Approaches and Challenges in Viable Service Systems Development. Contributions from INSEED.

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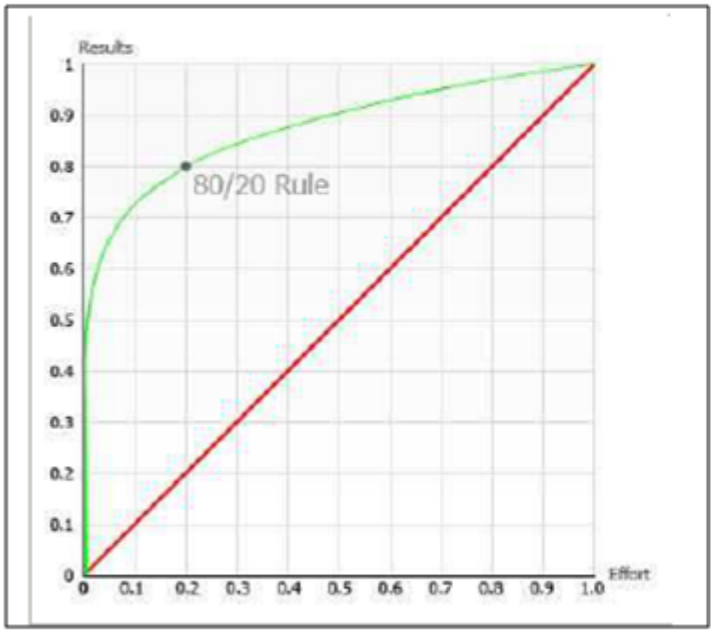
Summary

- Origins of the Viable System Model (VSM). The Enterprise model of Stafford Beer (1972→)
  - The enterprise “surviving” in its environment: complexity
- Service Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)
  - Not the (service) enterprise per se, but the intangible providers-clients relations, as Complex Service Systems with aggregated behaviour, balancing internal components and external constraints
- Theory of Constraints (TOC) and its extension Service Systems (Goldratt Institute, 1986 →)
  - TOC firstly applied to manufacturing and distribution, but managing constraints is crucial for system viability, so TOC for Services (Demirkan, IBM, 2011) extends TOC for software projects (Anderson, 2004)
- Some challenges and open questions - Modern viable service systems in Romania: how and where? (study from INSEED)
  - Healthcare – 2 new Master programs and Continuous formation
  - Software services, IT services - 3 new Master programs and Continuous formation
  - Manufacturing, SCM - 4 new Master programs and Continuous formation

I. Origins of the Viable System Model (VSM)

I. Origins of the Viable System Model (VSM). The Enterprise model of Stafford Beer (1972→)

Starting point: the 80/20 Rule (the Pareto principle) –
(Vilfredo Pareto, 1906, Italy: 20% of the people owned 80% of the wealth)



In general:

Any system has an effort applied to make it work.
This effort produces a pay-off from the system (otherwise it is abolished.)

Experience shows that (for **large systems**):
"80% of the effects are generated by 20% of the variables/causes in the system"

Examples:
- 80% of town traffic is on 20% of its roads
- 80% of a company's revenue comes from 20% of its products
- 80% of innovation comes from 20% of people,
- 80% of errors are caused by 20% of the components, etc.

I. Origins of the Viable System Model (VSM)

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Starting point: the 80/20 Rule (the Pareto principle) (*continuation*)

A power law distribution:

Pareto observed that $N(x) \sim x^{-\alpha}$,

where x - income lower limit, $N(x)$ - number of individuals with income greater than x and $\alpha \approx 1.5$.

- The essence of the 80-20 rule is that things are NOT distributed equally
- In the *perfect world*, every employee would contribute the same, every bug would be equally important etc., and planning would be simple.
- The ratio can change, and the numbers do not need to add up to 100 (s.a. 90/20 etc.).

Economic consequence: there is a diminishing marginal benefit of adding extra resources.

Managerial problem: how to prioritize tasks to focus resources?

MIND BREAK!

I. Origins of the Viable System Model (VSM)

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Prerequisites to VSM

- In the most general sense, **a system** is
  - ✓ a set of objects, along with
  - ✓ the relationships between the objects and between the object attributes; and
  - ✓ these objects can be **tangible** or **intangible** in nature (*Hall, A.D., & Fagen, R.E. (1956). Definition of system)*
- The term "**system**" is often used as a descriptor that defines a set of entities for which a mathematical model can often be constructed to characterize **interactions** (Wikipedia, 2005).
- the objects and relationship of interest is dependent upon **the perception of the observer**.
- An observer may be interested in **the behaviour of individual parts** in order to assess the larger system.
  - Assessment is made through the identification of both part and system variables.
  - "*a variable is a measurable quantity which at every instance has a definite numerical value*" .
  - However, only a subset of all the known variables is of interest for the purpose of assessment.
  - The system itself is "*then defined as any set of variables that the observer selects from those available…*" (Ross Ashby classic text *Design for a Brain* (1960)).

I. Origins of the Viable System Model (VSM)

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Prerequisites to VSM (*continuation*)

Systems are (*IBM- Almaden SSME Courses, 2007*):

- **Natural**
- **Manufactured**: artefacts, or designed creations of human beings
- **Socio-technological**: essentially combine aspects of natural and manufactured or designed systems
  - **Businesses and other enterprises** are both **designed and natural**. This is a challenge for the understanding of enterprises, including services enterprises, because the human aspect creates limits on the absolute ability to design the system as a whole
  - **Human social systems** constitute a major class of the kinds of systems that are **called complex adaptive systems**. They have the ability to adapt to various changing conditions, and the challenge is to balance adaptation with the proper level of control and standardization.

I. Origins of the Viable System Model (VSM)

I. Origins of the Viable System Model (VSM). The Enterprise model of Stafford Beer (1972→)

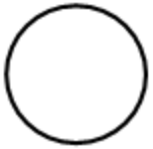
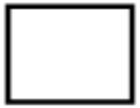
The VSM Template

- The **Viable Systems Model** (VSM) is a very rich view of the enterprise, which also views the enterprise as a set of generic domains.
- The theory of organizations as viable systems was originally articulated by **Stafford Beer**.
- According to this model, every viable system, from a bee colony to a nation, follows a template of management and operational functions, along with standard types of communication channels. This template is defined as follows.

I. Origins of the Viable System Model (VSM)

I. Origins of the Viable System Model (VSM). The Enterprise model of Stafford Beer (1972→)

The VSM Template (*continuation*)

Every organization (viable system) exists within some environment. This is the symbol for the **environment**.	
An **organization** is represented by a circle.	
Within every viable organization there exists some **management function**, represented by the square.	

The management function is accomplished according to a **model**, often not explicitly recognized, but necessarily present.	
These elements are clearly nested, with model within management, within the organization, within the environment. This in itself creates a **containment relationship**.	

I. Origins of the Viable System Model (VSM)

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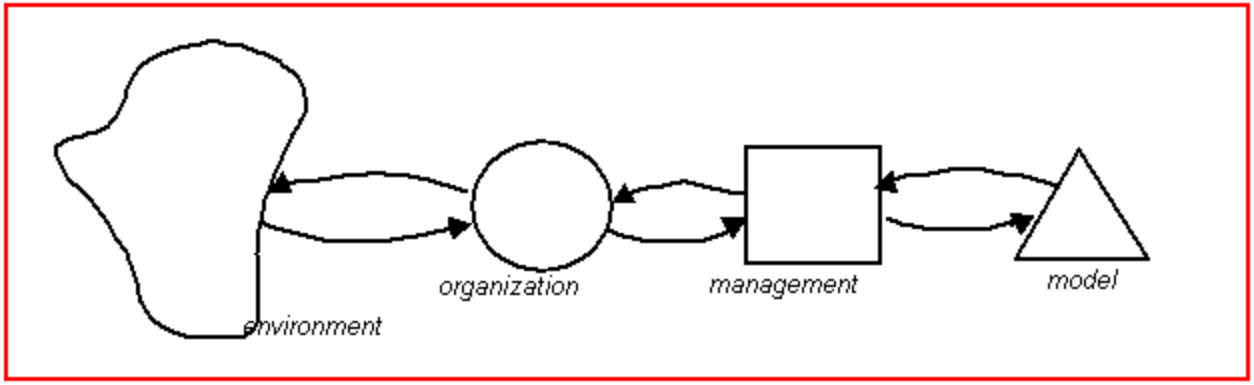
The VSM Template (*continuation*)

- Even though these elements are nested as shown above, the VSM is largely concerned with **channels for information.**
- In order to emphasize these communication channels, we can imagine that the elements outside of the containment relationship, are **linked together**, into an **operational unit** (the configuration of one organization, with its environment and its management structure).



- This is the level where **the basic functions of the organization** are accomplished.

I. Origins of the Viable System Model (VSM)

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The VSM Template (continuation)

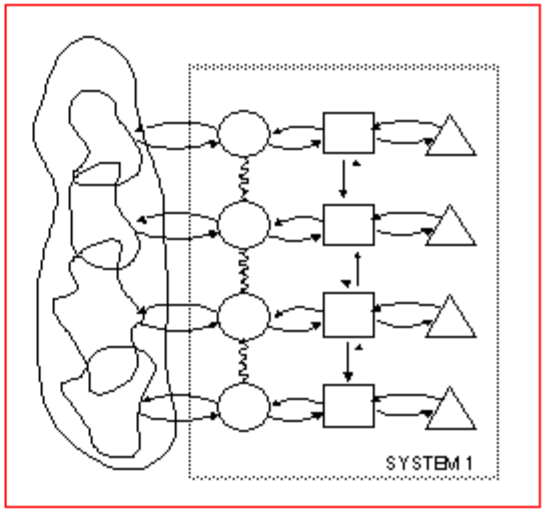
In practice it is possible that an organization has several operational units, with different, possibly overlapping parts of the environment.

Each operating unit is responsible for producing the primary results (products and services) that are the reason the organization exists.

The collection of interacting operating units, minus the environment, is the **VSM System 1**.

The information systems needs implied by System 1 include the ability to measure:

- productivity,
- cost per units produced,
- customer and supplier information,
- shop floor control,
- inventory management, etc.



I. Origins of the Viable System Model (VSM)

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The VSM Template (continuation)

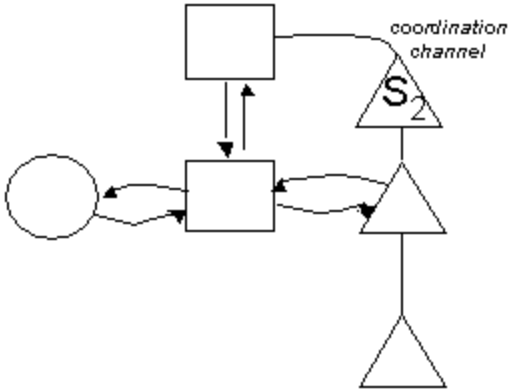
Present-oriented: CONTROL

System 2 is responsible for:

- **maintaining and**
- **coordinating**

the set of mental management models within the organization as a whole.

System 2 functions constitute "the way we do things around here".



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The VSM Template (continuation)

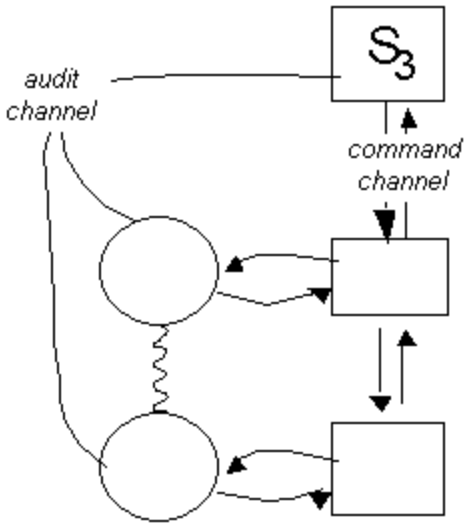
Present-oriented: SUPERVISION

System 3 uses:

- a **direct command channel to give orders** to the operating units via their *individual management structures*.
- It also uses an *audit channel* in its responsibility for the day-to-day, bottom-line processes of System 1's activities.

Necessity: There is a need

- to *filter* the information noise of day-to-day operational activity, while
- *amplifying the feedback* on key measures.



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The VSM Template (continuation)

Future-oriented: PLANNING

In contrast to System 3, **System 4** is responsible for **looking outward into the environment**:

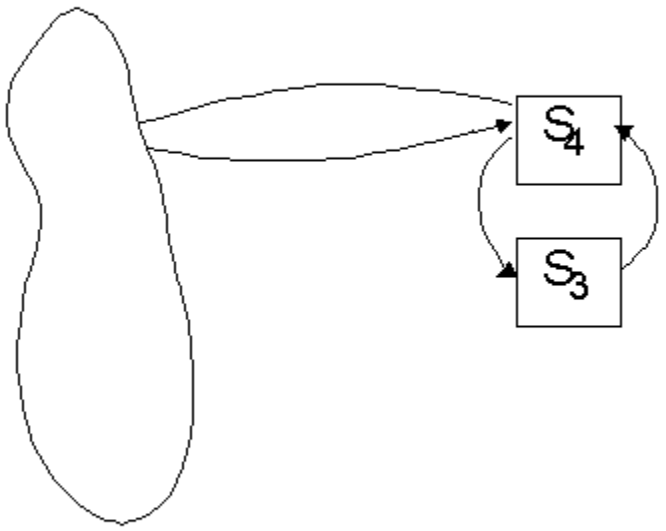
- as a *whole*, and as much as possible
- into the future.

It is the part of the organization that is oriented toward learning and change.

The information system needs of System 4 include:

- good receptors of external intelligence,
- market demographics,
- competitive information and the like.

System 4 also needs good information processing, or analytical support to be able to make sense of masses of data and to determine key indicators and trends.



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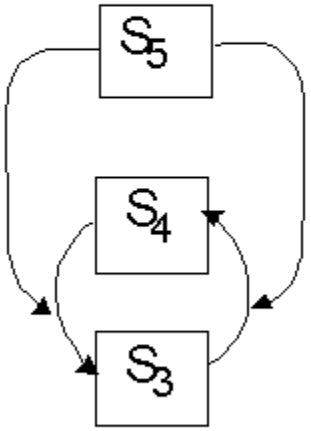
The VSM Template (continuation)

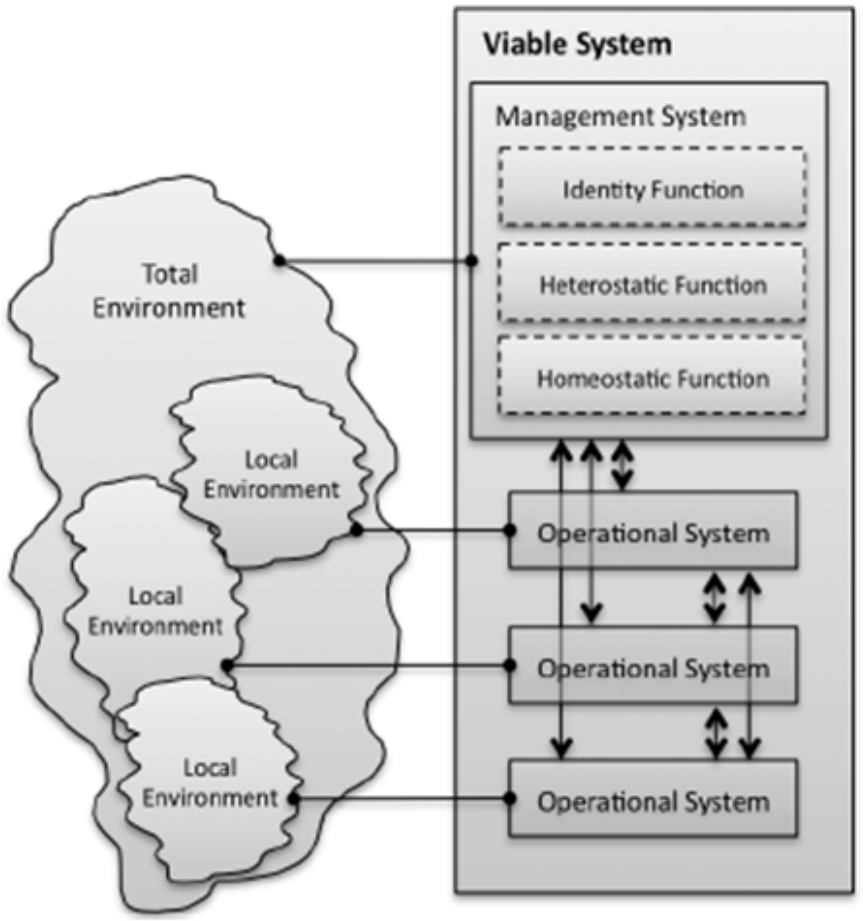
OPTIMIZATION between present and future goals

In order to **mediate** between the current and future needs of the organization there is a **System 5**, which ideally consists of the most *senior management*.

The information requirements for System 5 are not well served by current automation capability, given that the primary need is to **exert judgement**, and reconcile proposals put forth by Systems 3 and 4.



Viable System – a conceptual model



THE CONCEPTUAL MODEL OF A VIABLE SYSTEM

(A. Golnam, G. Regev, A. Wegmann, *On Viable Service Systems: Developing a Modeling Framework for Analysis of Viability in Service Systems*, in Exploring Service Science – Second Int. Conf. IESS 2011, Geneva, Febr. 16-18, Revised Selected Papers; 01/2011,

http://www.researchgate.net/researcher/5909_Arash_Golnam)

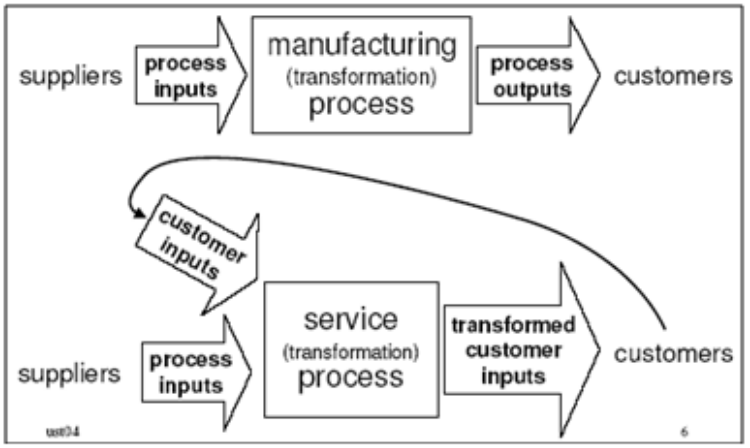
II. Service Systems, Viable Service Systems, Smart Service Systems

II. Service Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)

Prerequisites

- The concept of "**service system**" is central to service science (SS) and service-dominant (SD) logic (*S. L. Vargo and R. F. Lusch, 2004.*)
- A **service system** is defined as "a configuration of
  - people,
  - technologies,
  - organization and
  - shared information,

  able to **create value** to providers, users and other interested entities, through service" (*P. P. Maglio and J. Spohrer, 2008*)
- Recently, service science researchers have shown an increasing interest in studying **viable service systems (VSS)** and discovering the factors that contribute to the viability of a service system.



II. Service Systems, Viable Service Systems, Smart Service Systems

II Service Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)

Prerequisites (*continuation*)

- From a systems perspective, a system is **viable** only when it maintains some aspects that enable the observer to identify it **as different from other systems**. The observer, in effect, invents the system by perceiving a purposive unity (*G. M. Weinberg, An introduction to general systems thinking (silver anniversary ed.) Dorset House Publishing Co., Inc. New York, NY, USA, 2001.*)

  In other words, a system is defined only when an observer detects and identifies a set of entities standing in interrelations. Hence, *when a system loses the aspects* that help the observer distinguish it from other systems, *it passes out of existence*.

- As the study of viable systems is a disciplined inquiry in **systems science**, exploration of the contributions of systems science to the study of VSS has emerged as a topic of relatively high importance among the researchers in the field.

- A recent issue (Spring/Summer 2010) of the **Journal of Service Science** is dedicated to the insights and the inferences of systems science upon research in the realm of service and **in particular VSS**.

- Understanding the building blocks of systems science can lead to a better insight into the nature of the contributions that systems science can make to the study of VSS.

II. Service Systems, Viable Service Systems, Smart Service Systems

II Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)

Principles of Service-Dominant Logic

Vargo and Lusch (2004, 2006, 2008) proposed ten foundational premises upon which their new paradigm of service-dominant logic (S-D logic) was based in the contemporary service economy:

• service is the fundamental basis of exchange	-> *Exchange between system entities*
• indirect exchange masks the fundamental basis of exchange	-> *Service for Service*
• goods are distribution mechanisms for service provision	-> *Appliance for service provision*
• operant resources are the fundamental source of competitive advantage	-> *Distinctive resources for synergistic embeddeness*
• all economies are service economies;	-> *Service economy as modern economy*
• the customer is always a co-creator of value;	-> *Consumption for potential/effective transfer*
• **the enterprise** cannot deliver value, but **only offer value propositions**;	-> *Consonance for mutual satisfaction*
• a service-centred view is inherently customer-oriented and relational;	-> *Interactions for solutions*
• all economic and social actors are resource integrators; and	->*Participation in value co-creation processes*
• value is always uniquely and phenomenologically determined by the beneficiary.	->*Value culture improvement*

II. Service Systems, Viable Service Systems, Smart Service Systems

II Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)
Principles of Service Science

Service science (SS) is based on ten principles (Spohrer et al., 2008; Spohrer and Kwan, 2009):

* **resources;** main focus on:	➔ *Useful instruments activities*
* **entities;**	➔ *Openness of evolving systems*
* **access rights;**	➔ *Supra-systems relevance*
* **value co-creation interactions;**	➔ *Joint process within Service Systems*
* **governance interactions;**	➔ *Common finality, internal and external equilibrium*
* **outcomes;**	➔ *Value intended in an extended way*
* **stakeholders;**	➔ *Contextual influences and self-regulation*
* **measures** (quality, productivity, compliance, and sustainable innovation);	➔ *Up to now only qualitative*
* **networks; and**	➔ *Network embeddedness*
* **ecology.**	➔ *Service ecosystem*

II. Service Systems, Viable Service Systems, Smart Service Systems

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Foundations of Viable Systems Approaches

The VSA is based upon **several key principles** that are drawn from other disciplines:

* **a multidisciplinary interpretative approach**; (between holism and reductionism)	• Attensionshifting part->whole
* **open systems** (from system thinking);	➔ Every system is in strong relation with other systems
* **system boundaries**; (from system thinking)	➔ Valorising exchanges with environment for system's goal
* **autopoiesis and common finality**; (from chemistry and biology)	➔ Dense pattern of relations within supra and sub-systems
* **homeostasis and self-regulation**; (from natural and ecological sciences)	➔ Living organisms capacity to preserve own **VIABILITY** in any conditions
* **structures, systems, and equifinality**; (from natural and ecological sciences)	➔ Static versus dynamic representation of organisms

II. Service Systems, Viable Service Systems, Smart Service Systems

II Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)
Foundations of Viable Systems Approaches (*continuation*):

The VSA is based upon **several key principles** that are drawn from other disciplines

* **consonance and resonance**; (from sociology and psychology)	➔ Potential connectivity and its activation (structural compatibility and related system harmony)
* **SYSTEM VIABILITY** (from system thinking);	➔ System developing and **SURVIVING** within context in a consonant and resonant way
* **ADAPTATION AND RELATIONSHIP DEVELOPMENT** (from natural and ecological sciences); and	➔ Relationship and peripheral components, transformations and organization design; restructuring and organization plan rethinking
* **complexity and decision making** (from sociology and psychology).	➔ Qualitative traits of the observed phenomena correlating a combination of multiplicities and autonomies with the impossibility of any explanation and based on: ○ variety, ○ variability and ○ indeterminacy

II. Service Systems, Viable Service Systems, Smart Service Systems

II Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)

Smart Service Systems and Viable Service Systems

- Today services creation processes are knowledge-intensive and customized, based on client participation and input
- Following this logic, we can define **service systems** as value-co-creation configurations of
  - people,
  - technology,
  - value propositions connecting internal and external service systems, and
  - shared information (e.g. ,language, laws, measures, and methods; Spohrer et al., 2007) like an assemblage of united entities by some form of regular interaction or interdependence.

- **Firms and customers** are then **complex service systems**, performing *actions in the market* with the aim of reaching desired outcomes such as solutions and experiences (Mele and Polese, 2010).

- **Service Science research**, originally promoted and developed by *IBM Almaden Research Centre*, in USA, is now recently proposing advances focused upon **smart service systems**, also stimulated by
  - maintenance **technological advances** and
  - IT systems' latest proposals.
- **The origin of the idea** is based upon IBM proposal of IT advances for a **smarter planet**, implying that information communication technologies have to address the problems of the world today in a smarter and more reactive way, with a deep implication consisting in the *dynamism* and fast changes characterizing the world today.

II. Service Systems, Viable Service Systems, Smart Service Systems

II Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)
Smart Service Systems and Viable Service Systems (*continuation*)

- The concept of **smarter planet**, hence, is related to an instrumented, interconnected, intelligent planet in which there is:
  - growing data measurement attention,
  - more networks,
  - more learning and adaptation processes.

- Basically a **smarter planet** is about maintaining and improving our quality of life in a **sustainable manner**
- it is a complex system capable of serving customers better (this could be applied to
  - **water consumption and use,**
  - **electricity distribution and management,**
  - **public transportation,**
  - **education,**
  - **healthcare, etc.).**

II. Service Systems, Viable Service Systems, Smart Service Systems

II Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)
Smart Service Systems and Viable Service Systems (*continuation*)

- **Smart service systems** may be intended as **service systems**
  - designed for a wise and interacting management of their assets and goals,
  - capable of self-reconfiguration (or at least of easy inducted re-configuration) in order to perform enduring behaviour capable of satisfying all the involved participants in time.

- **Smart service systems** are then based upon ***interactions***, and may be represented by any of these:
  - Intelligent Utility Network and Metering,
  - Intelligent Transportation,
  - Consumer Driven Supply Chains,
  - Intelligent Oilfields,
  - Manufacturing Productivity, etc.

- Because **smart service systems** inevitably involve **multiple actors**, the organisational configurations need to take account of **network theory**. In contemporary research into 'smart service systems', network studies are playing an increasingly important role—including studies
  - of resource allocation (Frels et al., 2003) and
  - the advantages of collaboration, alliances and cooperative strategies (Castells, 1996; Gulati, 1998; Capra, 2002).

II. Service Systems, Viable Service Systems, Smart Service Systems

II Systems, Viable Service Systems, Smart Service Systems (Barile and Polese, 2010)
Smart Service Systems and Viable Service Systems (*continuation*)

- it is the contention of the study of Barile&Polese (2010) that the underlying **principles of the VSA and 'smart service systems' are essentially convergent.**
- The two theoretical concepts share many features in common, including an emphasis on:
  - **system theory;**
  - **resource integration;**
  - **system dynamics;**
  - **interaction; and**
  - **systems goals.**
- **A VIABLE SERVICE SYSTEM HAS TO BE, AT THE LEAST, A SMART SERVICE SYSTEM.**

Theory of Constraints - extension Service Systems

III Theory of Constraints (TOC) and its extension Service Systems (Goldratt Institute, 1986→)

Prerequisites

- **Theory of constraints** (TOC) is
  - a thinking process (1. What to change?; 2. What to change to ?; 3. How to cause the change?) and
  - a set of management applications

  based on principles that run **counter** conventional wisdom.
- **TOC** is best known in the manufacturing distribution sector, were it was originated.
- Awareness is growing in some service sectors (Health Care), it has been adopted **in high-tech industries** (Computer software -> INTANGIBILITY~services)
- Until recently, **TOC** was barely known in the Professional, Scientific and Technical Services (**PSTS**), because these services are highly customized.

Professional Services:	*Scientific Services*:	*Technical Services*:
• Law • Accounting • Consulting	○ Research ○ development	○ Development ○ Operation and ○ Support of various technologies

- Ricketts (IBM, 2011): TOC begins to be successfully adapted for PSTS, within applications s.a. *management* of *resources* (gas, electricity, etc.), *projects*, *processes* and *finances*.

Theory of Constraints - extension Service Systems

III Theory of Constraints (TOC) and its extension Service Systems (Goldratt Institute, 1986→)

TOC Focusing steps:

(Assumption: a process is composed of tasks that have to be performed by coordinated sub-systems)

1. **Identify the constraint** (the "weakest" subsystem in the "chain" and the corresponding task)
2. **Exploit the constraint:** make sure the constraint almost **never runs out of work** from its predecessors.
3. **Subordinate everything else**: starting work according to the constraint's capacity -> predecessors and successors work the same pace as the constraint.
4. **Evaluate the constraint**: add another machine or person to perform the constrained task.
5. **Repeat**: whenever the constraint moves (due to an increase or decrease capacity) production has to be re-scheduled around the **new constraint**.
   Ideally, the new constraint's capacity is higher than the old, and the whole system ratchets up to a **higher level** of productivity.

Theory of Constraints - extension Service Systems

III Theory of Constraints (TOC) and its extension Service Systems (Goldratt Institute, 1986→)

TOC Theory:

1. The way to maximize what a system as a whole produces is to maximize what its constraint produces.
2. Complex systems require simplifying, holistic solutions.
3. A system with more than one goal has to sub-optimizing most of them, if not all of them.
4. Measurements drive behaviour, so if you measure things wrong, you get the wrong behaviour.
5. Pushing a system requires constant steering but a system designed to pull steers itself toward the goal.
6. People will change when presented with an alternative that they recognize as superior and attainable.

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Ricketts (2008;2011): TOC for Services (TOCs) adapts TOC applications for the PSTS sector. By making TOC usable in the services sector, most different from manufacturing and distribution, TOC is now usable across the entire services spectrum.

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Some challenges and open questions

IV Some challenges and open questions –
Modern viable service systems in Romania: how and where?

A first conclusion: As change and adaptability is crucial for system survival, there is a natural relation between VIABILITY and constraint management (TOC) !

A first group of open questions.

Viable Service Systems and the concept of smart planet imply some basic assumptions:

- ✓ DEMOCRACY
- ✓ FREE MARKET and
- ✓ the belief that free market competition brings a decent level of life and wealth for the majority.

But:

- in democracy, the control belongs to an elected elite.
  - Old question: are the elected really the "good" ones ?
  - New question: what to do when, in today world, power glimpses from governments (nations) to trans-national companies ?
- Does the free market competition really respect the rules of the "game"? (see the today financial crisis and also the Pareto 20/80 law regarding the wealth repartition).

See: D. Dăianu, Când finanta submineză economia si corodeză democratia. Editura Polirom, 2012.

Some challenges and open questions

IV Some challenges and open questions –
Modern viable service systems in Romania: how and where?

A second group of "local" open questions.

Viable Service Systems and the concept of smart planet imply some basic technological assumptions:

- IT infrastructure, road and resources-supply (water, electricity, etc.)infrastructure
- mature manufacturing industry, prior to service sector development
- a "critical mass" of accordingly educated population
- a certain level of public and individual wealth

But:
Almost 50% of Romania is rural, meaning, in many cases, an "1900" development stage, regarding:

- roads,
- IT,
- local health services,
- water supply infrastructure
- wealth level of the communities, etc.

See: B. Murgescu, România si Europa. Acumularea decalajelor economice (1500-2010). Editura Polirom, 2010

Conclusions

- The challenge:
  - Romania has to become, simultaneously, MODERN and CONTEMPORARY !!
  - National R&D Programs in Service Science
  - Service Orientation in Holonic and Multi-agent Manufacturing – the SOHOMA series 2011, 2012, 2013 – an European presence, to be continued in November 2014 : SOHOMA'14 @ MOSIM, Nancy, France
  - Collaborative development of Service Systems with IT industry: IBM, RMS, CIMR, East Electric, Petrom, acp-IT
  - INSEED promotes skills development in CDIO of Service Systems with IT support and fosters service innovation
  - Services-related Master dissertation work and Ph.D. theses in the Service domain