Theoretical and Practical Pursuit of Enterprise Engineering

July 14th, 2014

Prof. Dr. Antonia Albani
Chair of Prof. Dr. Robert Winter
Institute of Information Management
University of St. Gallen
Müller-Friedberg-Strasse 8, CH-9000 St. Gallen
Tel: +41 71 224 3320    Fax: +41 71 224 2189
antonia.albani@unisg.ch
www.iwi.unisg.ch

Agenda

1 Enterprise Engineering
2 Theoretical Basis
3 Practical Application
4 Enterprise Engineering Network
What is Enterprise Engineering?

- Enterprise Engineering (EE) is an emerging scientific discipline that has enterprises as its object of study.
- EE considers enterprises to be designed systems, which consequently can be re-designed.
- EE is built on three foundational pillars:
  
  Enterprise Ontology
  Enterprise Architecture
  Enterprise Governance

The history of Enterprise Engineering

<table>
<thead>
<tr>
<th>Information Systems Sciences</th>
<th>Organization Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Data Systems Engineering</td>
</tr>
<tr>
<td>Content</td>
<td>Information, Communication</td>
</tr>
<tr>
<td>Intention</td>
<td>Commitment, Cooperation</td>
</tr>
</tbody>
</table>

### The discipline of Enterprise Engineering

**Principal authors:**
- J.-L.G. Dietz, Dušk University of Technology
- J.A.P. Hoogervorst, University of Antwerp

**Co-authors:**
- J.-P. Neumann, University of Antwerp
- N. De Bock, University of Antwerp
- J. Bals, University of Antwerp
- S. van Haeften, University of Antwerp
- M. Wittert, University of Antwerp
- J.L. Dietz, University of Antwerp
- J.A.P. Hoogervorst, University of Antwerp
- J. Dietz, University of Antwerp
- J.A.P. Hoogervorst, University of Antwerp

**Abstract:**
A survey of Taylor published a landmark in the organizational sciences: *In Principles of Scientific Management*. Many researchers have criticized on Taylor's principles, or have been influenced otherwise. The authors of the present paper conclude a survey of the management's development, and one that is focused on the discipline of Enterprise Engineering. In the future, the discipline will be known as a systematic reduction of complexity. Three generic goals are identified. The first one, intellectual manageability, is the key for mastering complexity. The second one, organizational concinnity, is the key for controlling complexity. The third one, social devotion, is the key for creating a coherent and consistent whole. This implies well designed distribution of authority and responsibility. (Enterprise Governance)

---

### The generic goals of Enterprise Engineering

- **Intellectual manageability**
  - In order to bring about organizational changes, one must keep insight and overview. This implies a well devised systematic reduction of complexity. *(Enterprise Ontology)*

- **Organizational concinnity**
  - The skillful and harmonious arrangement of organizational parts, so that it constitutes a coherent and consistent whole. This implies well devised design. *(Enterprise Architecture)*

- **Social devotion**
  - Enterprise Engineering takes a human centered view on organizations. This implies a well devised distribution of authority and responsibility. *(Enterprise Governance)*
How to reach the goals of Enterprise Engineering? (1/3)

- Example of engineering automobiles:

  | Construction | Assembly of mainly mechanical and electrical parts. |
  | Operating principle | Rolling on surfaces, being propelled by some power source. |
  | Power source | Engine(s) fuelled by fossil fuels (gasoline, diesel, …) or electricity. |
  | Operating Theory | Mechanics (gravity, friction). |

How to reach the goals of Enterprise Engineering? (2/3)

- Example of engineering aircrafts:

  | Construction | Assembly of mainly mechanical and electrical parts. |
  | Operating principle | Gliding on air, being propelled by some power source. |
  | Power source | Engine(s) fuelled by fossil fuels (kerosene). |
  | Operating Theory | Aerodynamics (lift by wings). |
How to reach the goals of Enterprise Engineering? (3/3)

- Engineering enterprises:

  - Construction
  - Operating principle
  - Power source
  - Operating Theory

---

Agenda

1. Enterprise Engineering
2. Theoretical Basis
3. Practical Application
4. Enterprise Engineering Network
The Enterprise Engineering Tree

APPLICATIONS

METHODS

THEORIES
philosophical  ontological  technological  ideological

The Enterprise Engineering Theory Framework

Ideological theories
devising and choosing things to make ethical, political, etc. ideas
EE-theories: α-theory

Technological theories
designing and making things
analysis and synthesis
EE-theories: β-theory, γ-theory

Ontological theories
understanding the nature of things
explanation and prediction
EE-theories: δ-theory, ε-theory

Philosophical theory
theoretical foundations
epistemology, mathematics, phenomenology, logic
EE-theories: θ-theory, ψ-theory, ρ-theory


© 7-14, IWI-HSG
The ψ-theory

- The ψ-theory (PSI stands for Performance in Social Interaction) consists of two parts: the general ψ-theory and the special ψ-theory.
- The general ψ-theory is a theory of human cooperation. Therefore, it is also called the human face or front side of the ψ-theory.
- The special ψ-theory clarifies the consequences of the general ψ-theory for the systems approach to organizations. Therefore, it is also called the system face or back side of the ψ-theory.

The general ψ-theory

- The operating principle of organizations is that subjects (human beings) enter into and comply with commitments regarding the production of products.
- Commitments are raised and dealt with in transactions.
  - These are interaction structures of coordination acts/facts between two actors, concerning a production act/fact.
  - One subject is the initiator of the transaction and the other is the executor.
- The effect of a coordination act is the creation of a coordination fact, which is an event (state change) in the coordination world of the organization.
- The effect of a production act is the creation of a production fact, which is an event (state change) in the production world of the organization.
Is it a production act/fact (P-act/fact) or a coordination acton/fact (C-act/fact) ?

C  “I’d like to have a bouquet of red tulips”
C  “Ok, I will get one”
C  “Here it is, your bouquet of red tulips” says Linda
C  “Oh, but I’d rather have those yellow roses”
C  “You are quite capricious, aren’t you?”
C  “Come on, I can make a mistake!” says Steven
C  “Alright, so you want a bouquet of yellow roses”
C  Steven gets the bouquet and is happy with it
C  Theo also gets a bouquet of roses from Linda
C  But Theo thinks that they are not fresh
P  Linda decides to give Jan the bouquet he asked
C  Jan asks Hans to sweep the path
C  But Hans says that he won’t do it
P  Theo sweeps the path
P  The broom is provided by Linda

Coordination acts

Every coordination act has this structure:

<performer> <intention> <addressee> <product>  Example:

Alicia | request | Celestine | ownership of a bouquet of tulips

**Performer:** a subject (human being in the role of social individual).

**Intention:** the kind of the commitment that the performer engages in towards the addressee. Examples: request, promise, …

**Addressee:** a subject (human being in the role of social individual).

**Product:** an independent fact in the production world; products must be uniquely identifiable in time and space (= state space of the production world).
Distinct human abilities in coordination

- **performa**
  - expose commitment
  - evoke commitment

- **informa**
  - formulate thought
  - educe thought

- **forma**
  - utter sentence
  - perceive sentence

---

The process of a coordination act

- **performa level**
  - (social correspondence)
  - expose commitment
  - evoke commitment

- **informa level**
  - (cognitive correspondence)
  - formulate thought
  - educe thought

- **forma level**
  - (notational correspondence)
  - utter sentence
  - perceive sentence

- **medium level**
  - physical interaction
  - realise decision
  - decide on response
Example of a transaction

Alicia: I’d like to have a bouquet of red tulips

Alicia: request: Celestine: order 387 is completed

Celestine: Just a moment

Celestine: promise: Alicia: order 387 is completed

Celestine: Here you are

Celestine: state: Alicia: order 387 is completed

Alicia: Thanks

Alicia: accept: Celestine: order 387 is completed

The transaction process

In the proposition phase, the actors discuss the product to be produced, and try to come to agreement.

In the execution phase, the executor produces some product.

In the result phase, the actors discuss the product that has been produced, and try to come to agreement.

Examples of the transaction process:

- Asking for flowers
- Ordering a book
- Applying for membership
- Creating
- Deciding
- Judging
- Having got the flowers
- Having got the book
- Having become member
The basic transaction pattern

The standard transaction pattern

rq: request
pm: promise
dc: decline
qt: quit
st: state
ac: accept
rj: reject
sp: stop

The standard transaction pattern
What kind of C-act/fact is it?

request
promise
state
?
?
?
state, accept
state
reject
P
request
decline
P
P

“I’d like to have a bouquet of red tulips”
“Ok, I will get one”
“Here it is, your bouquet of red tulips” says Linda
“Oh, but I’d rather have those yellow roses”
“You are quite capricious, aren’t you?”
“Come on, I can make a mistake!” says Steven
“Alright, so you want a bouquet of yellow roses”

Steven gets the bouquet and is happy with it
Theo also gets a bouquet of roses from Linda
But Theo thinks that they are not fresh
Linda decides to give Jan the bouquet he asked
Jan asks Hans to sweep the path
But Hans says that he won’t do it
Theo sweeps the path
The broom is provided by Linda

The complete transaction pattern

The complete transaction pattern

The complete transaction pattern
Implementation of a transaction (1/2)

- By the implementation of a transaction is understood the allocation of technological means to coordination and production

  "How can I help you, sir?"
  "I want to withdraw money" request
  "From your current account?"
  "Yes"
  "How much do you want?"
  "400 € please"
  employee fills out a form
  "If you sign here please"
  client signs the form
  "One moment please" promise
  employee issues banknotes <production>
  "Here you are, sir" state
  "Thank you" accept

Implementation of a transaction (2/2)

- By the implementation of a transaction is understood the allocation of technological means to coordination and production

  Welcome to the ING bank
  Please insert your card
  client inserts card
  Enter your PIN please
  client keys the PIN
  Choose the amount please
  client presses € 400 request
  Take your card please
  client takes the card
  Your money is being counted
  banknotes are produced <production>
  Take your money please
  client takes the banknotes
  state
  accept
The organizational building block

- Every (elementary) actor role is the executor role of exactly one transaction kind. It may be an initiator role in 0, 1 or more transaction kinds.
- An actor is a subject fulfilling an actor role. A subject may fulfill several actor roles (sequentially or simultaneously), and an actor role may be fulfilled by several subjects (sequentially or simultaneously or collectively).

Competence, authority, responsibility

- On the basis of competence, subjects are assigned a particular authority (actor role), which they are assumed to exercise with responsibility. For example, actors A1 have the authority to be executor in transactions T1, and actors A0 to be initiator.
- The competence to be executor of a transaction kind (promise, state) includes the competence to be initiator in the ‘sub’ transaction kinds (request, accept).
An actor A0 (the initiator of T1) comes to agreement with an actor A1 (the executor of T1) about the delivery of a product P1.

- Basically, A0 doesn’t need to care about what A1 has to do in order to produce P1.
- At some point in time, A1 addresses A0 and performs the state act in the transaction T1.

In order to produce P1, A1 needs a P2, a P3 and a P4! and …
The special $\psi$-theory

- The special $\psi$-theory takes the systems approach to organizations. Being the back side, PSI is read backwards (ISP), with two meanings:

  - **Intelligent System Partitioning**
    The three human abilities (performa, informa, and forma) can also be applied to production. This leads to partitioning an organization in three aspect organizations: B-organization (B from Business), I-organization (I from Informational) and D-organization (D from Documental).

  - **Integrated System Perspectives**
    The ontological model of an organization is the integration of four sub models or perspectives on the whole: Construction Model (CM), Process Model (PM), Fact Model (FM), and Action Model (AM).

Human abilities in production

- The three human abilities (performa, informa, and forma) also apply to production:

  - **Performa**
    The ability to perform original production acts, such as to create (manufacture, transport, observe), decide, judge.

  - **Informa**
    The ability to perform informational production acts, such as to remember, recall, compute (facts).

  - **Forma**
    The ability to perform documental production acts, such as to store, retrieve, transmit, copy (sentences, documents).
Intelligent System Partitioning

- **B-organisation**
  - creating
  - deciding
  - judging

- **I-organisation**
  - remembering
  - recalling
  - computing

- **D-organisation**
  - storing
  - retrieving
  - copying

---

Modelling the B-organisation

- **B-organisation**
- **I-organisation**
- **D-organisation**

---

© 7-14, IWI-HSG

Slide 33
Integrated System Perspectives

- **COORDINATION**
  - actors
  - transactions
- **PRODUCTION**
  - business processes
  - business events
  - business rules
  - work instructions

The essential model of an organization

- The essential model of an enterprise’s organization is the ontological model of its B-organization that comprises both interaction and interstriction.
What does the $\psi$-theory accomplish?

- By abstracting from realization and implementation (of the B-organization), a reduction of complexity is achieved.
- By 'compressing' the complete transaction pattern into one symbol, another reduction of complexity is achieved.

Does the $\psi$-theory help to reach the goals of Enterprise Engineering?

- Engineering enterprises:

  **Construction**
  Assembly of essential organizational building blocks

  **Operating principle**
  Entering into and complying with commitments by actors (actor role fullfillers), powered by some power source

  **Power source**
  People fuelled by Belgian beer and Flemish fries

  **Operating Theory**
  The EE-theories, in particular the $\psi$-theory
Agenda

1. Enterprise Engineering
2. Theoretical Basis
3. Practical Application
4. Enterprise Engineering Network

Design and Engineering Methodology for Organizations (DEMO)
Applying architecture and ontology to the splitting and allying of enterprises – The Rijkswaterstaat case

A scientific evaluation of telecom industry standards – The Alcatel-Lucent case
Towards a fast Enterprise Ontology based method for post merger integration – The KLM and Air France case

Agenda

1. Enterprise Engineering
2. Theoretical Basis
3. Practical Application
4. Enterprise Engineering Network
The CIAO! Network

- CIAO! stands for Communication, Information, Action & Organization
- The network (www.ciaonetwork.org) was founded in 2004 by Jan Dietz (Delft University of Technology) and Antonia Albani (University of St. Gallen)
- Current member institutes of the management board are:

<table>
<thead>
<tr>
<th>Institution</th>
<th>Professor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TU Delft (NL)</td>
<td>Prof. Jan Dietz</td>
</tr>
<tr>
<td>TU Lisboa (P)</td>
<td>Prof. José Tribolet, Prof. Pedro Sousa</td>
</tr>
<tr>
<td>University of Antwerpen/AMS (B)</td>
<td>Prof. Jan Hoogervorst, Prof. Henwig Mannaert, Prof. Hans Mulder, Prof. Martin Op 't Land, Prof. Jan Verelst</td>
</tr>
<tr>
<td>University of St. Gallen (CH)</td>
<td>Prof. Antonia Albani, Prof. Robert Winter</td>
</tr>
<tr>
<td>Higher School of Economics at Nizhny Novgorod (RU)</td>
<td>Prof. Eduard Babkin</td>
</tr>
<tr>
<td>Tokyo Institute of Technology (JP)</td>
<td>Prof. Junichi Iijima</td>
</tr>
<tr>
<td>University of Madeira (P)</td>
<td>Dr. David Aveiro</td>
</tr>
<tr>
<td>Public Research Centre – Henri Tudor (L)</td>
<td>Prof. Erik Proper</td>
</tr>
<tr>
<td>Czech Technical University Prague (CZ)</td>
<td>Prof. Jorge Sanz</td>
</tr>
<tr>
<td>IBM Research at Almeda (USA)</td>
<td>Robert Pergl, Dr. Joseph Barjis</td>
</tr>
<tr>
<td>University of Duisburg-Essen (DE)</td>
<td>Prof. Ulrich Frank</td>
</tr>
<tr>
<td>Federal University of Minas Gerais, Brazil (BR)</td>
<td>Prof. Marcello Bax, Prof. Mauricio Almeida, Prof. Renata Baracho</td>
</tr>
</tbody>
</table>

The CIAO! Mission

- CIAO! constitutes the scientific foundation of Enterprise Engineering
- CIAO! seeks to improve the societal performance of enterprises
  - CIAO! is human-centered: human communicative behavior is the starting point for investigating enterprises as well as the applicability of ICT
  - CIAO! is service-centered: enterprises deliver business services to each other. Information systems deliver information services to each other
- CIAO! paves the path towards a discipline of Enterprise Engineering
- Controls the execution of a common research agenda
- Stimulates exchanges of MSc and PhD students
Events supported by the CIAO! Network

- **Key event:**
  - Enterprise Engineering Working Conference (EEWC)

- **Interaction to other communities:**
  - TEE workshop @ CBI
  - E{T,E,A,M} tracks @ CBI
  - KEOD @ IC3K
  - ET tracks @ ECIS
  - EE tracks @ SAC ACM
  - EE tracks @ MCIS
  - EOMAS Workshop @ CAISE

The Enterprise Engineering Institute

- Manages DEMO as open standard
- Stimulates the application of DEMO and training in DEMO
- Manages the Register of Certified DEMO Professionals and offers a platform for meeting each other ([www.ee-institute.com](http://www.ee-institute.com))
- Current members of the board are:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joseph Barjis</td>
<td>professor Czech Technical University Prague</td>
</tr>
<tr>
<td>René Ceelen</td>
<td>director Cepo - secretary</td>
</tr>
<tr>
<td>Jos Hamilton</td>
<td>director Hamilton Consult</td>
</tr>
<tr>
<td>Jan Hoogervorst</td>
<td>former vice-president KLM, associate Sogeti</td>
</tr>
<tr>
<td>Philip Huysmans</td>
<td>professor University of Antwerp</td>
</tr>
<tr>
<td>Joop de Jong</td>
<td>director Mprise</td>
</tr>
<tr>
<td>Hans Mulder</td>
<td>director VIA Group - chairman</td>
</tr>
<tr>
<td>Bert Noorman</td>
<td>manager Sogeti</td>
</tr>
<tr>
<td>Martin Op 't Land</td>
<td>principal consultant Capgemini</td>
</tr>
<tr>
<td>Niek Pluijmert</td>
<td>director INQA - treasurer</td>
</tr>
<tr>
<td>Erik Proper</td>
<td>professor Tudor Institute</td>
</tr>
</tbody>
</table>