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TECHNICAL REPORT

ISA-TR-88.95.01-2008

Using ISA-88 and ISA-95 Together

Approved 1 August 2008

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At the time of publication of this document, the editions of the standards referenced within this document were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards indicated within this document.

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The following people served as active members of the joint working group for the preparation of this technical report:

Name	Company
Dennis Brandl	BR&L Consulting
Siem Broersen	GTI Group
David Chappell	CMAa-LLC
Leo Charpentier	Novatech Process Solutions
Lynn Craig *, ***	Manufacturing Automation Associates
Em delaHostria	Rockwell Automation
Yves Dufort	Invensys/Wonderware
Randy Dwiggins	Maverick Technologies
David Emerson	Yokogawa
Alistair Gillanders	DynoChem Inc.
Gavan Hood	Rockwell Automation
Charlotta Johnsson	Lund University
Baha Korkmaz	Invensys
Francis Lovering	Control Draw Ltd
Dawn Marruchella****	Emerson Process Management
Thomas Nash	Schering-Plough
Leif Poulsen	Novo Nordisk Engineering, A/S
Bianca Scholten	Ordina
Keith Unger**	Stone Technologies
Jean Vieille	Control Chain Group
Kathleen Waters	Genentech
Maurice Wilkins	Yokogawa

* Chairman
** Vice-Chairman
*** Chief Editor
**** Secretary

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Introduction

When the ISA-88 and ISA-95 standards are applied together in an application or project, some of the terminologies, models and key definitions in these two sets of standards need to be aligned to assist the users. A harmonization task group with members from the ISA88 and ISA95 committees has generated this technical report to document and map the overlaps, gaps, similarities and differences in these concepts, terms and definitions. This technical report is intended to enable an integration team to use these specifications jointly, in an application or project.

The purpose of the technical report is to

- Explain how ISA-88 and ISA-95 interrelate.
- Identify areas of overlap and gaps between ISA-88 and ISA-95
- Explain to practitioners how to use ISA-88 and ISA-95 together
- Reduce confusion in industry about the two series standards by answering such questions as:
  - Are they both needed?
  - Do they overlap?
  - Which should be used?
  - When is one more appropriate than the other?

Although the technical report does not take into account the recent proposed additions to both the ISA-88 and ISA-95 families of standards, the approach used in this harmonization task can be applied to facilitate the combined use of these two families of standards.

In particular, as the new parts of ISA-88, Part 4, Batch Production Records, and Part 5, Automated Equipment Control Models and Terminologies, and the additional parts of ISA-95, Part 4, Common Object Model and Attributes, and Part 5, Business-to-Manufacturing Transactions, become widely available, there are expected to be other areas of potential overlaps and gaps when these standards are used together.

However, the planned updates to the existing parts of both these standards families are intended to reflect some of the recommendations in this technical report in order to minimize the problematic areas and to facilitate their continued harmonization.

Readers of this technical report are encouraged to help further align these standards by providing comments to the ISA-88 and ISA-95 committees based on actual experience in applying these standards.

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Using ISA-88 and ISA-95 Together

1 Scope

This technical report is targeted for industry stakeholders (individual or teams) intending to use ANSI/ISA-95 for enterprise-to-control system integration and ANSI/ISA-88 for control system integration within a common project.

The specific goal is to help such an individual or team understand the key issues involved in using ISA-88 and ISA-95 together so that they can make appropriate choices. This technical report is the result of an effort to identify key areas of overlap and gaps between ISA-88 and ISA-95. It will not discuss issues that are not pertinent to both of the standards.

2 References

The following documents contain provisions that are referenced in this text. At the time of publication, the editions indicated were valid. All documents are subject to revision, and parties to agreements based on this technical report are encouraged to investigate the possibility of applying the most recent editions of the reference documents indicated below.

— ANSI/ISA -95.00.01-2000, Enterprise/Control System Integration Part 1: Models and Terminology

— ANSI/ISA -95.00.02-2001, Enterprise/Control System Integration Part 2: Object Model Attributes

— ANSI/ISA-95.00.03-2005, Enterprise/Control System Integration Part 3: Activity Models of Manufacturing Operations Management

— ISA-88.00.01-1995 Batch Control Part 1: Models and Terminology

— ANSI/ISA-88.00.02-2001 Batch Control Part 2: Data Structures and Guidelines for Languages

— ANSI/ISA-88.00.03-2003 Batch Control Part 3: General and Site Recipe Models and Representation

— ANSI/ISA-88.00.04-2006 Batch Control Part 4: Batch Production Records

3 Narrative Overview

3.1 Introduction

When the ISA-88 and ISA-95 series of standards are used within the same plant-wide automation system in an enterprise, it is necessary to align the various definitions in both standards in order for industry stakeholders to reap the intended benefits. Clearly implementations of these two series of standards need to work together. If their interaction is not understood, the intended benefits will not be realized and costly integration problems are likely to arise. The automation, operations and manufacturing solutions providers and consumers will have to work closely together in order to minimize and eventually eliminate these integration problems. This technical report is intended to improve these stakeholders' understanding of both standards series as well as their intent.

Although both standards are intended to enable manufacturing operations and control, they are different in coverage and approach. Table 1 provides a high-level comparison.

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Table 1. Comparison of approaches and coverage

	ISA-95	ISA-88
Orientation	Definition of workflow and information exchange for Manufacturing Operations Management.	Physical work execution for Batch and other types of manufacturing.
Conceptual Basis relative to Manufacturing Management Functions	Flexible structure of manufacturing management functions that interacts with business requirements.	Acknowledges but does not directly address manufacturing management functions.
Conceptual Basis relative to Process Control	Directly addressing most traditional process control activities is presently out of scope.	Well-defined equipment-oriented process control structure and function hierarchies extending to the bits and pieces of the manufacturing equipment itself.
Primary areas of concern	Addresses functionalities and applications at a level below enterprise business systems but above manufacturing control systems.	Addresses a lower level, directing, controlling and coordinating the people and equipment that perform or cause the physical transformation of raw or intermediate materials into final or intermediate products.
Affected Industries	Spans all types of manufacturing.	Written primarily in terms of batch manufacturing, but is often applied in other types of manufacturing.

A key task in attempting a combined use of the two standards is to recognize and identify where their definitions and models overlap and where there exists gaps when dealing with the information exchanges within the same application. When dealing with the overlaps and gaps, the user of the two standards has the challenging task of reconciling terminology whenever the two standards use either different terms to mean the same thing or the same term to mean different things. These tasks need to be accomplished to realize a successful combined use of ISA-88 and ISA-95.

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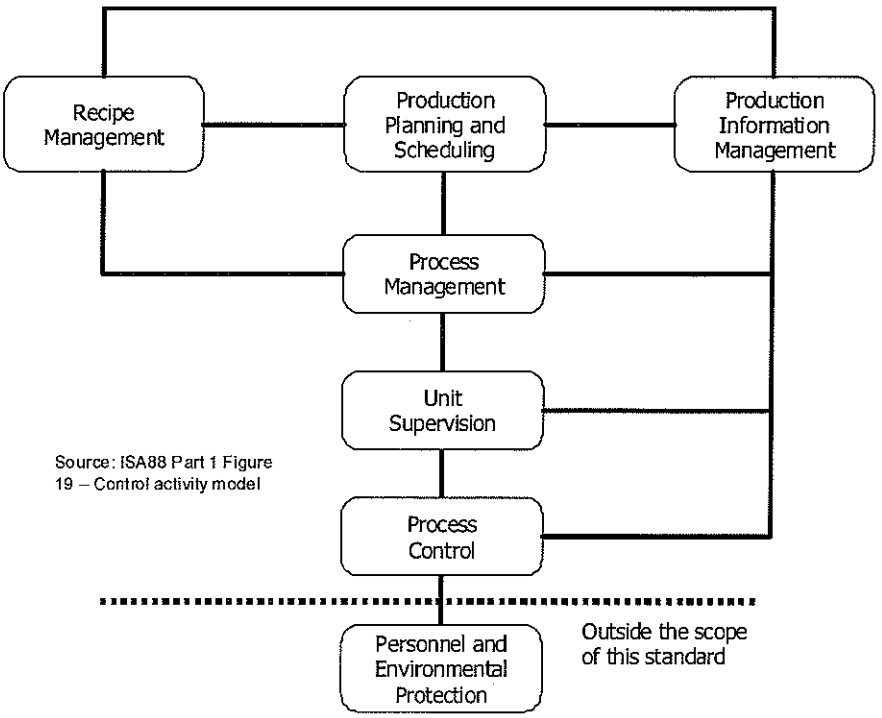

Figure 1 – ISA-88 Control Activity Model

3.2 Main areas of overlap

The control activity model in Part 1 of the ISA-88 standard is shown in Figure 1. It shows a hierarchy of three primary activities (i.e. Process Management, Unit Supervision and Process Control) that implement control. In addition, there are three other complementary activities (i.e. Recipe Management, Production Planning and Scheduling and Production Information Management) that exchange information with the primary activities to realize the effective and efficient production of the correct products.

In Figure 1, the Process Control activity represents the functionality required to accomplish traditional state oriented and regulatory control. Because ISA-88 is all about adding procedural control to more traditional.

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Source: ISA88 Part 1 Figure 2 – Physical model

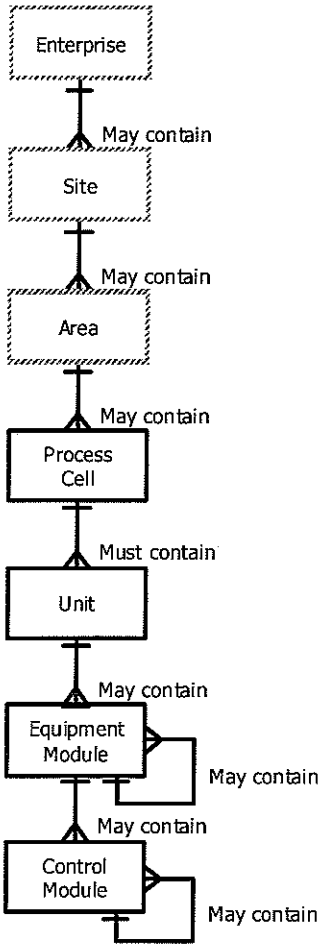

Figure 2 – ISA-88 Physical Model

Process Control, the Unit Supervision activity provides most of the functionality required to execute procedures and to direct the lower level functionality described in the Process Control activity. Since those procedures often must be performed in multiple units and common resources at the same time in a precise sequence with exact timing and because there could be many procedures active at the same time, a great deal of coordination is necessary. The coordination functions and the remainder of needed procedural control functionality are defined in the Process Management control activity. By their nature, the interconnection of the three primary control activities is viewed in ISA-88 as interactive and time sensitive. For that reason, they are essentially inseparable in any practical implementation where there is significant interaction of closely linked elements (units and common resources) of the manufacturing equipment being controlled.

While the control activities represent the functionality needed to implement procedural control, it is equipment that is, in fact, controlled. Unlike the more traditional view of process control that treats control as separate, abstract activities that focus primarily on manipulation of final control elements, procedural control addresses and provides functionality to groupings and assemblages of equipment.

ISA-88 defines a physical model (see Figure 2) with a hierarchy of four specifically defined equipment groupings and three higher levels, fairly abstract groupings that are depicted in dashed lines because they are specified as beyond the scope of the ISA-88 standard.

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The three primary control activities discussed above rather naturally align with levels in the ISA-88 physical model. The functionality defined in the Process Control activity controls the behavior of the equipment groupings called Control Modules and, occasionally, Equipment Modules. The Unit Supervision control activity provides the capability to execute embedded modular procedural elements (phases) to control the behavior of the equipment. The Process Cell is made up of Units and common resources, both made up of Equipment Modules and Control Modules. Control functionality in the Process Cell relies on the Process management control activity to track and direct the units and common resources, to coordinate their interactions and to keep complex procedures sorted out and working together to make the desired product.

As a result, the three primary activities are viewed in ISA-88 as tightly bound to the process cell, as well as the unit and the lower level equipment that make up the process cell. The other three complementary activities are specifically not part of the Process Cell and their functionalities transcend individual process cells. In the ISA-88 models, they are not tightly bound to any specific grouping of equipment and are not clearly related to any particular level in the physical model. However, these functionalities may be likely associated with equipment groupings in the Area, Site and Enterprise as shown in the physical model but not likely with the Process Cell.

When the first parts of the ISA-88 standard were issued, there was no recognized standard defining functions above the Process Cell. As a result, it was necessary to define the three higher-level control activities in order to make sense of the functions in the lower level control oriented activities. Process Management cannot function without a recipe and a schedule, both of which are likely to come from above or outside the Process Cell. The recipe, or the basis for it, is usually generated in some corporate R&D group. The detailed schedule needed by ISA-88 is usually generated by production operations management and must transcend all Process Cells or Work Centers involved in making the product if it is to be effective and promote manufacturing efficiency. The third higher level activity, "Production Information Management" was defined to accept, manage, store and distribute information from multiple Process Cells.

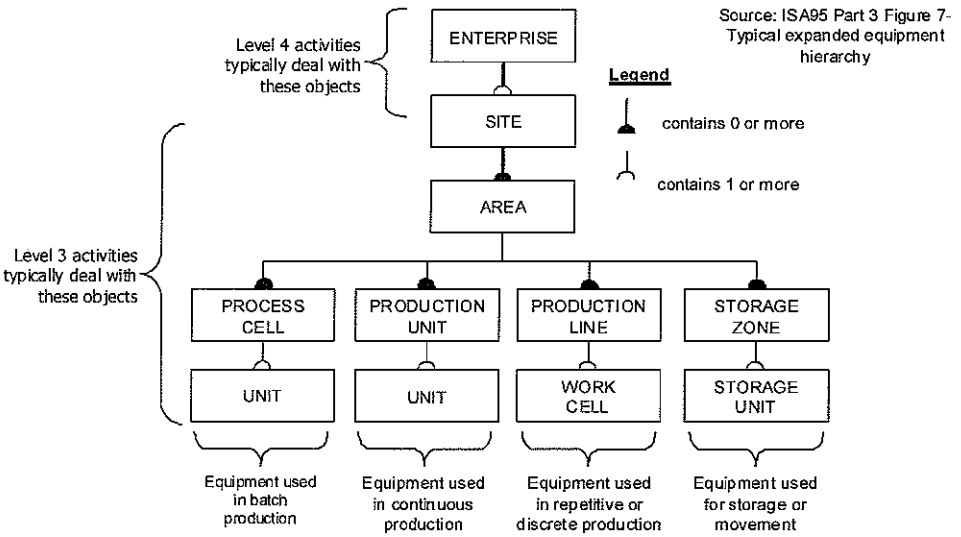

Figure 3 — ISA-95 Equipment hierarchy model

In the ISA-95 standards series, there are two forms of hierarchy – a physical equipment hierarchy and a functional (activity) hierarchy. Figure 3 (from ISA-95 Part 3, Fig. 7) illustrates an expanded equipment hierarchy, covering more types of manufacturing with less resolution as compared to Figure 2.

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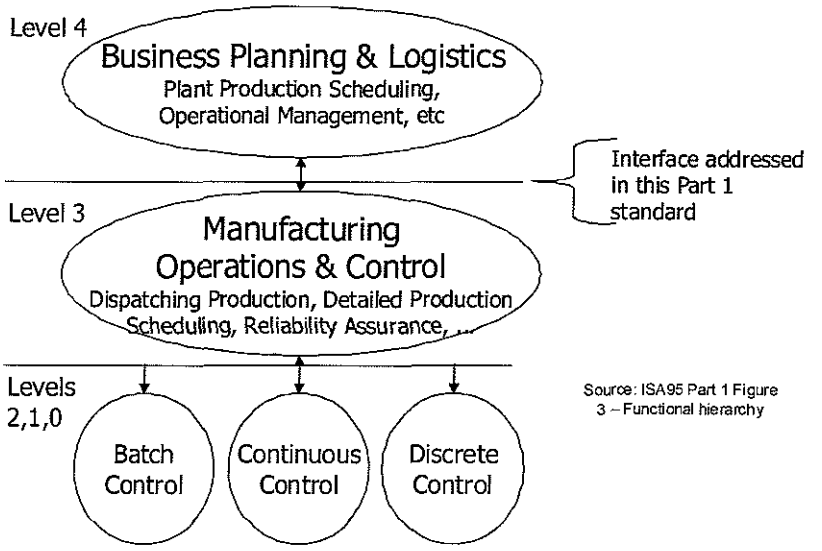

Figure 4 — ISA-95 Functional hierarchy

The ISA-95 activity hierarchy explicitly addresses the various categories of manufacturing operations management activities within Level 3 of the Purdue Reference Model (PRM) and their interactions with other levels, as shown in Figure 4 (from ISA-95 Part 1, Figure 3). Each manufacturing operations management category, such as production operations, maintenance operations and product quality testing operations can be further detailed in terms of a common generic set of detailed activities, as shown in Figure 5 (from ISA-95 Part 3, Figure 6).

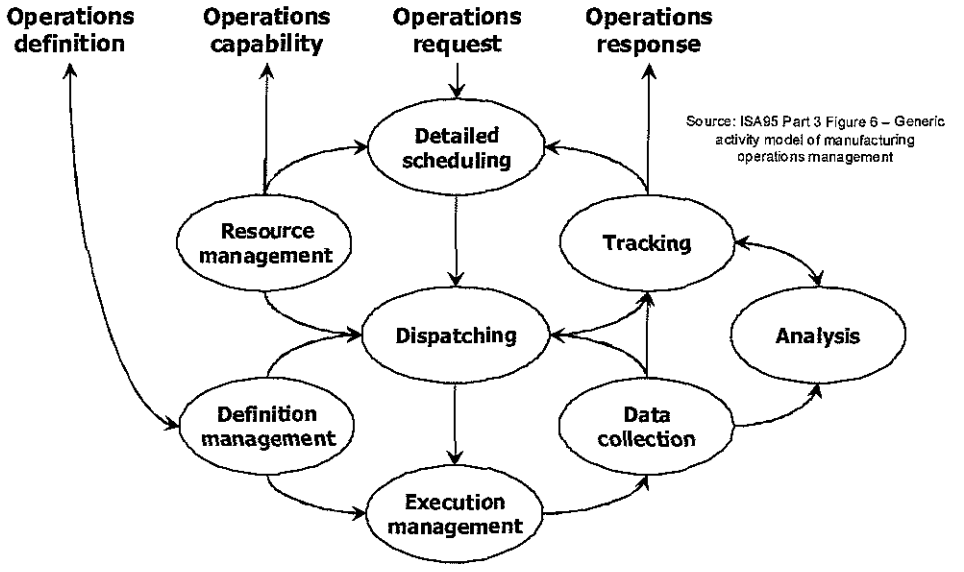

Figure 5 — ISA-95 Generic activity model: Manufacturing operations management

Although the activity names used in ISA-95 are slightly different from terms used in ISA-88, all three of the ISA-88 complementary activities (i.e. Recipe Management, Production Planning and Scheduling and Production Information Management) can be mapped to the ISA-95 Level 3 detailed activities as noted in Figure 6, from a perspective where the ISA-88 functional activities could have some aspects not considered within the ISA-95 definitions.

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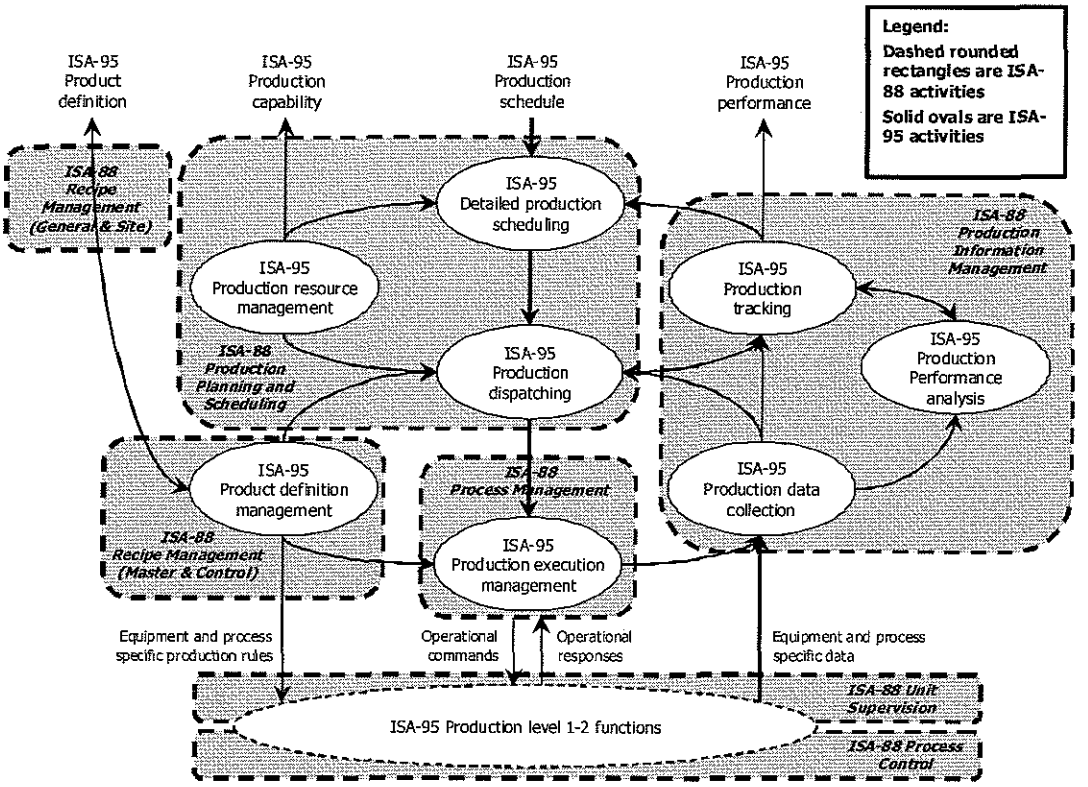

Source: ISA95 Part 3 Figure 9 – Activity model of production operations management – objects spread out and relabeled, ISA88 Part 1 Figure 19 – Control activity model resized and rearranged to map onto the ISA95 figure

Figure 6 — ISA-88 control activities overlaid on ISA-95 activities

A similar mapping can be envisioned where the ISA-95 activities and functions may have specific aspects not included within the ISA-88 activities and functions. The more general coverage of ISA-95 is particularly evident compared to the three higher level ISA-88 control activities (Production Information Management, Production Planning and Scheduling, and Recipe Management) or when other ISA-95 operational categories besides Production (e.g. maintenance and quality assurance testing) are considered.

The three higher level ISA-88 control activities fit nicely within the ISA-95 structure. However, the three primary control activities align more loosely.

- ISA-88 Production Information Management activity can be considered a placeholder for ISA-95 activities including Data Collection, Tracking and Analysis.
- ISA-88 Production Planning and Scheduling activity can be considered a placeholder for the subset of ISA-95 activities including Detailed Scheduling, Dispatching and Resource Management.
- ISA-88 Recipe Management activity, on the other hand can be considered to be a specialized and, in some cases more detailed, subset of the much more generally defined ISA-95 Product Definition Management activity.
- ISA-95 defines a function called Production Execution Management that almost exactly corresponds to the ISA-88 control activity called Process Management. That is a clear overlap with a primary ISA-88 control activity and, unlike the higher level control activities, has the potential for significant confusion stemming from the interaction of the functions in the activity models with the physical equipment depicted in the related physical models.

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