FEDEGARI

HMI

a pioneering approach to design in industrial automation

CASE STUDY

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INTRODUCTION

Fedegari is a global strategic partner for sterilization and biodecontamination control processes for pharmaceutical and biotechnology companies.
With over **70 years of experience**, Fedegari is globally recognized for its customized and innovative approach, providing tailor-made solutions to meet the demands of a highly regulated market, all with one goal: collective well-being. Recognizing the growing importance of Human-Machine Interaction (HMI) for operational efficiency and user satisfaction, Fedegari embarked on an ambitious project to redesign the Human-Machine Interface (HMI) for its TH5 system.

This case study **explores the market context** driving this initiative and highlights Fedegari's **pioneering spirit** in adopting advanced design methodologies and standards.

Market Context:
growing demand for usability and accessibility

The industrial automation market is increasingly characterized by complex systems that require intuitive and efficient user interfaces, enabling operators to monitor and control processes safely and effectively. In this context, usability (ease of use) and accessibility (the extent to which a product can be used by people with varying abilities) have emerged as critical success and competitiveness factors. Traditionally, industrial HMIs have focused primarily on functionality. However, there is a growing awareness of the benefits of user-centered design, which can significantly reduce errors, enhance operator performance, and improve situation awareness.

FEDEGARI'S VISIONARY APPROACH AND SOCIAL RESPONSIBILITY

With the redesign of the TH5 HMI, Fedegari demonstrated a proactive and forward-looking approach.

The company chose not only to adopt industry-specific guidelines such as ISA 101 (Human-Machine Interfaces for Process Automation Systems), essential for enhancing operator performance, reducing errors, and improving situational awareness, but also expanded its focus to include WCAG (Web Content Accessibility Guidelines). Incorporating WCAG best practices into the HMI design was essential to delivering an interface that is both user-friendly and equitable. It is crucial to emphasize that although WCAG was originally developed for web content, it is not mandatory for industrial HMIs. Nevertheless, Fedegari recognized their potential value in ensuring the interface was accessible to a diverse user base. This decision anticipates future regulations, such as the upcoming 2025 Accessibility Law, and reflects a strong commitment to social responsibility and a visionary understanding of diverse user needs. The goal is to **simplify user experiences**, not only by reducing human errors but especially by accommodating various operator capabilities in pharmaceutical operations.

The TH5 HMI redesign process:

a structured, user-centered approach

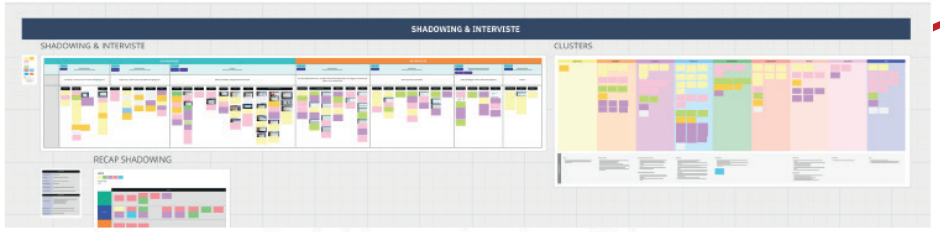
The TH5 HMI redesign project adopted structured UX/UI methodologies with a strong focus on the user at every stage of the design process. **Key activities included:**

COMPREHENSIVE EVALUATION:

Analysis of existing functionalities in Thema4 and TH5 and onsite shadowing sessions with experts to identify user interaction friction points.

USER INTERVIEWS AND COMPETITOR ANALYSIS:

Online customer interviews to understand behaviors and pain points, combined with competitor analysis to identify effective solutions. In total, 15 users participated, 10 competitors were analyzed, 191 findings were documented, and 9 areas for intervention identified.



INSIGHT GENERATION:

Grouping identified issues into thematic areas (navigation, dashboards, alarms, etc.) to define practical solutions. A key insight was "Navigation Overload and Complex User Flow," highlighting difficulties users faced in quickly locating essential information. Other significant insights related to continuous process visibility during production, and diversification and prioritization of alarms.

USER EXPERIENCE REDESIGN:

Functionalities reorganized according to new navigation principles and optimized information architecture.

USER INTERFACE DESIGN:

Development of interfaces based on optimized user flows, fully compliant with ISA 101 and WCAG standards. A central outcome was the creation of an HMI Style Guide, a comprehensive collection of components and guidelines ensuring visual and functional consistency.

Compliance with standards:

ISA 101 and WCAG

ISA101: The TH5 HMI redesign placed strong emphasis on compliance with ISA 101 guidelines, which focus on enhancing operator performance, reducing errors, and improving situation awareness. Implementation examples include:

Consistent Design:

Clear and memorable navigation patterns facilitated by the HMI Style Guide; interface elements like tables maintain consistency.

Situational Awareness Support:

Redesigned dashboards use contrast and prominent typography to highlight critical information such as alarms, minimizing sensory stimuli during normal operations to maintain operator focus.

Color Usage:

Color emphasizes critical information like alarms and abnormal conditions but is not the sole differentiation method.

Display Hierarchy:

Multi-level displays provide structured process views with drill-down options for additional details

User Types:

Various user types and their requirements were incorporated and documented, creating detailed functional maps prioritizing primary users.

Cognitive Limits:

Related content grouped using cohesive widgets and graphical representations to efficiently aid information processing.

The new TH5 HMI design is largely compliant with ISA 101 guidelines. However, due to the scope limitations of the design project, which does not extend to machinery and console design, only the applicable guidelines were implemented. While some selected guidelines may appear non-compliant at first glance, each has been carefully evaluated and mitigated.

Guidelines	Compliance	Mitigations
User types (Article 4.1.1)	✓	
User types (Article 4.1.1)	✗	Yes*
HMI style guide (Article 4.2.2)	✓	
HMI Toolkit (Article 4.2.3)	✓	
HMI system design (Article 4.3.2)	✗	Yes*
Test (Article 4.4.3)	✗	Yes*
Use of color (Article 4.2.2.1.2)	✓	
Display design (Article 4.3.4)	✓	
General principles of HMI design (Article 5.1)	✓	
Consistency of design (Article 5.1.1)	✓	
General HFE concepts (Article 5.1.3)	✓	
Situation awareness (Article 5.1.4)	✓	
Color (Article 5.2.1.1)	✓	
Background-foreground interactions (Article 5.2.1.3)	✓	
User cognitive limits (Article 5.3)	✓	
Display hierarchy (Article 6.3)	✓	

**The "TH5 HMI Design Report" documents this in detail, offering a reference for adopted methodologies and best practices.*

WCAG:

The Web Content Accessibility Guidelines (WCAG) were integral to ensuring the TH5 HMI design was accessible to users with diverse needs and abilities. Their application spanned every aspect of the project, from color contrast and typography to navigation and interactive elements, ensuring that inclusivity was not an afterthought but a core design priority. It ensures that users with disabilities, such as visual, auditory, cognitive, and motor impairments, can interact with the system effectively and efficiently.

Use of Color (WCAG 1.4.1 Level A):

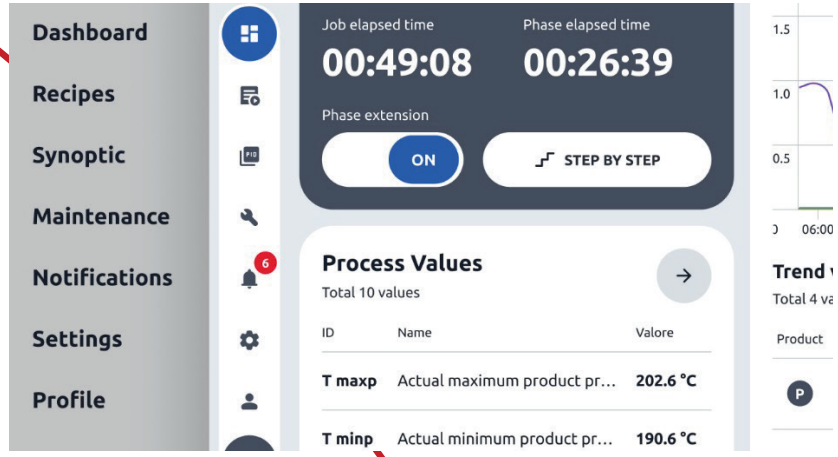
Information conveyed by color is distinguishable through icons or contrast.

Minimum Contrast (WCAG 1.4.3):

Typography maintains a contrast ratio of 8:1, exceeding the standard 4.5:1 for normal text. Interactive elements adhere to a 7:1 ratio.

Bypass Blocks (WCAG 2.4.1 Level A):

Direct access to primary functionalities without expanding panels.

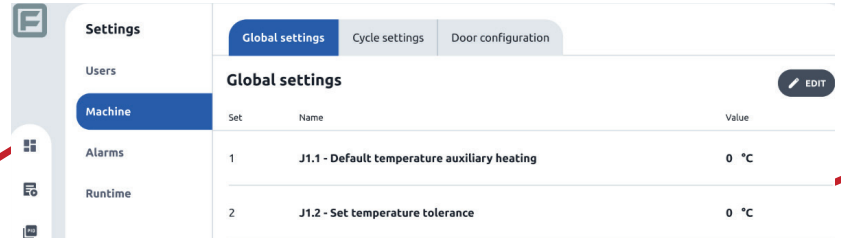


Multiple Ways (WCAG 2.4.5 Level AA):

The dashboard summarizes ongoing processes and alarms, providing clear access to details.

Headings and Labels (WCAG 2.4.6 Level AA):

Clear, descriptive headings help users locate and understand content.



Location (WCAG 2.4.8):

Clearly indicates the user's position within complex workflows.

Section Headings (WCAG 2.4.10 Level AAA):

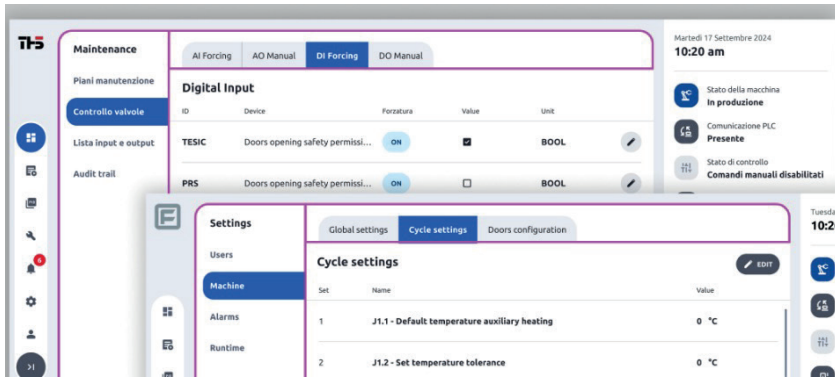
Contextual headings provide clear structure.

Target Size (WCAG 2.5.8):

Interactive elements have touch areas of at least 48x48 px or sufficient spacing between targets, reducing errors and accommodating various dexterity levels.

Consistent Navigation (WCAG 3.2.3 Level AA):

Navigation elements maintain consistent hierarchy and positioning.



Labels and Instructions (WCAG 3.3.2 Level A):
Clear instructions and labels provided for all input-required fields.

Error Prevention (WCAG 3.3.6 Level AAA):
Confirmation mechanisms for critical actions like process interruptions or saving recipes.

Avoid Redundant Entry (WCAG 3.3.7 Level A):
A side panel displays recently entered data to avoid redundant information retrieval.

These examples demonstrate attentive WCAG integration, balancing compliance with practical usability.

Guidelines	Compliance	Mitigations
Use of Color - Level A (Criterion 1.4.1)	✓	
Minimum Contrast (Criterion 1.4.3)	✓	
Resize Text – Level AA (Article 1.4.4)	✗	Yes*
Bypass Blocks - Level A (Criterion 2.4.1)	✓	
Multiple Ways - Level AA (Criterion 2.4.5)	✓	
Headings and Labels - Level AA (Criterion 2.4.6)	✓	
Location (Criterion 2.4.8)	✓	
Section Headings - Level AAA (Criterion 2.4.10)	✓	
Target Size (Criterion 2.5.8)	✓	
On input - Level A (Criterion 3.2.2)	✓	
Consistent Navigation - Level AA (Criterion 3.2.3)	✓	
Labels and Instructions - Level A (Criterion 3.3.2)	✓	
Error prevention - Level AAA (Criterion 3.3.6)	✓	
Redundant Entry – Level A (Criterion 3.3.7)	✓	

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CONCLUSION: a model of innovation and responsibility

The **TH5 HMI** redesign represents a significant advancement in industrial automation, notably through its voluntary integration of WCAG guidelines in addition to ISA 101 standards.

This approach underscores a commitment to surpassing baseline regulatory requirements and highlights a dedication to **inclusivity, accessibility, efficiency, and safety**.

By prioritizing user-centered design, the project sets a valuable example for future developments in the field of HMI design and interactions, **contributing positively** to broader industry practices.

References

The principles discussed in this document are based on established industry standards and accessibility guidelines. Key references include ANSI/ISA-101.01-2015, Human Machine Interfaces for Process Automation Systems and the WCAG 2.2 Understanding Documentation, from which relevant excerpts have been applied to ensure compliance and best practices in HMI design.

GLOSSARY OF KEY TERMS

HMI (Human-Machine Interface):
An interface that enables interaction between a human user and a system or machine.

UX (User Experience):
The overall experience a person has while interacting with a product, system, or service.

UI (User Interface):
The visual and interactive elements of a product or system with which a user interacts.

ISA 101:
An international standard that provides guidelines for designing Human-Machine Interfaces for process automation systems, with a focus on effectiveness, usability, and safety.

WCAG (Web Content Accessibility Guidelines):
International guidelines developed by the World Wide Web Consortium (W3C) to make web content more accessible to people with disabilities.

User-Centered Design:
An iterative design process that prioritizes the needs, behaviors, and feedback of users at every stage of development.

GLOSSARY OF KEY TERMS

Usability:
The ease with which users can use a product or system to achieve specific goals effectively, efficiently, and satisfactorily.

Accessibility:
The extent to which a product, service, or environment can be used by people with varying abilities, including individuals with disabilities.

Contrast Ratio:
The luminance difference between text and background, crucial for readability-especially for users with visual impairments.

Navigation Overload:
A condition in which users feel overwhelmed by the number or complexity of navigation options within an interface.

Process Visibility:
The user's ability to clearly view the current status, details, and progress of a process within a system.

Alarm Prioritization:
A system for categorizing alarms by importance or severity, enabling operators to respond effectively.

Information Architecture:
The organizational structure and presentation of information within a system or interface.

Atomic Design:
A design methodology that breaks an interface into fundamental components (“atoms”), which can be combined to form more complex elements like molecules, organisms, templates, and full pages.

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