced, among others, by the European Commission, according to which the production paradigm shifted from a strictly profit-driven logic to a logic more centered on people and the environment. The application of this Industry 5.0 approach within the corporate framework is formalized in the technological support to “the worker”, aiming to improve both individual and collective well-being without distorting the work duties under their responsibility. Instead of leveraging technology primarily for-profit generation (which occurs within the Industry 4.0 paradigm), the Industry 5.0 approach aims to act likewise on the technological lever but, in this case, to increase workers’ WELL-BEING by facilitating their work duties, as well as on the environmental working conditions, while maintaining product quality and economic performance, and simultaneously enhancing the SOCIAL SUSTAINABILITY of the workplace.

In this framework, the AGRIFOOD/AGRITECH field in general, and the WINEMAKING production chain in particular, have a huge potential as significant flagship fields of application for this concept, with Italy being one of the most important markets worldwide and with the related industry having had many negative impacts on the ecosystem since the start of viticulture, including the massive use of water, the generation of organic and inorganic waste streams, a significant use of energy, the emission of greenhouse gases, extensive use of chemicals, the suboptimal use of land, and an overall high impact on the ecosystem in general. For all these reasons, we dedicated a research project to implementing the Industry 5.0 principles in the Italian winemaking sector, placing the human workforce at the center of the production process and hence promoting and assessing his well-being at the workplace, as well as the environmental and socio-economic sustainability of the working scenario.

Methodology

CANTINA 5.0 focuses on four main pillars:

- QUALITY OF LIFE MONITORING: Employees are equipped with wearable sensors and administered questionnaires to assess their quality of life and its relationship with working conditions.
- ENVIRONMENTAL MONITORING: Internet-of-Things based devices and traditional detection methods, based on GC-MS, are employed to detect the presence of environmental pollutants in the wine cellars of participating wineries.
- ENVIRONMENTAL AND SOCIAL SUSTAINABILITY: Questionnaires are administered to the participating factories to assess their compliance with sustainability standards, both on the environmental side and on the social side, particularly regarding employees’ working conditions.
- WINE QUALITY ASSESSMENT: Chemical analysis of wine products, sensory analysis conducted by panel experts, along with emotional analysis conducted using wearable technologies on consumers, are performed throughout the project duration, to assess the quality of winery products in a 360° perspective.



Results

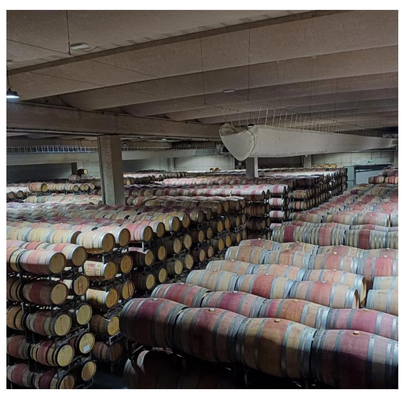
To date, 20 FACTORIES, of which 12 located in Friuli-Venezia Giulia (North-Eastern Italy) and 8 in Tuscany (Central Italy), have been involved in the project. All companies have completed questionnaires related to well-being of their employees and environmental sustainability topics. A subset of them were also monitored in terms of environmental pollutants via IoT-based devices and traditional GC-MS-based methods. A selected amount of employees were also equipped with wearables (smartwatches) to assess their physiological parameters during a one-week working timeframe in both harvest and non-harvest periods.

A sensory panel of experts assessed the sensory characteristics of wine products generously provided by the participating companies, which were also analyzed using traditional chemical methods.

Finally, emotional features of wine products, alone and combined with music, were assessed via wearables during dedicated events held in Pisa during five evenings in spring 2025 («5me – Cinque mercoledì di emozioni») within the CantinaJazz format, with roughly 50 attendees per event.

Conclusions

The project CANTINA 5.0 is still ongoing. The strong participation of winemaking companies and the positive public reception of the surrounding events organized within the framework of the project represent the main milestones achieved to date. In the upcoming months, further data collection campaigns will be organized at institutions where the monitoring at harvest time was not performed, yet; in addition, specific dissemination campaigns will be set up tailoring the specific needs of end-users and focus groups, to ensure effective OUTREACH and promote this approach in future R&D projects, at the national and European levels.



Finanziato dall'Unione europea NextGenerationEU
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
In Supremæ Dignitatis 1343 Università di Pisa
CNR - IFC

This work was supported by the European Union - NextGenerationEU, within the PRIN PNRR 2022 call for Grants, project “CANTINA 5.0”.