The Role of Standards in Future Manufacturing

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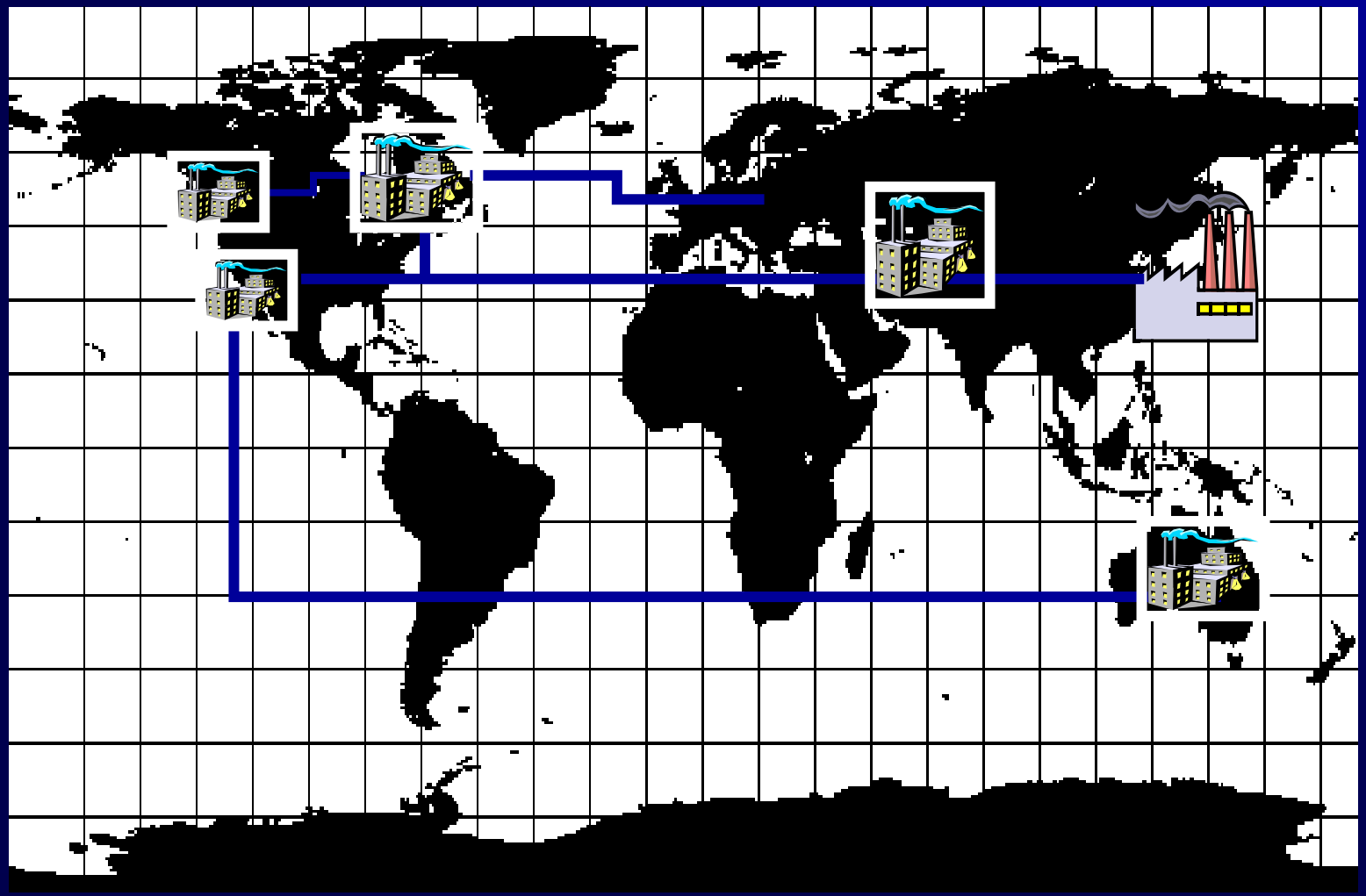
Dynamic Globalization



Manufacturing needs Information

Auto Manufacturer

Requirements

Detailed Design

Engineering Department

Cylinder Head Design

NC programs

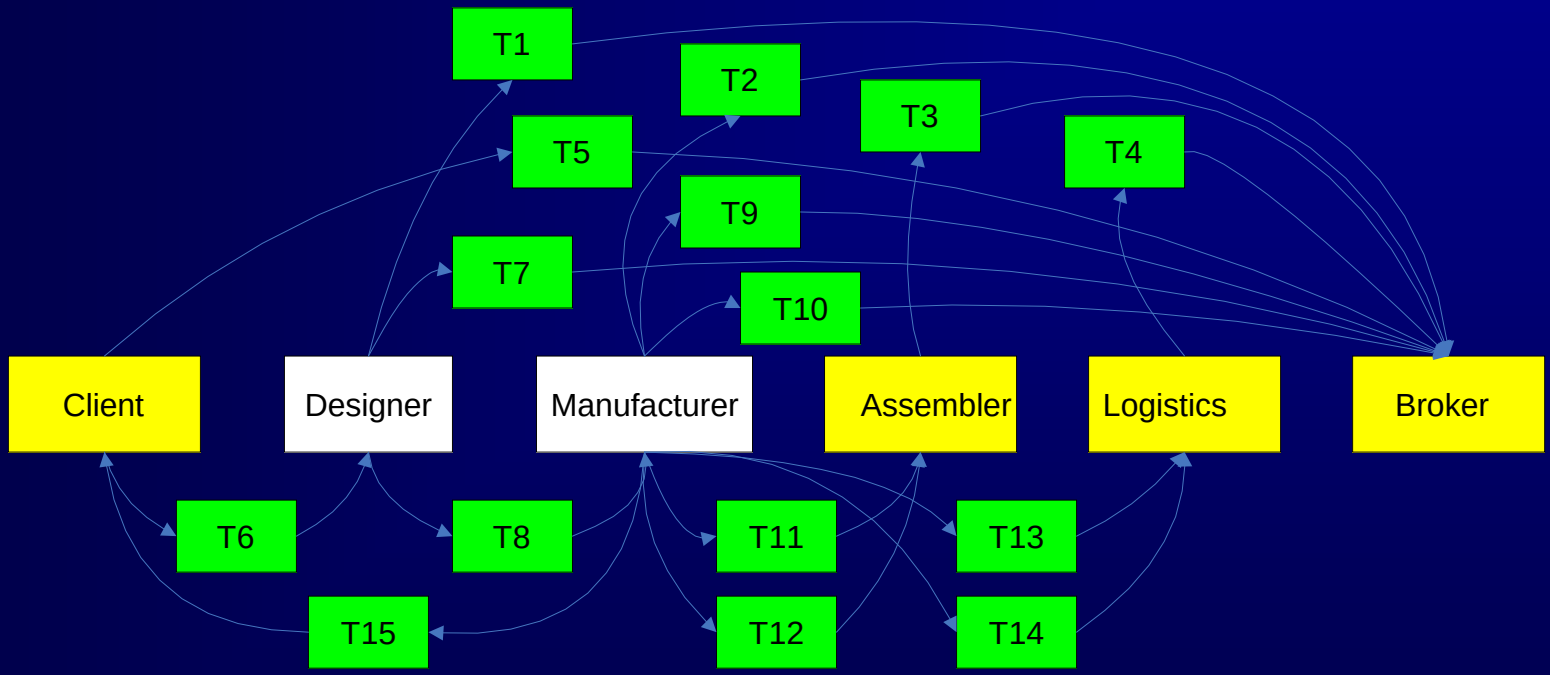
Foundry

Cylinder Head Design

Tooling

Machine Shop
(Tooling)

Supply Chains need more



Poor Integration is Costly

$1B in transportation sector for engineering & business data

$5B to the discrete manufacturing supply chain

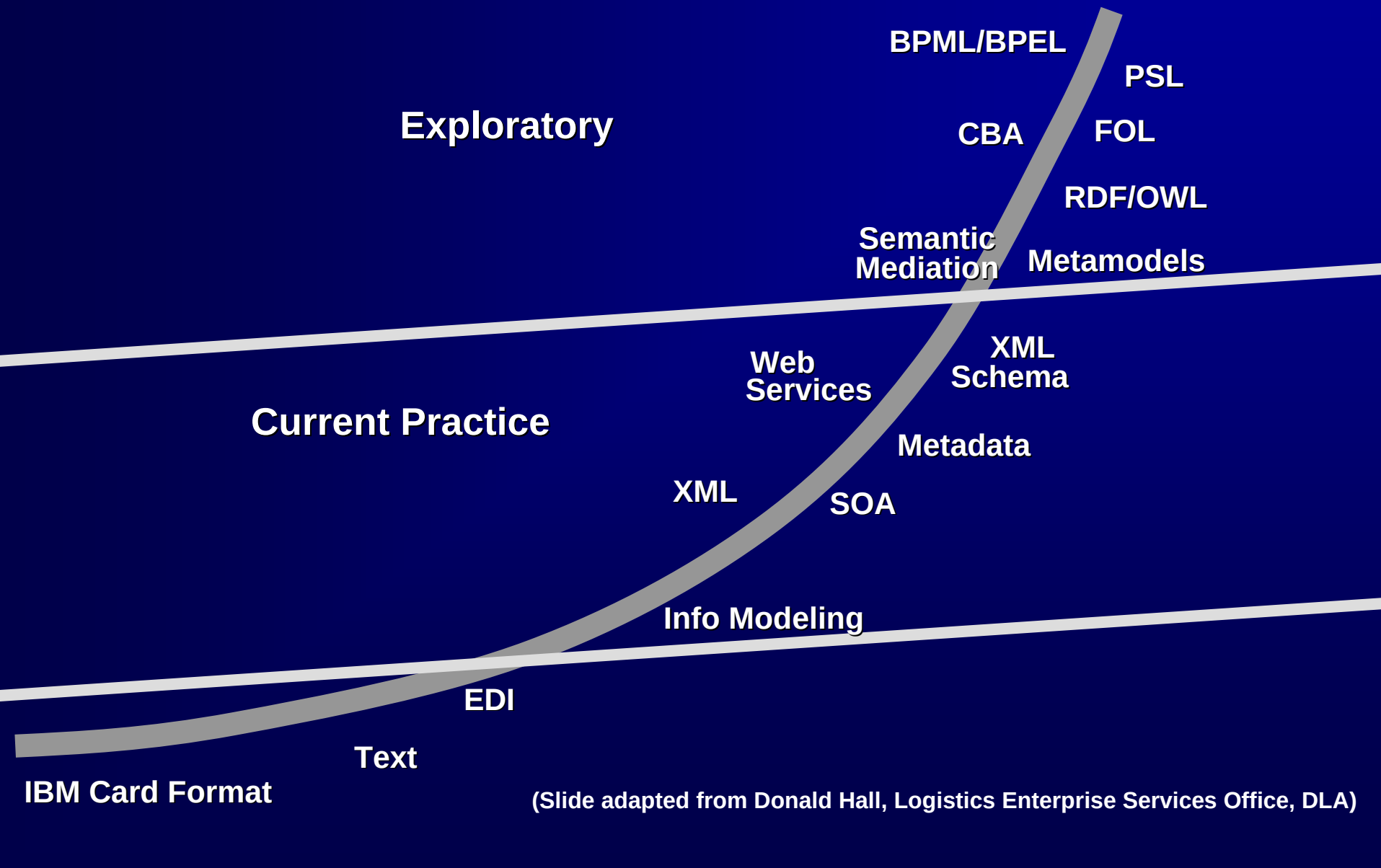
$15B to the capital equipment sector

Possible Solutions?

- ✗ Point-to-point customized integration – too many, too expensive to build & maintain
- ✗ Mandated vendor-specific solutions – pushes problems lower in the supply chain; doesn't solve them
- ✓ Using neutral standards – becoming the accepted solution around the globe

Which standards and how best to build them?

Technology Evolution



(Slide adapted from Donald Hall, Logistics Enterprise Services Office, DLA)

Standards Evolution

Many standards are text (natural languages)

More use of data models (XML, Schema, UML)

Need for semantic models (OWL, PSL, CL)

Some Examples

Text standards (e.g. ISO 14258, Requirements for enterprise-reference architectures and methodologies)

"3.6.1.1 Time representation

If an individual element of the enterprise system has to be traced then properties of time need to be modeled to describe short-term changes. If the property time is introduced in terms of duration, it provides the base to do further analyses (e.g., process time). There are two kinds of behavior description relative to time: static and dynamic."

Data model standards (e.g. ISO 10303-41, Product Description and Support)

```
ENTITY product_context
  SUBTYPE OF (application_context_element);
  discipline_type : label;
END_ENTITY;
```

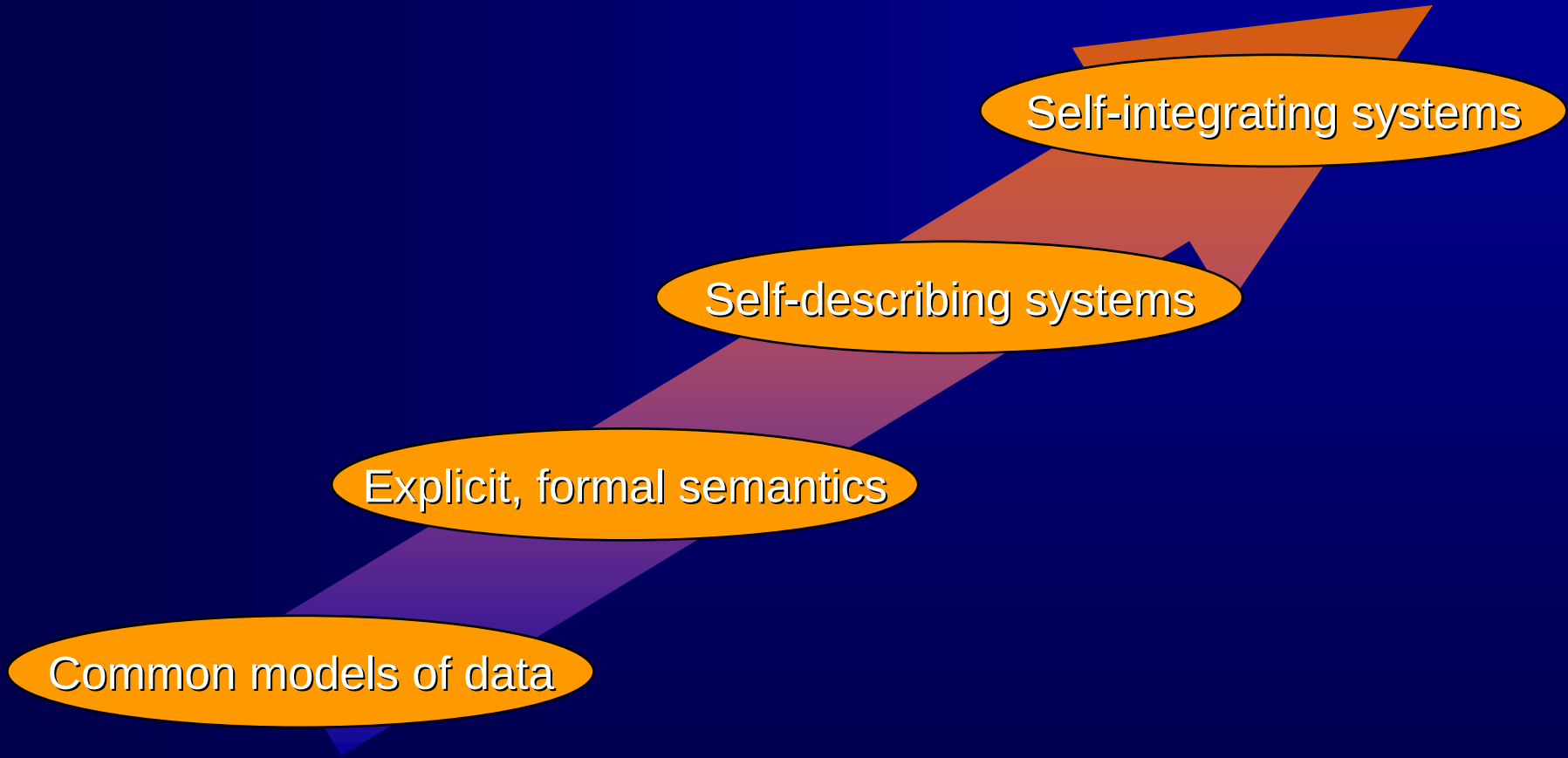
Semantic-model standards (e.g. ISO 18629-11, PSL Core)

```
(for all (?t1 ?t2 ?t3)
        (=>    (and    (before ?t1 ?t2)
                       (before ?t2 ?t3))
               (before ?t1 ?t3)))
```

Benefits of Semantics

- Reusability
- Automation
- Reasoning
- Understanding

The Arrow of Time

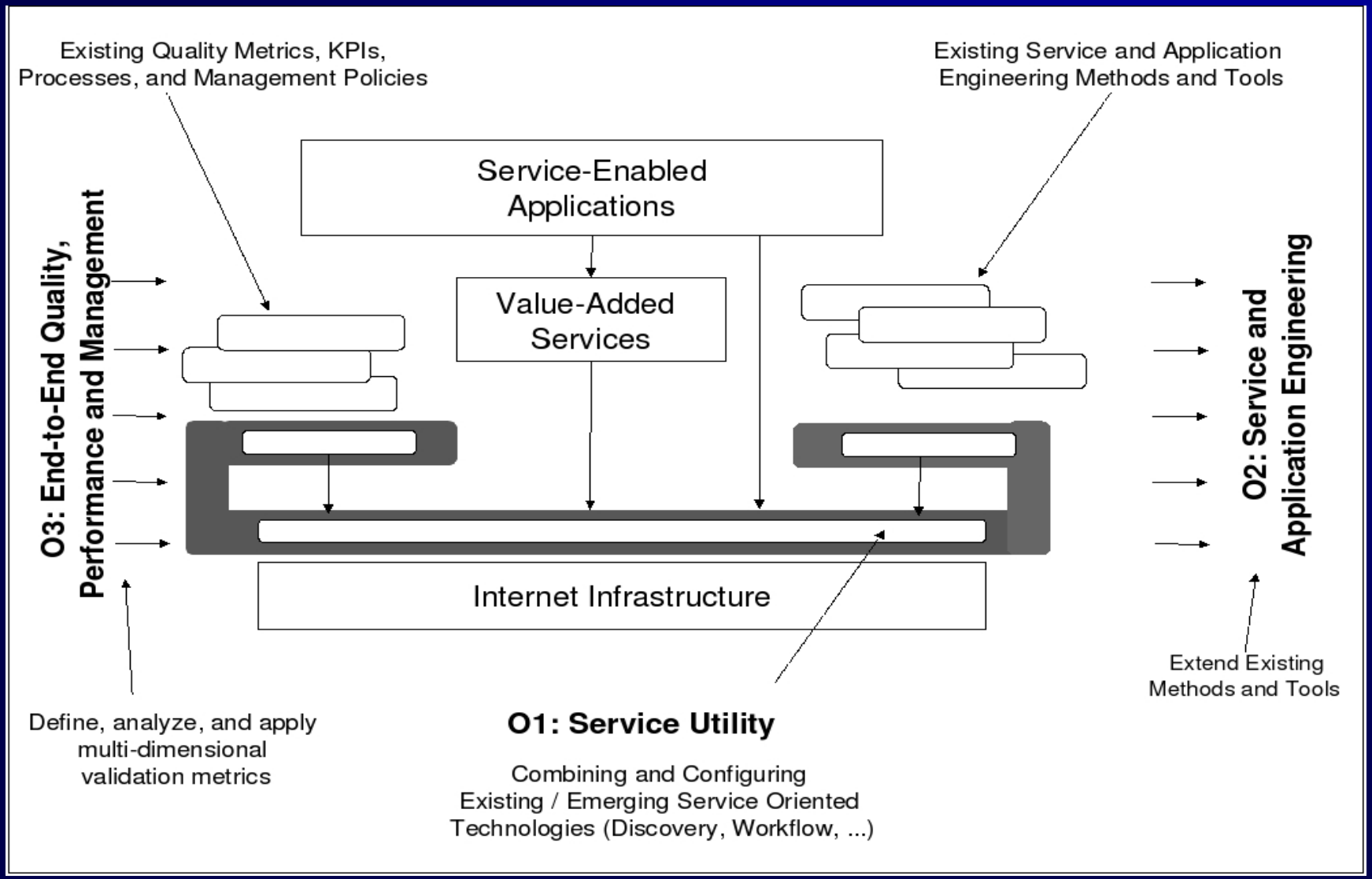


Two Questions

- What kind of information infrastructure could support this arrow?

- What kinds of standards are needed to implement this infrastructure?

One Infrastructure - E2ESU



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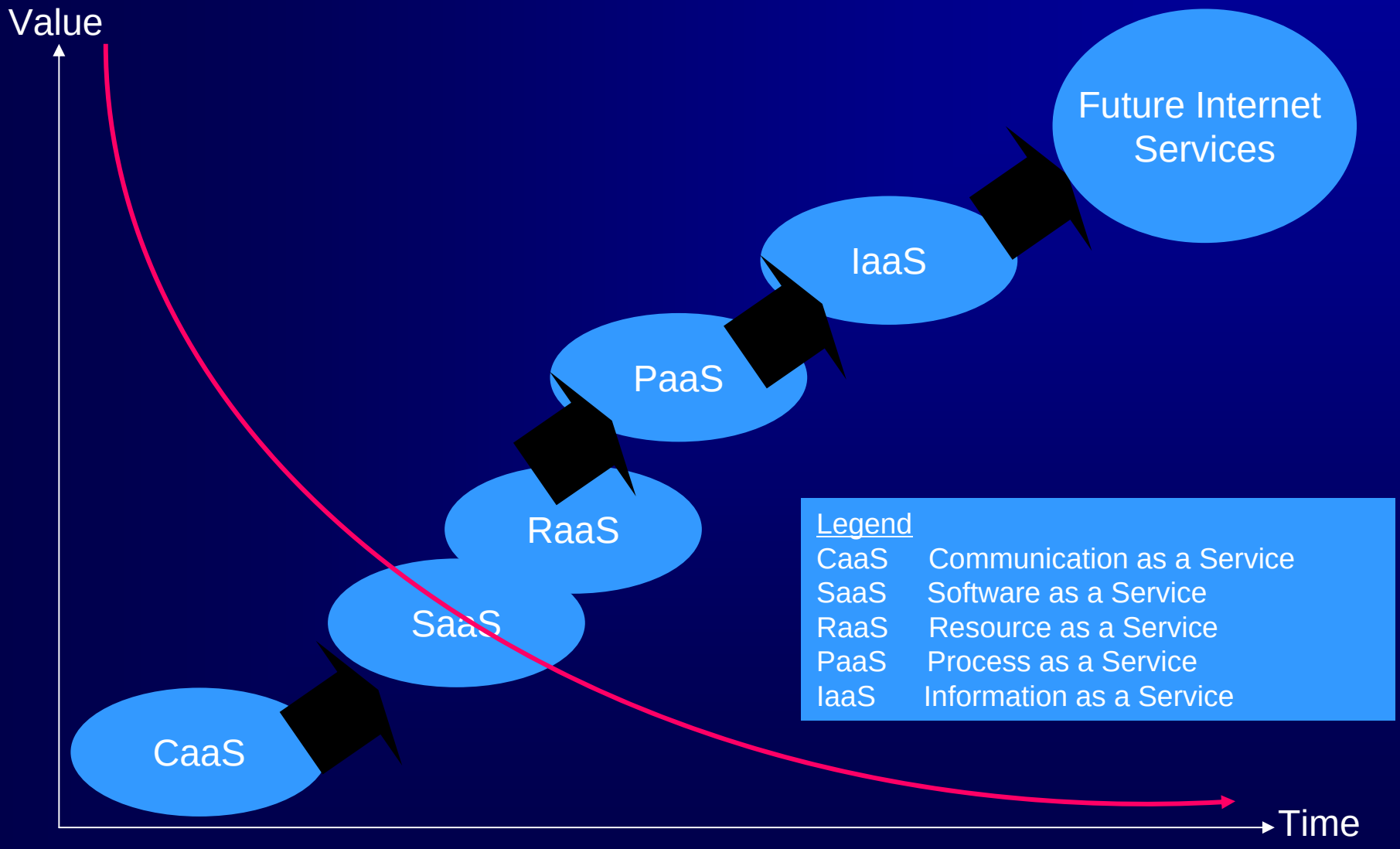
Critical Concepts

- More general notion of service
- Utilities paradigm
- End-to-end capabilities
- Internet of Services

More General View of Services

- Guaranteed underlying properties
- Easily assembled into more complicated services
- Capable of (semi) autonomous interoperation
- Not locked into any particular platform provider
- Fine tuned to the needs of the target customers
- Add direct value to the business operations
- Created and provided at low cost

Services Roadmap



Utility Services

- Class 1 - Generic Business Services
  - Services to access and execute routine, cross- sector business functions
  - Examples: authorisation, digital signature, and payment
- Class 2 - End-to-End Management Services
  - Services to manage the end-to-end linking and processing of services
  - Examples: orchestration, discovery, composition
- Class 3 - Information Exchange Services
  - Services to automate the exchange of information between services
  - Examples: information matching, mapping, translating
- Class 4 - System Services
  - Services for management, evolution, and system governance
  - Examples: prediction, monitoring, data collection, and policy services

Engineering These Services

- To be discovered in order to be used
  - Standardised and rich metadata
  - Comprehensive service description
  - Good match between description and requirement
- To live in an open and dynamic environment
  - Federated registries and repositories
  - On the fly composition of services
  - On the fly composition of information

End-2-End Services

- Utilities as a basis for Software Service infrastructures
- Services, Value Added Services and Service-based applications
- End-to-End properties
- Future Internet infrastructures

New Internet of Services

- Conversion from a data exchange view into a programmable service view
- Remote access to and composition of services as well as data
- Services assembled on the fly, dynamic configuration
- Services self describe and self discover
- Wide array of public and private services
- No presupposition of where services reside

Internet as Open Infrastructure

- Not locked into any technology paradigm or service platform
- Not owned or controlled by any entity
- No bias towards business models or service ecosystems, existing or emerging
- Applications talk to infrastructure, not to themselves
- An any-to-any paradigm

Need for New Standards

- Communication protocols
- Registries and repositories
- Service descriptions
- Lite content standards
- New modeling languages
- Common taxonomies/ontologies
- Performance metrics/methods

Summary

- Standards are key to future of manufacturing
- Evolution toward semantics-based ‘lite’ standards
- Evolution toward more general notion of services
- Potential for automated reasoning and discovery
- Potential for self-description and self-integration
- Internet of Services – anywhere, anytime, anything

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