Approaches and Challenges in Viable Service Systems Development

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Abstract. The Viable System Model, as a rich view of the enterprise originally developed within the theory of organizations, can be naturally extended to the service system development. The paper comparatively discusses, from the viability perspective, two recent approaches in the literature of service science: the smart service system concept and the service system approach within the theory of constraints. It is shown that both approaches can be interpreted as facets of the broader class of viable service systems. Finally, some specific challenges in viable service systems development are mentioned, with roots in some actual problems of the global capitalism or in specific difficulties of today emerging economies.

Key words: Viable System Model (VSM), service system, organization, task, complexity, management, smart service system, theory of constraints, modernity, free market, crisis

1 Introduction

Services comprise about 75% of mature economies today, and they are also a fast growing sector in emerging economies [1]. This motivates an intense preoccupation, in past decade, for establishing the philosophy of a new management and marketing, which highlights a paradigm shift away from the goods-dominant (G-D) logic, with roots in the Industrial Revolution [2]. This paradigm is the theoretical concept of service-dominant (S-D) logic, in which "goods are no longer the only transaction objects", and "service is seen as the real protagonist of interactions and transaction" [3].

A service system evolves within a dynamic environment and interacts, in a network, with other service systems. Also, it may have other interconnected service sub-systems, so the service system may have to face external disturbances, from the environment, but also internal disturbances, generated by one of its sub-systems. Thus, a main challenge in the development of a service system is to design it in a way that ensures the flexibility and adaptability crucial for its survival, or, in other terms, for its viability. From this perspective, the Viable System Model (VSM), earlier proposed by Stafford Beer within the theory of organizations [5], [6] is an initial point of such a development strategy.

Starting from the smart service concept proposed by Barile and Polese [7], which argue for the necessity of intelligent services, and from the Theory of Constraints (TOC) for services [1], extending the TOC paradigm [4] for manufacturing and distribution sectors to services, the paper discusses an interpretation of the two models from the viability perspective, showing that intelligence or an adequate estimation of the constraints hierarchy are characteristics of a viable service system. Thus, one can consider that smart service systems or service systems obeying to TOC principles are entities of the broader class of viable service systems.

The paper is structured as follows. A brief review of the VSM template is given in Section 2. The characteristics of the smart service system concept from the viability perspective are discussed in Section 3 and Section 4 contains a review of the extension of TOC to services, and a motivation for considering the tight relation between viability and constraint management. Finally, some concluding remarks are formulated within a larger context, which considers, as open questions, two categories of challenges in service systems development: the challenges born from the new problems raised by global capitalism and the challenges appearing at the local level of emerging but integrated economies, such as the Romanian economy.

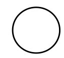
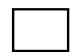
2 Origins: The Viable System Model

Any system has an effort applied to make it work and the effort produces a pay-off from the system. Starting, among others, from the studies of Vilfredo Pareto, dedicated, at the beginning of the 20^{th} century, to economic efficiency and income distribution, the research work of Stafford Beer [5], [6] focused, within the theory of organizations, on building an efficient enterprise model, as a solution to the managerial problem of tasks prioritization constrained by limited resources. Viability concerns, in essence, a good prioritization of tasks, making the organization able to survive. The presentation below is adapted from [8] and based on [5], [6].

Beer proposed the Viable Systems Model (VSM) as a cybernetic view of the enterprise, which considered also as a set of generic domains. According to this cybernetic 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. The key feature of a viable system is its functionality, and the structure of the system is subordinated to the functionality. This template is defined as follows, with basic symbols given in Table 1.

Every organization, (i.e. *viable system*), exists within some *environment*. An organization is represented by a *circle*. Within every viable organization there exists some management function,represented by a *square*. The management function is accomplished according to a model,often not explicitly recognized,but necessarily present and represented as a *triangle*. These elements are clearly nested,with model within management,within the organization, within the environment. This in itself creates a *containment relationship*.

Table 1. The basic elements VSM template [5], [6] (*adapted from [8]*)

Significance	Symbol
environment	
organization	
management function	
a mental management model	
a containment relationship	

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, the elements of the containment relationship are represented outside of and linked together, into an *operational unit* (Fig. 1). At this level, the basic functions of the organization are accomplished.

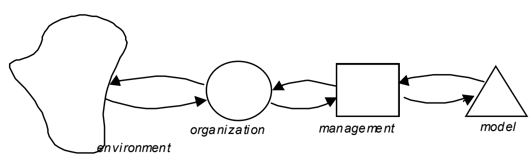


Fig. 1. The configuration of one organization, with its environment and its management structure [5], [6].

The key feature of the VSM is that an organization is not structured as a top-bottom hierarchical and static diagram of jobs, but as an interaction of subsystems, each one performing specific tasks according to specific but convergent objectives. If one can talk about hierarchy, this one is established by the objectives. These subsystems are briefly described below.

Each operating unit is responsible for producing the primary results (products and services). It is possible that an organization has several operational units, with different, possibly overlapping parts of the environment. The VSM *System 1* (Fig. 2) is a collection of interacting operating units, minus the environment. The information on which System 1 is functioning include the ability to measure productivity, cost per units produced, customer and supplier information, shop floor control, inventory management, etc.

The VSM *System 2* (Fig. 3a) is present-oriented and, in control-engineering terms, it is responsible for the CONTROL task, i.e. for maintaining and coordinating the the set of mental management models within the organization as a whole. One can say that System 2 functions constitute "the way we do things around here".

The VSM *System 3* (Fig. 3b) is also present-oriented and, in control-engineering terms, it is responsible for the SUPERVISION task: System 3 uses a *direct command channel* to give orders to the operating units via their individual management structures, and also an *audit channel* in its responsibility for the day-to-day, bottom-line processes of System 1's activities. The existence of System 3 is motivated by the need to filter the information noise of day-to-day operational activity, while amplifying the feedback on key measures.

In contrast to System 3, *System 4* (Fig. 4) is responsible for looking outward into the environment as a whole, and as much as possible into the future, so its function is PLANNING the organization evolution in its dynamic environment. Hence System 4 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 and competitive information, among others [8]. 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.

In order to mediate between the current and future needs of the organization there is a *System 5* (Fig. 5), which ideally consists of the most senior management. Hence the function of System 5 is OPTIMIZATION, i.e. taking optimal decisions. 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 (Fig. 3b) and 4, respectively).

The VSM modelling framework was successfully used to model the design of the viability in service system applications, such as utility companies in gas segment [9]. The interest for the work of Beer in the scientific community is illustrated also by the birth of the Viplan software [10], as modelling and design tool that helps to develop the VSM of an organization.

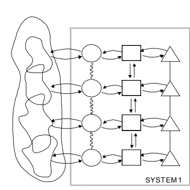
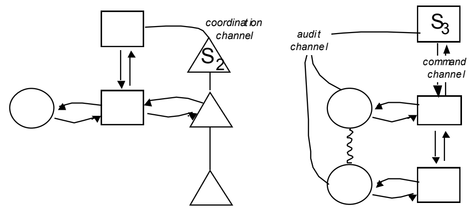


Fig. 2. The representation of the VSM System 1 [5], [6].



a) b)

Fig. 3. In a VSM, the control function of System 2 (a) and the supervision function of System 3 (b) concern the present activities [5], [6].

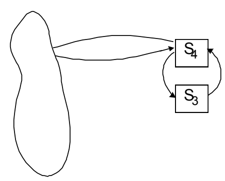


Fig. 4. The VSM System 4 is dedicated to planning so it is future-oriented [5], [6].

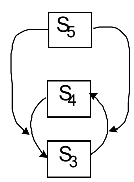


Fig. 5. The VSM System 5 makes optimal choices from the possibly contradictory proposals made by System 3 and 4, so it mediates beetween present and future goals of the organization [5], [6].

3 Viability of Smart Service Systems

3.1 Prerequisites

The concept of *service system* is central to service science (SS) and service-dominant (SD) logic [11]. In [12], 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.* 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.

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 [13]. 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 of the Journal of Service Science [14] is dedicated to the insights and the inferences of systems science upon research in the realm of service and in particular VSS. Thus, 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.

From the perspective of the theory of organizations, a service system works according to the ten foundational premises formulated by Vargo and Lusch and defining the new paradigm of service-dominant logic [11], [15], [16] and to the ten principles of service science [17], [18].

3.2 Smart Service Systems and the Viable Service System Approach

Today services creation processes are knowledge-intensive and customized, based on client participation and input, while firms and customers become complex service systems, performing actions in the market with the aim of reaching desired outcomes such as solutions and experiences [19].

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.

The concept of smarter planet, hence, is related to an instrumented, interconnected, intelligent planet in which there is growing data measurement attention, more networks and 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.).

On the other hand, in the general systems theory, the Viable Systems Approaches (VSA) is based upon several key principles that are drawn from other disciplines, such as system viability, from systems thinking or adaptation and relationship development, from sociology and psychology.

In the complex theoretical framework combining the general VSA view for services, the principles of service-dominant logic and the foundations of service science with the new concept of a smarter planet, Barile and Polese define in [7] the characteristics of *smart service systems*.

Smart service systems may be intended as service systems designed for *a wise and interacting management* of their assets and goals and capable of *self-*

reconfiguration in order to perform enduring behaviour capable of satisfying all the involved participants in time. In this view, 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.

Two essential ideas result from these facts and proposals: in the new trend towards a smarter planet, a service system has to be viable and a viable service system has to be at least a smart service system.

4 Theory of Constraints and Viability of Service Systems

Theory of constraints (TOC) is a thinking process proposed by the Goldratt Institute [4] based on the strategic questions:

1. What to change?
2. What to change to ?
3. How to cause the change?

combined with 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 of the values of the TOC approach is growing in some service sectors (such as Health Care); TOC has been adopted also in high-tech industries (such as Computer software, related to the intangibility as a feature also to services).

Until recently, TOC was barely known in the Professional Services (Law, Accounting, Consulting), Scientific Services (Research and Development) or in Technical Services (Development, Operation and Support of various technologies), -in brief, in PSTS-, because these services are highly customized.

In [1] it is emphasized that TOC begins to be successfully adapted for PSTS, within applications such as management of resources (gas, electricity, etc.), projects, processes and finances. Recall, in brief that, starting from the basic assumption that *a process is composed of tasks that have to be performed by coordinated sub-systems*, TOC proposes a hierarchy of focusing steps:

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, not the entry-point's capacity, thus preventing the process to be forced to chaos;

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.

According to TOC principles:

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.

Ricketts [1] shows that, in the today mature economies it the moment when *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*.

Common to the VSM, TOC focusses on process defined in terms of tasks, i.e. functions, so it is functional and not structural oriented. In terms of theory of organizations, one can interpret a constraint as a latent disturbance in a subsystem. In this view, the identification of the constraints in a process, in such a way that the tasks of the overall system continue to be accomplished is a form of adaptation, i.e. an action directed towards maintenance of viability.

5 Final Remarks

Adequate change capability and adaptability are crucial for system survival, so there is a natural relation between viability and constraint management (TOC) on one side, and the quality of being smart, on the other side. So one can regard the concept of smart service system as a a category of viable service systems and the TOC extended to services as a systematic way in which a viability of a service system is well managed.

Future development and applications of smart service systems and of constraint's theory for services will thus enrich, as important sub-domains, the larger frame provided by theory of organizations.

However, two aspects from today reality appear as open questions, when discussing the practical implications of developing viable service systems.

Firstly, Viable Service Systems and the concept of smart planet imply some basic assumptions, such as 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. So there is an old question: are the elected really the good ones ?. The new question would be: what to do when, in today world, power glimpses from governments (nations) to transnational companies? In other words, does the free market competition really respect the rules of the *game* in the sense of equality of chances? For example, is there a relation between the today financial crisis and the validity of Pareto's 20/80 law regarding the wealth repartition ? Part of these aspects are discussed in [20].

Secondly, Viable Service Systems and the concept of smart planet imply some basic technological assumptions, such as:

– existence of 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 and
– a certain level of public and individual wealth.

But emergent economies have to face problems related to these aspects, which turn into intractable constraints in the development of Viable Service Systems. Such problems, common also to the Romanian economy, are comparatively brilliantly analysed in [21].

Acknowledgments. This work was supported by ERRIC Project: Empowering Romanian Research on Intelligent Information Technologies Nr. contract: FP7-REGPOT-2010-1 No. 264207, 2010-2013.

References

1. Ricketts, J.A.: Theory of Constraints for Services: Past, Present and Future. In: H. Demirkan et al. (eds.) Service Systems Implementation, Service Science: Research and Innovation in Service Economy. LLC 2011, pp. 113–130. Springer (2011)
2. Barile, S. and Polese, F.: Linking the viable system and many-to-many network approaches to service-dominant logic and service science. Int.J. of Quality and Service Sciences. 2(1), 23–42 (2010)
3. Vargo, S.L. and Lusch, R.: Service-dominant logic: continuing the evolution. Journal of the Academy of Marketing Science, 35. 1–10 (2008)
4. AGI - Goldratt Institute, http://www.goldratt.com
5. Beer, S.: Brain of the Firm, 2nd Edition. John Wiley (1994)
6. Beer, S.: The Heart of Enterprise. John Wiley (1994)
7. Barile, S. and Polese F.: Smart service systems and viable service systems: applying systems theory to service science. Service Science, 2(1). 21–40 (2010)
8. McDavid, D.W.: Business patterns for enterprise solutions (Draft, version 1.2). Unpublished manuscript, International Business Machines Corporation, Almaden Research Center, San Jose, CA. (1998)

9. Golnam, A., Regev, G. and Wegmann A.: On Viable Service Systems: Developing a Modelling 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
10. Espejo, R., Bowling, Diane and Hoverstadt, P.: The viable system model and the Viplan software. Kybernetes, 28(6/7), 661-678 (1999), http://www.emerald-library.com
11. Vargo, S. L. and Lusch, R. F.: Evolving to a New Dominant Logic for Marketing. Journal of Marketing. 68(1), 1-17 (2004)
12. Maglio, P.P. and Spohrer, J.: Fundamentals of service science. Journal of the Academy of Marketing Science. 36(1), 18–20 (2008)
13. Weinberg, G. M.: An introduction to general systems thinking (*silver anniversary edition*). Dorset House Publishing Co., Inc. New York, NY, USA, (2001)
14. Barile S., Spohrer, J., Polese, Fr.: System thinking for research advances Editorial column. Service Science. 2, i–iii (2010), http://www.sersci.com/ServiceScience
15. Vargo, S. L., Lusch, R. F. and Morgan, F. W.: Historical perspectives on service-dominant logic. In: Lusch, R. F. and Vargo, S. L. (eds.) The Service-Dominant Logic of Marketing: Dialog, Debate and Directions, 29-42. M.E. Sharpe Inc., Armonk, New York (2006)
16. Vargo, S.L. and Lusch, R.: Service-dominant logic: continuing the evolution. Journal of the Academy of Marketing Science, 36, 1–10 (2008)
17. Spohrer, J., Anderson, L., Pass, N. and Ager, T.: Service Science and Service Dominant Logic. Otago Forum 2, 4-18 (2008)
18. Spohrer, J. and Kwan, S.K.: Service Science, Management, Engineering, and Design (SSMED): An Emerging Discipline - Outline and References. International Journal of Information Systems in the Service Sector. 1(3), 1–3 (2009)
19. Mele, Cristina and Polese, F.: Key dimensions of Service Systems: Interaction in social and technological networks to foster value co-creation. In: Demirkan, H., Spohrer, J., Krishna V. (eds.), The Science of Service Systems. 37–59 Springer, (2011)
20. Dăianu, D.: When finance undermines economy and democracy (in Romanian). Polirom, Iaşi (2012)
21. Murgescu B.: Romania and Europe: accumulation of economic discrepancies (1500-2010) (in Romanian). Polirom, Iaşi (2010)