Tinwisle Corporation

International Standards for System Integration

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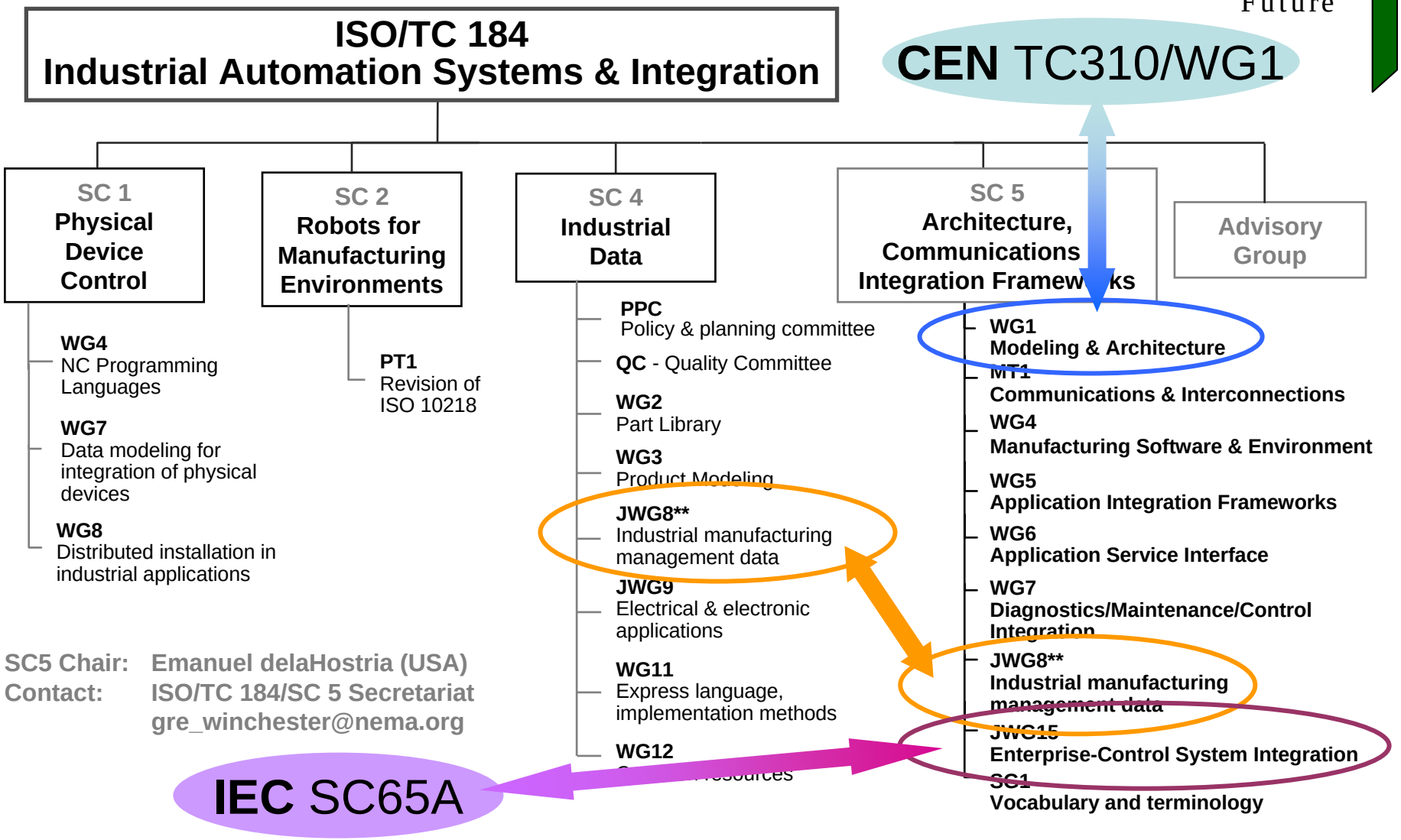
Convener ISO TC 184/SC 5/WG 1

International Standards for System Integration

- Context
- SC4 Success
- SC5 Interoperability
- SC5 Architecture
- Future Efforts

Who's standards

Context
Success
Interop.
Architect
Future



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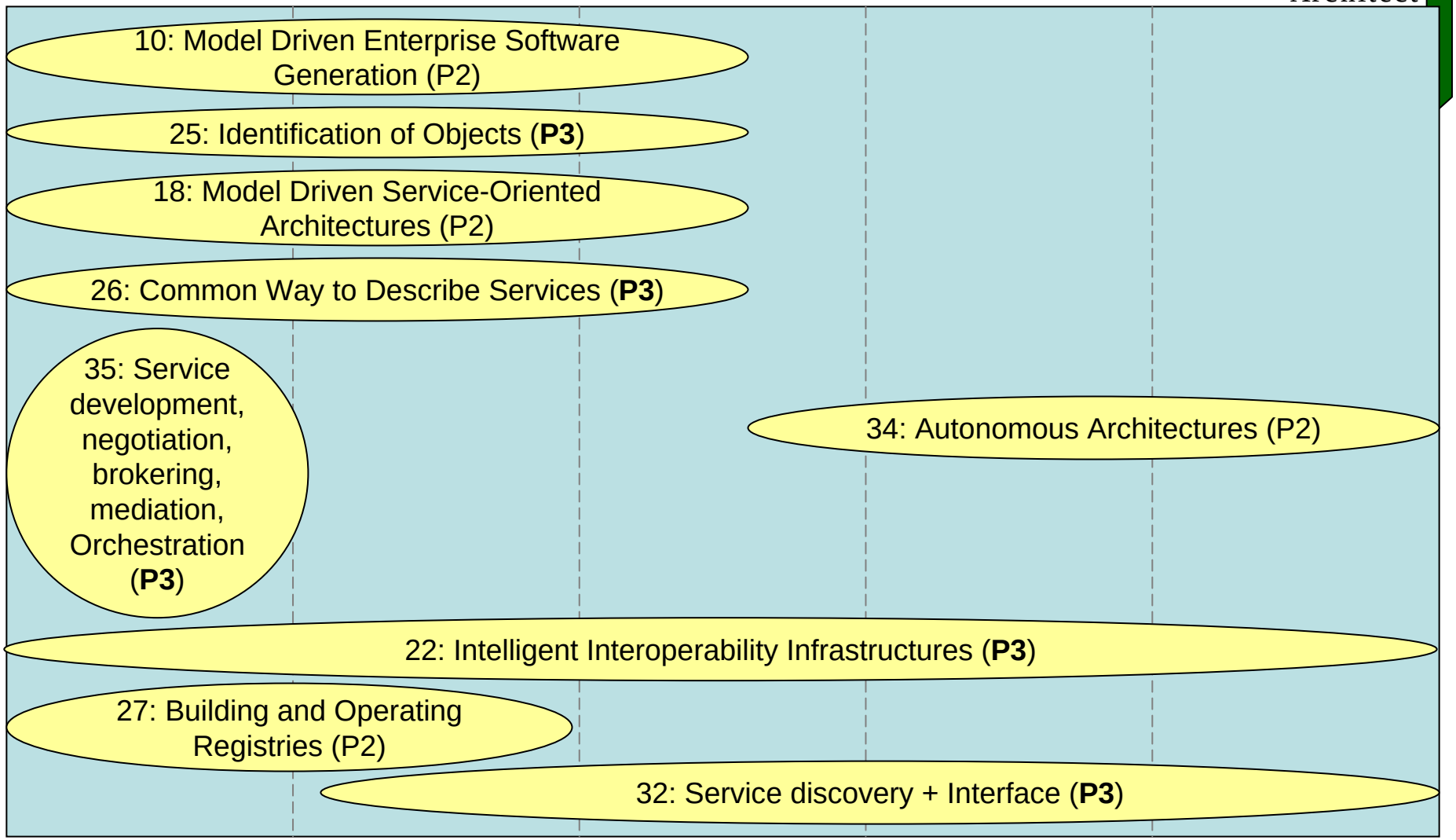
IDEAS Gap Analysis

Context
Success
Interop.
Architect
Future

- EC FP6 project (deliverable D3.4, .5, .6)
  - Interoperability Development for Enterprise Application and Software
- Gap – "missing pieces in research, technology and standardization to achieve a particular goal"
- 36 Gap categories in 3 domains – Enterprise Model, Architecture & Platform, Ontology

IDEAS Road map (Fig 13)

Context
Success
Interop.
Architect



NACFAM E-Manufacturing

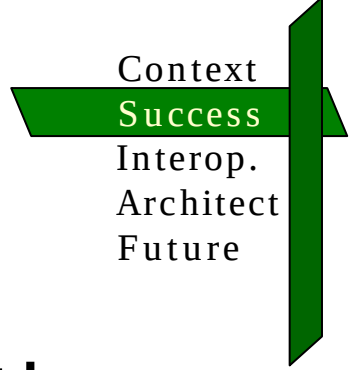
- Interoperability problem is more complex because it requires agreement on certain common principles and features before truly interoperable solutions can emerge.
- Solutions must…have the trust and acceptance of the industrial and software communities.
- Requires a mechanism to convene the right decision makers to produce the necessary agreement.

The supply chain effect

- High costs of interoperability particularly impact small and medium sized suppliers
- They often have to maintain redundant and costly software packages in order to communicate with their large EOM customers.
- Large manufacturing companies have pushed costs onto SME's by requiring "standardization" around their preferred systems.

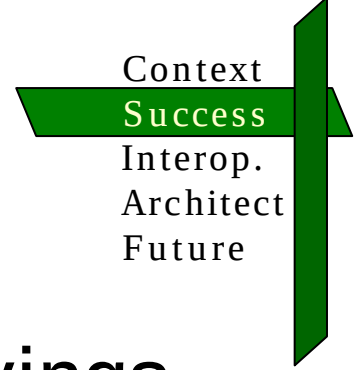
Source: Exploiting E-Manufacturing: Interoperability of Software Systems Used by U.S. Manufactures, NACFAM, Feb. 2001

Industrial Data – SC4



- ISO 10303 - STEP (Standard for the exchange of product model data)
  - EXPRESS language and bindings
  - Conformance and testing
  - Common resources
  - Industry specific application protocols
- Over 100 documents with more coming – including AP233 effort with INCOSE

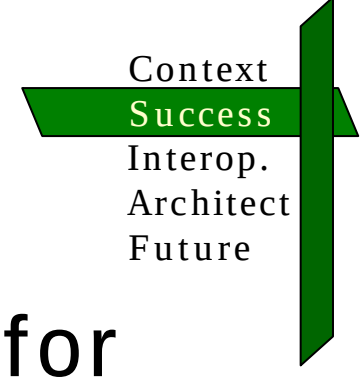
STEP success*



- Potential $928 million (2001$) savings per year by reducing interoperability problems in the automotive, aerospace, and shipbuilding industries in US
- ~ 17% ($156 million) of potential benefits quantified within scope of study are being realized
- Expect 75% benefit by 2010

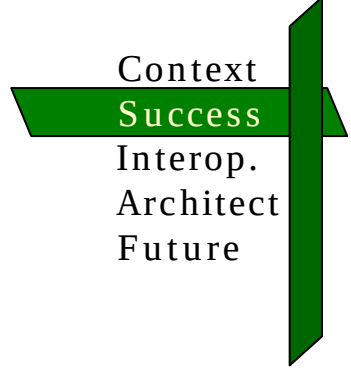
(* 2002 Gallaher study results)

Why STEP succeeds



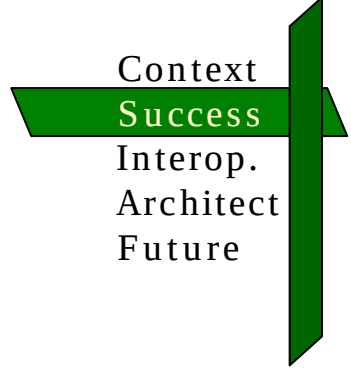
- Avoidance cost savings accounted for approximately half of the potential benefits of STEP
- 80% of avoidance costs were labor costs associated with the use and support of redundant CAx systems
- Mitigation costs resulting from file transfer and data reentry accounted for the balance of benefits

Process description



- ISO 18629
  - TC184 SC4/SC5 collaboration in JWG8
- PSL (Process specification language)
- Target is process information exchange
- Process information representation
- Process and model independence
- Lexicon, ontology, and grammar
- Different approach than ISO 10303
- 8 documents in various approval stages

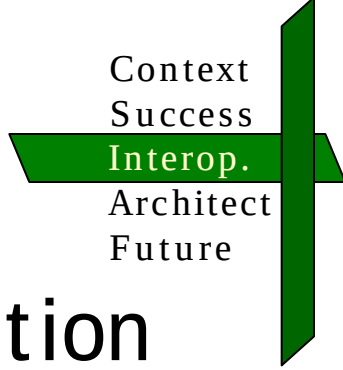
A ‘formal’ process




```
(forall (?occ)
(iff (occurrence_of ?occ make_harness_wire)
     (exists (?occ1 ?occ2 ?occ3)
        (and (occurrence_of ?occ1 extrude)
             (occurrence_of ?occ2 twist)
             (occurrence_of ?occ3 jacket)
             (min_precedes ?occ1 ?occ2
                  make_harness_wire)
             (min_precedes ?occ2 ?occ3
                  make_harness_wire))))
```

(Source: ISO/CD18629-44 Annex B)

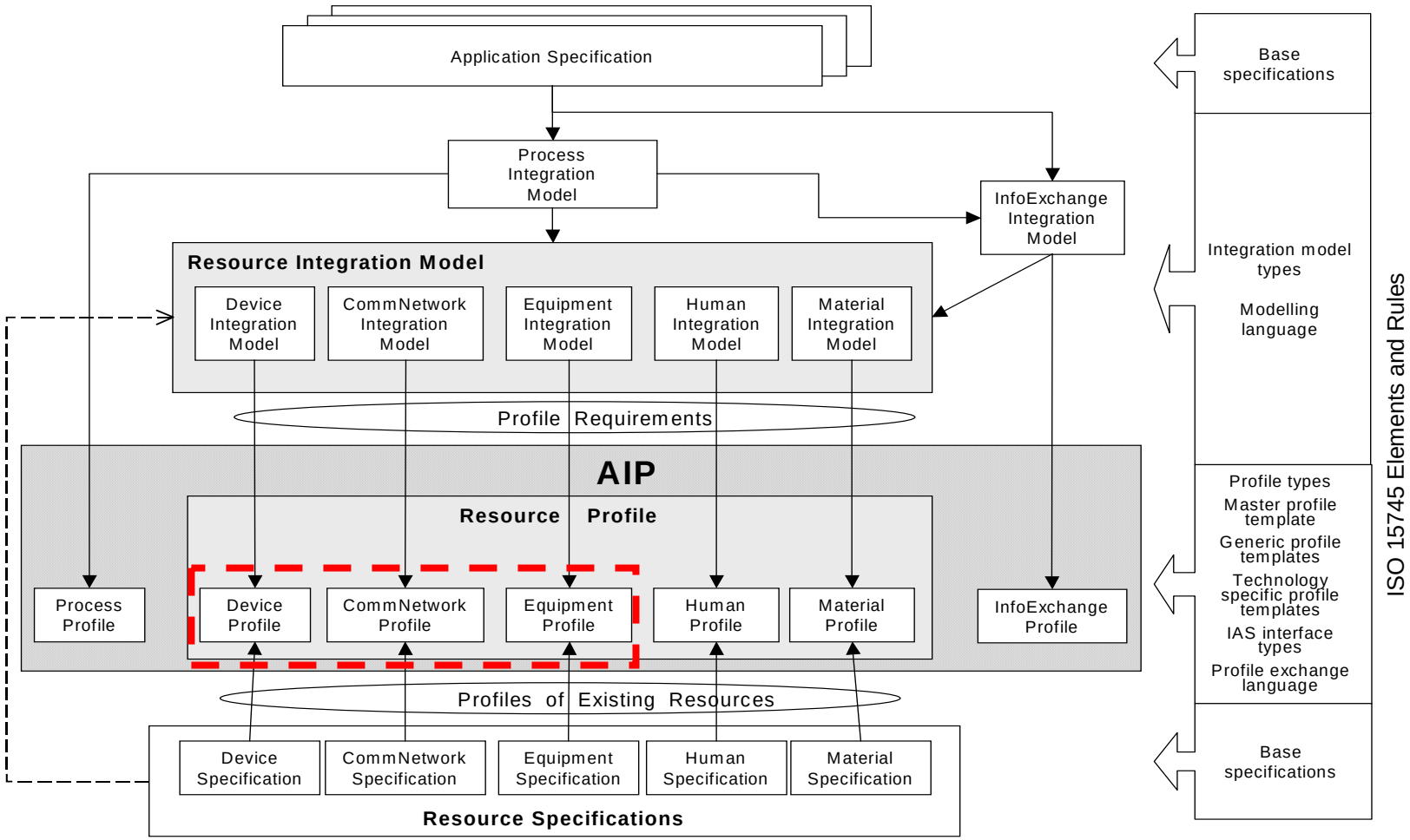
Application integration



- ISO 15745 – Open systems application integration framework
- Application integration framework
  - Elements and rules for integration requirements using integration models
  - Application interoperability profiles as interface specifications
- UML based integration models
- XML schemas for profile templates

Profiles for integration

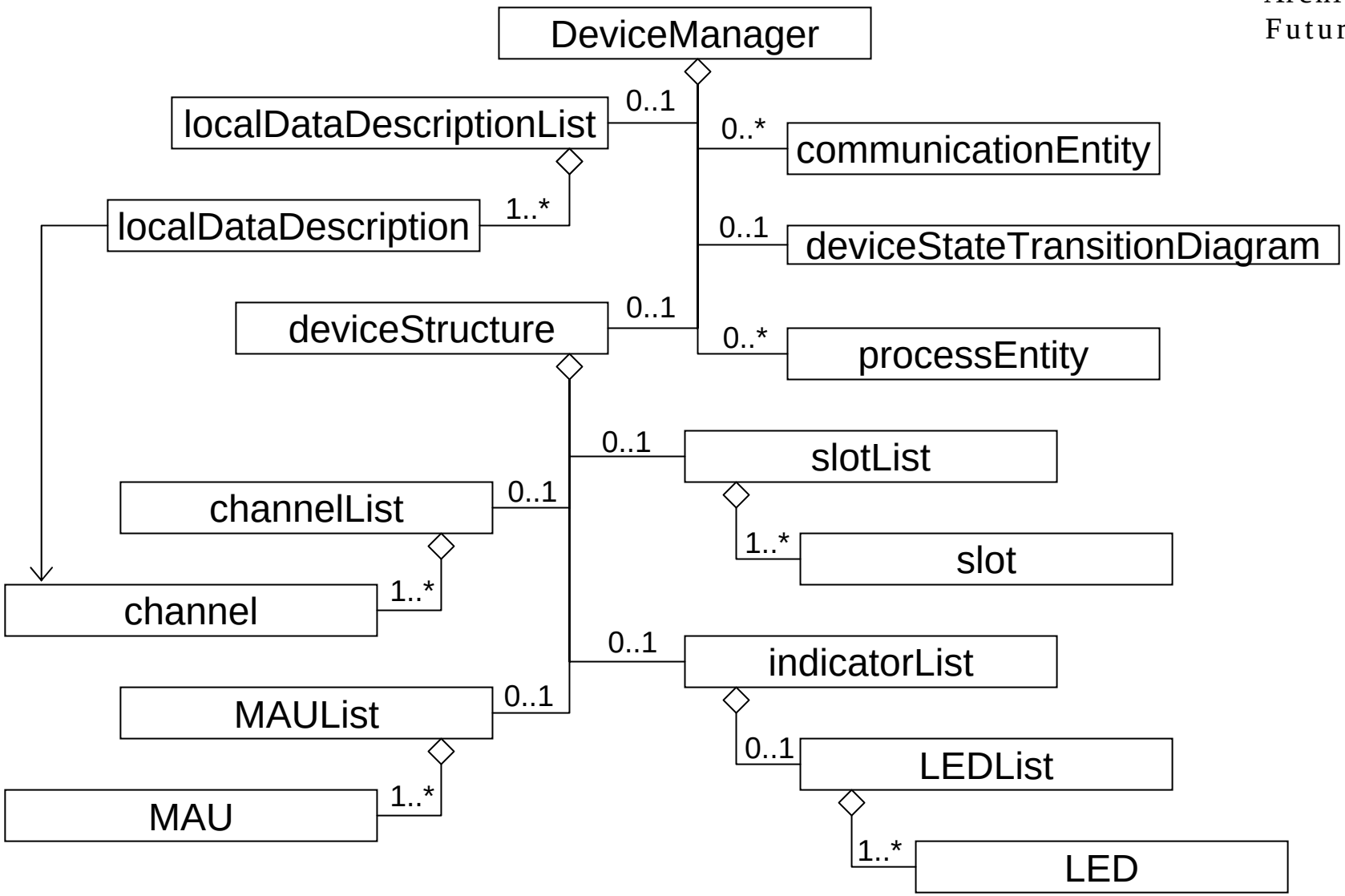
Context
Success
Interop.
Architect
Future



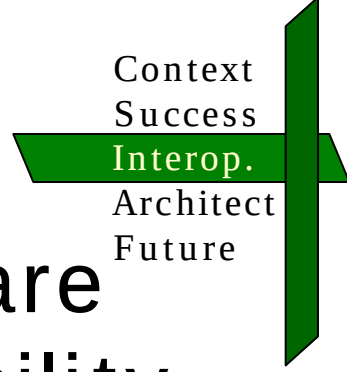
Source: ISO 15745-1 Figure 2. Profile development using ISO 15745

CANopen DeviceManager

Context
Success
Interop.
Architect
Future

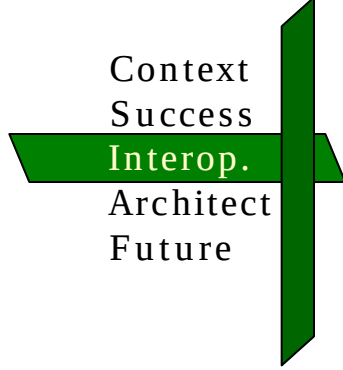


Software capability



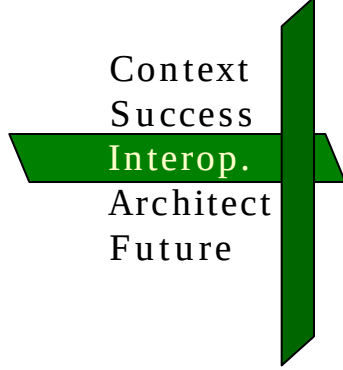
- ISO 16100 – Manufacturing software capability profiling for interoperability
  - Characterization of software interface requirements
  - Software unit capability elements and rules
  - IDEF0, UML models and XML profile schemas
- Manufacturing software units shall interoperate with one another, in support of a manufacturing activity, when the services requested by the former can be provided by the latter, using the same operating environment.

Capability classes



- Manufacturing Capability classes
  - Domain, Application, Information, Process, Resources, Activity, Function, Software Unit
- Software Capability classes
  - Computing system, Environment, Architecture, Design Pattern, Datatype, Interface/Protocol
- Role Capability class

Testing application services

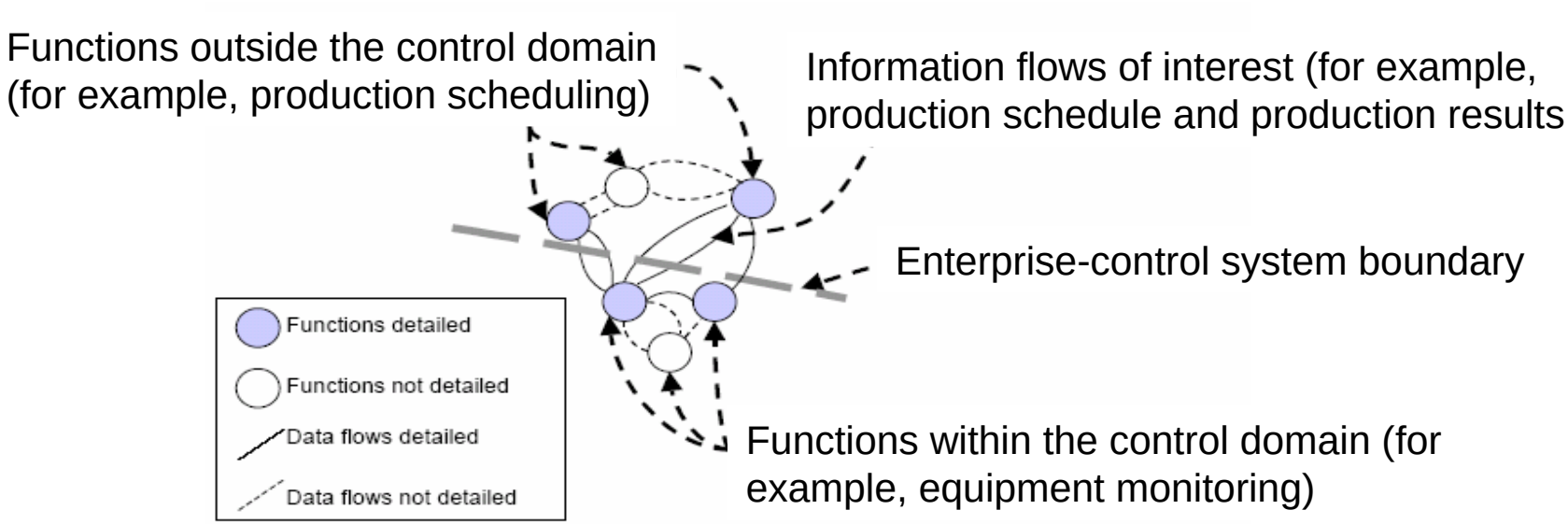


- ISO/DIS 20242 Service interface for testing applications
- A platform adapter called the **Resource Management Service Interface**
- A generic device driver with a generic device interface called the **Virtual Device Service Interface**
- A device capability description called the **Device Capability Profile Template**

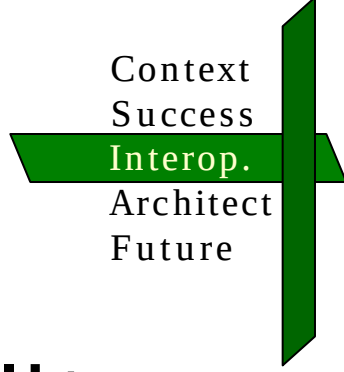
A boundary standard

Context
Success
Interop.
Architect
Future

- ISO 62264 Enterprise-control system integration
  - Object models for interfaces between enterprise business systems and manufacturing control systems



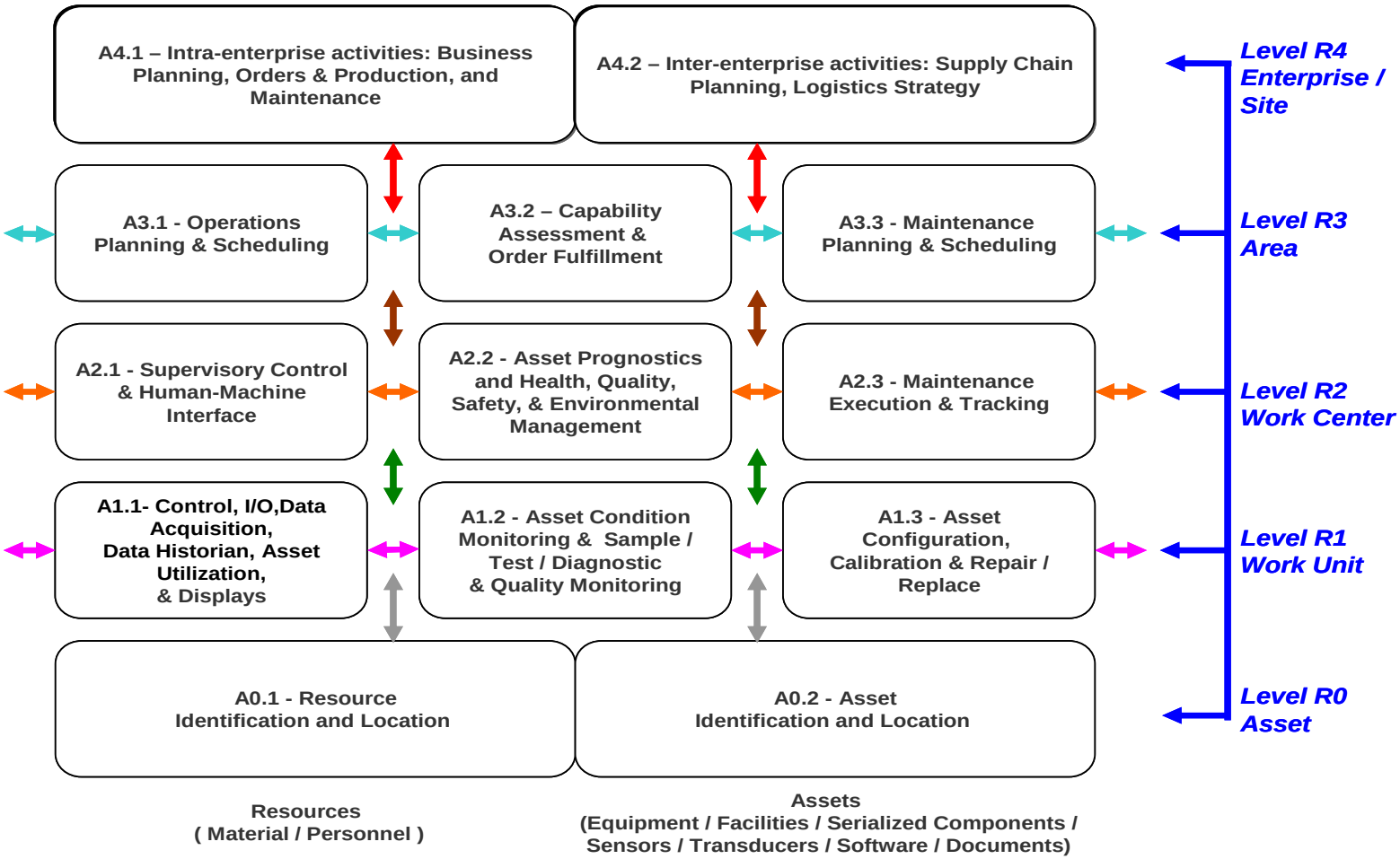
Diagnostics/Maintenance



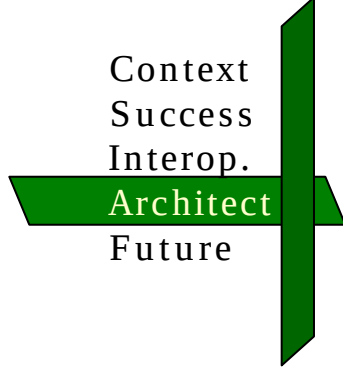
- ISO 18435 Diagnostics, capability assessment, and maintenance applications integration
- application integration reference architecture for equipment & automation devices
- application interoperability profile templates based on selected international & industry standards

Operation levels

Context
Success
Interop.
Architect
Future

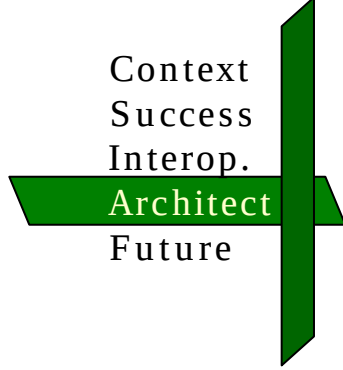


Basic concepts & rules



- ISO 14258:1998
  Industrial automation systems - Concepts and rules for enterprise models
  - Identifies basic concepts for: life-cycle, recursion, and iteration
  - Identifies concepts for structure and behavior representation using views
  - Places focus of standards for interoperability on inter-process communication.

Generalizing standards



- ISO 15704 – Requirements for enterprise-reference architectures and methodologies
- Merging of previous work - PERA, IEM, GRAI GIM, CIMOSA, and GERAM
- Presents principles for enterprise architecture
- Extends ISO 14258 with concepts for life history and genericity.

Scope of GERAM

Context
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Architect
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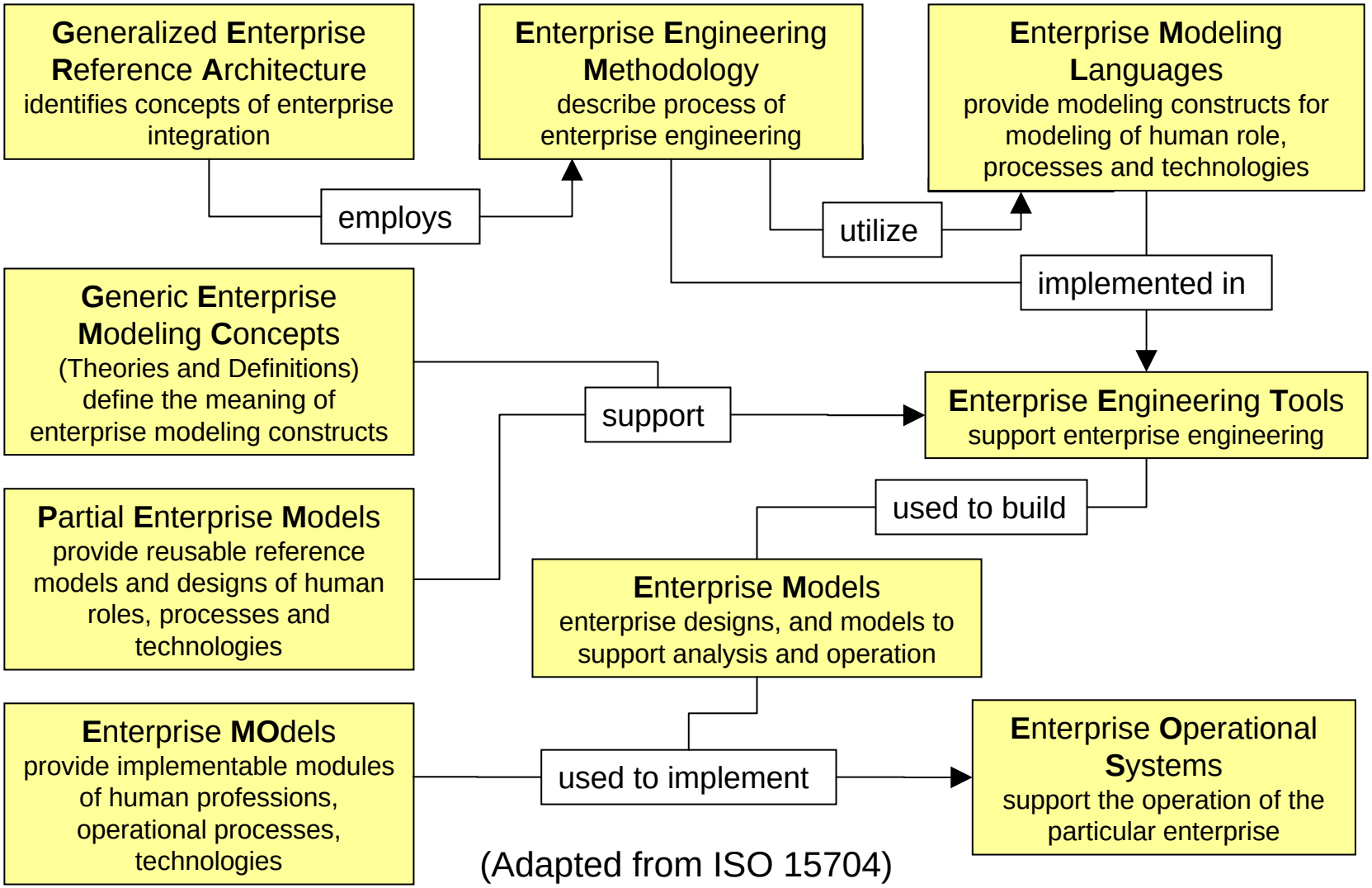
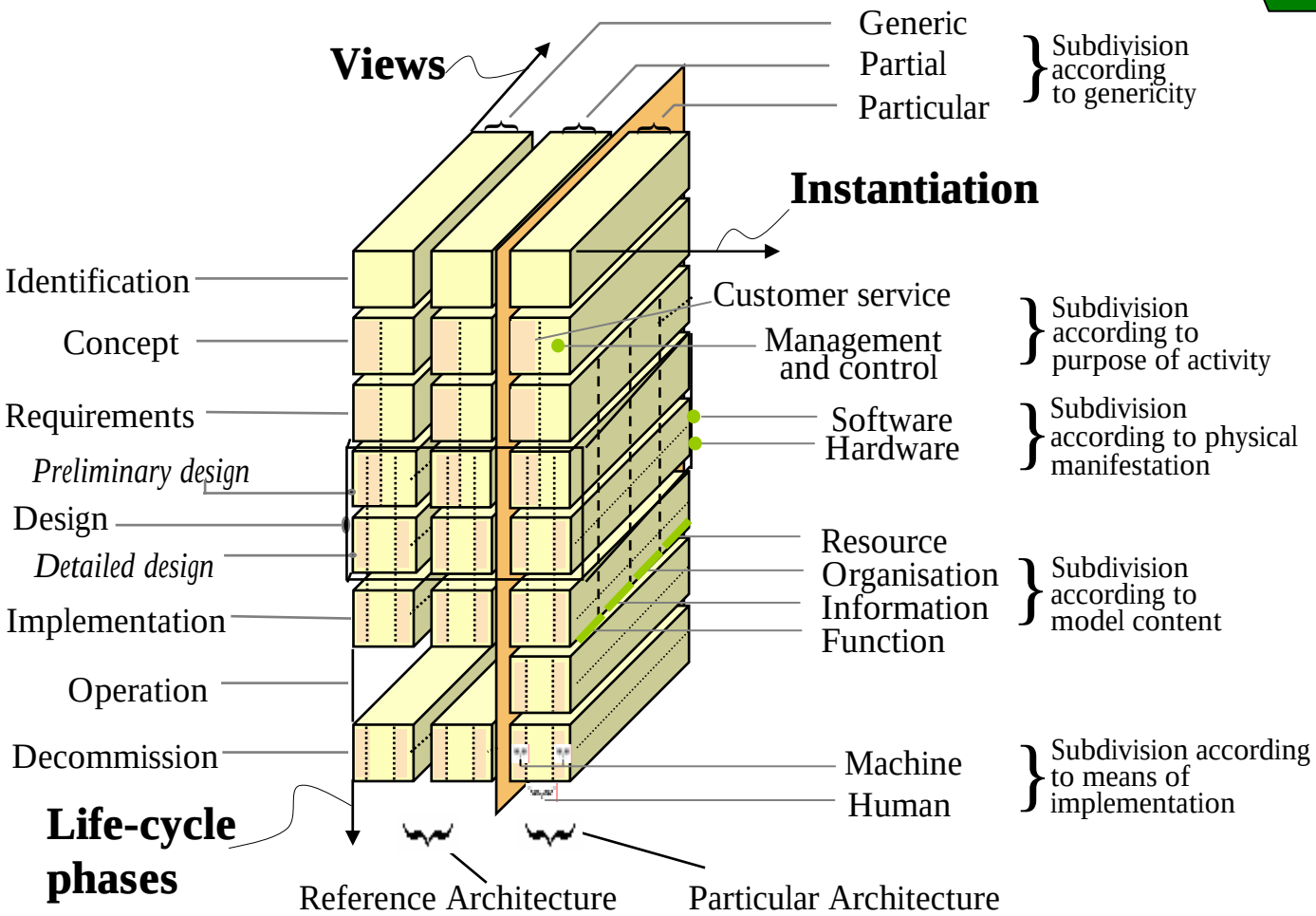


(Adapted from ISO 15704)

GERA framework



Source: ISO 15704:2000 Annex A and Figure 10, The GERA modelling Framework of GERAM [GERAM V1.6.3 http://www.cit.gu.edu.au/~bernus](used with permission)

ISO/FDIS 19439

Context
Success
Interop.
Architect
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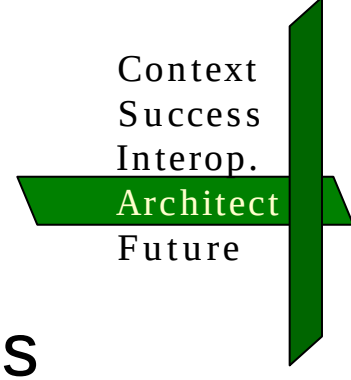
Enterprise integration – Framework for enterprise modelling

- Based upon CEN ENV 40003:1990
- Objective is to further enable model based execution using enactable models
- Aligned with IS 15704 (a GERA model)
- Articulates 3 dimensions of enterprise modeling as a framework:

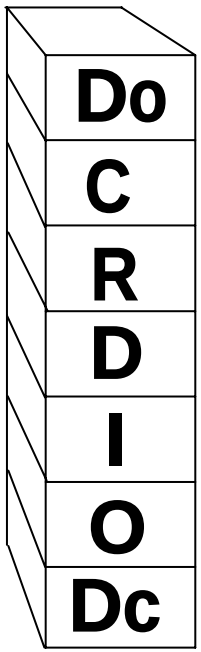
  Phase, View, and Genericity

Model phase -



the purposive ordinant dimension ordered by coordinates corresponding to the phases of the enterprise model life-cycle.

Enterprise **model phase**:



- **Domain** identification
- **Concept** definition
- **Requirements** definition
- **Design** specification
- **Implementation** description
- domain **Operation**
- **Decommission** definition

Identify

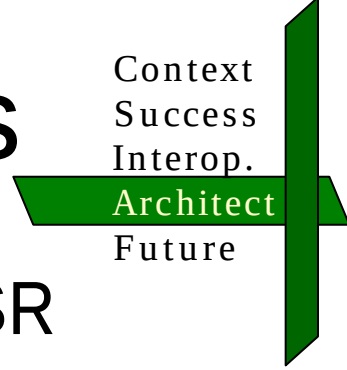
Elaborate

Use

Dispose

Emphasize model development process for process oriented modeling.

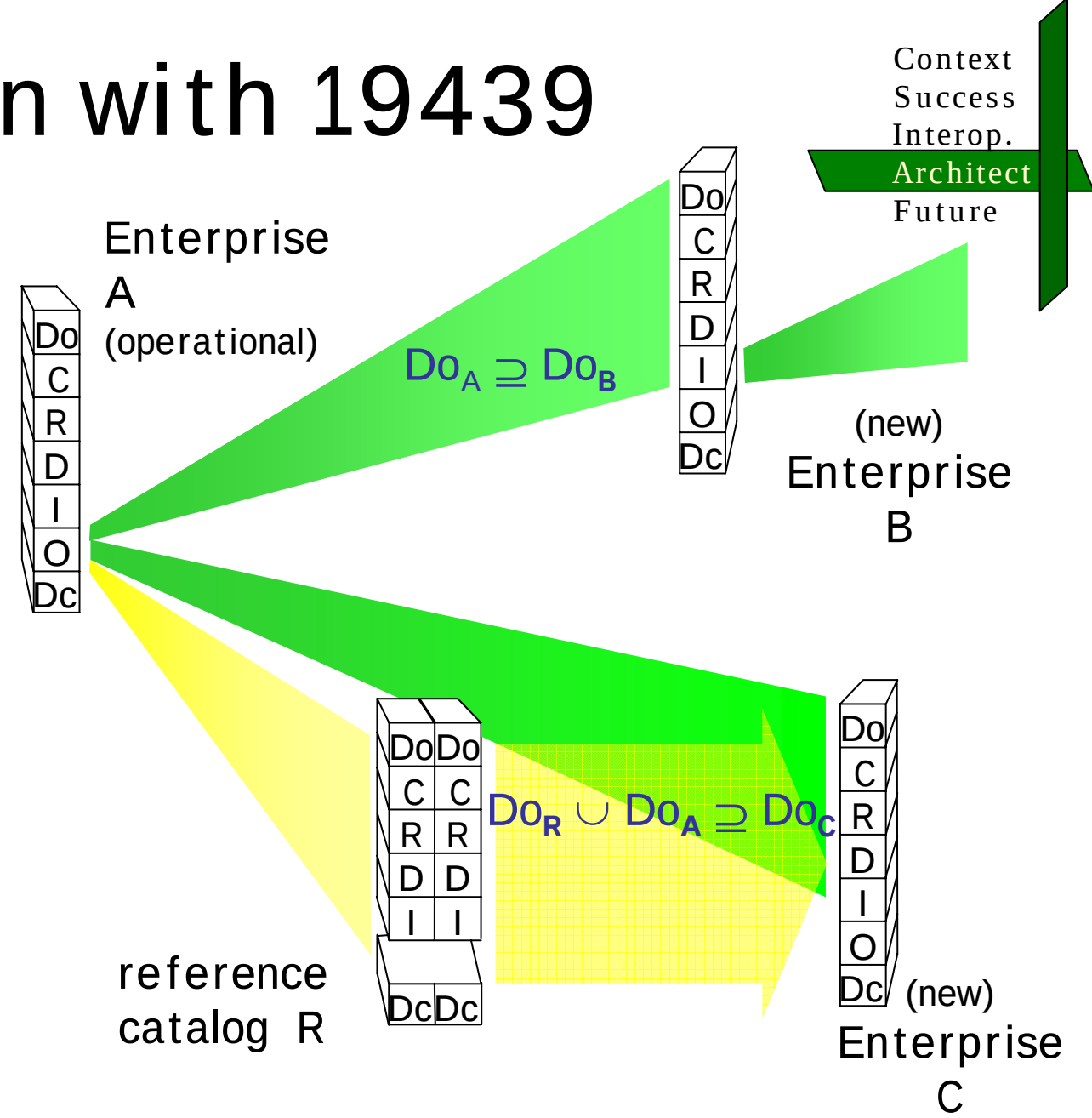
Many possible coordinates



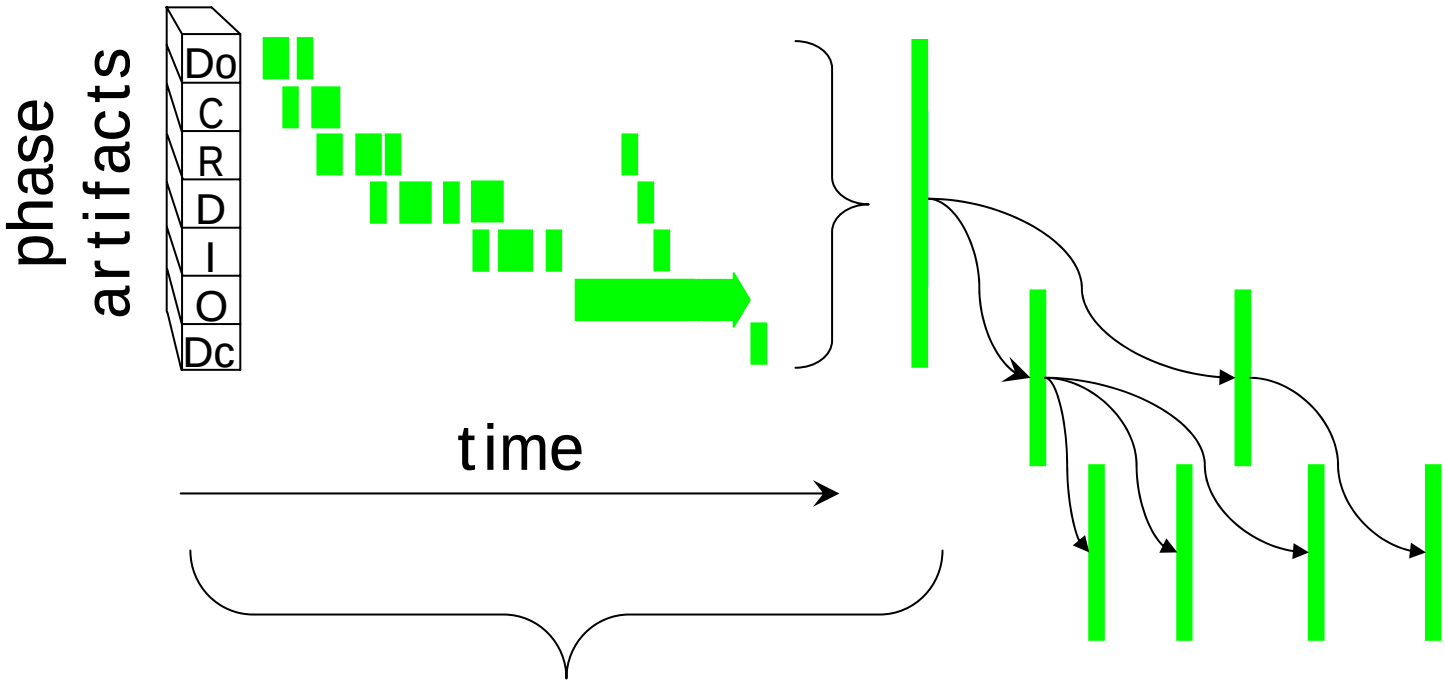
15288 Stage		19439 Phase		C4ISR Guidance
Concept		**Domain**	⟷	**Focus**
		Concept	⟷	**Scope**
Development		**Requirement**	⟷	**Characterize**
		Design	⟷	**Determine**
Production	⟷	**Implementation**	⟷	**Build**
Utilization		**Operation**	⟷	**Use**
Support				
Retirement	⟷	**Decommission**		

Recursion with 19439

Enterprise operations can model new enterprises either from its own particular models or using reference constructs and partial models.



Life history with 19439



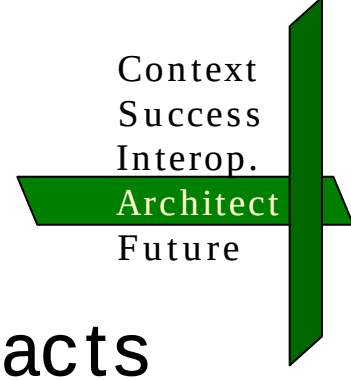
a complete life-cycle

a life history pictogram of related life-cycles

(point-in-time solution set)

Adapted from P. Bernus, Griffith University, Australia

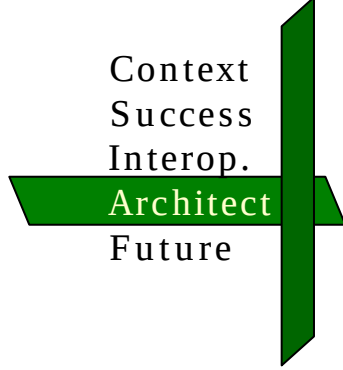
Model View -



an unordered ordinant dimension with pre-defined coordinates that partition facts in the unified model relevant to particular interests and context.

- A prescriptive partition of model content with distinct aspects considered sufficient for most discrete manufacturing
- View content varies with life-cycle model phase
- Function, Information, Resource, and Organization views

Model Genercity -



an ordered ordinant dimension that reflects 19439 as a “standard” framework.

Enterprise **genericity level**:

- **Generic** - reusable modeling language constructs
- **Partial** - prototype models of industry segment or industrial activity

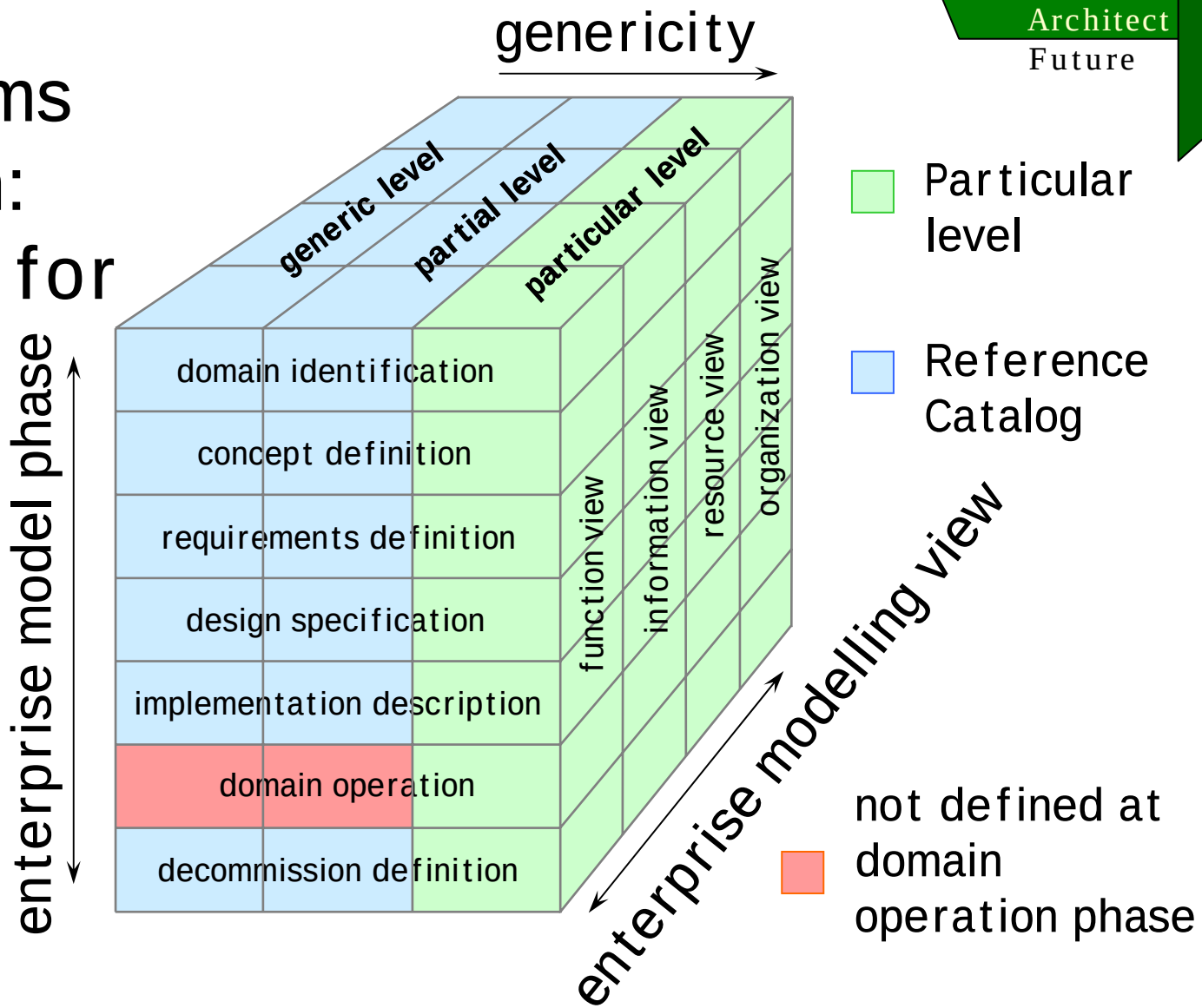
Reference catalog

- **Particular** - models of a particular enterprise domain

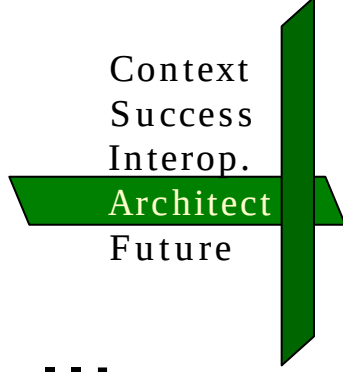
Graphic 19439 dimensions

Context
Success
Interop.
Architect
Future

CIM Systems Integration: Framework for Enterprise Modelling



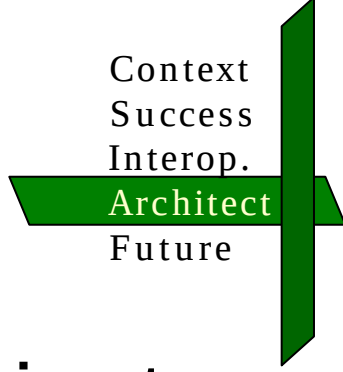
ISO/DIS 19440



Enterprise integration – Constructs for enterprise modelling

- Based upon CEN ENV 12204:1996
- Aligned with 15704 (an EML artifact)
- Articulates modeling constructs for manufacturing automation
- Organization and specialization using templates into structures for a specific purpose

Constructs of 19440



Domain

Business Process

Enterprise Activity

Event

Enterprise Object

Object View

Product

Order

Resource

Functional Entity

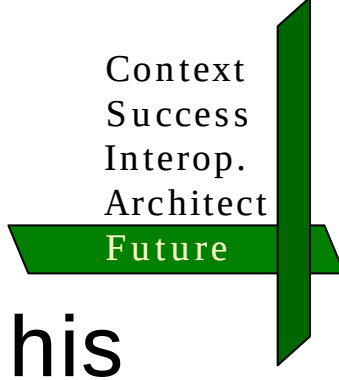
Capability

Organizational Unit

Organizational Role

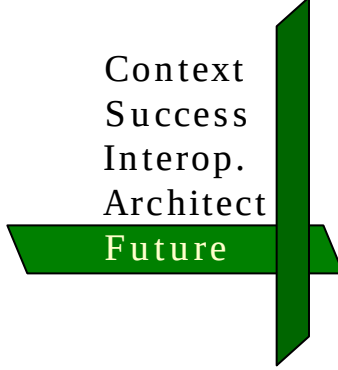
Decision Centre

WG1 Future actions



- ISO/FDIS 19439 to enter ballot this summer with 2005 publication expected
- ISO/DIS 19440 to enter ballot this summer - comment resolutions to occur 2005 – 2006 & publication in late 2006
- ISO 15704 systematic review begins this summer with revision target 2007
- NWIP for Process Analytics View using 19439 framework and 19440 constructs

Future SC5 Efforts



- Simulation tool integration requirements and criteria
- Use case for multiple standard use
- Coordinated asset registry
- Activity integration across levels
- Terminology harmonization
- Database of software unit capability
- Automation security