Viable System Model (VSM): A Holistic Approach to Organizational Sustainability

Arista Hakiki

Accounting Department, Economic Faculty of Sriwijaya University, Indonesia

DOI: https://doi.org/10.56293/IJMSSSR.2022.4625

IJMSSSR 2023
VOLUME 5
ISSUE 3 MAY – JUNE **ISSN: 2582 - 0265**

Abstract: This article attempts to show the role of the viable system model (VSM) in a holistic way for the sustainability of an organization. VSM is built on three main principles: viability, recursiveness, and autonomy. VSM has been observed in various sectors and shows concrete results as an application that is able to diagnose the work system as a whole by looking at the various advantages and disadvantages of a series of systems. This paper uses various sources of literature that can show the role of VSM in various sectors, by presenting the objectives, theories, methods and results of the study. The results of this study are expected to provide deeper insights regarding the implementation of VSM with various adaptive and efficient approaches to achieve an organization's sustainability goals. Discussion of research results shows that VSM with its advantages has been proven to be successfully implemented in various areas of the organization in a holistic manner. Implementation can be done in the organization as a whole, units/functions/parts of the organization and existing systems within the organization. Thus the authors see an opportunity that VSM is very possible to be implemented in an accounting information system (SIA). The existence of SIA as a provider of information for internal and external parties is becoming increasingly important as today's business organizations are increasingly complex. The development and implementation of an SIA with a holistic approach is certainly relevant for future research.

Keywords: viable system model; accounting information system; sustainability

1. Introduction

The organizational structure of most companies is very much driven by the functions within it. An organization will strive to carry out process improvements aimed at minimizing costs for all individual processes. However, this is a significant error because individual process optimization does not provide optimization for the entire process (Garcia & Garcia, 2019). Currently management is also facing challenges in external and internal relations. This is a consequence of the pressure for decision making in a short time and the lack of coordination between different parts of the organization, lack of adaptability or flexibility. Organizations often fail to view it holistically as agents, interacting and creating cooperative ecosystems. Therefore, the purpose of this study is to propose a holistic approach on how organizations can interact with the environment both internally and externally. The author tries to propose the application of the Viable System Model (VSM) as a tool that can see the organization holistically. VSM is built on three main principles: viability, recursiveness, and autonomy. Survival belongs to any system capable of reacting to internal and external perturbations to maintain a separate existence.

Several previous studies that observed the application of VSM in various sectors included small companies (Espejo, 1979, Al-Mutairi et al., 2005, Chan, 2011. VSM in political systems by Beer (1981) and Willemsen (1992). VSM on insurance companies by De Raadt (1987) and in various fields by Wspejo&Harnden (1989), Espejo (1990), Herold (1991), Espejo &Schwaninger (1993) and Leonard (2009) In the hotel sector carried out by Schwinger and Haff (1989).In the financial sector by Leimer (1990), Navarte et al. (2006), Trueba et al. (2012).The application of VSM in project management, information systems and innovation systems has been carried out by many researchers, including by Britton & Parker (1991), Van Kempen (1991), Schuhmann (19910, Devine (2005), Amar et al. (2006), Nystrom C.A. (2006), Morales Arroyo et al. (2012), Murad &Cavana (2012) , Preece et al.(2012), PucheRegaliza (2014a, 2014b, 2015), Bathallath et al.(2016) In the field of production, logistics and supply chain by Thiem (1998), Contreras (1999), Herrmann et al. (2008), Chroneer&Mirijamdotter (200(0, Badillo et al. (2011), Azadeh et al. (2012), Brecher (2013), Hildbrad&Bodhanya (2013), Oetiz& del Valle (2014), Stich &Groten (2015), Travella&Papadopoulus (2015).In the health sector, tests were carried out by Bachmann &

Michel (2001), Monreal-Alvarez (2004), Midgley (2006)Research by Shaw et al (2004) and Terra et al (2016) carried out on the energy sector. Brokers (2005) made observations on large companies (franchises) and Crisan Tran (2005, 2066) on Start-up companies. Various other sectors such as waste management (Dodis et al, 2005), communities of practices (Frost, 2005), virtual companies (Grizelj, 2005) and communications media sector (Turke, 2006) have made observations related to VSM applications. In the education sector it has been tested by Ramfrez et al. (2009), Oliveira (2010), Rojas &Tuesta (2011), Fitch et al.(2014) Application of VSM in social organizations by Vargas & Alonso (2011), Espinosa & Walker (2013).

This paper aims to present the concept of a viable system model as a tool that can assist management in managing organizations holistically. In this paper the authors also present a review of the relevant literature in an attempt to demonstrate the strengths of the VSM. Furthermore, the authors discuss the results of previous research by presenting the implementation of VSM in various sectors and opportunities for developing VSM in the future. The author also sees the possibility of VSM implementation in accounting information systems.

2. Concept and Literature Review

Viable System Model (VSM)

In the 1950s Stafford Beer was a senior manager in a steel company and began to develop new thinking in management by drawing on his understanding of control systems as described by the new science of cybernetics and systems theory, particularly from the fields of social and biological research. The complete VSM model was first published in 1972 in 'Brain of the Firm' where he first sets out the development of the model through the application of cybernetic principles to the functioning of the human body. When he developed the Viable Systems Model (VSM), Stafford Beer sought to develop "organizational science", using cybernetic systems and principles that underpin all organizations (Beer 1959, 1966, 1974, 1978, 1979, 1981, 1985, 1994). The criterion is how the organization creates viability, namely the capacity to continue to exist and develop in conditions that are sometimes unpredictable and in a volatile environment. This requires that organizations be ultra stable, capable of adapting precisely to their chosen environment, or adapting their environment according to themselves, even if they find themselves in situations that have not been foreseen. This not only means that we are looking at systems fulfilling some given or ascribed purpose, we are also looking at how systems create their own goals and maintain or change them over time (Hoverstadt, 2020)

The VSM is presented as a graphical model – a picture with a number of critical components (five sub-systems and an environment) that are connected together in a particular way and are needed for viability (see Fig. 1). The subsystems are:

• System 1 – the set of activities that the organization does which provide value to its external environment, the primary operations (System 1 is drawn in the standard diagram below as a set of circles)
• System 2 – the set of activities or protocols to coordinate operations that are needed to stop the different operations causing problems for one another (represented by the triangles on the right hand side of the diagram)
• System 3 – the management activities to do with allocating resources to operations and ensuring they deliver the performance the organization needs, which we might call 'managing delivery'
• System 4 – the management activities to do with understanding the environment and the future, with planning and change, the outcome of which is to develop the organization
• System 5 – the set of management activities to do with ensuring that the organizationworks as a system, specifically that there is a balance in decision makingbetween Systems 3 and 4, and also maintains the organization's identity andensures that activities undertaken are consistent with acceptable practice, whatwe would normally call governance.

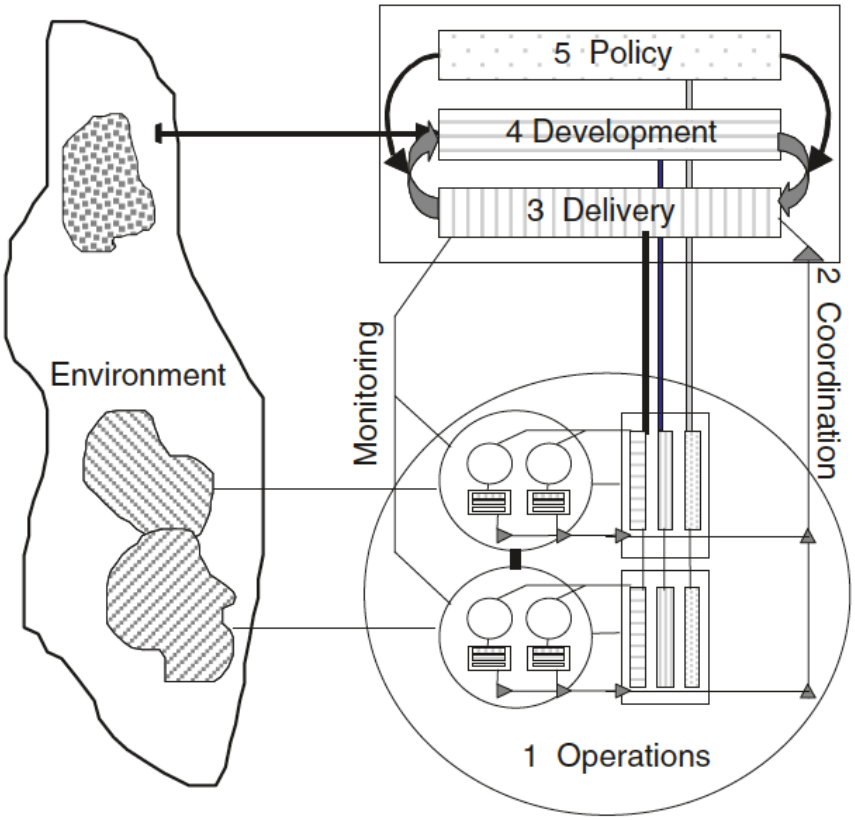

Figure 1. Viable System Model (VSM)

Literature Review

Sergio Gallego-García and Manuel García-García (2019) in their research entitled Design and Simulation of an Integrated Model for Organizational Sustainability Applying the Viable System Model and System Dynamics proposes a holistic approach on how organizations can interact with their environment, as well as internally. The purpose of this article is to develop a conceptual model for organizational sustainability at three levels: the company itself (with its functional area as an entity), its supply chain and the people in the company's area of influence. Viable System Model (VSM) and System Dynamics (SD) can implemented to achieve this goal. The method used is the design of a conceptual model of the relationship between logic and loop diagrams. Then the simulation and analysis of the results are carried out. The results show that the new model of organizational management is capable of making decisions in terms of its environment, its supply chain partners, and internal arrangements. Sustainability of the organization and related environment can be guaranteed. VSM provides the necessary structure to determine the relationship between areas and parameters that allows recursive optimization to occur. Organizational simulation using a conceptual model with collaborative mechanisms gives better results for key parameters relevant to all three levels of all entities: company impact, supply chain, and society. As a result, simulation becomes a decision support tool for managers. In conclusion this proposed approach enables companies to interact within their sphere of influence in an efficient approach. To prove the conceptual model, simulations for manufacturing supply chains and affected areas were carried out.

Volker Stich and Matthias Blum (2015) wrote A Cybernetic Reference Model for Production Systems Using the Viable System Model. The aim of this paper is to propose a holistic approach to how supply chain, production and sales store planning are interrelated. Hereby the Eligible System Model is applied. Standard communication channels can be defined among the three entities. In conclusion, this newly proposed approach enables the company to reduce required stock, production lead times, and labor allocation. This proposed approach increases the efficiency of all production planning processes. This in turn means less stock, shorter waiting times and a more efficient allocation of labour. This holistic approach is the key to success for companies, especially in

countries with high wages. In this paper, the application of Stafford Beer's Viable System Model (VSM) in production management has been discussed as a way to overcome these challenges. It has been used as a basis for building a holistic framework for a changeable production management system. After introducing the model prerequisites, the cybernetic production management structural framework is obtained from the Eligible System Model and determines the function of the system elements and their interactions. Further research is needed to support the principles of the presented solutions for different tasks to verify and validate the ability of the model to support control loop design. Thus special focus should be dedicated to determining input and output values for each system.

Nugroho Ari Setyawan (2018) wrote regarding Using a Viable System Model to Analyze Indonesia's Anti-Corruption Strategy. This paper uses the Viable System Model as a framework model for anti-corruption measures in Indonesia. This model is used by the author to understand Indonesia's anti-corruption measures in one model, understand the problems inherited by agencies and provide solutions for them to improve anti-corruption measures for the effectiveness of achieving a better Corruption Perception Index. for Indonesia. This paper promotes the Appropriate Systems Model as a framework for understanding how parties engage in anti-corruption measures in Indonesia. By knowing the field work maps of these agencies, solutions can be found so that these agencies can work more effectively through guidance and supervision of the real role of each agency in eradicating corruption in Indonesia. By using the requisite variety theory and the feasible model system theory, this paper examines the implementation of the viable system model theory in the context of law enforcement agencies in Indonesia. KPK (corruption eradication commission in Indonesia) as a single independent organization seen from the perspective of VSM, KPK is the reason for action against corruption in Indonesia (System 5). Coordinator of preventive and repressive actions carried out by enforcement and non-enforcement entities (system 2). Executors at the operational level as other institutions (system 1), supervisors and auditors for other agencies (system 3), and intelligence leaders for anti-corruption measures (system 4). The KPK is a system for the entire system in Corruption Eradication Actions in Indonesia. The KPK will involve other agency officials to join in the process of coordination, inspection, control and intelligence of the KPK. The conclusion of this paper is that there are two alternatives for implementing VSM for the KPK. The first option is to place the KPK as an independent institution which in the long run will get permanent employees and not get employees from other agencies. The second preference is how to form a KPK consisting of multi-source officials from government agencies and non-government sources, not only at the commissioner level. The VSM model provides a new perspective on how to deal with corruption in Indonesia. From this model, the KPK has a central role as the coordinator of all corruption eradication actions in Indonesia. KPK as a central role must take action to develop its coordination and oversight department so that it can consider integrating all resources owned by other organizations in the field of prevention and prosecution. The result is the institution's success in eradicating corruption through a significant increase in Indonesia's Corruption Perceptions Index

Raúl Espejo (2022) writes regarding The Cybernetics of political communications and social transformation in Colombia: the case of the National Audit Office (1995–1998). This article is about cybernetics of organizations in Latin America that report on work in Colombia in the Second Period Audit for the State National Audit Office (CGR), from 1995 to 1998. This was a project with hundreds of participants, with limited exposure in Latin America and beyond. Conceptually guided by the Viable System Model VSM. The VSM and VIPLAN methodologies guide organizational systems to manage the complexity of their environment through collaboration and coordination with others, not by trying to run alone in a fragmented way. It is in this context that the VIPLAN Methodology plays its role. Beyond its use as a modeling tool for organizational systems, it deals with situations that require flexibility, creativity, and adaptability. This paper suggests that VSM's appreciation of structure, relationships and interactions opens up spaces for participation, democracy and accountability.

Theodoros Spyridopoulos, Ioanna-AikateriniTopa, Theo Tryfonas and Maria Karyda (2014) wrote about A Holistic Approach for Cyber Assurance of Critical Infrastructure with the Viable System Model. This paper presents an improvement on traditional risk management methods in the risk assessment phase, by utilizing the cybernetic construction of the Viable System Model (VSM) as a means to look at risks holistically to Critical Infrastructure. This research exploits the recursive nature of VSM, modeling the Supervisory Control and Data Acquisition (SCADA system), the most commonly used ICS, as a VSM and identifying various assets, in interaction with the internal environment. In this paper we have used the VSM Model to identify the relationships between different parts within and outside the scope of Critical Infrastructure, Areas of concern with respect to 'cyber' and construct the overall system of assets, threats and vulnerabilities. within that scope. This study enriches

the identification steps of conventional risk assessment methods. The VSM approach improves yield as a diagnostic tool and combined with risk management can provide system resiliency at multiple hierarchical levels. This approach considers organizational issues (management, coordination, etc.) that play a role in a system's ability to mitigate cyber threats and vice versa. The conclusion of this paper is that risk assessment is an important part of the Critical Infrastructure protection process. There are a variety of risk assessment tools currently in use. The complexity of these systems poses great challenges for traditional applications. Existing methods struggle to manage dependencies in such an environment. In many cases it remains an unsolved problem.

Ezzat Alqurashi, Gary Wills, and Lester Gilbert (2013) researched A Viable System Model for Information Security Governance: Establishing a Baseline of the Current Information Security Operations System. This paper proposes a systemic model of ISG using cybernetics principles and systems as contained in the Staffor Beer Appropriate Systems Model (VSM). It also establishes the baseline of current information security operating systems by adopting and simulating B ISO/IEC 27035 and shows the simulation results. Adopting a viable system model of information security governance assists an organization not only in ensuring the effectiveness of internal controls but also in ensuring business continuity. Vinnakota (2011) states that there is increasing emphasis on the need for ISG models to deal with the dynamic nature of current changes and organizational complexity. The Viable Systems Model (VSM) provides a promising route to counter increasing threat levels and to meet the need for response at the organizational level (Gokhale, 2002). Although much work has been done to date, more studies need to be conducted to determine the feasibility of ISG components. The aim of this paper is to present a VSM ISG (VSMISG) to address current deficiencies. The literature review method was carried out to determine the components of information security that ensure the survival of the organization. This led to identifying the VSM which was adopted as the theoretical background of the proposed model. The conclusion from the paper is that the adoption of VSM from the cybernetics literature provides principles and system viability for ISG. We conducted a simulation to establish a baseline of the current information security operating system as defined in BS ISO/IEC 27035 (2011). The reported results are comparable to those determined in the HP case study. The current operating system is the only VSMISG component whose established base represents. Our future work will focus on demonstrating the importance of the direct feedback principle by simulating an information security policy system and connecting it to current operating systems via a direct feedback channel.

Volker Stich, Marcel Groten (2015) wrote about Design and simulation of a logistics distribution network applying the Viable System Model (VSM). This paper aims to propose a holistic approach to how distribution networks can be designed. Hereby the Eligible System Model is applied. Standard communication channels can be defined. In Conclusion the proposed approach enables the company to reduce required stock, lead times, labor allocation, and prospects for improving service levels. At FIR (Institute for Industrial Management) at RWTH Aachen University, an approach was developed to solve the problem of planning the distribution of demand and supply with the help of a Viable System Model. The purpose of this paper is also to propose a self-regulatory approach to how to design a distribution network. From the results it is clear that in most cases the VSM approach gives us a better response in terms of KPIs of delivery performance, stock, WIP, etc. In cases where the VSM simulation model does not respond better than all three other Non-VSM simulation models across all KPIs. Thus that VSM is able to provide a structure for efficiently allocating products (controlling). It can be concluded that the proposed approach can improve the efficiency of the distribution network. It also shows how the VSM approach is better when dealing with distribution logistics networks.

Amin Vahidi, Alireza Aliahmadi and Ebrahim Teimoury (2018) wrote about Researches status and trends of management cybernetics and viable system models. This paper reviews the underlying principles and scientific trends of cybernetics and the feasible systems model (VSM). Therefore, this paper aims to guide authors and managers who are active in management cybernetics and to inform them about past, current, and future trends in this discipline. This paper adopts qualitative and quantitative methods. First, descriptive and qualitative approaches are used to review and analyze historical trends in management cybernetics. Then a frequency (quantitative) analysis was performed on the first 1,000 publications in the field. Cybernetics appeared at the Josiah Macy conference in 1946. Later, Wiener introduced the field of cybernetics and Ashby, Von Foerster and McCulloch developed this concept as a scientific discipline. The field of Management cybernetics introduced by Beer is a combination of systems science, control and management. Beer presents VSM as an operational model in this area. Analyzing the 1,000 top-ranked publications shows that the field's introduction is reaching maturity and its further development is relatively mature. In addition, based on the analyzed trends, the application of the VSM model can now become very attractive. In this paper, major journals, authors, and research trends are analyzed.

The main application areas of this model are in IT and large-scale organizations. The implication of this paper for practitioners and researchers is to guide authors and managers to the most appropriate studies in the field, so that they can produce and use the most efficient studies in this field.

Sahar Saeed Rezk and Shahinaz Gamal (2018) wrote a paper entitled The viable system model and its applications in higher education: an overview. This paper assesses that the feasible system model (VSM) is a powerful tool mainly used to describe, solve, and control complex problems of systems independently. This allows systems to be flexible so that they can survive by responding and adapting their behavior quickly to expected or even unexpected changes in their surrounding environment. This study aims to provide a literature review on VSM as a conceptual framework for designing a viable system, and its application in higher education (PT). This review builds on the explanation of "What is organizational cybernetics?", clarifies the principles of VSM as a rational model for designing viable organizations, discusses its shortcomings and extended VSM, and then presents a literature review of VSM applications in HE based on papers primarily published from 1993. until 2017. Although there are many contributions made by implementing VSM in HE, the previously developed models using the Beer framework with drawbacks without reference to some important factors are neglected in it which are discussed in this review.

Julio César PucheRegaliza, Alfredo Jiménez, Pablo Arranz Val (2017) wrote a paper on the Viable system model structuring of success factors in software projects. The aim of this paper is to identify the key success factors of a software project structured according to a feasible systems model (VSM). To do so, an exploratory empirical analysis was performed on a series of software projects, in which the level of compliance with the requirements set by the VSM and the success rate of their development were identified. The results show that the most influential factors in achieving global feasibility in software projects are the surrounding environment, organizational units and intelligent systems. Based on these factors, a mathematical prediction model was developed, achieving 63.16 percent accuracy in its predictions.

3. Discussion

The advantages of VSM are primarily being able to assist management in managing the organization holistically (Stich & Blum, 2015). In addition, VSM is also able to assist management in preparing organizational strategic policies, making decisions related to the environment, partners, and internal arrangements. VSM also allows for recursive optimization so that the sustainability of the organization and related environment can be guaranteed (Garcia & Garcia, 2019). VSM has also proven to be used as a successful modeling framework in various fields. This is the answer to the researcher's dissatisfaction with the weaknesses of various pre-existing models/approaches. VSM is also considered very dynamic and flexible (Stich & Blum, 2015). VSM provides better results than the approaches/models used/previously used from an organizational performance perspective. There are many cases of the VSM approach that gives a better response in all Key Performance Indicators (KPI), both from the aspects of efficiency, effectiveness and service. VSM is the key to success for companies with complex networks. Through the examples and cases analyzed, it is clear that a sophisticated tool like VSM should be utilized (Stich &Groten, 2015)

As a holistic model, VSM is also capable of being collaborated /combined with various other relevant approaches/models with effective results. The risk assessment method is used for complex systems. The complexity of this system poses a big challenge for traditional/conventional applications/approaches. The VSM approach improves yield as a diagnostic tool and combined with risk management can provide system resiliency at multiple hierarchical levels. This approach considers the organizational issues (management, coordination, etc.) that play a role in the ability of a system to mitigate cyber threats and vice versa (Spyridopoulos, Topa, Tryfonas&Karyda, 2014). Even VSM can also be combined with standard operating standards such as BS ISO/IEC 27035 (2011) which produces a Viable System Model Information System Governance -VSMISG approach (Alqurashi, Wills & Gilbert, 2013).

VSM implementation also enables preventive actions, strengthens coordination and oversight. VSM provides a new perspective on how to overcome corruption in Indonesia. From this model, the KPK (Corruption Eradication Commission) has a central role as the coordinator of all corruption eradication actions in Indonesia. KPK as a central role must take action to develop its coordination and supervision so that it can consider integrating all resources owned by other organizations in the field of prevention and prosecution (Setiawan, 2018)

Based on the results of previous research and its superior characteristics, VSM has been implemented in various sectors such as: IT, Policy Making, Production, Social Issues, Service Industry, Software Development, etc. Research is carried out by practitioners and researchers (Vahidi, Aliahmadi&Teimoury, 2018). Research on the use of VSM for higher education institutions has also been carried out (Rezk& Gamal, 2018). The latest research, VSM is able to open up spaces for participation, democracy and accountability in new structures, relationships and social interactions, especially in the era of the Covid 19 pandemic. Current advances in digital technology enable new social relations that need to be developed further, not just the application of technology and methodology. Covid-19 makes it clear that different local and global interactions are needed to thrive during the pandemic period and opportunities to form new organizations (Espejo, 2022)

The empirical and practical implications show that VSM is a very useful tool for organizational project management. VSM knowledge will be of invaluable value to managers who wish to manage organizational projects successfully and survive in a complex and rapidly changing environment. Its application enables the diagnosis and detection of critical factors to achieve such success (Regaliza, Jimenez & Val, 2017). The discussion above shows that VSM with its advantages has been proven to be successfully implemented in various areas of the organization in a holistic manner. Implementation can be done in the organization as a whole, units/functions/parts of the organization and existing systems within the organization. VSM is very possible to be implemented in an accounting information system (AIS). The existence of SIA as a provider of information for internal and external parties is becoming increasingly important as today's business organizations are increasingly complex. The development and implementation of an SIA with a holistic approach is certainly relevant for future research.

References

1. Al-Mutairi S.G., Burns N.D., Backhouse C.J. (2005). Using a viable system model as a diagnostic tool for small-sized companies. International Journal of Services and Operations Management, 1(3), 220-238.
2. Amar P.A., Angulo G.L., Ortega M.M., Quintero J.D. (2006). El sistema de innovaci.n del departamento del atl.ntico: unamiradadesde la cibern.ticaorganizacional. GerenciaTecnol.gicaInform.tica, 5(12), 55-62.
3. Amin Vahidi, Alireza Aliahmadi and Ebrahim Teimoury; Researches status and trends of management cybernetics and viable system model;Iran University of Science and Technology, IUST, Tehran, The Islamic Republic of Iran; Kybernetes © Emerald Publishing Limited 0368 492X DOI 10.1108/K-11-2017-0433
4. Ashby, W. R. (1956). An introduction to cybernetics. London: Methuen
5. Azadeh A., Darivandi K., Fathi E. (2012). Diagnosing, simulating and improving business process using cybernetic laws and the viable system model: the case of a purchasing process. Systems Research and Behavioral Science, 29(1), 66-86
6. Bachmann M., Michel D. (2001). Das Pentagramm der Komplexit.tsbew.ltigung: Management Kybernetik am Beispiel des Schweizer Paraplegiker-ZentrumsNottwil. Verlag Paraplegie. Schweizer Parapelgiker-Stiftung. Basel.
7. Badillo I., Tejeda R., Morales O., Flores M. (2011). Supply Chain Management from a Systems Science Perspective. Supply Chain Management – New Perspectives. Prof. SandaRenko (Ed.).
8. Bathallath S., Smedberg .., Kjellin H. (2016). Project interdependency management in IT/IS project portfolios: from a systems perspective. Procedia Computer Science, 100, 928-934.
9. Beer, S. (1959). Cybernetics and management. London: English Universities Press.
10. Beer, S. (1966). Decision and control. Chichester: John Wiley.
11. Beer, S. (1974). Designing freedom. Chichester: John Wiley.
12. Beer, S. (1978). Platform for change. Chichester: John Wiley.
13. Beer, S. (1979). Heart of enterprise. Chichester: John Wiley.
14. Beer, S. (1981). Brain of the firm (2nd ed.). Chichester: John Wiley.
15. Beer, S. (1985). Diagnosing the system for organisations. Chichester: John Wiley.
16. Beer, S. (1994). Beyond dispute. Chichester: John Wiley.
17. Britton G.A., Parker, J. (1993). An explication of the Viable System Model for project management. System Practice, 1(2), 163-176.
18. Brecher C., Muller S., Breitbach T., Lohse W. (2013). Viable system model for manufacturing execution systems. Procedia CIRP, 7, 461-466.
19. Broker J.J. (2005). Erfolgreiches Management KomplexerFranchisesysteme auf Grundlage des Viable System Model. Dissertation HSG. Difo-Druck GmbH. Bamberg

20. Chan J.W. (2011). Enhancing organisational resilience: application of viable system model and MCDA in a small Hong Kong company. International Journal of Production Research, 49(18), 5545-5563.
21. Chroneer D., Mirijamdotter A. (2009). Systems thinking benefits in supply change management: an illustration of the Viable Systems Model in a Supply Chain. International Journal Intelligent Systems Technologies and Applications, 6, 3/4.
22. Contreras A. (1999). Metodolog.a de diagn.stico para sistemaslog.sticos. Revisa EAN, 38, 58-69.
23. Crisan Tran C.I. (2005). Assessing Stafford Beer's Viable System Model (VSM). Development of a measurement framework for an empirical test of the viability hypothesis. Conference paper, 13thWorld Congress on Systems and Cybernetics, Maribor, Slovenia, 6-10 July, 2005.
24. Crisan Tran C.I. (2006). Beer's Viable System Model und Die Lebensf.higkeit von Jungunternehmen-eineEmpirischeUntersuchung. Difo-DruckGmbh, Bamber.
25. De Raadt J.D.R. (1987). The implications of Beer's Viable System Model for organizational adaptation: a study in an insurance organization. General Systems, 30, 9-13.
26. Devine S. (2005). The viable systems model applied to a national system of innovation to inform policy development. Systemic Practice and Action Research, 18(5), 491-517.
27. Dodis C., Kitis K., Panagiotakopoulos D. (2005). Organizational Cybernetics For Waste Management Authorities: A Case Study. Available in: http://www.bvsde.paho.org/bvsacd/iswa2005/case.pdf (last access: 27/02/2017).
28. Espinosa A., Walker J. (2013). Complexity management in practice: A Viable System Model intervention in an Irish eco-community. European Journal of Operational Research, 225, 118- 129.
29. Espejo R. (1979). Information and Management: The Cybernetics of a Small Company. Journal Management Research New, 2(4), 2-15.
30. Espejo R., Harnden R. (1989): The Viable System Model. Interpretations and Applications of Stafford Beer's VSM. John Wiley & Sons. Chichester.
31. Espejo R. (1990). The Viable System Model. Systemic Practice and Action Research, 3(3), 219-221.
32. Espejo R., Schwaninger M. (1993): Organisational Fitness: Corporate Effectiveness through Management Cybernetics. Campus Verlag. Frankfurt/New York
33. Ezzat Alqurashi, Gary Wills, and Lester Gilbert; A Viable System Model for Information Security Governance: Establishing a Baseline of the Current Information Security Operations System; Electronics and Computer Science, University of Southampton, United Kingdom {eha1r10,gbw,L.H.Gilbert} @soton.ac.uk; L.J. Janczewski, H.B. Wolfe, and S. Shenoi (Eds.): SEC 2013, IFIP AICT 405, pp. 245–256, 2013,; © IFIP International Federation for Information Processing 2013
34. Fitch D., Parker-Barua L., Watt J.W. (2014). Envisioning public child welfare agencies as learning organizations: Applying Beer's Viable System Model to Title IV-E program evaluation. Journal of Public Child Welfare, 8(2), 119-142.
35. Frost B. (2005). Lebensf.higkeit von communities of practice imorganisationalenkontext. PhD Dissertation, University of Sant Gallen.
36. Grizelj F. (2005). KollaborativesWissensmanagement in virtuellen Dienstsleistungsunternehmen. Dissertation HSG. Difo-Druck GmbH. Bamberg.
37. Herrmann C., Bergmann L., Halubek P., Thiede S. (2008). Lean production system design from the perspective of the viable system model. In Manufacturing Systems and Technologies for the New Frontier. 309-314. Springer. London.
38. Herold C. (1991). Ein Vorgehenskonzeptzur Untemehmensstrukturierung: Eine heuristischeAnwendung des ModellsLebensf.higerSysteme. Dissertation Universit.t St. Gallen. DifoDruck Verlag, Bamberg
39. Hildbrand S., Bodhanya S. (2013). The potential value of the Viable System Model as a managerial tool. Management Dynamics, 22(2), 2-15.
40. Hoverstadt, P. (2020). The Viable System Model. In: Reynolds, M., Holwell (Retired), S. (eds) Systems Approaches to Making Change: A Practical Guide. Springer, London. https://doi.org/10.1007/978-1-4471-7472-1_3
41. Julio César PucheRegaliza, Alfredo Jiménez, Pablo Arranz Val; Viable system model structuring of success factors in software projects;"Viable system model structuring of success factors in software projects", International Journal of Managing Projects in Business, https://doi.org/10.1108/IJMPB-08-2016-0068
42. Leimer H.W. (1990). VernetztesDenkenals Basis für der strategischen. Probleml.sungs und Früherkennungsprozess in Banken. Dissertation HSG. Druckerei Wetzel
43. Leonard A. (2009). The viable system model and its application to complex organizations. Systemic

practice and action research, 22(4), 223-233.
44. Midgley G. (2006). Systemic intervention for public health. American journal of public health, 96(3), 466-472.
45. Monreal-.lvarez M. (2004). AspectosTe.ricos del Cambio Organizacionalenlos Hospitales. Cuadernos M.dicos Sociales, 44, 192-194.
46. Morales-Arroyo M.A., Chang Y.K., Barrag.n-Oca.a A., Jim.nez J., S.nchez-Guerrero G. (2012). Coordination mechanisms illustrated with project management using the Viable System Model (VSM) as organizational framework. Jindal Journal of Business Research, 1(2), 163-176
47. Murad R.S.A., Cavana R.Y. (2012). Applying the viable system model to ICT project management. International Journal Applied Systemic Studies, 4(3), 186-205
48. Narvarte P., Castillo C., Torres N. (2006). Estudio de la viabilidadorganizacional del sector cooperativo de ahorro y cr.ditoen Chile. 1er ColoquioInternacional de la Red RULESCOOP.
49. Nugroho Ari Setyawan; *The Indonesian National Police*; Using Viable System Model to Analyse Indonesia's Anti-Corruption Strategy;; Asia Pasific Fraud Journal; Volume 3, No.1st Edition (January-June 2018); *DOI:* 10.21532/apfj.001.18.03.01.02Nystrom C.A. (2006). Design rules for intranets according to the viable system model. Systemic Practice and Action Research, 19(6), 523-535.
50. Oliveira J.J. (2010). Modelo de Sistema Viable comoHerramienta de Dise.o. RevistaTecnol.gica ESPOL, 23(3), 1-8.
51. Ortiz M., del Valle M. (2014). Desarrollo de un sistemaautomatizado para el control de existencias y reposici.n de repuestos de unaempresa de repuestosautomotriz. RevistaEspacios, 35(5), 7-21.
52. Preece G., Shaw D., Hayashi H. (2013). Using the Viable System Model (VSM) to structure information processing complexity in disaster response. European Journal of Operation Research, 224, 209-218.
53. PucheRegaliza J.C. (2014a). An.lisiscualitativo del Modelo de SistemasViablessobreproyectos software del sector TIC en Castilla y Le.n. Direcci.n y Organizaci.n, 52, 26-37.
54. PucheRegaliza J.C. (2014b). Extending the Viable System Model scope on ICT-sector software projects in Castilla y Le.n. Kybernetes, 43(2), 192-209.
55. PucheRegaliza J.C. (2015). Quantitative analysis of Viable System Model on software projects in the ICT sector in Castilla y Le.n. Kybernetes, 44(5), 806-822.
56. Ramirez M., Medina V.H., de la Fuente D. (2009). Mejoramiento de gesti.nuniversitaria basadoenel Modelo de SistemasViables. Caso de estudio: Universidad Libre. Ingenier.a, 14(2), 59-66.
57. Raúl Espejo; The Cybernetics of political communications and social transformation in Colombia: the case of the National Audit Office (1995–1998);; Received: 3 September 2021; Accepted: 15 October 2021; Published online: 28 January 2022; © The Author(s), under exclusive licence to Springer-Verlag London Ltd., part of Springer Nature 2021; AI & SOCIETY (2022) 37:1255–1267; https://doi.org/10.1007/s00146-021-01352-4
58. Rojas J., Tuesta J. (2011). Estudio de unaexitosagesti.n de unainstituci.n de formaci.nprofesional peruana desdeelenfoque de sistemas de Stafford Beer. ECIPER., 8(2), 180-189.
59. Sahar Saeed Rezk and Shahinaz Gamal; The viable system model and its applications in higher education: an overview;Department of Socio-Computing, Faculty of Economics and Political Science, Cairo University, Giza, Egypt; Kybernetes © Emerald Publishing Limited 0368-492X DOI 10.1108/K-04-2018-0185
60. Schwaninger M., Haff P. (1989). CyberSyn. Ein kybernetisches Management-System. Anwendungsmodell und Test. Forschungsbericht Universit.t St. Gallen.
61. Schuhmann W. (1991): Infomations-Management: Unternehmensführung und Informations system eaussystem theoretischer Sicht. Campues Verlag. Frankfurt/New York.
62. Sergio Gallego-García and Manuel García-García; Design and Simulation of an Integrated Model for Organisational Sustainability Applying the Viable System Model and System Dynamics; Research Area of Productive Systems at UNED University, Madrid, Spain; © IFIP International Federation for Information Processing 2019 Published by Springer Nature Switzerland AG 2019F. Ameri et al. (Eds.): APMS 2019, IFIP AICT 567, pp. 555–563, 2019. https://doi.org/10.1007/978-3-030-29996-5_64
63. Sitch V., Groten M. (2015). Design and simulation of a logistics distribution network applying the Viable System Model (VSM). Procedia Manufacturing, 3, 534-541.
64. Shaw D.R., Snowdon B., Holland C.P., Kawalek P., Warboys B. (2004). The viable systems model applied to a smart network: the case of the UK electricity market. Journal of Information Technology, 19(4), 270-280.
65. Tavella E., Papadopoulos T. (2015). Expert and novice facilitated modelling: A case of a viable system

model workshop in a local food network. Journal of the Operational Research Society, 66(2), 247-264.
66. Terra L.A., Ventura C.A., Medeiros M.L., Passador J.L. (2016). Strategies for the Distribution of Power in Brazil: A Proposal from the Perspective of the Viable System Model (VSM). Systems Research and Behavioral Science, 33(2), 224-234.
67. Theodoros Spyridopoulos, Ioanna-AikateriniTopa, Theo Tryfonas and Maria Karyda; A Holistic Approach for Cyber Assurance of Critical Infrastructure with the Viable System Model;Cryptography Group, University of Bristol, UK; Department of Information and Communication Systems Engineering; University of the Aegean, Greece; This work was supported by the Systems Centre and the EPSRC funded Industrial Doctorate Centre in Systems (Grant EP/G037353/1); N. Cuppens-Boulahia et al. (Eds.): SEC 2014, IFIP AICT 428, pp. 438–445, 2014; IFIP International Federation for Information Processing 2014
68. Thiem I. (1998). Ein Strukturmodell des Fertigungsmanagements: SoziotechnischeStrukturierung von Fertigungssystemenmit dem Modell Lebensf.higerSysteme. Dissertation zurErlangung des Grades Doktor-Ingenieur. Fakult.t fürMaschinenbau. Ruhr Universit.t Bochum, Bochum.
69. Trueba B., Badillo I., Morales O. (2012). Diagn.stico del sistemafinanciero, la banca comercial y elsistema de portafoliosbasadoenelModelo de SistemasViables. Cient.fica, 16(2), 55-65.
70. Türke R.E. (2006). Towards productive and sustainable forms of interaction in governance. Kybernetes, 35(1/2), 164-181.
71. Van Kempen M. (1991). ExterneInformationsbeschaffung von Unternehmungenaussystemtheoretischer Sicht. Dissertation Universit.t St. Gallen. ADAG Administration &Druck AG, St. Gallen
72. Vargas J.I., Alonso I. (2011). Metodolog.as del pensamientosist.mico y suusoenelan.lisis de la viabilidad de las organizaciones rurales en Colombia. 9. Encuentro Colombiano de Din.mica de Sistemas.
73. Volker Stich and Matthias Blum; A Cybernetic Reference Model for Production Systems Using the Viable System Model;; Institute for Industrial Management (FIR), Campus Boulevard 55, 52074 Aachen, Germany; © IFIP International Federation for Information Processing 2015; S. Umeda et al. (Eds.): APMS 2015, Part I, IFIP AICT 459, pp. 169–176, 2015; DOI: 10.1007/978-3-319-22756-6_21
74. Volker Stich, Marcel Groten; Design and simulation of a logistics distribution network applying the Viable System Model (VSM); Institute for Industrial Management at RWTH Aachen University,Campus-Boulevard 55, 52074 Aachen, Germany; 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015© 2015 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license; Peer-review under responsibility of AHFE Conference.
75. Willemsen M.H. (1992). Die Schweizerische Eidgenossenschaftalslebensf. higes System: Kybernetische Analyse des schweizerischenpolitischen System. Dissertation HSG. Verlag Rüegger.