



Beyond IPPD: Distributed collaboration in a Systems-of-Systems (SoS)- context

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Agenda

- **Setting the stage**
- Governance-Demand Challenge and IPPD
- Beyond CMMI V1.2 IPPD
- Summary and conclusions
- Backup



Questions from our abstract

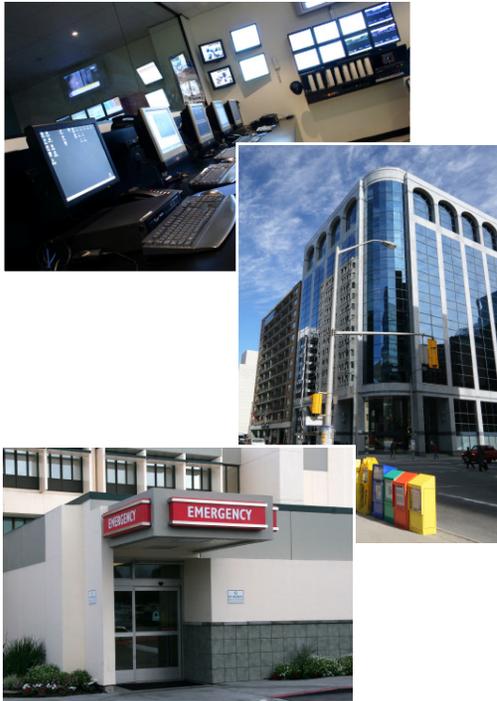
- How do you resolve conflict among suppliers and customers when you (especially you the supplier!) do not have a direct line of authority?
- How do you navigate the different governance structures that lead to different processes being put into use that may not be compatible?
- How do you respond to the customer's "real" needs if you're a supplier?
- How do you know who to tell your real needs to if you're on the operations side?

We'll answer these by looking at characteristics of complex systems of systems that drive issues in these areas, then look at possible solutions and the implications of those for IPPD content in CMMI v1.2

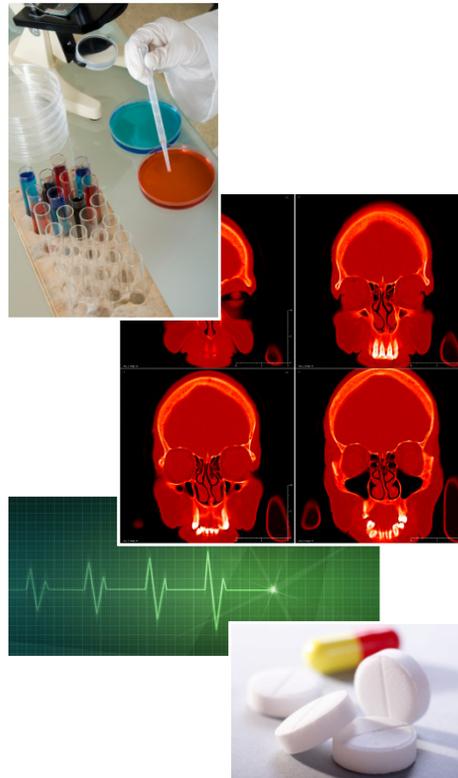


“Simple” definition of system of systems

A collaboration among autonomous systems (both technical and organizational)



...in relation to some use

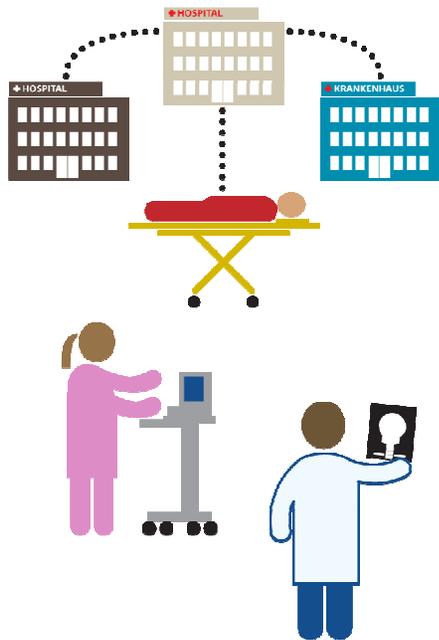


...within a changing, unpredictable context

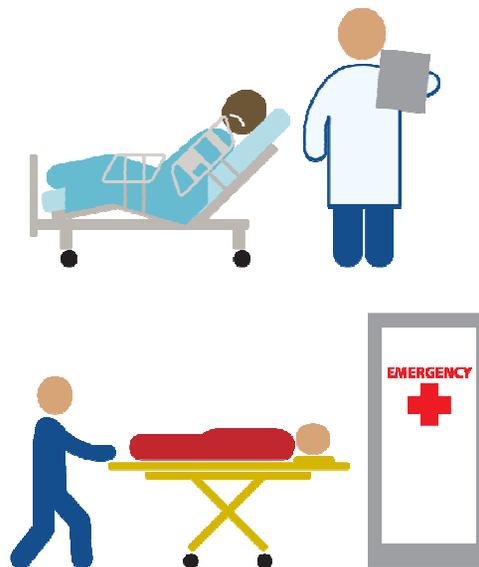


Achieve an effective emergency response: an intuitive example

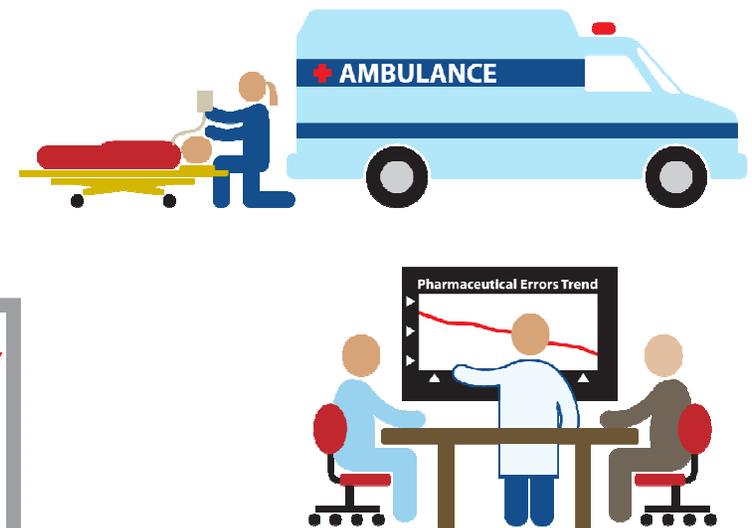
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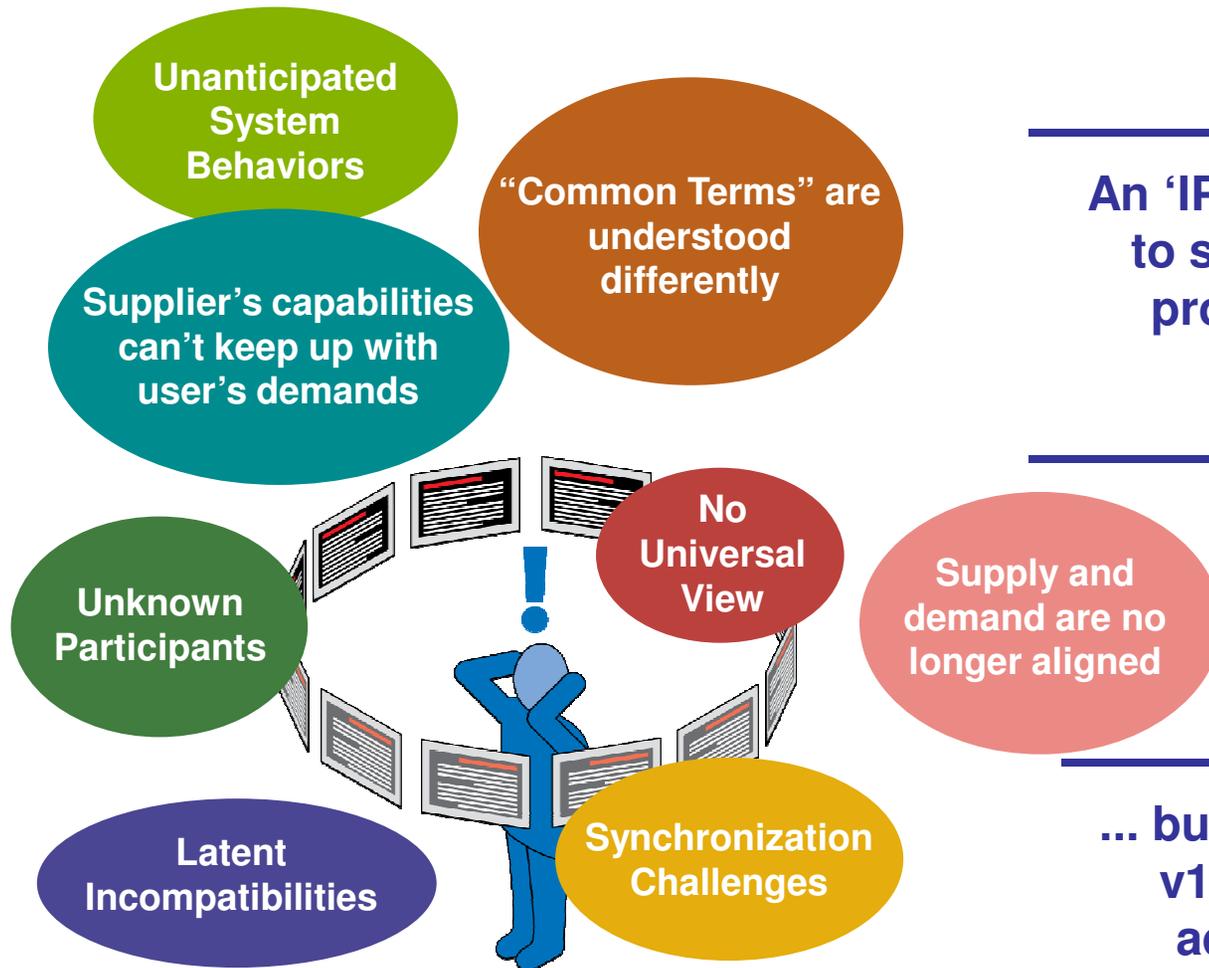
...in relation to some use



...within a changing, unpredictable context



Some Problems Faced in Distributed Collaboration in a SoS context



An 'IPPD'-attitude is required to successfully master the problems of distributed collaboration

... but IPPD 'as is' (within CMMI v1.2) does not completely address these problems



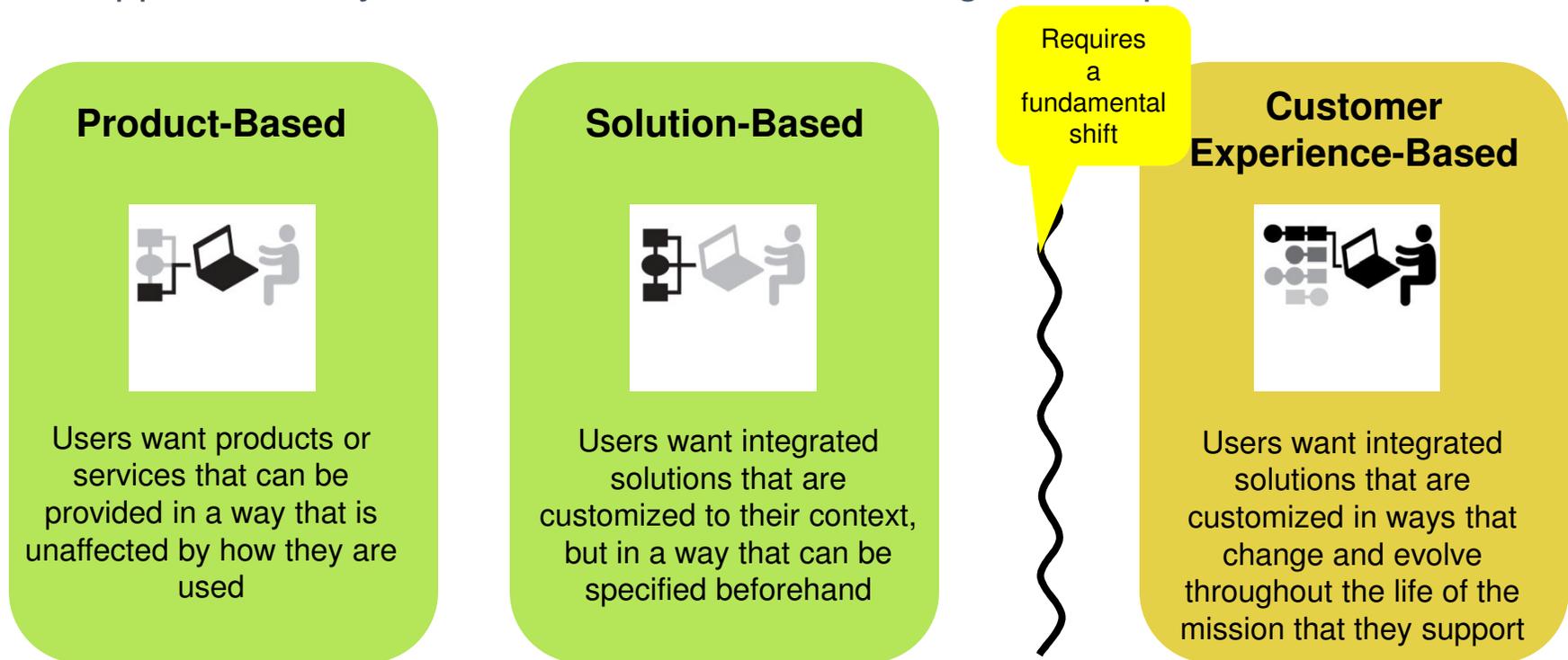
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Distributed Collaboration leads to an Agile World where the Customer Experience drives the solution

- Customers and users want specialized solutions in ever-shorter time frames, continuously adapted to their changing and evolving situations.
- Suppliers and systems have to become more agile to respond.



*'Turbulence' as per [Emery 1965]
Categories adapted from [Prahalad 2003]*



Distributed Collaboration in a SoS context leads to concepts of Distributed Governance

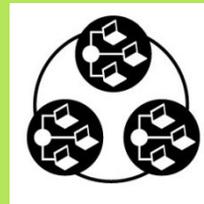
- Number, type, and roles of participants are increasingly diverse, reflecting differing vested interests.
- Scarce resources and the need for concurrent uses make a single decision authority increasingly unlikely.

Single Task “System”



A single program directs composition
—little potential for conflict

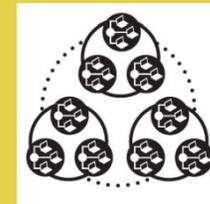
Single Enterprise



A real or virtual entity directs how multiple entities collaborate to compose multiple programs
—resolves potential conflicts by imposing constraints

Requires a fundamental shift

Multiple Enterprises



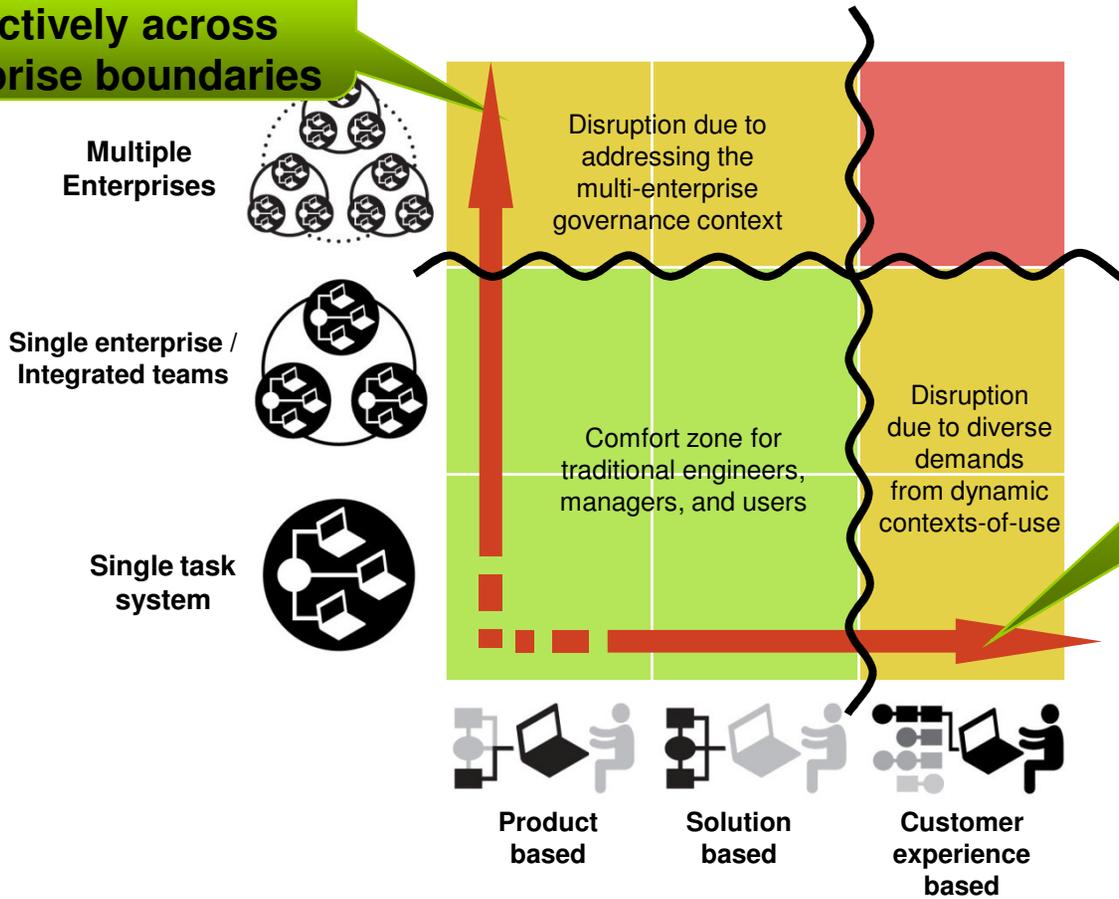
Multiple real or virtual directing entities making competing demands on SoS
—conflict resolution requires negotiating mutual constraints



Combining Customer Experience-driven solutions and Distributed Governance leads to a Double challenge

2 - Collaborating effectively across enterprise boundaries

Governance Framework



1 - Developing flexible responses to unanticipated situations

Nature of Response to Demand

[Boxer 2006-1]



IPPD currently addresses, at most, the product- and the solution-based responses to customer demand

IPPD (Integrated Product and Process Development) in CMMI V1.2:

- *A systematic approach* to product development that achieves a *timely collaboration of relevant stakeholders* throughout the product lifecycle to better satisfy *customer needs* (CMMI Glossary).

Critical concepts contained in that definition:

- *systematic approach*: guided by a priori defined principles, plans and patterns of action
- *timely collaboration*: collaboration relationships planned a priori (mainly synchronous)
- *relevant stakeholders*: stakeholders a priori identified, included in a plan and accordingly involved
- *customer needs*: assumes that the customer needs are systematically known and committed to a priori



IPPD currently builds on *integrated teams*

Integrated team:

- A group of people ... who are *committed to delivering specified work products in timely collaboration*. Integrated team members ... are *collectively responsible* for delivering the work products *as specified*. An integrated team should include empowered representatives ... that have a stake in the success of the work products. (CMMI Glossary)

Critical concepts contained in that definition:

- *Committed to delivering specified work products*: committed with respect to the a priori defined shared vision and product specifications
- *Timely collaboration*: means collaboration according to the plans
- *Collectively responsible ... as specified*: responsibility relates to the a priori defined specifications



IPPD currently assumes the existence of *clear governance mechanisms and authority*

Central Governance paradigm:

- IPPD assumes the existence of an organizational infrastructure with *clear channels of responsibility and authority*. (OPD, SG 2 & SP 2.1)
- This assumption is reinforced by the CMMI-definition of ,organization‘:
 - An administrative structure in which people collectively manage one or more projects *as a whole*, and whose *projects share a senior manager* and operate under the same policies. (CMMI Glossary)

Critical concepts contained in that definition:

- *Clear channels of responsibility and authority*: even if multiple enterprises are involved, a single source of ultimate authority is assumed
- *Managing projects as a whole*: assumes that the same norms are being used across a portfolio of projects
- *Sharing a Senior Manager*: assumes a single enterprise viewpoint of organization



Critical Leverage Points for IPPD in a SoS-context

Current CMMI 1.2 IPPD

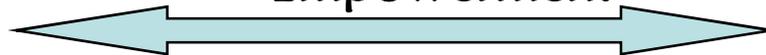
- Central Governance, planned a priori

- Timely collaboration as planned a priori

- Shared vision and shared responsibility are key, defined a priori

- Known and defined a priori

Governance & Empowerment



Collaboration & Integrated teams



Requirements & Operational Concepts



IPPD for a SoS-context

- Multi-party, decentralized governance)

- Processes may be asynchronous; decoupling of development and integration tempos

- Willingness and capability to integrate into dynamically evolving contexts

- Understanding the variety of demand contexts more important than trying to “pin down” a single set of requirements

- Interface conformance and Interoperability is more important



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Additional Richness for IPPD in CMMI V1.1 (1/2)

OEI SP 2.1: *Establish Leadership Mechanisms.*

This SP accounted for loose forms of governance like consultative and collaborative. Might be reformulated: *‘Establish collaboration mechanisms’*

OEI SP 2.2: *Establish Incentives for Integration.*

- We have to compensate the loss of central governance by other appropriate means to motivate and promote collaborative behavior. .
Might be reformulated: *‘Establish social rules / codes of conduct’* that every participant in the community commits to adhere to.



IPPD in a SoS – context

Implications for *Governance & Empowerment*

- We will lose the clear coordination and sanctioning mechanisms of a central governance authority
 - Instead, we will have to rely more on ,social‘ mechanisms to enforce effective collaboration
 - Trust will become more important
 - To foster trust, adopt mechanisms of the ,social software world‘ and of the ,open source world‘
- Understand which processes are critical to interoperate among the involved enterprises
 - Need mechanisms for agreeing on process governance
- Empower the system component producers to take decisions appropriate to the situational needs – even if they were not planned a priori
 - Understanding the variety of ways that customers will use and engage with our products is key to going beyond pre-specified requirements



Additional Richness for IPPD in CMMI V1.1 (2/2)

IPM SP 3.1: *Define Project's Shared vision Context.*

- This SP explicitly acknowledges that we are a project with interfaces that does not operate in isolation. It also stresses the fact that we might not be responsible for all results of the overlying mission. Instead of trying to govern the whole mission we should restrict our efforts to clearly defined boundaries.
- If other constituents external to us make use of our products or services, we can abstract from it as long as we obey to the interface requirements.
- The growing importance of ,developing against standards' instead of ,developing against requirements' should be dealt with in a reformulated SP



IPPD in a SoS – context

Implications for *Collaboration & Integrated Teams*

The concept of an *integrated team* will take on a different meaning:

- Loosely coupled teams will emerge with no clear lines of authority
- More negotiation skills than a-priori planned procedures and rules
- A differentiation of the roles will be likely:
 - System component producer
 - System integrator/synthesizer who integrates the system based on system components
 - This may very well be someone from within the traditional „customer“ environment
- Prerequisites on the side of the system component producer:
 - Willingness / readiness that his components will be integrated also in contexts that were never heard of or thought about before
 - Capability to deliver to the defined interface standards
 - Capability to characterize and understand the varieties of demand their systems will be subject to



Potential Change for CMMI (as opposed to enriching with CMMI V1.1)?

Generic Practices

- Add data management generic practice (similar to Registry Services in the SOA world)?
 - To highlight the need for being explicit about process data available & being shared



IPPD in a SoS context

Implications for *Requirements & Operational Concepts*

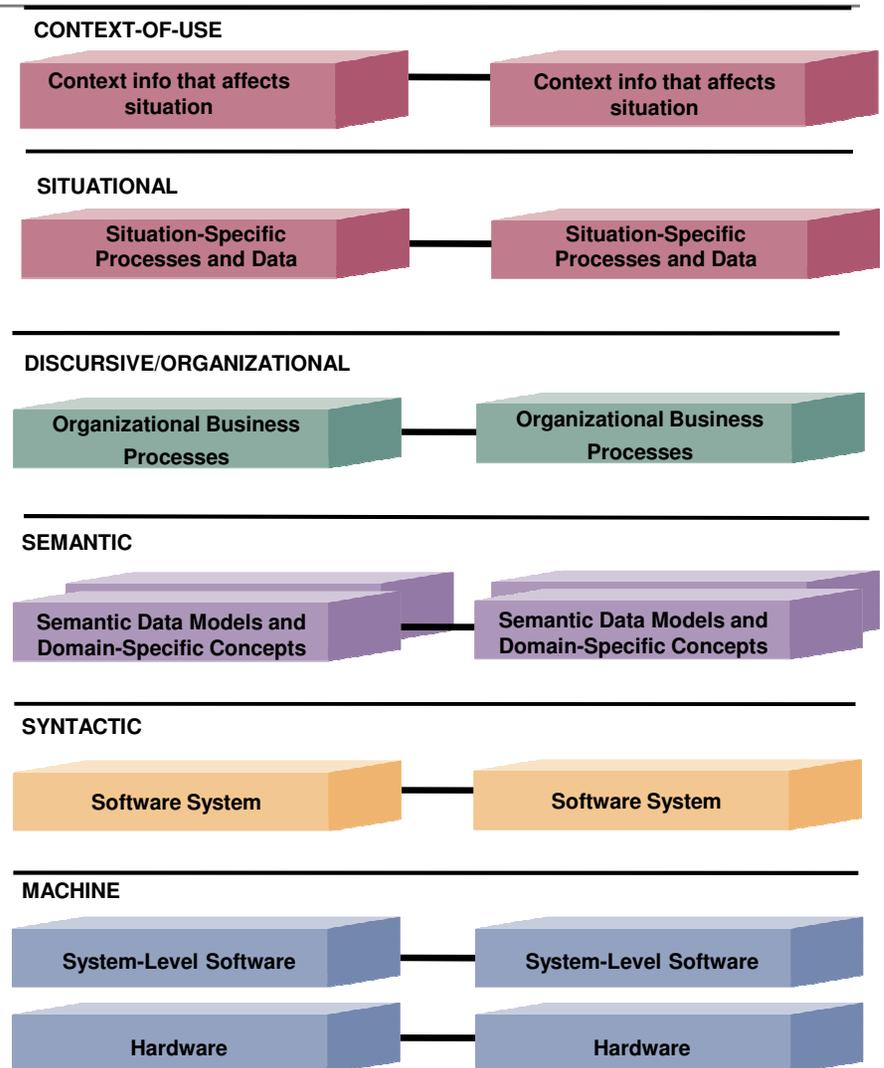
- Importance of interoperability of system components is growing, which includes growing importance of interface descriptions and conformance to standards; however, standards are not enough..
- Instead of 'development against requirements' ,development against a varied set of capabilities, tuned to expected situations, is becoming more important
- Conformance tests to standards / standard test suites is becoming more important at system component level
- Use of pilots and prototypes to cope with phenomena like emergent system behaviour can help test reasonableness of our suite of expected situations— not every system behaviour can be exactly be planned for a priori nor tested exhaustively
- Usage of industry-wide accepted reference models might become more important (healthcare industry is trying to go this direction)
- Need to look at multiple layers of interoperability



We Need to Address Multiple Layers of Interoperability

•As we move up the stack

- Standardization decreases in importance
- Implementation becomes domain- and organization-specific
- Implementation experience tends to decrease
- Machine-to-machine interaction becomes less important, but the rest of the stack builds on it



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Summary

- Whether you talk about complex systems, families of systems, systems of systems, etc., the characteristics that distinguish these systems and drive much of their complexity also drive a different character of solutions than we've focused on in the past:
 - More focus on layers of interoperability above behavioral semantics
 - Distributed governance, not just distributed teams, is needed
 - CMMI—DEVv1.2 is necessary, but not sufficient
 - Some additional Support comes from v1.1 content
 - Some issues are outside of scope of current CMMI instances



Next Steps

- TN in work: *Process Considerations in Systems of Systems*
- Processes, Tools, Techniques to support operating effectively in systems of systems environments: *Systems of Systems Navigator*



Related Materials

- Tutorial SEPG 2006: *CMMI in a SoS Context*
- Presentation SEPG EU 2007: *SURVIVAL in a SoS World*
- TN 2008: *Process Considerations in Interoperable Acquisition*

Please contact Suzanne Garcia if you have trouble finding any of these....



For Additional Information

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THANK YOU!!!





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