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**Enterprise-Control System Integration**

**− Part 9: Common Operations Management Events**

**DRAFT for**

**ISA95 REVIEW**

ANSI/ISA-d95.00.09-ed1 WD01

Enterprise-Control System Integration − Part 9: Common Operations Management Events

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INTRODUCTION

This document defines the common operations management process-centric events and is to be used in conjunction with ANSI/ISA-95.00.01, ANSI/ISA-95.00.02, ANSI/ISA-95.00.03, ANSI/ISA-95.00.04 and ANSI/ISA-95.00.05.

The scope of this document is limited to defining the semantics and structure of the common operations management process-centric events for the activity models defined in ANSI/ISA-95.00.03 and the Level 4 functions which generate information exchanges with Level 3.

The goal of the standard is to reduce the risks, costs and errors associated with implementing enterprise systems and operations management systems in such a way that they inter-operate and easily integrate. The standard may also be used to reduce the effort associated with implementing new product offerings. The goal is to have enterprise systems and control systems that interoperate and easily integrate.

This document defines the common process-centric events involved in notification of real-world operations management events arising from the activity models defined in ANSI/ISA-95.00.03.

The models and terminology defined in ANSI/ISA-95:

1. emphasize good manufacturing operations management integration practices during the entire life cycle of the systems;
2. can be used to improve existing integration capability of manufacturing operations management systems; and
3. can be applied regardless of the degree of automation.

Specifically, ANSI/ISA-95.00.01, ANSI/ISA-95.00.02, ANSI/ISA-95.00.03, ANSI/ISA-95.00.04, ANSI/ISA-95.00.05 and this document provide a standard terminology and a consistent set of concepts and models for integrating manufacturing operations management systems in an event driven manner. Benefits produced will:

1. reduce the user’s time to reach full production levels for new products;
2. enable vendors to supply appropriate tools for implementing integration of manufacturing operations management systems;
3. enable users to better identify their needs;
4. reduce the cost of automating manufacturing processes;
5. optimize supply chains; and
6. reduce life-cycle engineering efforts.

It is not the intent of the standards to:

1. suggest that there is only one way of implementing integration of manufacturing operations management systems;
2. force users to abandon their current way of handling integration; or
3. restrict development in the area of integration of manufacturing operations management systems.

ENTERPRISE-CONTROL SYSTEM INTEGRATION –

Part 9: Common operations management events

# Scope

This document defines common operations management events for information exchange within Level 3 and between Level 3 and Level 4 manufacturing operations management activities.

# Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/ISA 95.00.01, Enterprise-control system integration – Part 1: Models and terminology

ANSI/ISA 95.00.02, Enterprise-control system integration – Part 2: Object models and attributes

ANSI/ISA 95.00.03, Enterprise-control system integration – Part 3: Activity models of manufacturing operations management

ANSI/ISA 95.00.04, Enterprise-control system integration – Part 4: Objects and attributes for manufacturing operations management

ANSI/ISA 95.00.05, Enterprise-control system integration – Part 5: Business to manufacturing transactions

# Terms, definitions, abbreviations and conventions

## Terms and definitions

For the purposes of this document the terms and definitions given in ANSI/ISA 95.00.01 as well as the following apply.

physical resources

*personnel, physical asset, material lot* and *material sublot* objects

resource definitions

*personnel class, equipment, equipment class, physical asset class, material definition and material class* objects

## Conventions

Italics are used, beyond the use defined in ISO/IEC Directives Part 2, to emphasize the ISA-95 specific meaning of terminology. They are used for the following cases:

* Names of objects used in exchanged data

# Scoping and structuring models

The common operations management event exchanges defined in this document have been scoped and structured in accordance with models defined in other parts of this standard.

The scope of manufacturing operations information is identified in Figure 9 of ANSI/ISA-95.00.03 of this standard. This information scoping figure is depicted in Figure 1 below. It identifies the four categories of manufacturing operations information that correspond to the four categories of manufacturing operations activities. The information corresponds to four major types of information as shown in Figure 1:

1. Schedule and request information – Information about requests to perform work within one or more categories of activities.
2. Performance and response information – Information about work performed within one or more categories of activities.
3. Capability information – Information about the capabilities to perform work within one or more categories of activities.
4. Definition information – Information about the definition of work that could be performed within one or more categories of activities.



Figure 1 - Manufacturing operations information

The generic activity model from part 3 of this standard has been applied as a structuring model to support identification and classification of common operations management events. The generic activity model is depicted in Figure 2 below.



Figure 2 - Generic activity model of manufacturing operations management

NOTE Not all information flows are depicted in Figure 2. In any specific implementation, information from any activity may be required by any other activity. Where the model is expanded for specific activities, the lines indicating information flows are not intended to be exclusive lists of information exchanged.

# Common operations management events

## General

The common operations management events are process centric event driven information exchanges that are published as a consequence of a real world event that triggered the execution of a task within an ISA-95 function. They are information exchanges that contain the process context of the real world event and a bundled set of ISA-95 objects on which the publisher has taken action.

Each common operations management event defined in this document occurs during the execution of a Level 3 or Level 4 function.

The semantic meaning and structure of common operations management events are defined in this document. The common operations management event objects defined in this document each represent a single specific process centric event. The *operations event* model defined in ISA-95.00.02 can be used to represent any process centric event.

The objects specified in this document for inclusion in the common operations management event structure are defined in ISA-95.00.02 and ISA-95.00.04. Each common operations management event corresponds to a noun used with the *notify* verb defined in ISA-95.00.05.

The functions that publish common operations management events are normatively defined in this document. Subscribing functions are not normatively defined. Any function may subscribe to a common operations management event. Typical subscribing functions to the common operations management events are depicted in this document.

Each common operations management event exchange shall comprise at least one object, even if the event structure permits object multiplicity of 0..n for all objects.

NOTE: Publication of a common operations management event with zero bundled objects would result in an information exchange which would lack sufficient information for a subscriber to fully understand the real world event that the common operations management event is intended to convey.

## Common definition management events

### Level 4 and Level 3 functions

Common definition management events are published from Level 4 or Level 3 functions. *Operations definitions* and *process segments* are managed by Level 4 functions and are exchanged with Level 3 functions. The Level 3 definition management function is responsible for managing *work masters*, *resource relationship networks* and *workflow specifications*.

EXAMPLE Creation and maintenance of *operations definitions* and *work masters* when an end-to-end supply chain, inclusive of its associated plants, is configured in Level 4 and Level 3 functions respectively. This might be done in readiness for the introduction of a new product into an enterprise.

### Operations defined

The *operations defined* event is raised by level 4 functions to notify when operations definitions and process segments are defined. A key focus of the Level 4 supply chain operations definition process is the *operations definitions* and *process segments* required to support Level 4 activities such as master/operations scheduling, sales & operations planning, financial forecasting, etc. and to align Level 4 planning with a plant’s Level 3 activities.

Figure 3 provides a typical set of subscribers to the *operations defined* event.



Figure 3 - Typical operations defined event subscriptions

NOTE: The subscriptions illustrated in this figure are not intended to be exclusive or exhaustive lists of subscriptions. In any specific implementation, any event may be subscribed to by any other function.

Table 1 defines the structure of the *operations defined* event.

Table 1 - Operations defined event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Process segment* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Operations definition* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Work defined

The *work defined* event is raised by the definition management activity to notify when *work masters*, *resource relationship networks* and *workflow specifications* are defined.

Figure 4 provides a typical set of subscribers to the *work defined* event.



Figure 4 - Typical work defined event subscriptions

Table 2 defines the structure of the *work defined* event.

Table 2 - Work defined event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Work master* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Resource relationship network* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Workflow specification* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

## Common resource management events

### Resource defined

The *resource defined* operations event notifies definition of and changes to resource definitions used across the supply chain and within the plant. As a result, this event provides for the mastering of resource definitions. Resource definitions are used commonly between Level 3 and Level 4 functions, and therefore this event may be consumed by Level 3 and Level 4 subscribers.

Figure 5 provides a typical set of subscribers to the *resource defined* event.



Figure 5 - Typical resource defined event subscriptions

Table 3 defines the structure of the *resource defined* event.

Table 3 - Resource defined event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Personnel class* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Equipment class* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Equipment* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Physical asset class* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material class* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material definition* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Hierarchy scope* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

NOTE 1 *Person* and *physical asset* objects are omitted from the *resource defined* common operations management event as they are examples of physical resources, as opposed to design resources.

NOTE 2 *Hierarchy* scope has been defined with the changed action in order to support *hierarchy scope* deletions. When a child *hierarchy scope* is deleted, its parent is required to be changed to reflect that it has one less child. Implementations are advised to use the changed action with care. Situations can arise where the changed action results in the movement of a hierarchy scope to elsewhere in the hierarchy. This could result in the creation of invalid object references in historic information exchanges.

NOTE 3 Property objects (e.g. *personnel class property*) of a parent object are implicitly included in the event structures, with the same valid actions as their parent object. Property objects are related to their parent objects by a composition relationship, which means that the child is inseparable from the parent.

### Resource acquired

The *resource acquired* event notifies the acquisition of new physical resources. The physical resource(s) may have been acquired through processes such as procurement, recruitment or processes that produce *material lots/sublots*. Figure 6 provides a typical set of subscribers to the *resource acquired* event.



Figure 6 –Typical resource acquired event subscriptions

Table 4 defines the structure of the *resource acquired* event.

Table 4 –Resource acquired event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Person* | added | 0..n |
| *Physical asset* | added | 0..n |
| *Material lot* | added | 0..n |
| *Material sublot* | added | 0..n |
| *Resource relationship network* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

*NOTE: Equipment* and *equipment asset mappings* have been omitted from the *resource acquired* event and are included in the *resource adjusted* event, as the mappings will typically be established upon commissioning (i.e. the adjustment) of the *physical assets* rather than when they are procured (i.e. the acquisition).

### Resource adjusted

The *resource adjusted* event provides the ability for Level 4 supply chain operations processes or the resource management activity to notify Level 3 activities of adjustments to physical resources. The physical resource(s) may have been adjusted through processes such as commissioning of a *physical asset*, updated procurement information or changes to a *material lot* during operations scheduling or as a result of a test. Figure 7 provides a typical set of subscribers to the *resource adjusted* event.



Figure 7 - Typical resource adjusted event subscriptions

Table 5 defines the structure of the *resource adjusted* event.

Table 5 –Resource adjusted event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Person* | changed | 0..n |
| *Equipment* | changed | 0..n |
| *Physical asset* | changed | 0..n |
| *Equipment asset mapping* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material lot* | changed | 0..n |
| *Material sublot* | changed | 0..n |
| *Resource relationship network* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Resource retired

The *resource retired* event provides the ability for Level 4 supply chain operations processes or the resource management activity to notify Level 3 activities when physical resources have been retired from service. The physical resource(s) may have been retired from service through processes such as disposal of a *physical asset*, when *personnel* leave an organization or when *material lots* are delivered to customers. Figure 8 provides a typical set of subscribers to the *resource retired* event.



Figure 8 - Typical resource retired event subscriptions

Table 6 defines the structure of the *resource retired* event.

Table 6 –Resource retired event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Person* | deleted | 0..n |
| *Equipment* | deleted | 0..n |
| *Physical asset* | deleted | 0..n |
| *Equipment asset mapping* | changed | 0..n |
| deleted | 0..n |
| *Material lot* | deleted | 0..n |
| *Material sublot* | deleted | 0..n |
| *Resource relationship network* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Operations capability managed

The *operations capability managed* operations event provides the ability for Level 4 supply chain operations process to notify Level 3 activities of changes to total and unattainable *operations capabilities.*

EXAMPLE 1 An unattainable *operations capability* may be added as a result of a change to personnel availability due to approval of annual leave.

EXAMPLE 2 An unattainable *operations capability* might be added or changed when scheduling in aggregates (e.g. day granularity) to cover average/expected breakdowns.

EXAMPLE 3 Total *operations capability* changes may arise as a result of changes to process segments, operations definitions, resource definitions and/or physical resources or as a result of engineering or analysis and improvement activities.

NOTE The operations/work resource managed/committed/used events require that each event notification is able to communicate added, changed or deleted capability information for a specific resource for a specific capability type (i.e. total, unattainable, committed, available, used and unused). Implementations are advised to consider that operations and work capability IDs are therefore sufficiently specific to allow resource capability information to be maintained.

Figure 9 provides a typical set of subscribers to the *operations capability managed* event.



Figure 9 – Typical operations capability managed event subscriptions

Table 7 defines the structure of the *operations capability managed* event.

Table 7 – Operations capability managed event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Operations capability* (total and unattainable) | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Work capability managed

The *work capability managed* operations event provides the ability for the Level 3 resource management function to notify other Level 3 activities of changes to *work capabilities.*

EXAMPLE 1 An unattainable *work capability* may be added as a result of personnel absence due to sickness.

EXAMPLE 2 Total *work capability* changes may arise as a result of changes to work masters, workflow specifications, resource definitions and/or physical resources or as a result of engineering or analysis and improvement activities.

Figure 10 provides a typical set of subscribers to the *work capability managed* event.



Figure 10 – Typical work capability managed event subscriptions

Table 8 defines the structure of the *work* *capability managed* event.

Table 8 – Work capability managed event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Work capability* (total and unattainable) | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Operations resource committed

The *operations resource committed* operations event provides the ability for Level 4 supply chain operations processes to notify Level 3 activities of impacts to *operations capabilities* when resources have been committed in an *operations schedule*. Figure 11 provides a typical set of subscribers to the *operations resource committed* event.



Figure 11 – Typical operations resource committed event subscriptions

Table 9 defines the structure of the *operations resource committed* event.

Table 9 – Operations resource committed event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Operations capability* (available, committed, unattainable) | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Work resource committed

The *work resource committed* operations event provides the ability for Level 3 resource management activities to provide notification of the commitment of resources in a *work schedule*. Figure 12 provides a typical set of subscribers to the *work resource committed* event.



Figure 12 – Typical work resource committed event subscriptions

Table 10 defines the structure of the *work resource committed* event.

Table 10 – Work resource committed event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Work capability* (available, committed, unattainable) | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Operations resource used

The *operations resource used* event notifies the recognition by level 4 functions that one or more resources have been used in operations. Figure 13 provides a typical set of subscribers to the *operations resource used* event.



Figure 13 – Typical operations resource used event subscriptions

Table 11 defines the structure of the *operations resource used* common operations management event.

Table 11 – Operations resource used event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Operations capability* (used, unused) | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Work resource used

The *work resource used* event provides the ability for Level 3 resource management activities to provide notification that one or more resources have been used in work. Figure 14 provides a typical set of subscribers to the *work resource used* event.



Figure 14 – Typical work resource used event subscriptions

Table 12 defines the structure of the *work resource used* common operations management event.

Table 12 – Work resource used event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Work capability* (used, unused) | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Qualification test specified, specification adjusted & specification retired

The *qualification test specified*, *qualification test specification adjusted* and *qualification test specification retired* events provide notification of qualification test specifications that may be generated by Level 4 processes and/or by the Level 3 resource management activity. Figure 15 provides a typical set of subscribers to the *qualification test specified*, *qualification test specification adjusted* and *qualification test specification retired* events.



Figure 15 – Typical qualification test specified, specification adjusted & specification retired event subscriptions

Table 13 defines the structure of the *qualification test specified* event.

Table 13 – Qualification test specified event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Qualification test specification* | added | 1..n |

Table 14 defines the structure of the *qualification test specification adjusted* event.

Table 14 – Qualification test specification adjusted event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Qualification test specification* | changed | 1..n |

Table 15 defines the structure of the *qualification test specification retired* event.

Table 15 – Qualification test specification retired event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Qualification test specification* | deleted | 1..n |

### Equipment capability test specified, specification adjusted & specification retired

The *equipment capability test specified*, *equipment capability test specification adjusted* and *equipment capability test specification retired* events provide notification of *equipment capability test specifications* that may be generated by Level 4 processes and/or by the Level 3 resource management activity. Figure 16 provides a typical set of subscribers to the *equipment capability test specified*, *equipment capability test specification adjusted* and *equipment capability test specification retired* events.



Figure 16 – Typical equipment capability test specified, specification adjusted & specification retired event subscriptions

Table 16 defines the structure of the *equipment capability test specified* event.

Table 16 – Equipment capability test specified event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Equipment capability test specification* | added | 1..n |

Table 17 defines the structure of the *equipment capability test specification adjusted* event.

Table 17 – Equipment capability test specification adjusted event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Equipment capability test specification* | changed | 1..n |

Table 18 defines the structure of the *equipment capability test specification retired* event.

Table 18 – Equipment capability test specification retired structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Equipment capability test specification* | deleted | 1..n |

### Physical asset capability test specified, specification adjusted & specification retired

The *physical asset capability test specified*, *physical asset capability test specification adjusted* and *physical asset capability test specification retired* events provide notification of *physical asset capability test specifications* that may be generated by Level 4 processes and/or by the Level 3 resource management activity. Figure 17 provides a typical set of subscribers to the *physical asset capability test specified*, *physical asset capability test specification adjusted* and *physical asset capability test specification retired* events.



Figure 17 – Typical physical asset test specified, specification adjusted & specification retired event subscriptions

Table 19 defines the structure of the *physical asset capability test specified* event.

Table 19 – Physical asset capability test specified event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Physical asset capability test specification* | added | 1..n |

Table 20 defines the structure of the *physical asset capability test specification adjusted* event.

Table 20 – Physical asset capability test specification adjusted event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Physical asset capability test specification* | changed | 1..n |

Table 21 defines the structure of the *physical asset capability test specification retired* event.

Table 21 – Physical asset capability test specification retired event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Physical asset capability test specification* | deleted | 1..n |

### Material test specified, specification adjusted & specification retired

The *material test specified*, *material test specification adjusted* and *material test specification retired* events provide notification of *material test specifications* that may be generated by Level 4 processes and/or by the Level 3 resource management activity. Figure 18 provides a typical set of subscribers to the *material test specified*, *material test specification adjusted* and *material test specification retired* events.



Figure 18 – Typical material test specified, specification adjusted & specification retired event subscriptions

Table 22 defines the structure of the *material test specified* event.

Table 22 – Material test specified event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Material test specification* | added | 1..n |

Table 23 defines the structure of the *material test specification adjusted* event.

Table 23 – Material test specification adjusted event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Material test specification* | changed | 1..n |

Table 24 defines the structure of the *material test specification retired* event.

Table 24 – Material test specification retired event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Material test specification* | deleted | 1..n |

## Common scheduling events

### General

The creation of *operations schedules* or *work schedules* may create new *material lot/sublot* objects that had not previously been made available by the resource management activities. *Material lots/sublots* may also be updated as a result of scheduling and/or rescheduling processes. *Material lots/sublots* may also originate from execution management (unplanned stocks).

EXAMPLE: Acme enterprise schedules production at one of its sites by batch. Material lot ID’s are created with a planned disposition and assigned to each scheduled production batch as part of the detailed scheduling process. The details of the created material lots are therefore required to be bundled into the event which the detailed scheduling process publishes.

### Operations scheduled & rescheduled

The *operations scheduled* and *operations rescheduled* operations event provides the ability for Level 4 supply chain operations scheduling processes to notify Level 3 activities of new and revised *operations schedules* and associated *material lot* and/or *material sublot* information. Figure 19 provides a typical set of subscribers to the *operations scheduled* and *operations rescheduled* event.

Level 4 supply chain operations scheduling processes may include, but are not limited to, sales & operations planning (S&OP), master scheduling, material requirements planning (MRP) and manufacturing resource planning (MRPII). A level 4 operations scheduling run may result in the creation of new operations schedules, but it may also result in updating and/or deleting of existing operations schedules.

EXAMPLE Regularly published *operations schedules* (e.g. weekly or monthly) may replace previously published *operations schedules*. In such a case, the previously published *operations schedule* may require an update to its status, or in some implementations, may be deleted.

Any new *operations schedule* may introduce new *material lots/sublots* (with a planned disposition) or may change already defined *material lots/sublots*. Consequently, the *operations scheduled* operations event must include an *operations schedule* and any added, changed or deleted *material lots/sublots* (with a planned disposition). It may also need to include a changed and/or deleted *operations schedule* and their associated *material lots/sublots*, depending upon local implementation rules.

The Level 4 *operations rescheduled* event is similar to an *operations scheduled* event, and may introduce *new material lots/sublots* (with a planned disposition) or may change or delete already-defined *material lots/sublots*. Consequently, any change to an *operations schedule* could potentially result in the change of an existing *operations schedule* or the deletion of an existing *operations schedule* and an addition of a new *operations schedule* replacing the previous *operations schedule* (or part thereof). The *operations rescheduled* event also includes added, changed and/or deleted *material lots/sublots* resulting from the rescheduling activity.



Figure 19 – Typical operations scheduled and operations rescheduled event subscriptions

Table 25 defines the structure of the *operations scheduled* event.

Table 25 – Operations scheduled event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Operations schedule* | added | 1..n |
| changed | 0..n |
| deleted | 0..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

NOTE: Regularly published *operations schedules* (e.g. weekly or monthly) may replace previously published *operations schedules*. In such a case, the previously published *operations schedule* may require an update to its status, or in some implementations, may be deleted. The changed and deleted actions for the operations schedule object exist to support such a process.

Table 26 defines the structure of the *operations rescheduled* event.

Table 26 – Operations rescheduled event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Operations schedule* | changed | 1..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Work scheduled & rescheduled

The *work scheduled* and *work rescheduled* events provide the ability for Level 3 detailed scheduling activities to provide notification of new and revised *work schedules* and associated *material lots/sublot* information. Figure 20 provides a typical set of subscribers to the *work scheduled* and *work rescheduled* events.

Any new *work schedule* may introduce new *material lots/sublots* (with a planned disposition) or may change already defined *material lots/sublots*. Consequently, the *work scheduled* operations event shall include a *work schedule* and any added or changed *material lots/sublots*. It may also need to include a changed and/or deleted *work schedule* and its associated *material lots/sublots*, depending upon local implementation rules.

The *work rescheduled* event is similar to a *work scheduled* event, and may introduce *new material lots/sublots* (with a planned disposition) or may change already-defined *material lots/sublots* (with a planned disposition). Consequently, any change to a *work schedule* could potentially result in the change of an existing *work schedule* or the deletion of an existing *work schedule* and an addition of a new *work schedule* replacing the previous *work schedule* (or part thereof). The *work rescheduled* event shall also include added, changed and/or deleted *material lots/sublots* resulting from the rescheduling activity.



Figure 20 – Typical work scheduled and work rescheduled event subscriptions

Table 27 defines the structure of the *work scheduled* event.

Table 27 – Work scheduled event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Work schedule* | added | 1..n |
| changed | 0..n |
| deleted | 0..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |

Table 28 defines the structure of the *work rescheduled* event.

Table 28 – Work rescheduled event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Work schedule* | changed | 1..n |
| *Material lot* | added | 0..n |
| *Material lot* | changed | 0..n |
| *Material lot* | deleted | 0..n |
| *Material sublot* | added | 0..n |
| *Material sublot* | changed | 0..n |
| *Material sublot* | deleted | 0..n |

## Common dispatching events

### Work dispatched

The *work dispatched* event provides the ability for Level 3 dispatching activities to provide notification of dispatched work. Figure 21 provides a typical set of subscribers to the *work dispatched* event.



Figure 21 – Typical work dispatched event subscriptions

Table 29 defines the structure of the *work dispatched* event.

Table 29 – Work dispatched event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Job list* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

## Common execution management events

### General

Level 2 functions provide information to the Level 3 execution management function of work that has been performed. As work is performed, material lots/sublots could potentially be created (where they were not described by any schedule, but were still executed) or adjusted (as the material lot/sublot depletes or increases).

EXAMPLE: In mining, material resources are often accumulated in stockpiles prior to processing through the fixed plant. The quantity and quality characteristics of the material are adjusted continuously as material is added or removed from the stockpile. This requires that updates are made to material lot/sublot information at the same time as work performance is updated.

### Work executed & reconciled

The *work executed* and *work reconciled* events provides the ability for Level 3 execution management activities to provide notification of the execution of work and any possible adjustments through *job response* and potentially *material lot/sublot* information. Figure 22 provides a typical set of subscribers to the *work executed* and *work reconciled* events.



Figure 22 – Typical work executed and work reconciled event subscriptions

Table 30 defines the structure of the *work executed* event.

Table 30 – Work executed event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Job response* | added | 1..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

Table 31 defines the structure of the *work reconciled* event.

Table 31 – Work reconciled event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Job response* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

### Work commenced, redirected, completed & aborted

The *work commenced, work redirected, work completed* and *work aborted* events provides the ability for Level 3 execution management activities to provide notification of key state changes to work under the control of execution management. Figure 23 provides a typical set of subscribers to the *work commenced, work redirected, work completed* and *work aborted* events.

The *work commenced* event is notified when new work commences and includes new *work directive* and new *job response* information as well as any relevant *material lot/sublot* information.

The *work redirected* event is notified when existing in flight work is changed. This may take the form of changing one or more existing *work directives*, or may also result in replacing *work directives* with new ones. It also includes one or more *job responses* as well as any relevant *material lot/sublot* information.

The *work completed* and *work aborted* events are raised when work is completed or aborted respectively and *include* *job response* information, change to *work directive* information as well as any relevant *material lot/sublot* information.



Figure 23 – Typical work commenced, work redirected, work completed and work aborted event subscriptions

Table 32 defines the structure of the *work commenced* event.

Table 32 – Work commenced event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Job response* | added | 1..n |
| *Work directive* | added | 1..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

Table 33 defines the structure of the *work redirected* event.

Table 33 – Work redirected event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Job response* | added | 1..n |
| *Work directive* | changed | 1..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

Table 34 defines the structure of the *work completed* event.

Table 34 – Work completed event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Job response* | added | 1..n |
| *Work directive* | changed | 0..n |
| deleted | 0..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

Table 35 defines the structure of the *work aborted* event.

Table 35 – Work aborted event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Job response* | changed | 1..n |
| *Work directive* | changed | 0..n |
| deleted | 0..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

## Common tracking events

### Performance tracked & reconciled

The *performance tracked* and *performance reconciled* events provide the ability for Level 3 tracking activities to provide notification of *operations performance* and/or *work performance* to other Level 3 and Level 4 functions. In addition to *operations performance* and/or *work performance*, the information exchanged can also include the resultant *material lot/sublot* information that pertains to the performance of work that has been tracked. Figure 24 provides a typical set of subscribers to the *performance tracked* and *performance reconciled* events.



Figure 24 – Typical performance tracked and performance reconciled event subscriptions

Table 36 defines the structure of the *performance tracked* event.

Table 36 – Performance tracked event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Operations performance* | added | 0..n |
| *Work performance* | added | 0..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

Table 37 defines the structure of the *performance reconciled* event.

Table 37 – Performance reconciled event structure

|  |  |  |
| --- | --- | --- |
| Object | Action | Multiplicity |
| *Operations performance* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Work performance* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material lot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |
| *Material sublot* | added | 0..n |
| changed | 0..n |
| deleted | 0..n |

# Compliance

Any assessment of compliance of a specification shall be qualified by the following:

1. the use of the terminology defined in this standard;
2. the common operations management events supported;
3. a statement of the total compliance concerning definitions and common operations management events or, in case of partial compliance, a statement identifying explicitly the areas of noncompliance.

1. - Example cross industry business process (informative)

This annex provides an illustrative example of how a manufacturing organization could employ the common operations management events defined in this document to support their business processes. This annex is informative only.

* 1. Supply chain definition process



Figure 25 - Supply chain definition process

* 1. Procurement and recruitment processes



Figure 26 - Procurement and recruitment processes

* 1. Scheduling process



Figure 27 - Scheduling process

* 1. Dispatching process



Figure 28 - Dispatching process

* 1. Execution process



Figure 29 - Execution process

* 1. Breakdown inspection & repair process



Figure 30 - Breakdown inspection & repair process

1. - (Informative) Questions and answers about events
   1. What problem is this document seeking to provide a solution for?

**Question:**

What problem is this document seeking to provide a solution for?

**Answer:**

This document is one of three key outcomes from the ISA-95 process-centric messaging working group (PCMWG). The PCMWG was formed to address the following problem statement:

1. Part 5 has no method to specify an exchange of a bundle of verb/noun messages to maximize transactional integrity when a real-world event takes place. This can cause some data inconsistency within receiving systems.
2. The Sender is unable to sufficiently specify the process context of the real-world event. Therefore, the Receiver(s) must infer the process context based on accumulated data and message data content. This often results in high cost, complex and error-prone logic in the Receiver systems.

The other two outcomes from the PCMWG is the addition of the operations event model in ISA-95.00.02 and the addition of the notify verb in ISA-95.00.05.

* 1. What is a process centric event?

**Question:**

What is a process centric event and how is it distinguished from a data centric event?

**Answer:**

A process-centric event contains the process context of the real-world event which caused its publication as well as all pertinent information from the perspective of the publisher. Therefore, a subscriber to a process-centric event (eg. NOTIFY work commenced) will know explicitly the process-context of the event. For example, it will know that that the job response within the work commenced event has been sent because work has been commenced on the associated job order.

A data-centric event does not contain the process context of the real-world event which caused its publication. Therefore, a subscriber to a data-centric event (e.g. SYNC ADD job response) does not know why it has been instructed to add the specified job responses. For example, it does not explicitly know if the job response has been sent because work has been commenced, completed or redirected on the associated job order.

* 1. Why do we need these events?

**Question:**

Why do we need the events defined in this document? Why can’t we just use the part 2 operations event?

**Answer:**

The events defined in this document have been selected to provide an additional set of nouns to be used with the notify verb from Part 5. (e.g. notify work dispatched). This provides a finite set of semantically explicit events that endpoint applications can be configured to support the common operations management events arising from Level 3 and Level 4 functions. Once adopted, it will make a significant improvement in interoperability of enterprise and operations management systems.

The benefit of event-specific objects over simply using the operations event object is that it makes the events strongly typed in implementation. An operations event is weakly typed in implementation because the same schema definition (e.g. XSD in XML) is used for all events. The objects defined in this document are strongly typed because each object has a specific, explicitly defined structure appropriate for the specific event each object represents.

Strong typing in the implementation (e.g. using XSDs for XML) is very useful because it lowers the cost, effort and risk required to implement messaging logic in middleware as well as endpoint applications.

Each of the events defined in this document could be realized using the generic operations event object. However, they would not be strongly typed in implementation. Middleware and endpoint applications would require sophisticated logic to parse the exchange, determine if it complies with the record specification and which common operations management event it corresponds to. This would add cost, complexity and risk to implementations.

Bibliography

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