



## **KYKLOS 4.0**

### **Circular Manufacturing Handbook: Best Practices and Lessons Learned (v1.0)**

#### **Introduction**

Circular manufacturing, exemplified by the KYKLOS 4.0 project, introduces innovative services and technologies to create a Circular Manufacturing Framework. This handbook incorporates insights from KYKLOS 4.0, providing an extended guide for implementing circular manufacturing practices into a Platform to optimize the product lifecycle.

#### **Positive User Experience**

KYKLOS 4.0 Platform provides a positive user experience (UX) by integrating elements of intuitive design and human-computer interaction principles. Intuitive user experience design and usability elements (like ease of use and efficiency) can significantly leverage the users' acceptance towards the adoption of green processes and integration of the KYKLOS 4.0 solutions. KYKLOS 4.0' consumer-centric approach enhances consumer experience by delivering better services aligned with consumer needs and wants.

KYKLOS 4.0 supports the following UX characteristics which are essential for its efficient implementation in different industrial contexts and its overall acceptance by the users.

- Easiness to learn and use: KYKLOS 4.0 is highly perceived as easy to use, since it supports an intuitive interface design enabling even amateur users to navigate the system effectively. Overall, users require minimal technical support to navigate the platform. Its cohesive information structures aid findability, enabling easy discovery of information. KYKLOS 4.0 also offers a comprehensive documentation. Finally, KYKLOS 4.0 supports easy installation





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and integration with existing systems. This is proven by the fact that different services provided by the system have been well integrated with other components and services.

- Usefulness and efficiency: KYKLOS 4.0 delivers all expected functionalities for task completion. The system's functionalities, such as the Maintenance Scheduler, Life Cycle Assessment (LCA), Decision Support System (DSS), and relevant Application Programming Interfaces (APIs), are highly useful in organizing maintenance tasks, providing environmental insights, facilitating communication with the backend, and calculating circularity indicators. Communication with backend through APIs is straightforward and works seamlessly. KYKLOS 4.0 also enables quick and efficient task execution.

## **Detailed User Manuals**

In combination with the intuitive design and positive user experience, KYKLOS 4.0's users highly appreciate the detailed user manuals which aid users in understanding and utilizing various features. The manuals significantly reduce the time needed to train and learn how to use the tools. They also eliminate the need to seek for expertise technical advice.

## **Benefits for Industrial Applications**

KYKLOS 4.0 offers a cost-effective holistic solution and can be implemented in both older and modern machines, making it accessible for Small and Medium-sized Enterprises (SMEs). The integration of KYKLOS 4.0 solutions can offer significant benefits in various industrial sectors, particularly in sustainability, resource management, automation, and process optimization.

The main benefits of the solution include early identification of problems in the production process, leading to the prevention of unnecessary waste. Through analysis, companies that integrate KYKLOS 4.0 can categorize the sources of problems and





correlate them with parameters related to reusable scrap, resulting in a list of ideas and solutions to improve circulation rates, energy efficiency, process stability, and profitability.

The KYKLOS 4.0 Marketplace offers potential for a new sales channel, targeting SMEs in the manufacturing sector which focus on enhancing circularity aspects of processes and products.

Overall, KYKLOS 4.0 can be applied to industry to support the following achievements:

- **Business Competency and Profitability**

The integration of energy measurement devices, along with the development of a scalable solution, not only strengthen the company's competence but also have a direct positive impact on operational efficiency, waste reduction, and environmental sustainability.

The integration of KYKLOS 4.0's scalable and configurable solution, allows it to be seamlessly incorporated into both older and modern machines at a considerably reduced cost, presenting a strategic opportunity for SMEs.

The scalable nature of the KYKLOS 4.0 implies adaptability to varying operational scales, contributing to enhanced business competency. Moreover, the ability to identify and address operational issues at an early stage through the implemented solution has a direct impact on efficiency and resource utilization. The prevention of unnecessary waste and the correlation of problems with specific parameters provide valuable insights for process optimization. All these can contribute to improved production stability and profitability.

Furthermore, the solution's ecological alignment becomes a strategic advantage in the current business landscape, where environmental considerations are increasingly important. The capability to compare and manage energy consumption not only demonstrates corporate responsibility but also aligns with the broader trend of sustainability. These advancements





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promote the company's technological innovativeness and enhances its brand image.

- **Environmental Impact Assessment and Improved Decision-Making**

KYKLOS 4.0 solutions such as waste traceability and energy consumption monitoring can contribute to understanding energy usage and circularity, leading to actionable insights to make processes greener. The need for such a solution is emphasized in the context of current ecological concerns and fluctuating energy prices due to geopolitical situations. The ability to compare energy consumption helps in planning production, calculating energy costs, and influencing the pricing of final products. One of the biggest benefits for the manufacturers is increased awareness about their processes in terms of energy usage per machine and circularity. KYKLOS 4.0's integrated Life Cycle Assessment (LCA) tool provides insights into environmental impacts, enabling adjustments for greener processes. For instance, LCA provides insights regarding the environmental impact of certain processes and assists a factory manager understand how each process affects the impact in CO<sub>2</sub> and adjust accordingly. Furthermore, real-time view through the control panel aids in monitoring and controlling production processes, optimizing decisions. All these can support effective decision-making by providing insights into energy consumption, resource allocation, and real-time data monitoring, leading to optimized resource selection and reduced energy consumption.

- **Resource Management and Optimization**

The KYKLOS 4.0 Maintenance Scheduler organizes maintenance actions, assigns tasks to technicians, and optimizes time resources for efficient operations. It accelerates businesses' digital transition to boost advancement and recovery. The application of Artificial Intelligence (AI) optimizes production mechanisms for personalized products with extended lifecycles.





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- **Cost-Effectiveness**

The integration of KYKLOS 4.0 solution is expected to significantly decrease the industries' operational costs. The solution also contributes to the optimization of production costs by assessing the production costs based on different process variants and energy consumption. The adoption of KYKLOS 4.0 demonstrates at least a 15% improvement in operational efficiency through KYKLOS 4.0 Ecosystem, by integrating KYKLOS 4.0 services and closed-loop systems into manufacturing processes. This can also be supported through the implementation of second-use solutions for materials, parts, and components across manufacturing sectors.

- **Automation and Advanced Technology Integration**

Using advanced technology for automation reduced training time to learn how to use the KYKLOS 4.0 platform, improved collaboration between operators and machines, and provided real-time monitoring for better decision-making. KYKLOS 4.0 also supports identification of suboptimal processes by detecting processes not performing optimally and recommending further improvements.

