Virtual Organizations Breeding Environment (VBE)

Hamideh Afsarmanesh

University of Amsterdam
h.afsarmanesh@uva.nl

Lecture 4
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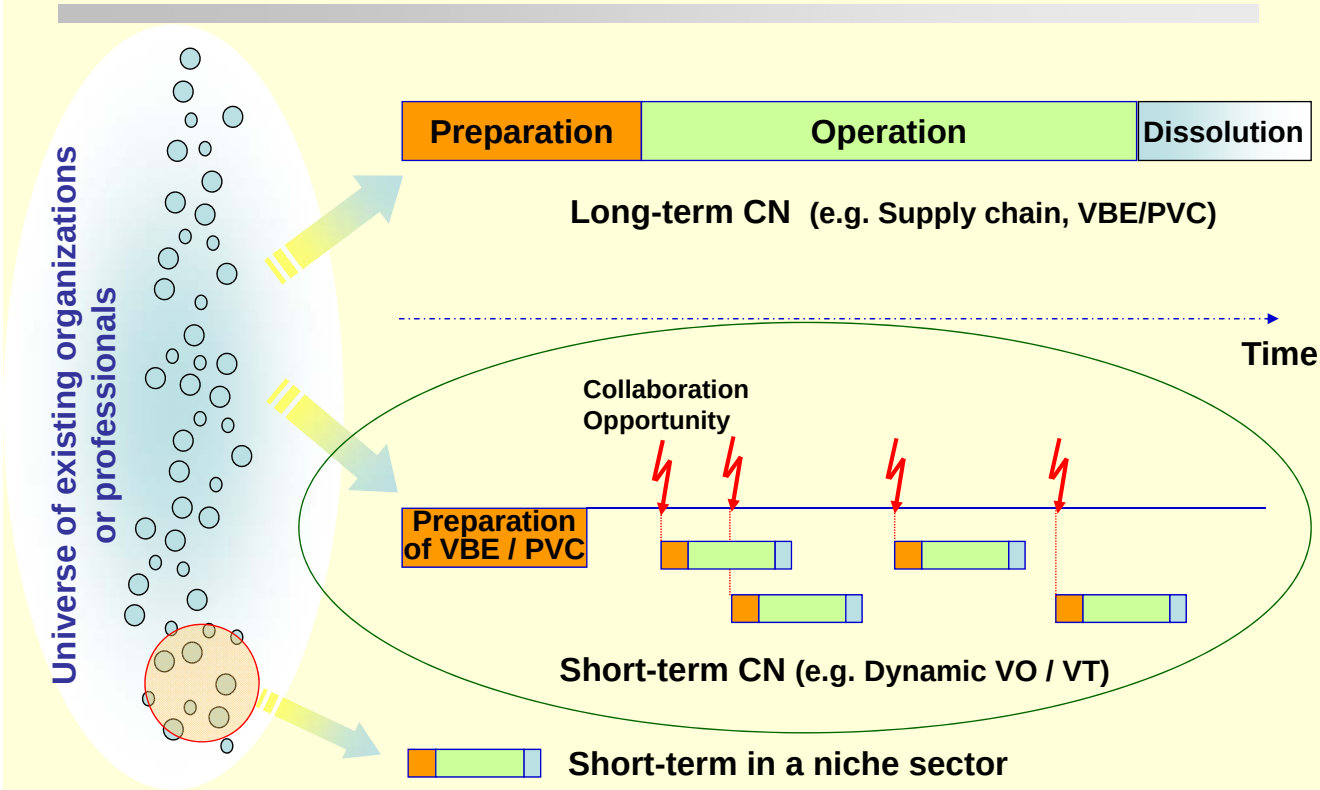
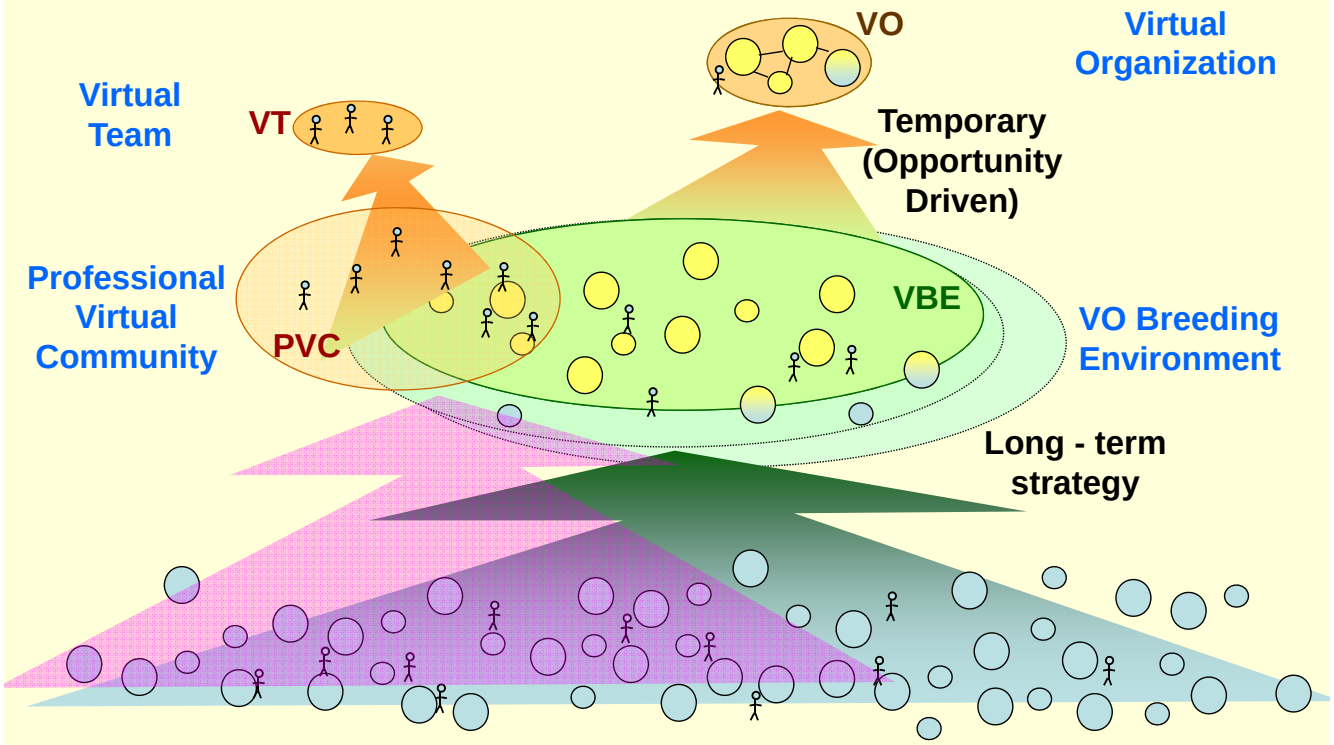
FORMATION OF CNs - Different kinds of CN



ROLE OF BREEDING ENVIRONMENTS



PRE-ESTABLISHMENT OF STRATEGIC ALLIENCE

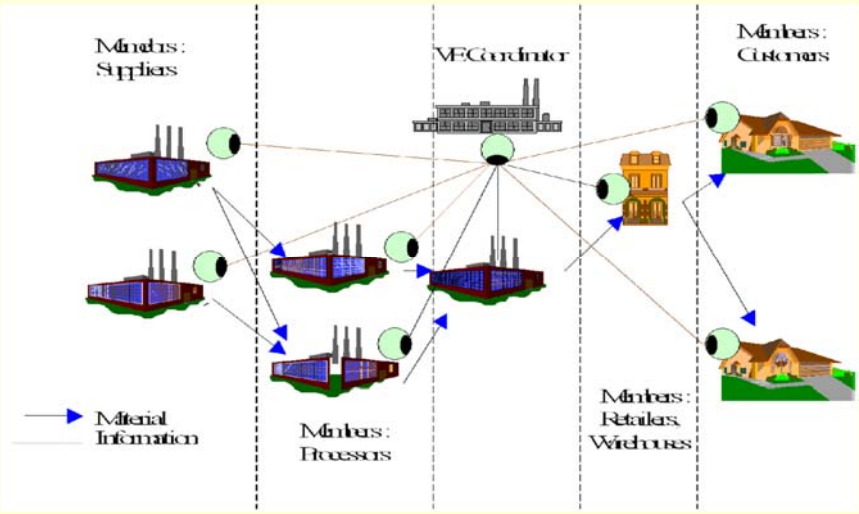
Before you can configure and establish a VO, you need to know who is who in the potential environment to select from ...

- ***Need for pre-establishment of strategic alliances (VBE) in different application areas that can facilitate the VO creation***

VIRTUAL ORGANIZATION (VO)

VO is a dynamic goal-oriented Collaborative Network (CN)

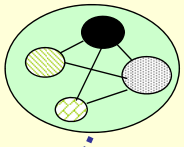
"A virtual organization is a temporary alliance of enterprises that come together to share skills, competencies, and resources in order to better respond to business opportunities, and whose collaboration is supported by computer networks."



VOs AND VBEs

2 MAIN KINDS OF CNs

VOs (Virtual Organizations - collaborating partners)
Cost-/time-effective creation of goal-oriented *dynamic VOs/VTs* requires an underlying strategic CN (i.e. VBE/PVC)

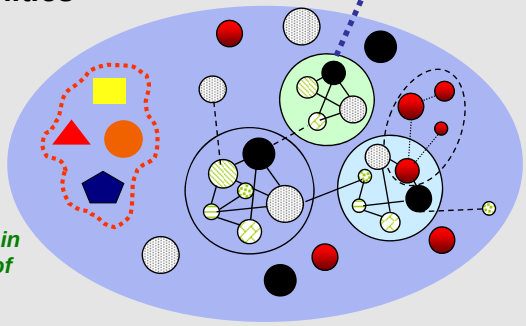


VBEs (Virtual organizations Breeding Environments – cooperating)
Long term strategic CNs – *VBEs* and *PVCs*) provide *necessary conditions*

- *required for effective configuration and formation of VOs/VTs at the strike of emerging collaboration opportunities*

e.g.:

- *Automated search and matching (with multi-dimensional ranking of groups of organizations/individuals) to best fit the required specificities of the Collaboration Opportunity (CO), e.g. a call for tender*
- *Measuring trustworthiness of actors*
- *Integration of legacy systems (DBs)*
- *Decomposing the CO into detailed characteristics, in order to compare against the qualifications/abilities of actors in the VBE/PVC*



- *prepare their members for collaboration in VOs/VTs*

e.g.:

long term agreements, common ICT infrastructure, common working/sharing policies

LONG-TERM ALLIANCES

"***VO Breeding environment*** **(VBE) – represents an association of organizations and their related supporting institutions, adhering to a base long term cooperation agreement, and adoption of common operating principles and infrastructures, with the main goal of increasing their preparedness towards rapid configuration of temporary alliances for collaboration in potential Virtual Organizations. Namely, when a collaboration opportunity is identified by one member (acting as a broker), a subset of VBE organizations can be selected to form a VE/VO**

Professional virtual community **(PVC) – represents an association combining the concepts of virtual community and professional community. Virtual communities are defined as social systems of networks of individuals, who use computer technologies to mediate their relationships. Professional communities provide environments for professionals to share the body of knowledge of their professions such as similar working cultures, problem perceptions, problem-solving techniques, professional values, and behavior.** "

SOME EXAMPLES OF VBEs

virtuelle-fabrik.com
Metal-mechanics sector
Switzerland, Germany

iecos Integration Engineering and Construction Systems
Engineering & Manufacturing
Mexico

ISOIN
Aeronautics sector
Spain

CeBeNetwork Engineering & IT
Aeronautics sector
Germany

Swiss Microtech Enterprise Network
Watch industry sector
Switzerland, China

ORONA eic
Metal-mechanics sector
Spain

Supply Network Shannon
Electronics sector
Ireland

Joensuun Tiedepuisto
netWork Oasis / Science Park
Finland

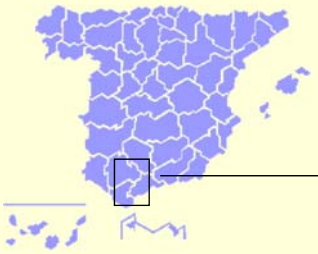
torinowireless ideas and enterprise
Telecommunications sector
Italy

KER KOUVOLA ENGINEERING REGION
Engineering
Finland

TechMoldes
Moulds industry
Brazil

Example:
ISOIN (Aerospace)

Andalusian Aeronautical cluster



EADS **3 PLANTS**

AIRBUS **1 PLANT**

fundación HÉLICE **93 SMES**
48 CORE

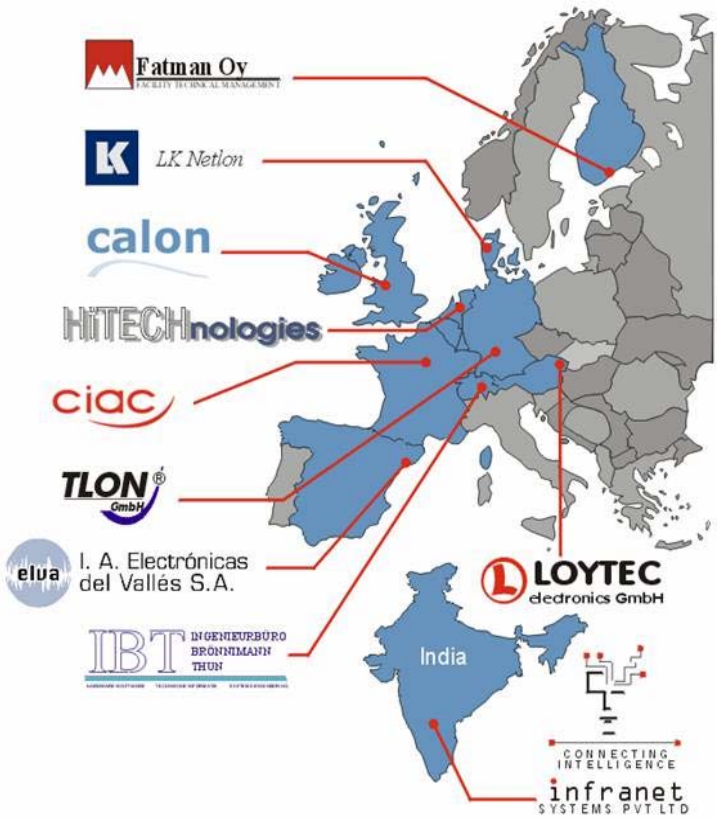
Employment 4.500
Turnover M€ 645
97% SMEs 123M€
(24% of Spanish SMEs)

All of them currently in expansion to make room for new programs A400M, A380, etc

Example:
Infranet-Partners (Telecommunication)

Infranet Partners is a network of small companies specialising in Infranet solutions based on LonWorks® technology. The network was established in 1999 with 4 founding members and today there are 10 participants in the network.

- **Creating a comprehensive pool of Technology and Application resources.**
- **Serving customers as a single organisation offering locally adapted solutions from this shared pool.**
- **Combining Product range under the Infranet Partners brand.**
- **Providing a comprehensive product range and support backed by frequent cross training.**
- **Providing a comprehensive Training program across Europe.**
- **Sharing technical support and knowledge of different markets to provide solutions for customers.**
- **Sharing marketing information using an advanced dynamic groupware marketing tool to enable them to act faster to meet customer requirements**

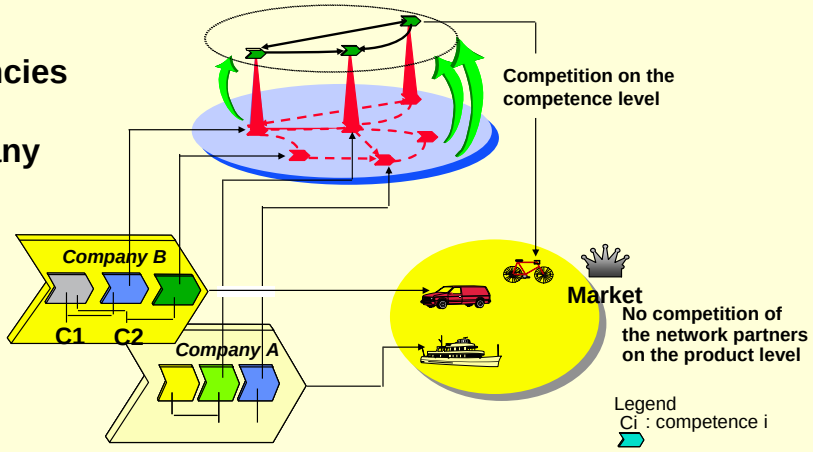


Example:
VIRTUELLE FABRIK (Electro-Mechanics)

Pool of SMEs

Machine building competencies

Switzerland & South Germany



Various sub-networks

Virtuelle Fabrik

Example:
CeBeNetwork (Aeronotics)

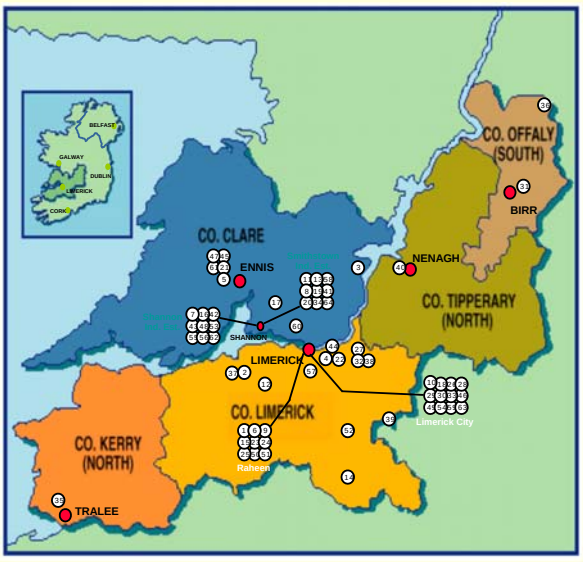
CeBeNetwork Group

- **Network:**
  - **More than 30 co-operation partners**
  - **More than 20 years aerospace experience**
  - **More than 5000 highly skilled engineers, scientists and technicians**
  - **EN 9100 quality management**
- **Engineering services**
  - **Prime contractor CeBeNetwork**
  - **Best in class solutions for specific and non specific design work**
- **IT services**
  - **6 IT companies in France, UK and Germany**
  - **High performance systems**
  - **B2B solutions**
- **Onsite experts**
  - **4 companies act as agents for international aerospace specialists**

Integrated Portfolio for Product Engineering

- **Testing & Aerodynamics**
- **Computer Aided Engineering**
- **Design Engineering**
- **Process & Technology Management**
- **Software Engineering**
- **Systems Engineering**

Example:
Supply Chain Shannon (Engineering Electronics)



Over 80 Engineering & Electronics Sub-Supply Companies in the Region

Sector Now Employing Over 4000

Large Multinationals located in the Region

Turnover in excess of €200m

Limited Export Activity Nationally or Internationally from Region

Competitive threats from economic downturn and low labour cost regions

25 companies in SNS

Example:
CONSEN Euro-Group

Grouping of European SMEs who have agreed to cooperate as Euro-Cluster in Information Society Technologies projects, tenders and business throughout Europe

CONSEN is a non-profit, independent and international consulting firm constituted in November of 2004 in Barcelona.

Open-Source Software, Contents, Standards, Infrastructures and Information Society Technologies

A member of CONSEN Partners network Grouping owns shares and pays an annual fee and receives benefits in four major areas:

- **research and innovation,**
- **marketing and promotion,**
- **network building, and**
- **organization.**

Example: SWISS MICROTECH

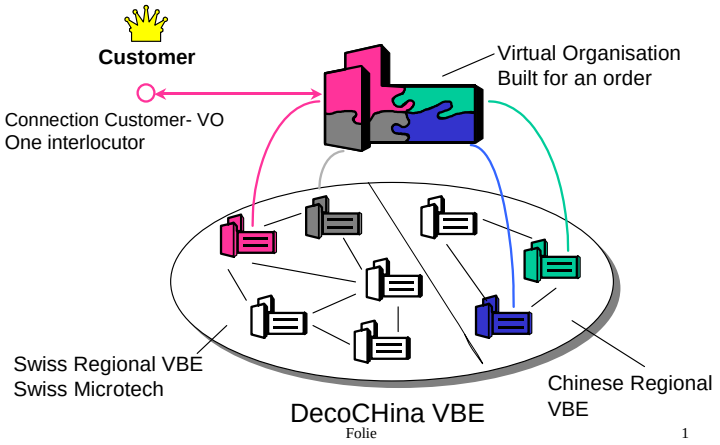
Enterprise Network (association):
- -Azurea Technologies SA
- - Boillat SA
- - DIXI Cylindre SA
- - Ravine SA
- - Detech SA
- - Groupe Estoppey-Reber SA
- - ADAX SA

Micromechanics
Network established in 2001

Interest to create own products of the network

Collaboration to China considered (China strategy is being built)

The DecoCHina global network



Folie 1

STUDY OF MORE THAN 100 EXISTING LONG-TERM NETWORKS / VBES (IN ECOLEAD)

E.g.

Case	Members	Location	Domain
Virtuelle Fabrik	100	Switzerland, Germany	Mechanical industry
Kiesel	>15	Germany	Services, Environment
Virtec	>9	Brazil	Manufacturing
CEFAMOL	136	Portugal	Plastic moulds
Virtual Enterprise Networks Yorkshire	>25	UK	IT, Machinery, Bio-tech, e-Learning
Bipolo Ticino	>13	Switzerland	Life sciences
Virtual Biotech Company	>150	Germany	Biotechnology
PVC	45	Australia	Plastics
Regional Net for Ontario	-	Canada	Telecommunications
VIRFERBRAS	>12	Brazil	Moulds
Fenix Cluster	>250	Mexico	Electronics, metal & plastic
Biotechnology cluster	411	USA	Biotechnology
Biotechnology cluster	>160	Canada	Agro-food, biotechnology
Advanced Business Services	>6	USA	Credit, lending, investments
Helsinki ICT cluster	79	Finland	Telecommunications
CARPI	2068	Italy	Textile / clothing
Mining Cluster	-	Chile	Mining industry
Motorsport Valley	40	UK	Motor-sport
Verkko A	12	Finland	Process industry
Automotive cluster	54	Slovenia	Automotive industry
Plasttechnics cluster	>60	Slovenia	Plastics

VBE CATEGORIES

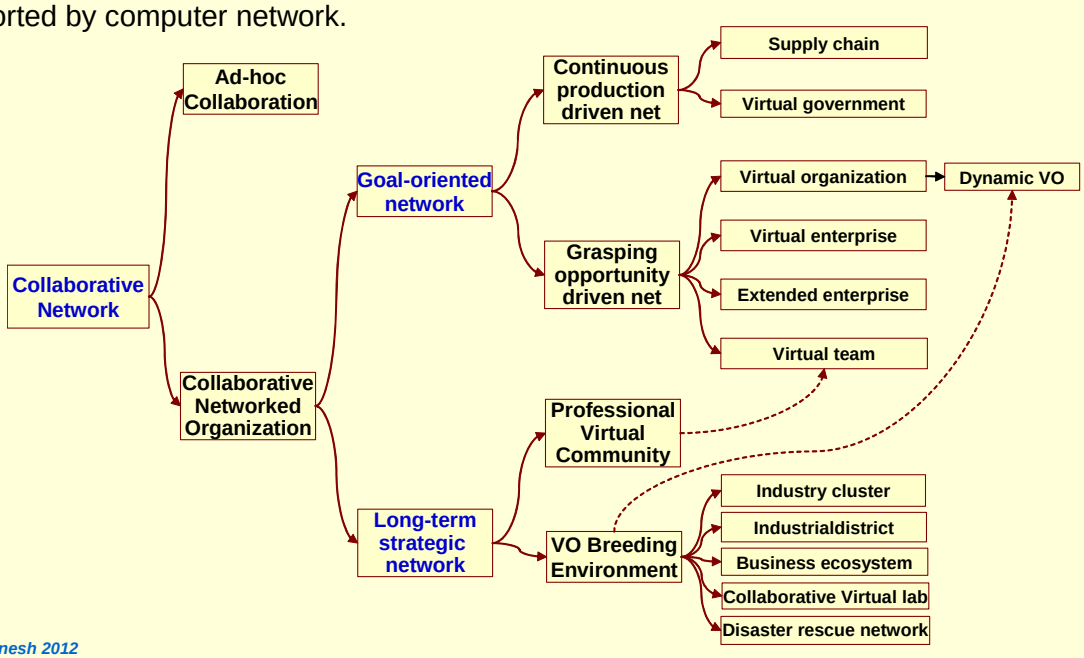
Main collaboration driver

- **Customer induced** ... To qualify as a supplier
- **Capacity achievement** ... Too big a "problem" / market
- **Complement competencies** ... New markets, new products, also dimmension
- **Regional ecosystem** ... To preserve local specificities, tradition, culture ... Benefit from government incentives

	Membership	Overlapping of competencies	Support institutions	Market access
A1 Customer induced	-Enterprises & other -Highly selective	-Possible	-Limited	-Extremely focused
A2 Capacity achievement	-Organizations in same domain/sector	-Mostly	-Limited	-Focused on a domain (in general)
A3 Complement competencies	-May cover various sectors -Basic adhesion rule	-Possible, limited (regulated)	-Limited	-Generic (as possible)
A4 Regional ecosystem	-Specific sector (mostly) -Regional basis	-Possible	-Strong	-Generic, with regional focus

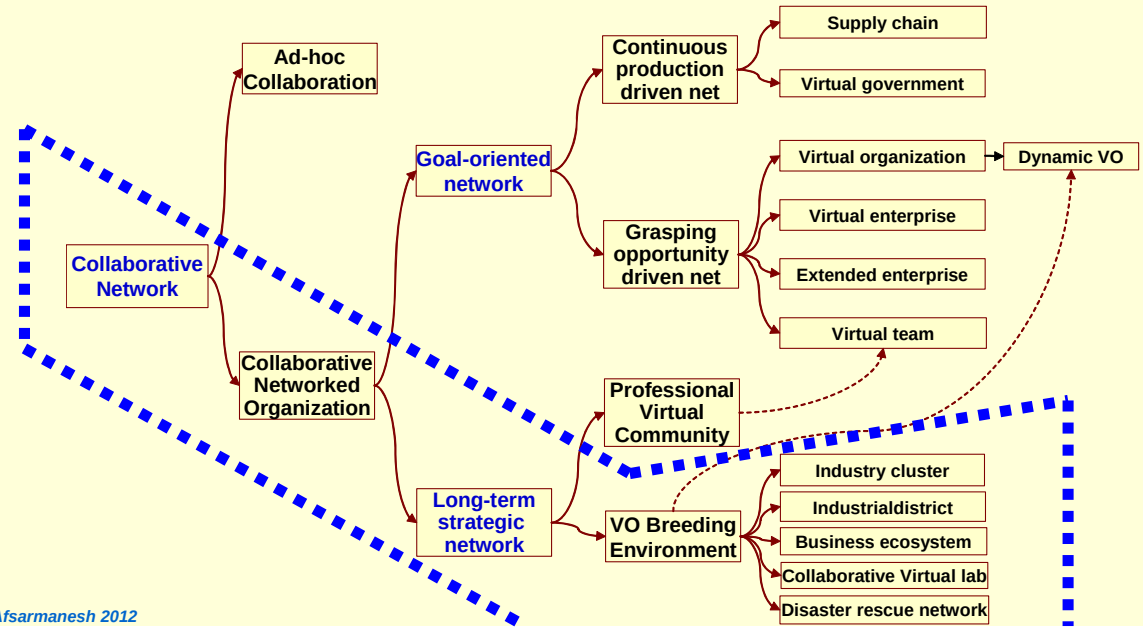
CN TAXONOMY

A **collaborative network** (CN) is an alliance constituted by a variety of entities (e.g. organizations and people) that are largely autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals, but that collaborate to better achieve common or compatible goals, and whose interactions are supported by computer network.

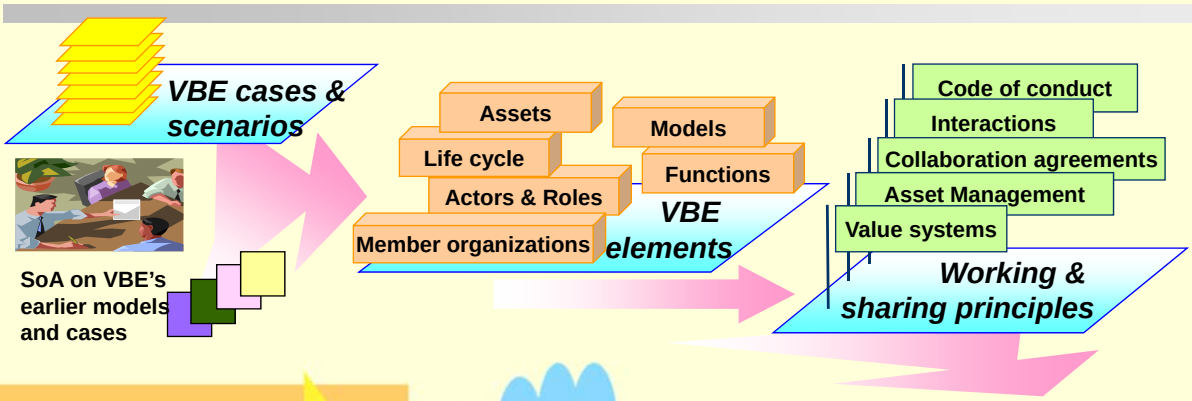


LONG TERM STRATEGIC ALLIANCE - VBE

A **collaborative network** (CN) is an alliance constituted by a variety of entities (e.g. organizations and people) that are largely autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals, but that collaborate to better achieve common or compatible goals, and whose interactions are supported by computer network.



VBE – REQUIREMENTS ANALYSIS



- **Need to Revisit Business Perspective**
- **Need for advanced research in:**
  - **Comprehensive characterization**
  - **VBE Typology**
  - **Reference modeling**
  - **Concepts/Functionality of VMS**
  - **Conc./funct. Of VO creation**

SOME REASONS TO JOIN A VBE

Market-related reasons

- Coping with market turbulence
- Increase chances of survival
- More chances to compete with larger companies
- Lobbying & market influence (branding / marketing)
- Easier access to loans
- Cheaper group insurance
- Better negotiation power (e.g. Joint purchasing)
- Prestige, reputation, reference
- Access to /explore new market /product (e.g. Multidisciplinary sector)
- Expand geographical coverage
- Increase potential for innovation
- Economy of scale
- Achieve (global) diversity
- ...

Organizational reasons

- Management of competencies and resources
- Approaches to build trust
- Improve potential of risk taking
- Support members through necessary re-organization
- Learning & training
- Shared bag of assets
- Organize success stories & joint advertisement
- Help in attaining clear focus / developing core competencies
- ...

Preparedness

- Agility for opportunity-based VO creation
- Effective common ICT infrastructure
- Mechanisms, guidelines for VO creation
- General guidelines for collaboration
- Increase chances of VO involvement
- ...

WHY REMAINING IN A VBE?

The initial attracting factors are not exactly the same that keep members happy in the long run!

- Profit from businesses
- Benefiting from the existing infrastructure
- Better marketing possibilities (fairs, cheaper admission costs, better publicity/visibility (better location) …)
- Better strategic position through the VBE
- Easy access to complementary skills
- Explore new market / new product (multi-disciplinary-sector), expand geographical coverage
- Potential for innovation
- Continue profiting from the opportunities only available through the VBE
- Fight against a common enemy
- Better negotiation power
- Existing success stories and advertising
- Gain higher rank for more opportunities

Need for objective indicators!

SYSTEM OF INCENTIVES

to attract and maintain VBE members

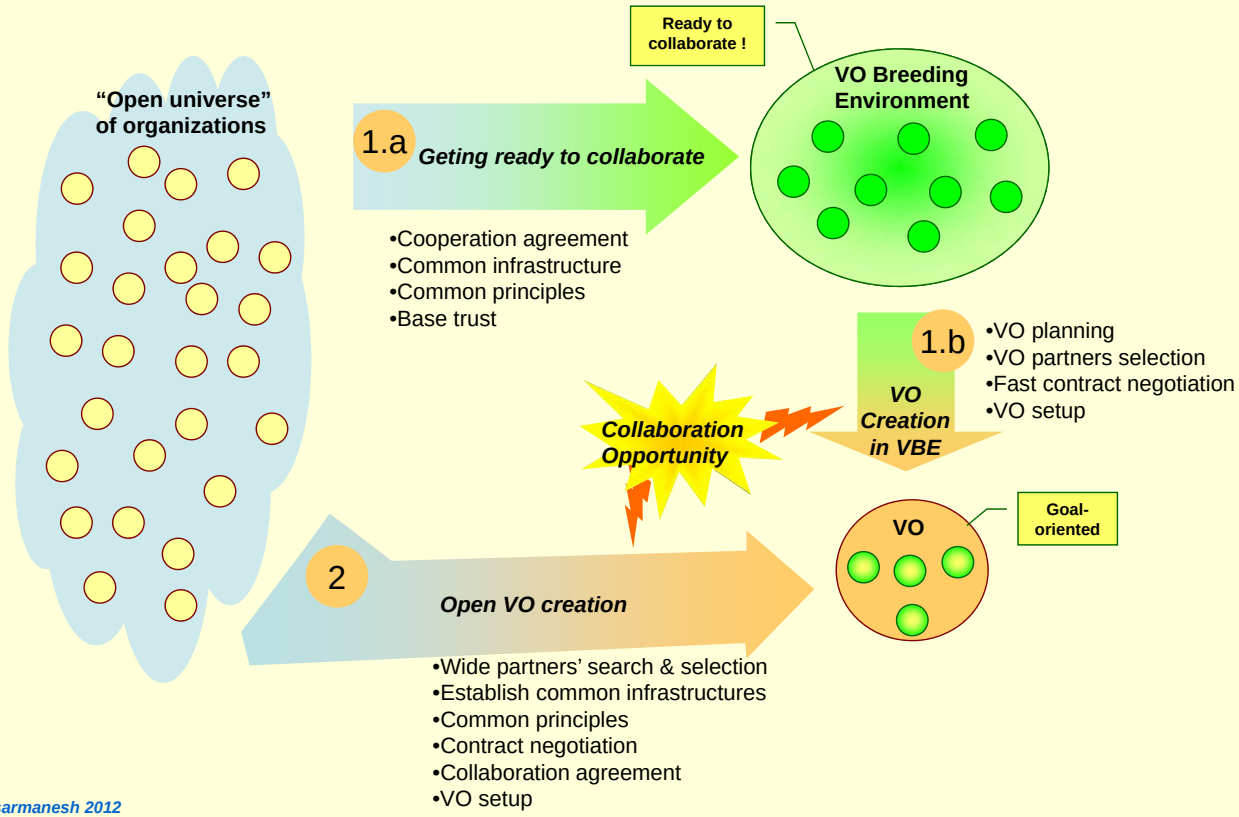
Example incentives:

1. ***For business related VBEs:*** economic profit and knowledge:
   - (i) Guaranteed participation in a given number of VOs during a given period of time (difficult to materialize in practice),
   - (ii) Access to a set of basic tools etc. provided in the VBE bag of assets,
   - (iii) Access to other members public profiles,
   - (iv) Tutorials, Courses and Conferences to enhance productivity (and core competencies) in companies,
   - (v) Initial evaluation of the member, and commitment to provide constructive suggestions/advice to better its status in a given period of time.
2. ***For universities:*** the openness of VBE projects, possibility for student practices, early introduction to industry practices, and better links between industry and academia
3. ***For R&D organizations:*** the exploitation of their technological advances, and links between research and market
4. ***For government organization involvement:*** directly related to the social and economic impact of the VBE, e.g.: increase in employment rates, increase in gross product, better infrastructures, and SME developments.

Awards and Sanctions → **As a base incentive for VBE members, a set of rules that are defined to collect "points" (e.g. for taking active roles) to receive more benefits**

[Afsarmanesh, 2007]

CREATION OF VO – 2 APPROACHES



VBE ACTORS, ROLES AND RIGHTS

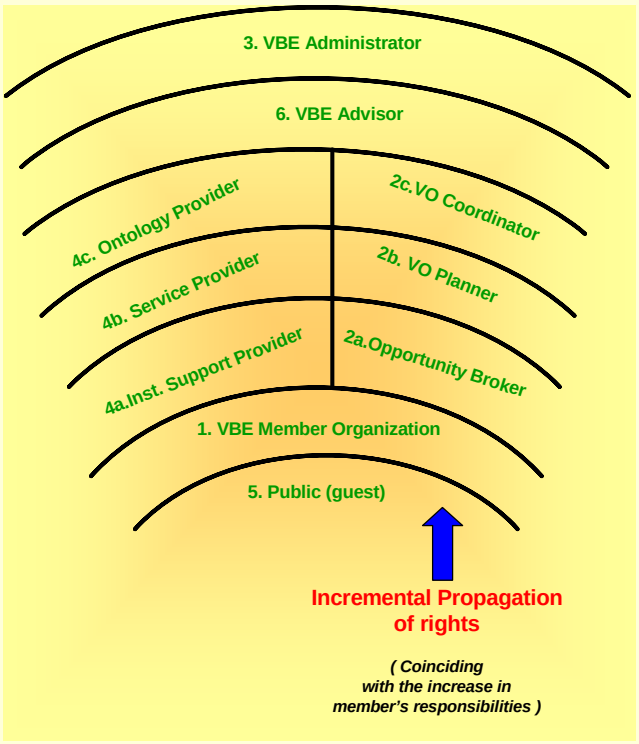
Main roles:

- **VBE Administrator (Manager/Coach)**
- **Opportunity broker**
- **VO planner (Integrator)**
- **VO coordinator**
- **VBE Member**

Other roles:

- **Support institution assistance provider**
- **Common tools/services provider**
- **Common Ontology provider**
- **VBE advisor (board)**
- **Public (guest)**

One actor can play multiple roles simultaneously



[Afsarmanesh, 2007]

SOME DIFFICULTIES IN COLLABORATION

- **Resources** – ownership and sharing of resources is a typical difficulty, whether it relates to resources brought in by members or resources acquired by the coalition for the purpose of performing the task.
- **Rewards** – finding a fair way of determining the individual contributions to a joint intellectual property creation is a rather challenging issue. Intellectual property creation is not linearly related to the proportion of resources invested by each party. At the very base of this issue is the need to reach a common perception of the exchanged values, which requires the definition of a benefits model and a system of incentives, based on a common value system.
- **Commitments** – whenever there is an attack or any other obstacle to the collaboration do parties respond as a whole, facing the consequences together, or do each one try to "save its neck"?
- **Responsibilities** – a typical phenomenon in collective endeavors is the dilution of responsibility. A successful collaboration depends on sharing the responsibilities, both during the process of achieving the goal, and also the liabilities after the end of the collaboration.

These issues must be settled by a set of common working and sharing principles.

THE MAIN ICT NEEDS

What ICT support is needed for CNs?

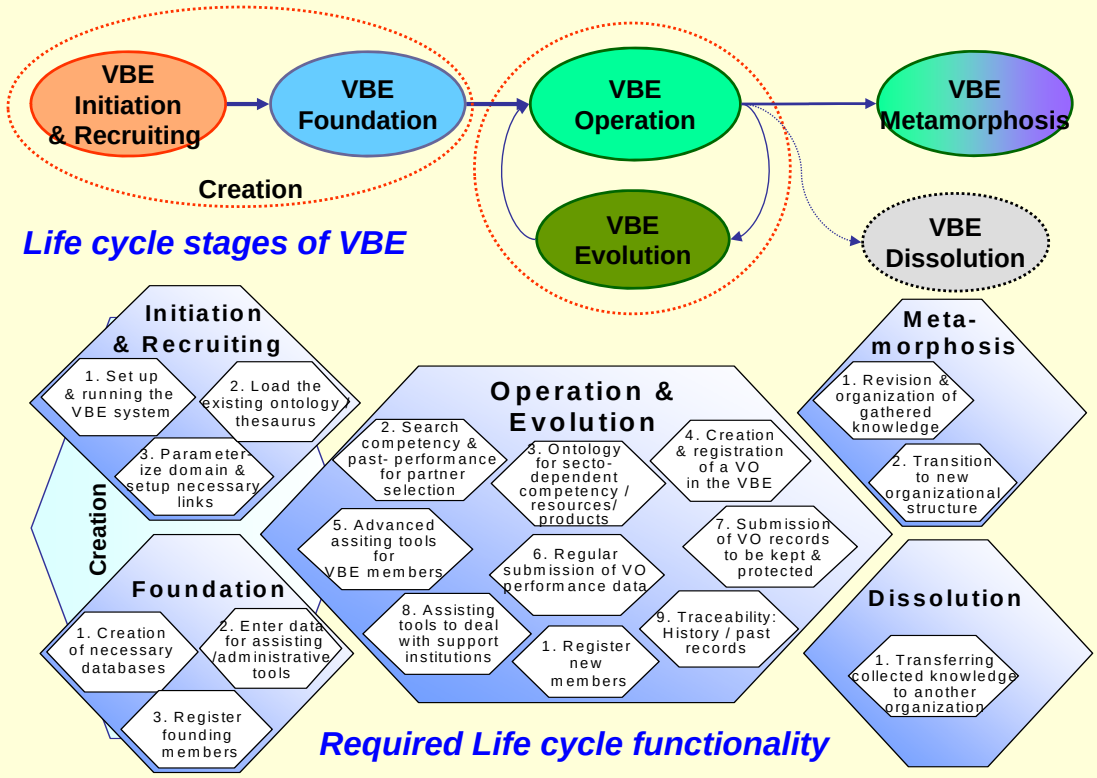
ICT infrastructure:

- **Safe communications, Information sharing, Coordination**
- **Interoperability and legacy systems integration**
- **Collaboration platform**
- **...**

ICT services: ***(Supporting all phases of CN life cycle)***

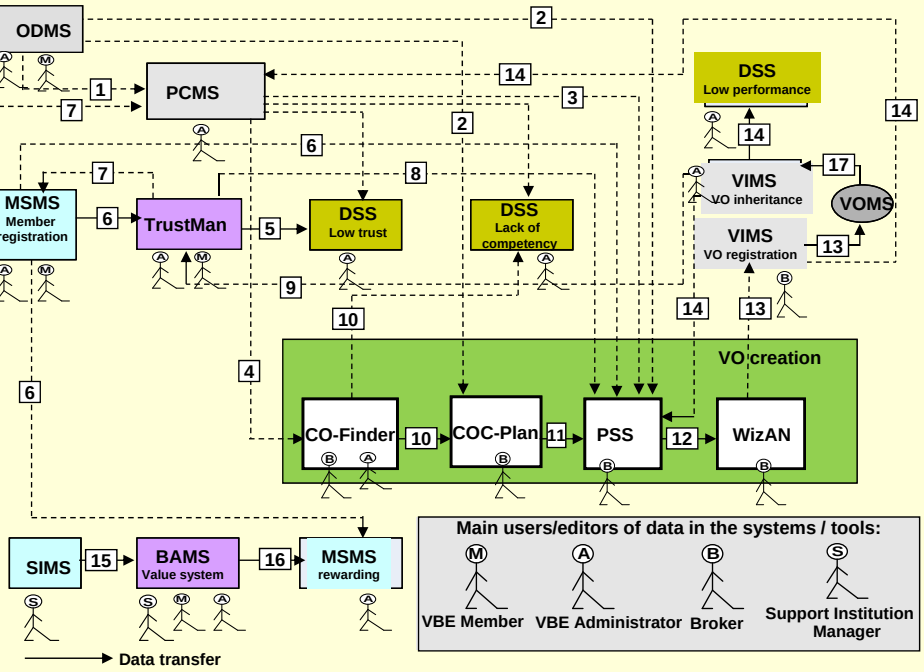
- **Creation: Planning, partners selection, negotiation, contracting, ...**
- **Operation: Management, Conflict resolution, Performance management, ...**
- **Evolution: Partners search, reconfiguration, ...**
- **Dissolution: Inheritance mechanisms, ...**
- **...**

VBE LIFE CYCLE FUNCTIONALITIES



[Afsarmanesh, 2007]

VBE management system – Main sub-systems



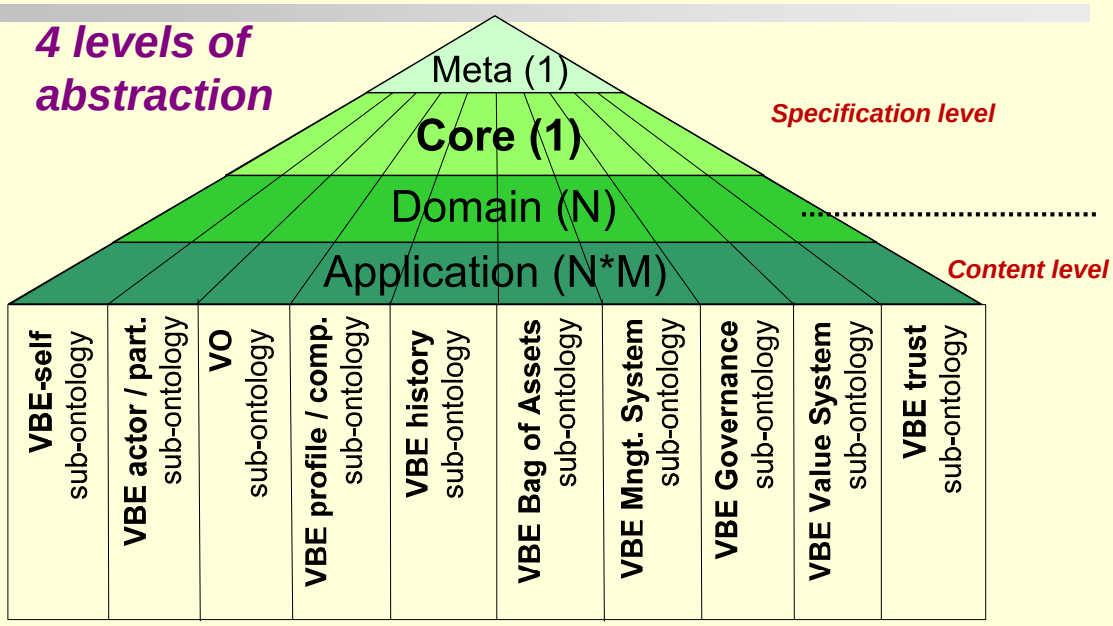
1	Profile/competency classification	6	Members' general data	12	VO model and candidate partners
2	Profile/competency element classification	7	Bas trust level of membership applicants	13	VO model and VO partners
3	Member's competency specification	8	Specific trustworthiness of VO partners	14	Processed VO inheritance
4	Competency classes	9	Organizations' performance data from the VO	15	Support institutions' general data
5	Low base trust level of organizations	10	Collaborative opportunities' definitions	16	Asset contributors' general data
		11	VO model	17	VO inheritance

3 SUBSYSTEMS SUPPORTING VBE

VBE Information Sub-Systems

- **Ontology management**
- **Profile & Competency management**
- **Trust management**

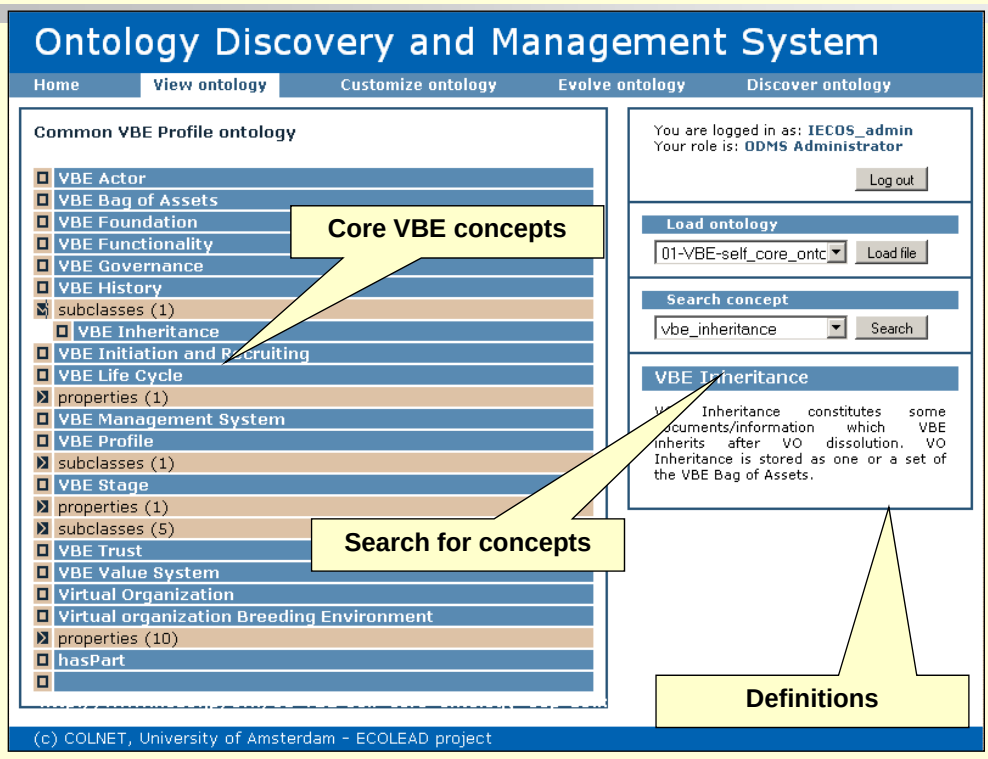
Unified VBE ontology specification



10 sub-ontologies

(complementary VBE knowledge partitions)

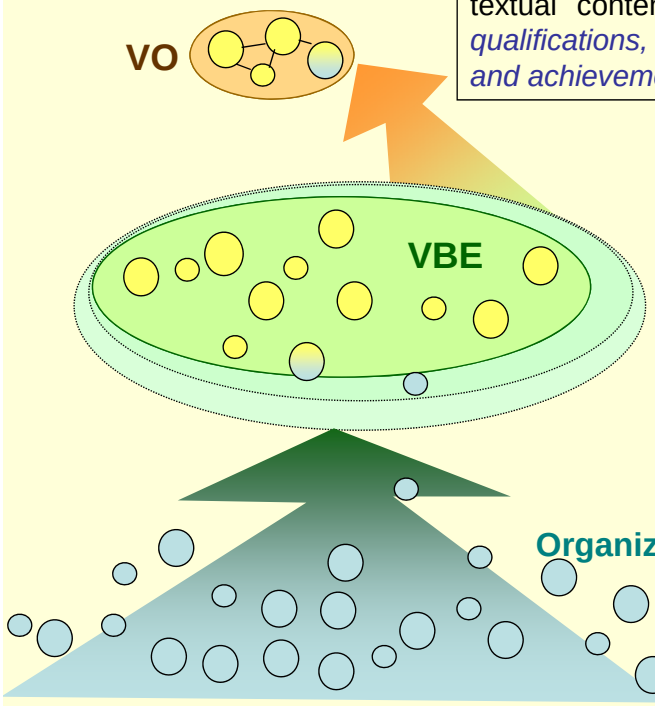
GUI for VBE ontology management system



(Inspired by Protégé, but simpler and tailored for VBE actors, to navigate, edit, and use for discovery)

MAIN COMPONENTS OF VBE PROFILES

The ***VBE profiles*** provide structured descriptions (mostly textual content) about the VBE entities, addressing their *qualifications, and the records of their related past activities and achievements*.



- Introduction to the VBE members
- Evaluation of the VBE performance
- Introduction / advertising in the market / society

VO profile

- Promotion towards new members and customers
- Provision of up-to-date information about the VBE to the VBE members

VBE profile

- Creation of awareness inside the VBE
- Selection of partners for new VOs
- Evaluation of members by the VBE administration
- Introduction / advertising in the marker / society

Organization *profile*

[Afsarmanesh, 2007]

VBE Competency model – Supporting dynamic / agile VO creation

- **Currently large VBEs fail chances to respond to emerging collaboration opportunities due to inability to dynamically process and analyse the competencies (i.e. qualifications and abilities) of their member organizations**

- **For dynamic/agile configuration and creation of a VO, competencies of the VBE actors must be matched against the detailed specificities of the CO to which it is planned to respond**

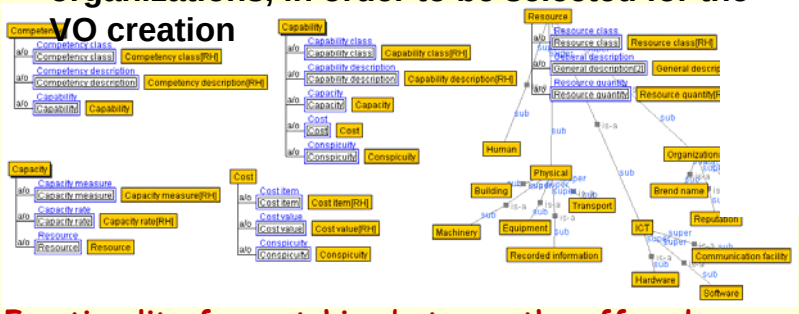
Example call for tender

Bidding Type	International Competitive Bidding
Project Name	CAIRO NORTH COMBINED-CYCLE POWER PLANT PROJECT (THE EGYPTIAN ELECTRICITY HOLDING COMPANY (EEHC), A JOINT STOCK COMPANY ESTABLISHED BY LAW NO. 164 YEAR 2000 (FORMERLY EGYPTIAN ELECTRICITY AUTHORITY), HAS SECURED A LOAN FROM THE ARAB FUND FOR ECONOMIC AND SOCIAL DEVELOPMENT AND HAS REQUESTED THE PARTICIPATION OF THE EUROPEAN INVESTMENT BANK (EIB) TO FINANCE THE PROCUREMENT OF MATERIALS AND ASSOCIATED SERVICES FOR SEVERAL PACKAGES OF THE CAIRO NORTH COMBINED-CYCLE POWER PLANT PROJECT)(
Financier	
Tender Notice No.	Not Provided
Description	DESIGN, FABRICATION, FURNISHING, DELIVERY, INSTALLATION, TRAINING, TESTING, START-UP AND COMMISSIONING FOR 2 X 250 MW (ISO) GAS TURBINE GENERATORS AND AUXILIARIES (TWO 250 MW (ISO) COMBUSTION TURBINE GENERATORS, AND ONE 250 MW (NOMINAL) STEAM TURBINE GENERATOR), INCLUDING ALL MECHANICAL AND ELECTRICAL WORK REQUIRED FOR A COMPLETE OPERATIONAL SYSTEM.

A collaboration Opportunity (CO)

The 4C-model of VBE competency

We have identified the generic set of elements constituting VBE members' competencies, i.e. with the 4C-model *(including the Capabilities + Capacities + Costs + Conspicuities)*, that comprehensively specifies the needed information from VBE member organizations, in order to be selected for the VO creation

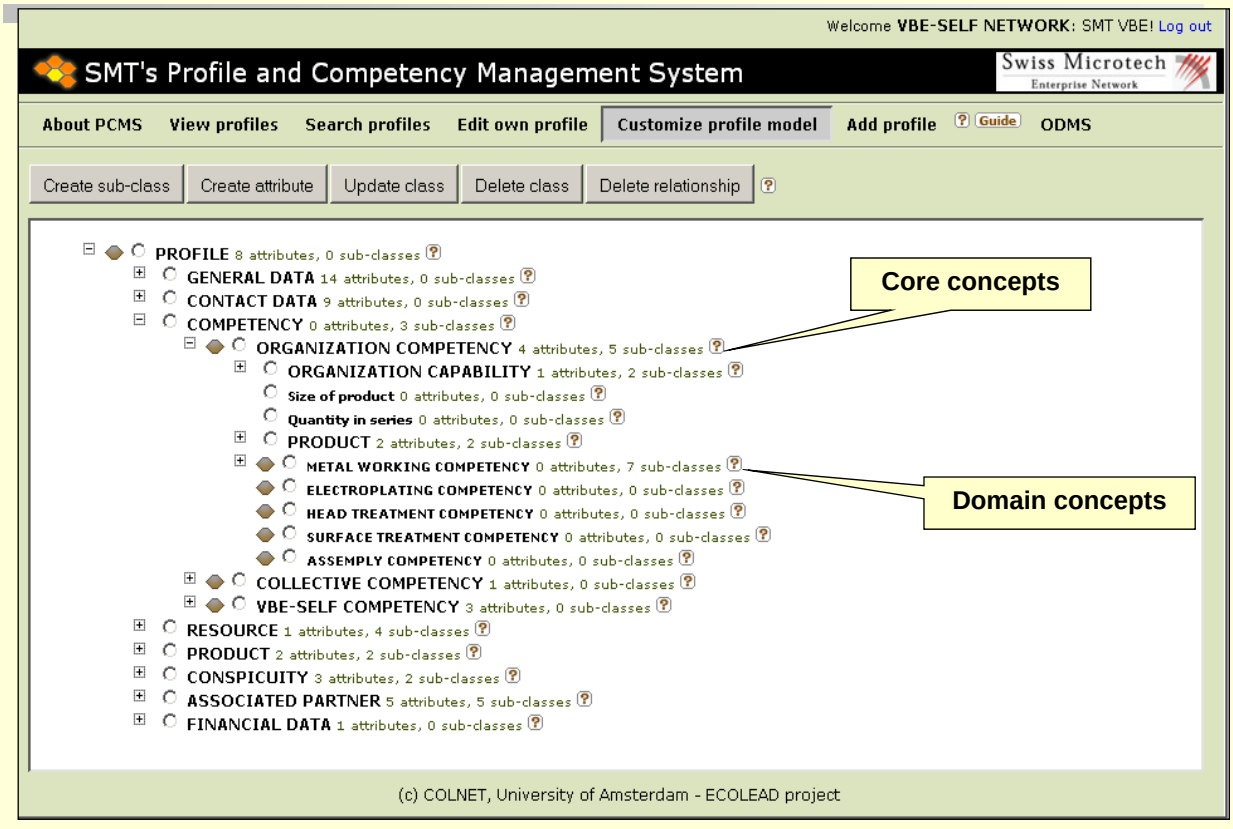


- **Competency**
  - Competency class
  - Competency description
  - **Capability**
    - Capability class
    - Capability description
    - **Capacity**
      - Capacity measure
      - Capacity rate
      - *Resource*
        - Resource class
        - Resource description
        - Resource quantity
      - *Conspicuity*
    - *Product*
    - **Cost**
      - Cost item
      - Cost value
      - *Conspicuity*
    - **Conspicuity**
      - Conspicuity class
      - Document title
      - Document ID
      - Issuer
      - Validity period

Functionality for matching between the offered competencies by VBE actors, against the CO specificities (weighted multi-dimensional match), supported by other applicable functionalities from ontology engineering

Generic comprehensive 4C-model of competency

GUI for competency management system



TRUST IN VBEs

WHY TRUST?

Based on earlier research…

- 50-80% of inter-organizational relationships fail
- Trust as a critical factor in inter-organizational relationships

It is important to understand trust…

- nature of trust
- dynamics in trust
- how to build trust?
- how to measure trust?
- trust building tools?

[Blomqvist, 2004]

TRUST – WHEN NEEDED IN VBEs

WHEN IS TRUST NEEDED?

The higher the uncertainty...

- emerging technologies
- emerging markets
- economic situation
- risky projects
- new business models

The higher the turbulence...

- blurring industry boundaries
- convergence
- consolidation

The higher the need for speed...

- law of increasing returns
- dominant market position
- fast-track projects

The higher the complexity...

- systemic products
- inter-disciplinary knowledge
- switching costs
- web of partners is needed

The higher the asymmetry...

- complementary knowledge
- diverse actors
- different cultures
- different power

The higher the need for innovation...

- knowledge-workers
- complementary knowledge
- voluntary nature of innovation
- commitment

…the higher the need for trust

[Blomqvist, 2004]

TRUST IN VBEs

-How to establish and promote trust in VBEs:

- Among member organizations in the VBE?
- Between the organization and the VBE administration?
- Between the customer and the VBE?

- How can the VBE management system (VMS) assist member organizations in:

- Assessing current trust levels of other organizations in the VBE?
- Foreseeing their trustworthiness in the coming time?
- Establishing trust relationships with each other?

Trust level assessment & management

Perspective	Requirements	Trust criteria
1. Structural	Structural strength	Size
		Competencies
		Personnel experts
	Business strength	Centres
		Geographical coverage
		Workload allocation
		Joint ventures
2. Social	Community participation	Activities participated
		Service contribution
	Community compliance	Standards complied
3. Economical	Capital	Cash
		Physical capital
		Material capital
	Financial stability	Cash in
		Cash out
		Profit/Loss
		Operational costs
	VO - financial stability	Cash in
		Cash out
		Profit/Loss
	Financial standards	Auditing standards
		Auditing frequency
4. Technological	ICT- Infrastructure	Network speed (Broadband)
		Interoperability
		Availability
	Technology standards	Protocol standards
		Software standards
		Hardware standards
		Security standards
	Platforms	Operating systems
		Programming languages
	Platform experience	VO based experience
		External project based experience
		Duration held
5. Managerial	Stable management	Years in power
		Management structure
		Frequency of power change
	VO-Collaborative behaviour	VO opportunistic behaviour occurred
		VO successful collaborations
		VO participation as organizer/leader
	Reliability	Quality
		Adherence to delivery dates

Set of trust elements

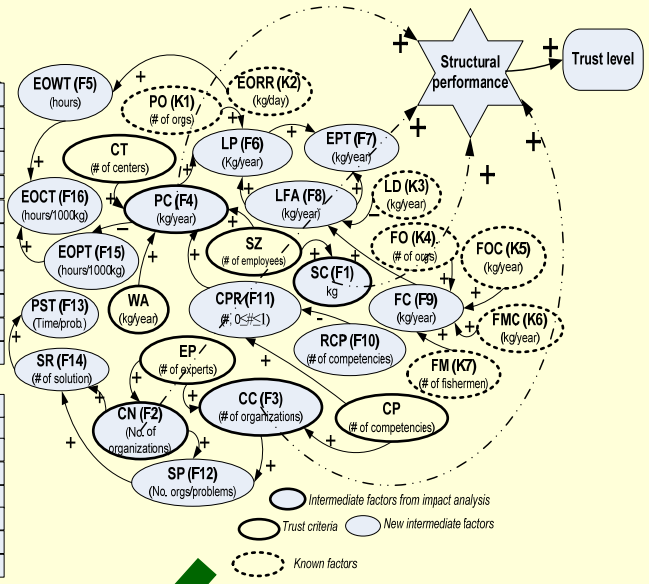
Trust assessment – Causal analysis

- **Analyzing causal influences among trust criteria, intermediate factors and known factors**
- **Translating causal influences into mathematical equations**

applies concepts inspired by system dynamics discipline

Intermediate Factors		
F5	Export order waiting time	EOWT
F6	Local processing	LP
F7	Export	EPT
F8	Local fish availability	LFA
F9	Fishing capacity	FC
F10	Required competency	RCP
F11	Competency ration	CPR
F12	Shared problems	SP
F13	Problem solving time	PST
F14	Solution re-use	SR
F15	Export order processing time	EOPT
F16	Export order completion time	EOCT

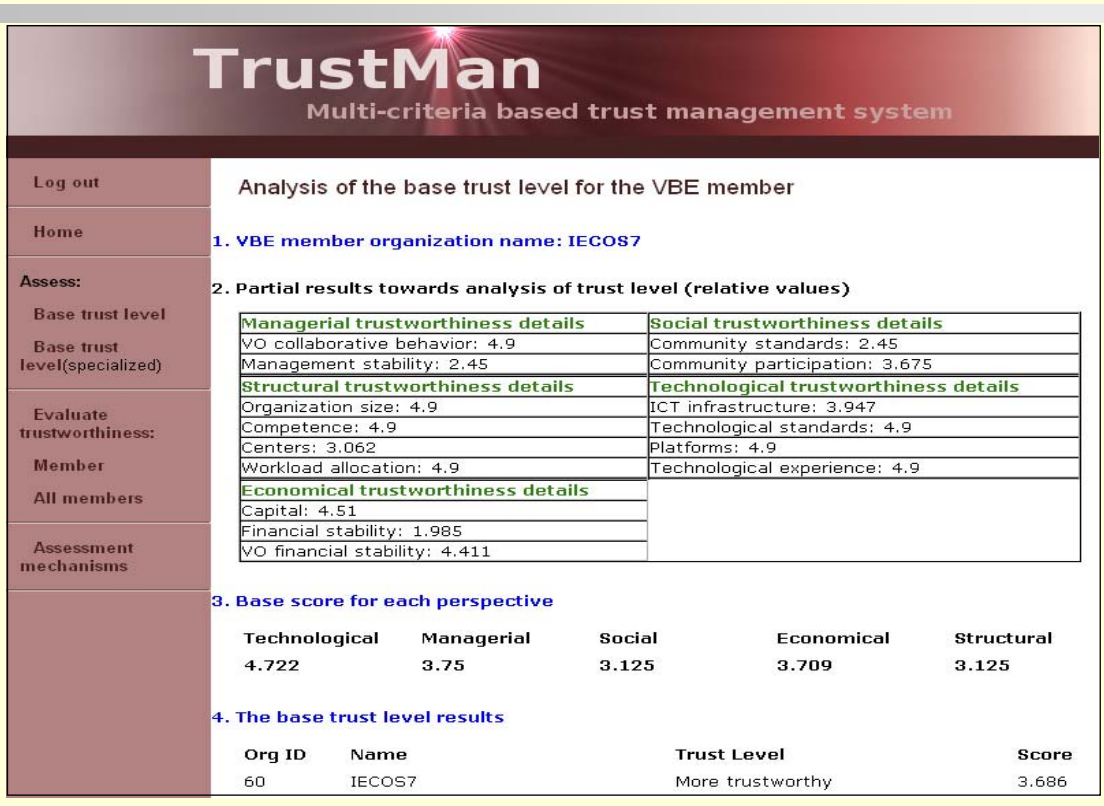
Known Factors		
K1	Processing organization	PO
K2	Export order request rate	EORR
K3	Local demand	LD
K4	Fishing organizations	FO
K5	Fishing organization capacity	FOC
K6	Fishermen capacity	FMC
K7	Fishermen	FM



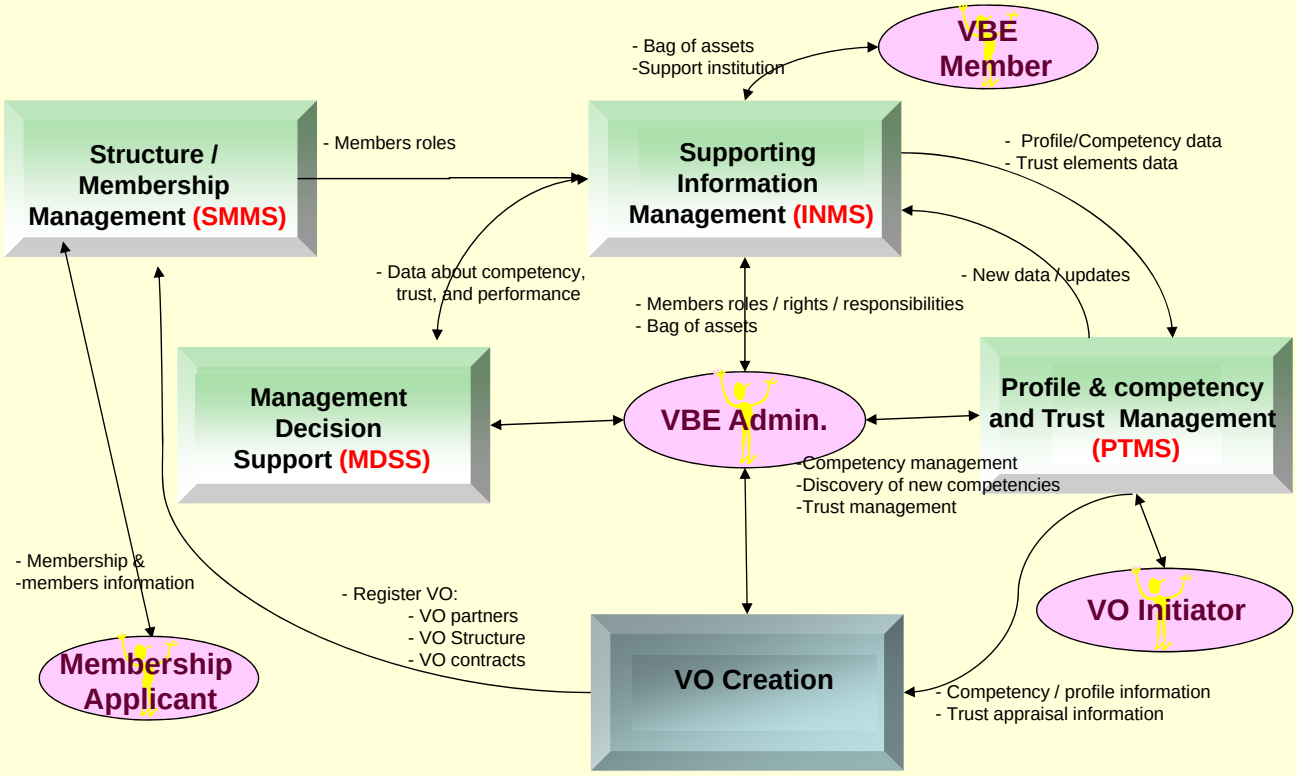
$$PC = SZ * WA * \frac{CP}{RCP} * CT$$

PC: Production capacity
SZ: Size
WA: Workload allocation
CP: Competency
RCP: Required competencies
CT: Centers

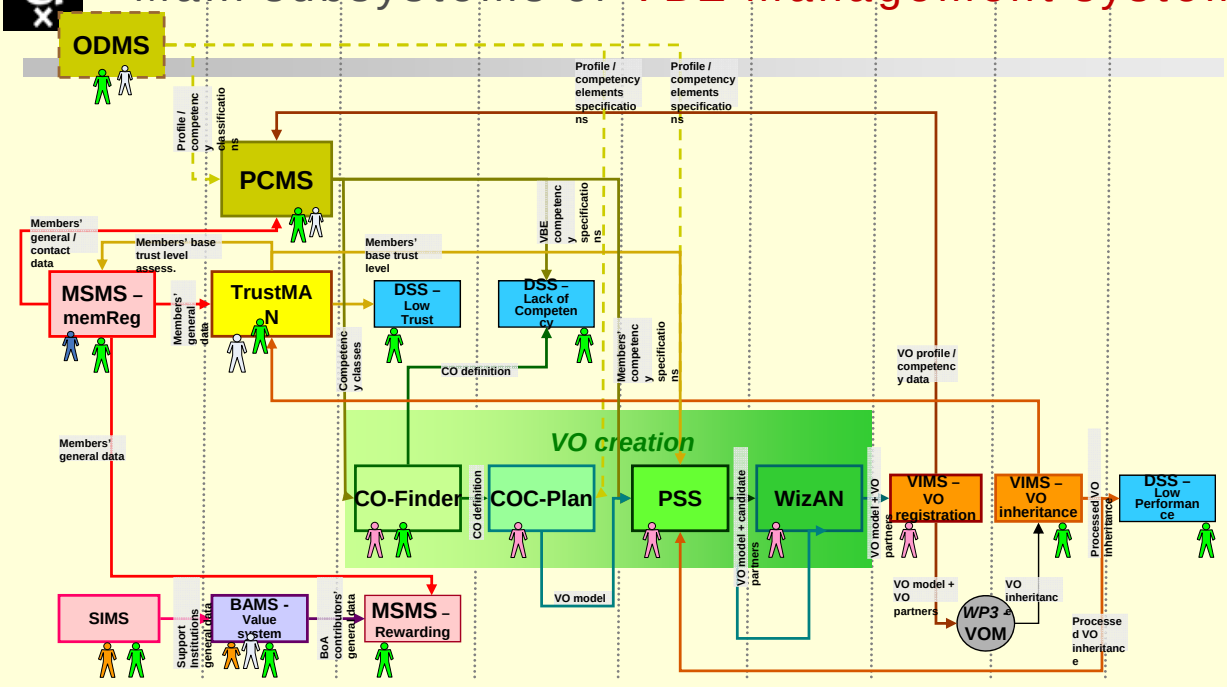
Trust management system GUI



ECOLEAD: VMS ARCHITECTURE & USERS



Main subsystems of VBE management system



Data transfer:

* In the color of their originator

Main users/editors of data in the systems / tools:

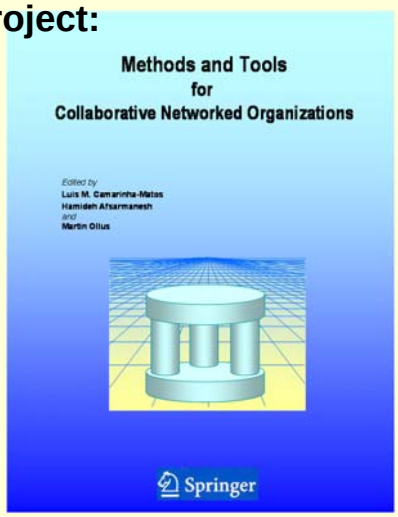
- VBE Administrator (Steven Carroll)
- VBE Member (Walter Vanegas ASMA Director)
- VBE Member Robert More (MM) Paula Nelson (ALCA)
- Broker (Alexandra White)
- Support Institution Manager

Conclusion

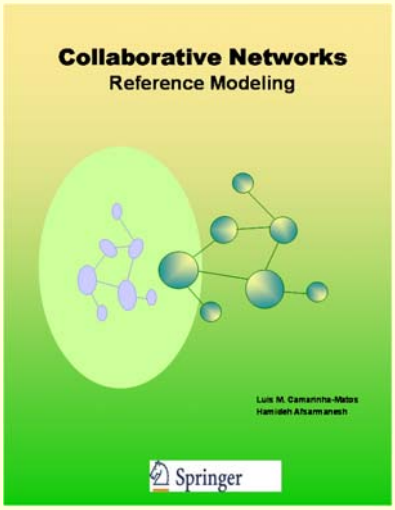
- Collaborative Networks manifest in a wide and growing range of application scenarios.
- Pre-establishment of supporting long-term strategic alliances, can provide the needed environment for creation of cost- and time-effective dynamic virtual organizations and virtual teams.
- Gathering up-to-date information on wide variety of aspects are necessary for efficient creation of dynamic opportunity-based collaborative networks.
- A main challenging criterion for the success of collaborative networks is the effective management of the wide variety of information that needs to be handled inside the CNs to support their functional dimension.
- Advanced CN support platforms require modeling and management of heterogeneous and incomplete & imprecise information, which calls for a combination of approaches such as federated databases, ontology engineering, computational intelligence, and qualitative modeling and reasoning.

To read more on CNs

More details on many of the mentioned subjects can be found in the following two books generated through the results of ECOLEAD project:



Methods and tools for Collaborative Networked Organizations
L.M. Camarinha-Matos, H. Afsarmanesh, M. Ollus (Ed.s)
Springer, 2008.



Collaborative Networks: Reference Modeling
L.M. Camarinha-Matos, H. Afsarmanesh
Springer, 2008