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Towards EI as a science: Considerations and points of view

UNINOVA
Instituto de Desenvolvimento de Novas Tecnologias

GRIS
Group for Research in Interoperability of Systems

GRIS Group for Research in Interoperability of Systems

- GRIS Characteristics
  - Research group composed of dynamic, motivated and determined minds
  - Focus on Interoperability of Systems and Collaborative Business Networks
  - Seek Scientific and Technological excellence with a strong industrial drive and applicability.
- Long and Sustained RTD Experience
  - Continuous participation in research programmes: National and Regional level; EC level (FP4, FP5 and FP6); and worldwide level (e.g. IMS programme).
  - Permanent involvement in key initiatives focusing the Interoperability paradigm, e.g. IDEAS-roadmap, ATHENA-IP, INTEROP-NoE, etc.
- Strong Industrial Commitment
  - Pushing sector-based synergies enabled by Interoperability and Standards, e.g. funStep initiative in Furniture, IAI-Iberian in Construction, STEP-based approach in Aeronautic, Standards and Interoperability push in eHealth, etc.

Enterprise Interoperability

- Stand alone domain
  - Engineering
    - Yet another system
    - Yet another methodology
- An enabler
  - For developing complex systems

Science and Engineering

- **We got results by engineering (short term). We got results by scientific research (long term).**
  - **We die without short term results.**
  - **We decline without long term results.**
- **Clear separation between engineering, technology and research.**

Engineering:

Working better (whatever)

Scientific:

Academic need to clearly specify what is the research domain and what he intends to explore and do differently and better and how can you evaluate and measure the work (assessment).

Judgement by peers at an earlier stage.

What is EI today ? What about tomorrow ?

- Is it a technology ?
- An applied science ?
- An engineering discipline ?

Philosophy -> Science -> Engineering-> Technology

(where we are, and want to go ?...)

Laws, theories, conjectures, models

EI and interoperability in other domains

- What's the connection between EI and the interoperability in other domains
  - E.g., medicine (transplants), social, psychology, politics, chemistry, …
- Is interoperability just an issue for tangible assets ? What about the intangible ones ?
- What domains should EI community look in ?

EI and Complex Systems

- Non-Linear
- Feedback
- Evolutive
- Adaptative
- Self-monitoring
- Learning capabilities

Study of systems based on performance
Whatever it has interoperability or not

CAUSAL systems vs FEEDBACK based systems

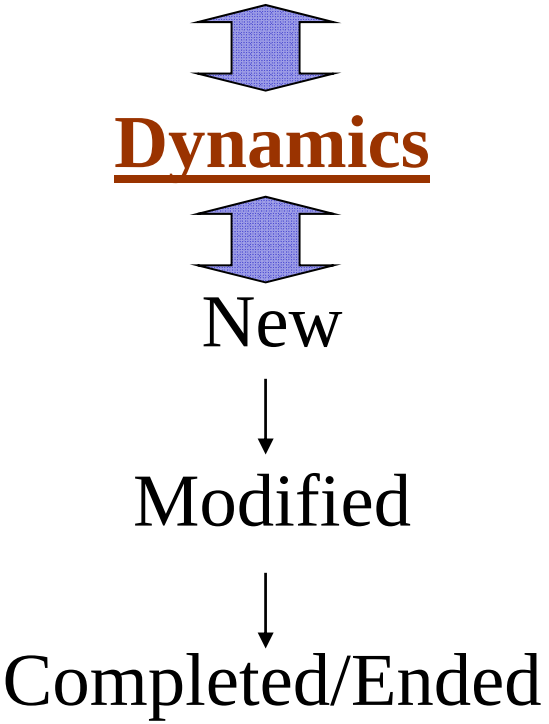
STEADY STATE vs TRANSIENT RESPONSE (non-linear)

STABILITY vs INSTABILITY added value

System's dynamics (non linear behaviour)

- COMPONENTS
  - New components
  - Modified components
  - Killed components
- Relations
  - New relations
  - Modified relations
  - Ended relations

Instability of the system



Dynamics behaviour

- How to monitor
- How to cope with interoperability
- How to do conformance testing
- How to do interoperability checking

- New challenges
  - How to learn/know about systems evolution (dynamics) ?
  - How to monitor ?
  - How to adjust ?

Theory for knowledge interoperability*

- Based on 2 properties fundamental to intelligence:
  - Maximization of transfer
    - Whenever possible, new structure should be described as the transfer of existing structure
  - Maximization of recoverability
    - The generative operations must allow maximal inferentiability from data sets

*Inspired from: “A generative theory of shape”, Michael Leyton, Springer, 2001

Mazimization of transfer

- Any agent is regarded as **displaying intelligence** and insight **when** it is able to *transfer* actions used in previous situations to new situations
- The **ability** to transfer **past solutions** onto **new problems** is at the very core of what it means to have knowledge
- Thus, the generative sequences must maximize transfer along the sequences

Maximization of recoverability

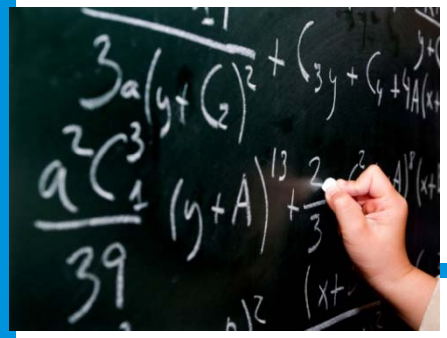
- A **basic factor** of intelligence is the **ability to give casual explanations**.
  - An agent must be able to infer the causes of its own current state, and identify why it failed or succeeded
  - The fundamental goal of science is explanation, which is the inference from causes to effects
  - A similar process occurs in reverse engineering, which requires inferring from a *physical* example of an object, the operations needed to manufacture it,

Theory for knowledge interoperability*

- All these examples involve
  - being presented with a data set
  - Inferring from the data set a sequence of operations which will generate that data set
- In other words
  - There must be a set of inference rules by which the generative operations can be infered from the data set
- CAUTION:
  - Generativity is not always enough
    - It must be assured the *recoverability* of that generativity
    - The generative operations must be recoverable from the data set

Challenge:

Move from Complexity to Understandibility by KI



Complexity → ***KI*** → **Understandibility**

Current situation and the IQ

- Global financial markets*
  - are in disarray, but prospects for innovation in the real economy have never been more robust
  - Innovations are increasingly built to work together, or "interoperate"

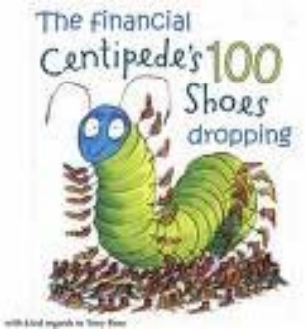
- **IQ: Interoperability Quotient**
  - IQ of discrete components and systems
    - Scientific, Socio-Economic and Technology
    - Influence constructively the behavior of other systems and components
    - Increasingly determines economic value
  - IQ indicator
    - Low IQ indicates innovation destined to underachieve.
  - Playing well with others has become the new standard for innovation excellence

*Interoperability: the great enabler,, FT,Michael Schrage , 2009

Do we really need EI science ? Advantages ? Risks ?

- Poem: The distracted centipede (Anonymous)

A centipede was happy quite, until a toad in fun
Said, "Pray, which leg comes after which?“
This raised his doubts to such a pitch
He fell distracted in the ditch
Not knowing how to run.



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THANK YOU !...

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