Information Systems Modelling For Enterprise Systems Interoperability

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Agenda

- What is an Enterprise System?
- Enterprise Systems Interoperability
- Semantic Modelling
- Information Systems Modelling
- Some thoughts...
What is an Enterprise System?

- APS: Advanced Planning and Scheduling System
- ERP: Enterprise Resource Planning
- SCM: Supply Chain Management
- CRM: Customer Relationship Management
- MES: Manufacturing Execution System
- SCE: Supply Chain Execution
- SFC: Shop Floor Control
- PDM: Product Data Management
- PLM: Product Lifecycle Management

Business

Manufacturing/Services
Enterprise Systems Interoperability
What is interoperability?

ISO/IEC 2382

01.01.47 interoperability: The capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units.
What’s the problem?

Organisational Interoperability
Technical Interoperability
Semantic Interoperability
Semantic Interoperability
Semantics Modelling

English translation of Welsh: “I am not in the office at the moment. Please send any work to be translated”
What is semantic interoperability?

- A sender's system $S$ is _semantically operable_ with a receiver's system $R$ if and only if the following condition holds for any data $p$ that is transmitted from $S$ to $R$:
  - For every statement $q$ that is implied by $p$ on the system $S$,
    - there is a statement $q'$ on the system $R$ that
      - (1) is implied by $p$ on the system $R$, and
      - (2) is logically equivalent to $q$.
  - the receiver must at least be able to derive a logically equivalent implication for every implication of the sender's system.
Issues source: “Lost in translation”

- There is NO lingua franca for enterprises, they all “speak” different languages
- However, some are “less different” than the others:
  - Enterprise models (loose alphabets)
  - Reference models (strict alphabets)
  - Ontologies (formal alphabets)
Information Systems Modelling

- Multiple languages
- Multiple business vocabularies
- Multiple domains of interest
- Relational-oriented vs. Object-oriented
- Conceptual model vs. Implementation schema
From a schema to an ontological model
Fact-oriented transformations

- ORM (Object Role Modelling) (Halpin, 1989) alike
- Attribute free
- Focus on facts (concepts)

(Lezoche, et al, 2012)
Purchase Order model as conceptualized
Fact-oriented Purchase Order model

- Automatically processed
- Prototype in MEGA Suite
- Not to be used by humans
- Input to an ontological analysis
The semantic-dependency graph related to the fact-oriented model
Partitioning the semantics embedded into a conceptual model
Interoperability assessment

Interoperability Map

$IEM = (\nu_{1 \rightarrow 2}, \varepsilon_{1 \rightarrow 2}^e)$

$IIM = (\nu_{1 \rightarrow 2}, \varepsilon_{1 \rightarrow 2}^e)$

$IPM = (\nu_{1 \rightarrow 2}, \varepsilon_{1 \rightarrow 2})$

Semantics gap

Semantics transformation

Semantics transformation

$\varepsilon_{1 \rightarrow 2}^e = 100\%$

$\varepsilon_{1 \rightarrow 2} = 100\%$

$Risk = (100\%, 100\%)$

(Yahia, et al, 2012)
Interoperability Measures Map, from an ERP to a MES

ERP: Enterprise Resource Planning
MES: Manufacturing Execution System

Effectiveness

$\varepsilon_{1\to2}^c = 100\%$

Risk of non-effectiveness $\varepsilon_{1\to2}$

$\varepsilon_{1\to2} = (48\%; 100\%)$

Semantic Gap

$\varepsilon_{1\to2}$

Interoperability Measure $V_{1\to2}$

Minimal Effective Interoperability (MEI)
Maximal Potential Interoperability (MPI)
Maximal Intrinsic Interoperability (MII)
Full Interoperability (FI)

$(55\%; 89\%)$

$(55\%; 100\%)$

$(100\%; 100\%)$
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