

**Standards**

Certification

Education & Training

Publishing

Conferences & Exhibits

Setting the Standard for Automation™

ISA TECHNICAL REPORT

ISA-TR101.01-2022

HMI Philosophy

**This ISA Technical Report was approved
on 6 September 2022**

NOTICE OF COPYRIGHT

This is a copyright document and may not be copied or distributed in any form or manner without the permission of ISA. This copy of the document was made for the sole use of the person to whom ISA provided it and is subject to the restrictions stated in the *Copyright of ISA Standards* policy. It may not be provided to any other person in print, electronic, or any other form. Violations of ISA's copyright will be prosecuted to the fullest extent of the law and may result in substantial civil and criminal penalties.

**Documents**

Document Sharing Hub

ISA-TR101.01-2022

HMI Philosophy

ISBN: 978-1-64331-222-4

Copyright © 2022 by the International Society of Automation. All rights reserved. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), without the prior written permission of the publisher.

ISA
3252 S. Miami Blvd., Suite 102
Durham, North Carolina 27703 US

Email: standards@isa.org

PREFACE

This preface, as well as all footnotes and annexes, is included for information purposes only and is not part of ISA-TR101.01-2022.

This technical report has been prepared as part of the service of ISA, the International Society of Automation, toward a goal of helping in the understanding and use of ANSI/ISA-101.01-2015, *Human Machine Interfaces for Process Automation Systems*. To be of real value, this document should not be static but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, ISA Standards and Practices Board, standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards, recommended practices, and technical reports. The Department is further aware of the benefits to USA users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, the Department will endeavor to introduce SI and acceptable metric units in all new and revised standards to the greatest extent possible. *The Metric Practice Guide*, which was published by the Institute of Electrical and Electronics Engineers (IEEE) as ANSI/IEEE Std. 268-1992, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards. Participation in the ISA standards-making process by an individual in no way constitutes endorsement by the employer of that individual, of ISA, or of any of the standards, recommended practices, and technical reports that ISA develops.

This technical report is structured to follow the ISA Style Guide.

CAUTION — ISA ADHERES TO THE POLICY OF THE AMERICAN NATIONAL STANDARDS INSTITUTE WITH REGARD TO PATENTS. IF ISA IS INFORMED OF AN EXISTING PATENT THAT IS REQUIRED FOR USE OF THE DOCUMENT, IT WILL REQUIRE THE OWNER OF THE PATENT TO EITHER GRANT A ROYALTY-FREE LICENSE FOR USE OF THE PATENT BY USERS COMPLYING WITH THE DOCUMENT OR A LICENSE ON REASONABLE TERMS AND CONDITIONS THAT ARE FREE FROM UNFAIR DISCRIMINATION.

EVEN IF ISA IS UNAWARE OF ANY PATENT COVERING THIS DOCUMENT, THE USER IS CAUTIONED THAT IMPLEMENTATION OF THE DOCUMENT MAY REQUIRE USE OF TECHNIQUES, PROCESSES, OR MATERIALS COVERED BY PATENT RIGHTS. ISA TAKES NO POSITION ON THE EXISTENCE OR VALIDITY OF ANY PATENT RIGHTS THAT MAY BE INVOLVED IN IMPLEMENTING THE DOCUMENT. ISA IS NOT RESPONSIBLE FOR IDENTIFYING ALL PATENTS THAT MAY REQUIRE A LICENSE BEFORE IMPLEMENTATION OF THE DOCUMENT OR FOR INVESTIGATING THE VALIDITY OR SCOPE OF ANY PATENTS BROUGHT TO ITS ATTENTION. THE USER SHOULD CAREFULLY INVESTIGATE RELEVANT PATENTS BEFORE USING THE DOCUMENT FOR THE USER'S INTENDED APPLICATION.

HOWEVER, ISA ASKS THAT ANYONE REVIEWING THIS DOCUMENT WHO IS AWARE OF ANY PATENTS THAT MAY IMPACT IMPLEMENTATION OF THE DOCUMENT NOTIFY THE ISA STANDARDS AND PRACTICES DEPARTMENT OF THE PATENT AND ITS OWNER.

ADDITIONALLY, THE USE OF THIS DOCUMENT MAY INVOLVE HAZARDOUS MATERIALS, OPERATIONS OR EQUIPMENT. THE DOCUMENT CANNOT ANTICIPATE ALL POSSIBLE

APPLICATIONS OR ADDRESS ALL POSSIBLE SAFETY ISSUES ASSOCIATED WITH USE IN HAZARDOUS CONDITIONS. THE USER OF THIS DOCUMENT MUST EXERCISE SOUND PROFESSIONAL JUDGMENT CONCERNING ITS USE AND APPLICABILITY UNDER THE USER'S PARTICULAR CIRCUMSTANCES. THE USER MUST ALSO CONSIDER THE APPLICABILITY OF ANY GOVERNMENTAL REGULATORY LIMITATIONS AND ESTABLISHED SAFETY AND HEALTH PRACTICES BEFORE IMPLEMENTING THIS DOCUMENT.

THE USER OF THIS DOCUMENT SHOULD BE AWARE THAT THIS DOCUMENT MAY BE IMPACTED BY ELECTRONIC SECURITY ISSUES. THE COMMITTEE HAS NOT YET ADDRESSED THE POTENTIAL ISSUES IN THIS VERSION.

ISA (www.isa.org) is an international professional association that sets the standard for those who apply engineering and technology to improve the management, safety, and cybersecurity of modern automation and control systems used across industry and critical infrastructure. Founded in 1945, ISA develops widely used international standards for industrial automation, safety, and cybersecurity; certifies industry professionals; provides education and training; publishes books and technical articles; hosts conferences and events; and provides networking and career development programs for its members and customers around the world.

ISA owns Automation.com, a leading online publisher of automation-related content. In addition, through a wholly owned subsidiary, ISA bridges the gap between standards and their implementation with the ISA Security Compliance Institute (www.isasecure.org) and the ISA Wireless Compliance Institute (www.isa100wci.org).

The following ISA101 WG1 members served as leaders and/or technical experts in developing this technical report:

NAME	AFFILIATION
D. Lee, ISA101 WG1 Co-Chair	Emerson Automation Solutions
L. Lang, ISA101 WG1 Co-Chair	Cargill
G. Lehmann, ISA101Co-Chair	AECOM
M. Wilkins, ISA101 Co-Chair	Yokogawa MKHQ
C. Monchinski, Co-Managing Director	Automated Control Concepts
N. Sands, Co-Managing Director	DuPont Company
E. Aguirre	Instituto Mexicano del Petróleo
M. Amando	Geosistemas y Control S.A. de C.V
D. Board	Rockwell Automation
P. Brett	Honeywell
A. Bryant	Oxy Inc.
J. Chow	ExxonMobil
W. Cohen	Intel
V. D'Amore	Talascend/Bechtel
L. Dubois	Manage4U
B. Fitzpatrick	Wood
J. Guevara	John Zink
W. Hollifield	PAS Global
A. Jacobs	Better HMI Panels
D. Lutz	Nova Chemicals
L. Myers	ILS-Automation
G. Nasby	CN Rail
D. Northrup	Saudi Aramco
K. Patel	Signature Automation
R. Pikaar	ErgoS Human Factors Engineering
T. Perret	Ecoles Techniques du CIFOM et du CPLN

M. Ramey	DuPont Company
D. Reed	Rockwell Automation
M. Richer	GCM Consultants
R. Schiedermayer	Consultant
D. Schweitzer	Eastman Kodak Co.
R. Timmermans	VTTI BV
B. Vail	AECOM
D. Visnich	Burns & McDonnell
R. Weibel	TiPS

This technical report was approved for publication by the ISA Standards and Practices Board on September 6, 2022.

NAME	AFFILIATION
D. Zetterberg, Vice President	Consultant
D. Bartusiak	Collaborative Systems Integration, LLC
D. Brandl	BR&L Consulting, Inc.
P. Brett	Honeywell Inc.
D. Dunn	WS Nelson
J. Federlein	Consultant
B. Fitzpatrick	Wood
S. Fluchs	admeritia GmbH
J.-P. Hauet	Hauet.com
D. Lee	Emerson Process Management
G. Lehmann	AECOM
T. McAviney	Consultant
V. Mezzano	Fluor Corp.
C. Monchinski	Automated Control Concepts Inc.
G. Nasby	Canadian National Railway Company
D. Reed	Rockwell Automation
N. Sands	DuPont
H. Sasajima	FieldComm Asia LLC
I. Verhappen	Willowglen Systems Inc.
D. Visnich	Burns & McDonnell
W. Weidman	Consultant
J. Weiss	Applied Control Solutions LLC
M. Wilkins	Yokogawa UK Ltd.

This page intentionally left blank.

FOREWORD

In 2006, the ISA Standards and Practices Board activated the ISA101 committee to create standards for computer-based human machine interfaces (HMI) for the process industries. In July 2015, the ANSI/ISA approval process was completed for the standard: ANSI/ISA-101.01-2015, *Human Machine Interfaces for Process Automation Systems*, commonly referred to as ISA-101. Starting in late 2015, the ISA101 committee established working groups to produce technical reports (TRs), designed to augment the standard with additional rationale, usage guidelines, and examples in different areas of human machine interfaces. Four technical reports are being created by these working groups:

- WG1 – HMI Philosophy
- WG2 – HMI Usability and Performance (published 2019)
- WG3 – HMI for Mobile Platforms
- WG4 – HMI for On-Machine Applications

Each technical report is written to be a stand-alone document. In an effort to minimize repetition, the technical reports have cross references.

This technical report, ISA-TR101.01, produced by WG1, is designed to provide guidance, rationale, and examples for those who need to understand and develop an HMI philosophy. Future editions will include guidance for an HMI style guide.

The guidance as presented in this document is general in nature and should be applied to each system as appropriate by personnel knowledgeable in the manufacturing process and control system(s) to which it is being applied. The guidance includes suggestions on appropriate techniques that are generally applicable. Selection of activities and practices for a given system is the responsibility of the system's users and/or support staff.

It is intended that this guidance will be updated over time as experience is gained. As such, while the general format of this guidance is expected to remain relatively stable, the specifics of its application and specific solutions are expected to evolve.

This page intentionally left blank.

Contents

FOREWORD	7
1 Scope	11
1.1 General applicability	11
1.2 The HMI lifecycle	11
2 References	11
2.1 Normative references	12
2.2 Nonnormative references	12
3 Terms and definitions	12
3.1 Definitions	12
3.2 Acronyms	17
4 Introduction	17
5 HMI philosophy document contents	18
6 General	19
6.1 Purpose and function of HMI system	19
6.2 Operating goals	19
6.3 Scope	19
6.4 Definitions	20
6.5 References (optional)	20
6.6 Lifecycle management	20
6.7 Roles and responsibilities	20
6.8 Related site procedures	23
7 System standards	23
7.1 HMI philosophy	23
7.2 HMI style guide	23
7.3 HMI object library or toolkits	27
8 Design	28
8.1 HMI design principles	28
8.2 User, task, and functional requirements	29
8.3 Security	33
8.4 Control room design considerations	34
9 Implementation	34
9.1 Build displays	34
9.2 Build console	34
9.3 Testing	35
9.4 Training	35
9.5 Commissioning	36
9.6 Verification	36
10 Operate	37
10.1 In service	37
10.2 Decommission	37
10.3 Maintain	37

11	Continuous work processes	37
11.1	Management of change	37
11.2	MOC types	37
11.3	Audit.....	38
11.4	Performance monitoring	39
11.5	Validation	39
Annex A	– Example table of contents for HMI philosophy	41

Figures

Figure 1	– HMI Lifecycle (Figure 2 from ISA-101)	11
Figure 2	– Example of an HMI roles & responsibilities matrix	22
Figure 3	– Example graphical object depiction	27

Tables

Table 1	– Example HMI philosophy contents	18
Table 2	– Example MOC table	38

1 Scope

1.1 General applicability

This technical report was written in support of the standard ANSI/ISA-101.01-2015, *Human Machine Interfaces for Process Automation Systems*, hereinafter referred to as ISA-101. The goal of this technical report is to provide guidance on how to implement the recommendations and the requirements described in the HMI Philosophy subclause (4.2.1) of the standard. It outlines potential approaches and provides specific examples that can be included in an HMI philosophy in order to properly manage the system standards, design, implement, operate, and continuous work processes lifecycle steps.

This technical report is not intended to be used as an organization's HMI philosophy. Instead, it provides details as to the desirable content. The objective of this TR is to be the starting point for the development of an HMI philosophy document; it provides examples that can be used in an HMI philosophy. Annex A has an example table of contents (TOC), which can be used as a starting point in generating an HMI philosophy document.

NOTE: This technical report does not contain any mandatory (normative) requirements.

1.2 The HMI lifecycle

Figure 1 shows a diagram of the scope of an HMI lifecycle, reproduced from the ISA-101 standard. The development of an HMI philosophy, as one of the system standards, is an essential element of the lifecycle model.

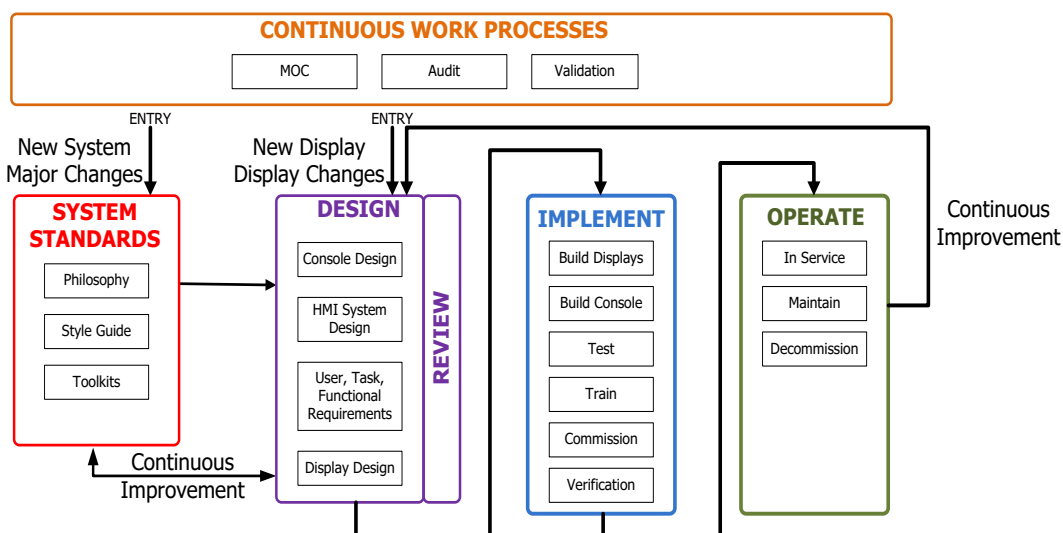


Figure 1 – HMI Lifecycle (Figure 2 from ISA-101)

2 References

The following normative and nonnormative reference documents are useful for the application of this TR. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2.1 Normative references

ANSI/ISA-101.01-2015, *Human Machine Interfaces for Process Automation Systems* (2015) [ISA-101]

ANSI/ISA-18.2-2016, *Management of Alarm Systems for the Process Industries* (2016) [ISA-18.2]

ISO 11064-5, *Ergonomic design of control centres – Part 5: Displays and Controls*

ISO 11064-7, *Ergonomic design for control centres – Part 7: Principles for the evaluation of control centres*

2.2 Nonnormative references

EEMUA-201, *Control Rooms: A guide to their specification, design, commissioning, and operation*. Third Edition (2019)

ISA-TR101.02-2019, *HMI Usability and Performance* (2019) [TR-02]

3 Terms and definitions

For the purposes of this technical report, all terms defined in ISA-101.01, 3.1 are used with their identical meaning. For ease of reference, these terms are repeated in this clause. Where different from ISA-101, the source of the definition is shown in square brackets.

3.1 Definitions

3.1.1

alarm

an audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition requiring a timely response. [ANSI/ISA-18.2-2016]

3.1.2

alarm flood

a condition during which the alarm rate is greater than what the operator can effectively manage (e.g., more than 10 alarms per 10 minutes). [ANSI/ISA-18.2-2016]

3.1.3

alert

an audible and/or visible means of indicating to the operator an equipment or process condition that requires awareness, and which does not meet the criteria for an alarm. [ANSI/ISA-18.2-2016]

3.1.4

aspect ratio

the ratio between the total horizontal and total vertical pixels on a screen (e.g., 4:3 or 16:9).

NOTE: Displays designed for one aspect ratio screen (e.g., 4:3) may appear distorted when shown on a screen with a different aspect ratio (e.g., 16:9).

3.1.5

commissioning

procedures prior, or related, to handing over a system for placing it into service. These procedures often include acceptance testing (FAT, SAT, and SIT); handing over drawings and documentation; delivering instructions for operation, maintenance, and repair; and providing training to personnel.

3.1.6

console

the hardware, software, and furniture or enclosure at which users monitor and/or control the process, which may include multiple stations, communication devices, and other devices (e.g., cameras, barcode devices, pushbutton stations).

3.1.7

control room

a room with at least one HMI console from which a process is monitored and/or controlled that possibly contains other control system equipment and/or other facilities for operators.

3.1.8

control system

a system that responds to input signals from the equipment under control and/or from an operator and generates output signals that cause the equipment under control to operate in the desired manner. [ANSI/ISA-18.2-2016]

3.1.9

controller

the hardware that executes functions for monitoring and control of one or more process variables.

NOTE: In some industries, the primary user of the HMI is called the controller. Within this document, the term controller is used as defined in ANSI/ISA-101.01-2015, 3.1.13.

3.1.10

dashboard

a graphical summary showing various pieces of important information typically used to give an overview of a process or part of a process.

3.1.11

display (graphic, window)

a visual representation of the process and related information used by the operator for monitoring and control.

3.1.12

display style (display format, graphic layout)

a description of the generic layout of a display and its presentation of information, not referring to any particular content.

3.1.13

distributed control system (DCS)

a computerized control system for a process or plant usually with many control loops, in which autonomous controllers are distributed throughout the system, but there is no central operator supervisory control.

3.1.14**drill down**

a method of navigation in which successive displays show increasing detail for smaller subsets of the system scope.

3.1.15**faceplate**

a display, part of a display, or popup used for monitoring and/or direct operation of a single control loop, device, sequence, or other entity.

3.1.16**graphic element**

a component part of a graphic symbol, such as a line or circle.

3.1.17**graphic symbol**

a visual representation of a process component, instrument, or condition in a display composed of a combination of simple graphic elements.

3.1.18**human factors engineering (HFE, ergonomics)**

a scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theoretical principles, data, and methods to design in order to optimize well-being and overall performance.

3.1.19**human machine interface (HMI, HMI system)**

the collection of hardware and software used by the operator and other users to monitor and interact with the control system and with the process via the control system.

3.1.20**keyboard**

an input device that allows the user to type characters, values, or commands to affect the control system.

3.1.21**margin**

the space between an object and surrounding objects on a display.

3.1.22**monitor (video display unit, VDU, computer screen, LCD display) – noun**

an electronic device for the display of visual information in the form of text and/or graphics.

3.1.23**monitor – verb**

to maintain awareness of the state of a process, by observing variables or the change of variables against limits or other variables, to keep track of operations and enable timely and appropriate response to abnormal conditions.

3.1.24**navigation**

a function that supports users in locating desired information in an HMI-based information system, and also in guiding the selection of displays or the act of selecting a display.