Applications of the Viable Systems Model in IS Research –
A Comprehensive Overview and Analysis

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Abstract

The interwovenness of information technology and organizational structures suggests an understanding of organizations as systems of high complexity. The Viable Systems model (VSM), grounded on cybernetic principles, is a popular approach enabling researchers to assess the complexity of organizations heavily relying on information systems (IS). Although IS scholars have increasingly applied the VSM in recent years, the different studies lack a common ground in terms of a systematic approach. By conducting a concept-driven systematic literature review, we investigate the state of the art of IS research applying VSM in a real-world setting. We analyze and systematically compare the identified studies to direct future research on applications of the VSM. We identify a set of VSM specific benefits. While the VSM provides an innovative perspective to common IS topics, its application mostly lacks a rigorous evaluation and fails to exhaustively derive the identified benefits.

1. Introduction

Organizations face increasingly turbulent and rapidly changing environments [1, 2]. Their success highly depends on the ability to cope with changing conditions of strategic and operational nature. To survive and ensure long-term success, organizations need to respond quickly and be ready to adapt to shifting environmental circumstances.

Since the challenge to adapt in a timely manner is in many cases (e.g., data related to capital markets, electricity market, complex system architectures, or social networks) directly accompanied by the capability of processing huge quantities of information, most organizations heavily rely on information technology (IT) (e.g., [3–5]). The resulting interwovenness of IT and organizational structures suggests an understanding of both as socio-technical systems of high complexity – namely information systems (IS). A system is considered complex if it exhibits characteristics like a large number of strongly interacting elements, probabilistic and non-linear system behavior, system evolution and emergence over time, and strong interaction across system boundary with the environment [6, 7]. Assessments of organizations to direct future business thus need to cope with high complexity.

The Viable Systems Model (VSM), developed in the 1950s [8–11], originates from organizational cybernetics and is a popular approach to assess organizations and their complexity [12, 13]. The VSM is a meta-model that focuses on an organization’s viability. Organizations attributed with viability are apt for survival. In this context, organizations can refer to any kind of living systems like organisms, societies, or enterprises. However, in reality the latter are often steered by insufficient models like profitability [14]. Different theories and models need to be considered to deal with the degree of variety demanded by an ever-changing environment.

On a global scale, cybernetic concepts have rarely been applied in contemporary IS research – at least not explicitly [15]. This lack of awareness indicates a critical gap between IS research and theoretical insights from interdisciplinary fields like cybernetics. However, the VSM has recently found its way into IS research (e.g., [6, 16–18]). While traditionally applied to enterprises, various articles show VSM’s general applicability to socio-technical systems. Examples include complex system architecture [19], IT governance [17], and IS agility [20]. We thus believe the VSM to be highly relevant for IS research.

While various (diverging) approaches of applying the VSM in IS research exist (cf. [16, 17, 21]), research lacks an overview from which a meaningful approach to apply the VSM can be derived. A promising first step to strengthen awareness and foster applicability of the VSM, is to provide an overview and analyze how the VSM has been applied.
The intention of such an application is either to analyze, diagnose, or design a system that already exists or should be designed from scratch for a specific real-world setting. Furthermore, an assessment of benefits achieved by this application strengthens VSM’s value for researchers. We intend to fill this gap by performing a concept-driven systematic literature review [22] of IS outlets as well as a qualitative content analysis of identified literature. Our research objective is thus to ascertain the state of VSM real-world applications in IS research. Our study informs how the VSM has been applied and can be applied in IS research. We emphasize VSM benefits and provide implications that help coping with shortcomings of previous studies. The VSM as a strong visualization approach also helps to improve communication among researchers and practitioners.

We proceed as follows. Next, we embed the VSM in the context of organizational cybernetics and systems science. Then, we describe our research approach. Subsequently, we present and discuss our findings. We finally conclude with implications.

2. Theoretical background

2.1. Organizational cybernetics and systems science

Cybernetics is the interdisciplinary science of regulation and control in any system [23]. The term organizational cybernetics is framed by the idea that cybernetic principles can be applied to all kinds of organizations, their interactions (within and between), and their control in order to make them more efficient and effective – Stafford Beer being one of the most famous advocates of this view [8]. Beer is considered the first to have explicitly applied cybernetic principles in the context of management – mainly manifested in the VSM [24] (cf. section 2.2). This can be seen as a reaction to the deficiency of thinking about organizations on the basis of distinct disciplines and not in a holistic and systemic way. The so-called systems approach (also referred to as systems thinking, cf. [25]), born from the effort to build theories that deal with invariant features of systems, is based on cybernetics and systems sciences in general [14]. Systems science can be seen as an overarching term that subsumes the set of disciplines that think in systems (e.g., cybernetics, chaos theory, systems dynamics, and complex systems). Therefore, the VSM represents a meta-model grounded in organizational cybernetics to approach complex organizations in a systemic manner.

2.2. The Viable Systems Model

Central to the VSM is the concept of viability [9–11]. A system is attributed with viability if it is able to maintain a separate existence. Hence, it is able to adapt its behavior to changes in its environment that were unforeseeable when the system was designed. A viable system is required to maintain a specific identity and can be delineated from its environment. However, it intrinsically depends on its environment due to constant information and resources exchange. A viable system cannot survive in a vacuum.

The VSM as a meta-model operationalizes the Law of Near Decomposability [16]. According to this law, subsystems within a complex system can be identified as there is generally more interaction within subsystems than among subsystems [26]. The VSM guides to divide complex systems into their subsystems and eventually to manage complexity. A fundamental principle of the VSM is Ashby’s Law of Requisite Variety which states that only variety can absorb variety [17, 23]. Variety can be regarded as the number of possible system states. In order to survive, an organization needs a control system that copes with variety. This control system operates on broader targets than financial or business goals as it needs to be able to overthrow and reinvent the shape of business if necessary. Consequently, this control system exhibits a higher variety than the organization’s environment and the organizational units it ought to control. If so, the whole organization is able to survive. Hence, it maintains the ability to fulfill its purpose.

"The purpose of a system is what it does” [9, p. 128], representing the producing divisions of an organization. Such a division can constitute a viable system if it contains a control system and one or more producing systems. This principle of recursion can be applied until reaching systems or parts that are not viable any more. Vice versa, viable systems can be a part of a more comprehensive viable system on a higher level. For instance, an enterprise could be part of a regional sector which in itself forms a viable system. Depending on the perspective adopted, the same enterprise can be a part of several more comprehensive viable systems (e.g., joining a partnership with other enterprises, membership in a research and development consortium). Thus, recursion is a multi-dimensional principle [14].

To be attributed with viability, a system needs to perform at least five different tasks or functions. These are associated with specific subsystems: (1) production, (2) coordination, (3) execution, (4) planning, and (5) identity [9–11]. These functions serve to maintain a system’s separate identity and to
fulfill its purpose. The five corresponding subsystems on one level of recursion form a logically closed entity that constitutes a viable system.

Figure 1 depicts the viable system adopted from one of the identified real-world applications [27]. In this case, the authors investigate the role of communication and coordination for project success in a data warehouse implementation project in one of the leading Austrian banks. The project is embedded in an organization-wide program triggered by a major change in banking regulations. In the following, we present a VSM real-world example for illustrative reasons and tangibility.

2.2.1. Subsystem 1: Production. By fulfilling the system’s overall purpose, Subsystem 1 (S1) is an action-oriented subsystem in contrast to the others which are responsible for control and management functions. Considering the VSM example, S1 on the first level of recursion represents the three project fields. S1 on the second level of recursion (project bundles) is only indicated in Figure 1, whereas the third level of recursion (projects) is not depicted.

2.2.2. Subsystem 2: Coordination. Subsystem 2 (S2) performs the function of dealing with oscillation behaviors of S1. To this end, a process of auto-regulation aiming to maintain a homeostasis in the system is implemented. This is accomplished by coordinating activities of S1 (e.g., preventing S1 to take actions which harm the system). In the example, S2 represents coordination through direct communication between project fields [27]. This role was adopted by the project field leaders.

Figure 1. The Viable Systems Model [27]
2.2.3. Subsystem 3: Execution. Subsystem 3 (S3) plans and allocates system resources. S3 does not formulate rules; it directs S2 and S1. Thus, S3 manages the system’s daily operations. Subsystem 3* (S3*) represents a communication channel in the system that links all operational units – especially those on lower levels of recursion – with subsystem S3. Hence, S3 can obtain information that would otherwise be communicated in an aggregated form by S1 and S2. In the example, S3 represents the project management team on the first level of recursion that directs the three aforementioned project fields [27]. Each project field (S1 on first level of recursion) has a leader representing S3 on the second level of recursion (not depicted in Figure 1). These leaders thus adopt two roles, that is, S2 on the first level of recursion and S3 on the second level of recursion.

2.2.4. Subsystem 4: Planning. Subsystem 4 (S4) is responsible for anticipating future developments. Its function is to identify relevant long-term changes and threats from the environment. Being aware of the system’s current situation, S4 needs to evaluate whether adaptions are necessary to maintain the system’s viability. In the example, the overall project management team fulfills the function of S4 on the first level of recursion [27]. On the second level of recursion, a similar structure is adopted: the aforementioned project field leaders represent S4 (not depicted in Figure 1).

2.5 Subsystem 5: Identity. Subsystem 5 (S5) forms the political system that represents the supreme rules and values of the system. S5 is responsible for maintaining the identity of the system. Similarly to S2, keeping a homeostasis of all involved systems of S1, S5 regulates the relation between S3 and S4, which is characterized by the conflict of present versus future. In the example, S5 is represented by the program management team responsible for the organization-wide program and controlling the overall project management team (S3 and S4 on first level of recursion) [27].

3. Research approach

Our approach is twofold. First, we conducted a concept-driven literature review [22] of VSM real-world applications in IS research. Second, we applied qualitative content analysis [28] to identify benefits from applying the VSM to real-world systems.

3.1. Literature review

We conducted a concept-driven literature review [22] to identify IS research articles in which the VSM is applied in real-world settings. We explicitly exclude real-world applications in which the authors do not directly apply the VSM as integral part of their research method as we are primarily interested in implications for researchers. Therefore, we have chosen a four-step approach to identify such studies.

First, we identified an initial set of potentially relevant articles by conducting a systematic search of the following databases: ACM Digital Library, AIS Electronic Library, EBSCOhost, IEEE Xplore, ProQuest, and ScienceDirect. We searched each database for any of the following phrases within the search fields title, abstract, and keywords: “viable systems model” and “viable system model”. We also considered adding the term “VSM” to the search expression but neglected this extension due to a vast amount of irrelevant results which referred to “VSM” as an abbreviation for a different terminology (e.g., Value Stream Mapping). Additionally, we expected relevant literature to spell the term in full before introducing the abbreviation VSM in an article. Concluding, we presume that this did not influence our number of relevant results in a negative way. We did not restrict the search period since the resulting number of articles was manageable.

Second, to focus the review on IS relevant literature, we filtered the results further by considering publications only within outlets of the Association for Information Systems (AIS) list of management information systems (MIS) journals and added proceedings of major IS conferences. Hence, a number of 153 journals and seven conferences were searched.

Third, we assessed whether entries in the resulting list of research articles applied the VSM in a real-world setting. At least two researchers independently categorized the articles. A third researcher was consulted to categorize articles in cases of uncertainty. Furthermore, we evaluated an article’s full text to make the final decision. We identified nine research articles matching our criteria.

Fourth, we accumulated the results by identifying further relevant studies using the approach of searching forward and backward [22] on our primary result set (i.e., the aforementioned nine articles). For searching forward, we used Web of Science as recommended [22] and additionally Google Scholar. According to our experience, Google Scholar (established in 2004) provides a more comprehensive impression on the actual number of citations. Applying the same categorization as in step 3, we identified four additional relevant articles. Thus, our final result set consisted of 13 articles (cf. Table 1 for an overview of literature review results). Twice, we considered two articles as a single study as the more current article is the continuation of the previous one.
and their reporting largely overlaps (i.e., [20], [29] and [21], [30], cf. Table 2). Henceforth, we thus refer to eleven studies or rather 13 articles. We present the identified studies in section 4.1.

<table>
<thead>
<tr>
<th>Table 1. Literature review results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication name</td>
</tr>
<tr>
<td>Journal of Information Technology</td>
</tr>
<tr>
<td>European Journal of Operational Research</td>
</tr>
<tr>
<td>Journal of Database Management</td>
</tr>
<tr>
<td>International Journal of Information Management</td>
</tr>
<tr>
<td>Hawaii International Conference on System Sciences</td>
</tr>
<tr>
<td>International Conference on Information Systems</td>
</tr>
<tr>
<td>Americas Conference on Information Systems</td>
</tr>
<tr>
<td>European Conference on Information Systems</td>
</tr>
<tr>
<td>Pacific Asia Conference on Information Systems</td>
</tr>
<tr>
<td>Australasian Conference on Information Systems</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

3.2. Qualitative analysis

We conducted a qualitative content analysis, following the core procedure of bootstrapping techniques [28]. Our categories represent benefits of applying the VSM, whereas our items are descriptions (text passages) from the articles. In a team of three, we applied a three-step approach.

First, each researcher independently identified descriptions that account for benefits resulting from applying the VSM. After an initial coding, two of the researchers compared and discussed their results. They decided that coded descriptions should go at least into some detail (in contrast to broad statements) to grasp the exact origin of the benefit. This approach reduced the risk that identified benefits result from other factors in the specific study. After coding all articles, the two researchers compared and discussed their overall results until they identified a consolidated set of descriptions for each article. Thereby, descriptions were discarded if they neither reported a benefit (rather they listed VSM characteristics) nor were inherent to the VSM (e.g., benefits derived from combining the VSM with complementary models).

Second, the two researchers mutually categorized the descriptions and labeled the resulting benefit categories. During this process, several descriptions were broken down to better match a particular benefit category. Furthermore, categories were reformulated and therefore their conceptual notion changed at times, which required reallocating their associated descriptions. This process continued until each description could be matched to one or several categories of benefits.

Third, the two researchers compared their consolidated description allocation and benefit categories with the third researcher, who had independently conducted steps 1 and 2 before the two other researchers. We chose this parallel approach for two reasons: (1) to show feasibility of deriving substantial benefits as we only expected these benefits to exist (single researcher approach); (2) to ensure inter-subjectivity and reliability of the process (dual researcher approach). Finally, the three researchers jointly discussed their two sets of independently derived benefit categories. The aim was to arrive at a substantial set of benefit categories – substantial in the sense that these benefits emerged in a repetitively manner in the analyzed studies. In this step, the researchers agreed upon a common caption for conceptually identical categories. Conceptually differing categories were merged into a super-category, incorporated, or broken down into pre-existing conceptually broader categories. After agreeing upon a common set of categories and their corresponding definitions, each researcher reviewed the allocated descriptions again and verified that these matched the assigned category definition. During this verification, no issues arose and we see the derived benefit categories as being substantial for VSM real-world applications. We provide details and discussion of these benefits in section 4.2.

4. Findings

4.1. VSM real-world applications

Our overview of VSM real-world applications is structured as follows. As neither of the identified studies provides a common approach, nor did we identify a general structure in literature, we chose the following four aspects. First, we provide an overview of these studies by focusing on their diverging methodological aspects. Second, we describe the studies’ motivation to use the VSM. Thereby, we provide a systematic overview of VSM applications, which serves as an impetus for future research. Third, considering the studies’ purpose, we distinguish between using the VSM to describe, diagnose, or design [17] a setting in the real world. We believe that analyzing the different types of purposes leads to insights concerning the different potentials that can be associated with VSM applications. Finally, we analyze to which extent the VSM applications have been subject to evaluations. Without assessments, the findings gathered in studies are only of limited value [31]. These four aspects are elaborated in the following subsections.

4.1.1. Study overview. Table 2 shows an overview of the studies identified in our literature review. We present the study’s purpose (cf. section 4.1.3) and describe the studies in general according to a goal-
Table 2. Studies applying the VSM in IS research

<table>
<thead>
<tr>
<th>Study</th>
<th>Object</th>
<th>Purpose</th>
<th>Focus</th>
<th>Viewpoint</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>[6]</td>
<td>System science based project management system</td>
<td>Design</td>
<td>Rigor</td>
<td>Researchers and practitioners</td>
<td>Complex system of systems project with multiple government agencies</td>
</tr>
<tr>
<td>[16]</td>
<td>Smart Business Networks</td>
<td>Diagnose</td>
<td>Smartness</td>
<td>Researchers and practitioners</td>
<td>United Kingdom electricity market</td>
</tr>
<tr>
<td>[17]</td>
<td>IT governance structures</td>
<td>Design</td>
<td>Effectiveness</td>
<td>Researchers and practitioners</td>
<td>Global telecommunications company; international design, engineering, and construction firm</td>
</tr>
<tr>
<td>[18]</td>
<td>Information and knowledge flows in virtual enterprise</td>
<td>Diagnose</td>
<td>Adaptiveness, competitiveness</td>
<td>Researchers and virtual enterprise members</td>
<td>Small to medium-sized virtual consulting company located in Germany specialized in the fields of law, financial, and corporate management</td>
</tr>
<tr>
<td>[19]</td>
<td>Complex system architecture</td>
<td>Design</td>
<td>Viability</td>
<td>Researchers and practitioners</td>
<td>Domain-specific software architecture for B2B</td>
</tr>
<tr>
<td>[20], [29]</td>
<td>IS agility</td>
<td>Diagnose</td>
<td>Agility</td>
<td>Researchers, IT professionals, and business stakeholders</td>
<td>Client organizations of an Australian major IT and business services consultancy</td>
</tr>
<tr>
<td>[21], [30]</td>
<td>Information flows</td>
<td>Design</td>
<td>Efficiency</td>
<td>Researchers and managers</td>
<td>Decision support in the supply chain at arvato services healthcare</td>
</tr>
<tr>
<td>[27]</td>
<td>Information and communication</td>
<td>Diagnose</td>
<td>Effectiveness</td>
<td>Researchers and consultants</td>
<td>IS development project (data warehouse) within one of the leading Austrian banks</td>
</tr>
<tr>
<td>[33]</td>
<td>Information processing</td>
<td>Diagnose</td>
<td>Viability, effectiveness, rapidness</td>
<td>Researchers</td>
<td>Disaster management and response</td>
</tr>
<tr>
<td>[34]</td>
<td>Information channels</td>
<td>Design</td>
<td>Viability</td>
<td>Researchers and managers</td>
<td>Management of non-commercial virtual community</td>
</tr>
<tr>
<td>[35]</td>
<td>Relations of communication, control, and organizational structures</td>
<td>Diagnose</td>
<td>Effectiveness</td>
<td>Researchers and database developers</td>
<td>Database development project in a manufacturing company in England</td>
</tr>
</tbody>
</table>

oriented template derived from the context of the goal-question metric [32]. This template refers to the criteria of object of the study (e.g., information system, process), its quality focus (e.g., effectiveness, efficiency), viewpoint of the study’s recipients (e.g., researchers, practitioners), and study’s context (e.g., project X, organization Y). The studies in our review cover a high diversity of systems to which the VSM was applied, ranging from rather technical themes like software architecture [19] to inter-organizational structures and processes [16]. All studies apply the VSM to systems associated with organizational structures. Various viewpoints are adopted ranging from researchers’ view to more practitioner-oriented views like those of database developers (cf. Table 2). In one case, researchers not only adopt an internal practitioner’s viewpoint but also engage in a rather participative form of research [17]. Except for one study [33], all studies investigate a single case.

4.1.2. Motivation. There is a recurring motif for applying the VSM. Eight studies state that complexity of the underlying system is a focal issue [6, 16–19, 21, 27, 30, 33]. Moreover, authors state that environmental influences on the investigated systems are not sufficiently understood [18, 21, 30], unforecastable [16], or quickly fluctuating [20, 29]. This calls for a systemic view in contrast to traditional ones that have so far derived unsatisfactory results in the context of complex organizations [18]. Some authors are generally interested in the systems science view as they argue that there is not a single correct representation of a specific system [6]. “The need for inclusion of multiple perspectives [7] has long been recognized as an important consideration in systems-based methodologies” [6, p. 2]. Many studies justify their choice of the VSM since it provides rigorous theory grounded on cybernetic principles [21, 27, 34]. Further, it is argued that as cybernetics principles incorporate a high degree of generalizability they cannot be avoided in studying non-trivial information-processing systems [19] or self-organizing systems [17].

1 We exchanged the original citation with our own numbering.
4.1.3. Purpose. We distinguish between three different purposes to apply the VSM [17]. First, being applied descriptively, the VSM can be used to illustrate existing structure of a system in a real-world context. In this context, the VSM is a meaningful template to “provide an alternative language with which to discuss [related] issues” [17, p. 51]. Second, the VSM is applicable as tool to diagnose the effectiveness of existing systems of high complexity. Finally, scholars might design viable systems by using the VSM as process guide.

Six of the eleven analyzed studies apply the VSM to diagnose an existing system (cf. Table 2). As no study applies the VSM solely to describe an existing system, this option seems to be neglected so far. The third option, that is, to design a system according to the VSM, is probably the most ambitious and complicated one. The theoretical conceptualization of a system from scratch requires in-depth insights into existing structures and processes. Nevertheless, we identified five studies that apply the design option.

These studies result in artifacts that are usually based on existing concepts and enriched with VSM concepts like viability. In concrete, the artifacts are a system science based project management system [6], a domain-specific software architecture [19], a supply chain system [21, 30], a virtual online community [34], and IT governance structures [17].

4.1.4. Evaluation. Finally, we analyzed the extent to which VSM applications have been evaluated. In general, we identified a lack of such justification processes. In the following, we describe the studies in more detail. One study, for instance, designs a viable project management system [6]. Although the study’s authors “are confident in the fundamental structure and basis for the model” [6, p. 9], they pose several questions concerning the system’s validity that are open for future research. This finding applies to other studies as well. While the application of VSM to real-world phenomena is empirically based, there is lack of empirical justification for mapping the empirical to theoretical concepts [16–19, 21, 27, 34, 35]. Without justifying and evaluating this mapping, the findings gathered are only of limited value [31]. In another study, the model was empirically validated using a survey and partial least squares analysis [20, 29]. However, the resulting model is validated instead of the VSM application. Nevertheless, this approach represents a useful way to strengthen empirical correctness and relevance of the resulting model.

4.2. VSM benefits

In this section, we report benefits achieved by applying the VSM to real-world systems. These benefits pertain to researchers, practitioners, or other stakeholders who directly apply the VSM (i.e., VSM users). We derived the following six benefits from our qualitative content analysis (cf. section 3.2).

4.2.1. Viability. With the help of the VSM, users are able to assess the viability of real-world systems. For instance, this can help in the context of organizational integration in order “to design a viable and healthy organization for the future” [30, p. 2000]. For some authors viable means both, being effective in the present [33, 35] and successful in the future [30, 35].

4.2.2. Transparency. Applying the VSM helps users who deal with local parts of a system to see the bigger picture and grasp the system in a broader context [30, 35]. Due to its strong focus on visualization, the authors of one study put it this way: “The primary contribution of the VSM was that it helped stakeholders and researchers to challenge their previous assumptions regarding the flow of information between operational units and individuals […]. Thus everybody was able to see the big picture, the actual flow of information to and from the operational units, and the impact on other systems of the VSM” [34, p. 10].

4.2.3. Modeling. Basically, the VSM describes systems by depicting them through three different types of components: (1) organizational structure of subsystems, (2) the environment, and (3) communication flows between subsystems and between subsystems and the environment (cf. columns in Table 3).

<table>
<thead>
<tr>
<th>Table 3. Modeling options</th>
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<tbody>
<tr>
<td>(1)</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Diagnosis</td>
</tr>
<tr>
<td>Design</td>
</tr>
</tbody>
</table>

When modeling, most authors focused on one specific type of components. Furthermore, modeling activity can be distinguished by purpose of description, diagnosis, and design. The VSM therefore enables users to model system parts of interest with specifically intended purposes. These options highlight VSM’s manifold applicability for modeling purposes. Studies where the options have been exceptionally applied are shown in Table 3.

4.2.4. Modularization. The VSM helps users to decompose complex systems into their sub-parts. Such decompositions help to (1) analyze interactions among subsystems and between the system and its environment, (2) analyze functions or roles of subsystems, and (3) understand how different levels of hierarchy influence each other. Utilizing decomposability and the concept of viability, Karayaz et al. [6] transform the original five
subsystems into a system consisting of nine subsystems. In this transformation process, the five subsystems are subject to further separation. For instance, subsystem 4, originally assigned to intelligence, is divided into subsystems 4 (Development) and 4* (Learning & Transformation). The function to capture and process “information for operational impact and strategic implications” is thus separated from the function that “is essential to effective transformation of the system based on shifts in the operational context and environment” [6, p. 5].

4.2.5. Combinability. The VSM is particularly useful in combination with other methods or models. However, we do not refer to merely embedding the VSM into broader research approaches (e.g., participatory action research [17]). We identified three studies that heavily utilize this benefit. In the first, the VSM is applied to study knowledge management in virtual enterprises [18]. The VSM is integrated with various systemic approaches into a multi-method approach. The authors argue that “[t]he composition of systemic methodologies can result in powerful multi-methodologies that effectively compensate complexity, combine different mental pictures and perspectives and handle diversity in a creative and innovative manner” [18, p. 305]. In the second, the authors investigate disaster management and combine the VSM with a model of organizational knowledge [33]. The authors conclude that this combination “really helped to identify the […] issues […] that could reduce the viability of the operational and control systems that respond to major disasters” [33, p. 216]. In the third, the VSM is used to close the gap between the theoretical and practical perspective on IS agility [20, 29]. The authors argue that the concept of agility reflects that of viability. Moreover, to extend an IT governance framework and achieve a framework that supports agility, the authors apply the VSM to neatly close the gap. Summarizing, we generally observed that authors are apt to integrate the VSM in their portfolio of theoretical tools.

4.2.6. Context independency. The VSM has been transferred to various contexts. Basically, each study investigated a different type of organization (cf. Table 2). The contexts range from technical themes like a software architecture [19] to inter-organizational structures and processes [16] (cf. section 4.1.1). Considering these two studies, the former uses the VSM to develop a viable system architecture [19], which includes defining additional components, component interfaces, and a component transfer protocol. The latter study uses these interfaces to verify intelligence embedded within an inter-organizational network, that is, the UK electricity market [16]. Although the authors of the latter study are aware that the interfaces have been designed for software architecture, they apply the VSM and its interface extension as they seek to examine the interface structure and interfacing protocol in their viable system. The authors justify this decision by arguing that the underlying extended model for the software architecture applies to viable systems in general.

5. Discussion

Although we only identified 13 relevant articles, we believe the VSM to be highly relevant for IS research as (1) the authors of all studies gained a new perspective on common IS problems and (2) the VSM application seems to be an upcoming trend. While the first of the articles has been published in 1999, nine of the remaining articles have been published since 2007.

The diverging purposes of VSM applications are an interesting aspect. We believe one explanation for the phenomenon that none of the studies has applied merely the descriptive approach of the VSM to be the limited value of following this purpose. Solely describing an existing system does not provide insights into the analyzed problem context. Rather, the diagnostic approach is a suitable means to gather innovative findings by assessing existing systems with the VSM. However, diagnosing a system requires a system description in terms of a mapping onto the five subsystems. The design-orientation leads to new artifacts. This is especially relevant for design science research [36]. Researchers designing artifacts of high complexity might thus rely more often on the VSM in future.

Most studies focus on a partial set of VSM benefits. Only one study [35] incorporates almost all identified benefits. In general, researchers seem not to be aware of the comprehensive set of benefits when applying the VSM as benefits are often not explicitly formulated. To exploit the VSM’s full potential, researchers need to be aware of possible benefits and explicitly report them. Although we believe the identified benefits to be substantial for our set of studies, we cannot guarantee their completeness as they are based on our set of VSM studies. For instance, although researchers regularly apply the concept of recursion, authors have never considered its multi-dimensional character, which can be used to model even more complex nesting of systems. Furthermore, the small number of analyzed studies represents a limitation of our study in terms of generalizability of results. To increase the number of cases, future research could consider related fields to IS. Other disciplines have also used the VSM to
assess highly complex systems (e.g., crime detection [37]). Regarding these might lead to further insights paving the way for a systematic VSM application. For instance, suggesting a potential research model with our identified VSM benefits as independent variables, a larger set of studies would be needed for robust testing.

There is lack of validation of VSM applications so far. In our view, there are predominantly two reasons for this. On the one hand, all examples analyze high complexity in diverging contexts where it is necessary to abstract from detailed information. An evaluation might therefore be rather complicated. On the other hand, few studies exist so far that apply the VSM to phenomena of the real world. Systematic approaches for such applications are therefore subject to further research and might come along with sufficiently rigorous evaluation approaches.

None of the studies utilizes an extensive multiple case approach. Only one study performs a combination with quantitative methods [20, 29]. An explanation for this might be that systemic approaches like the VSM require rather intensive – in contrast to extensive [38] – examination of a system to derive holistic insights. Still, we argue that studying the VSM especially in a multi-case context could be fruitful for further validation. A recent study that applies a dual-case approach [33] is a promising first step.

The identified studies seem not to be highly interrelated. We analyzed cross-references between the 13 identified articles and except from Kawalek and Wastell [35], who are generally cited, we found only two cross-references ([19] cited by [16] which is in turn cited by [33]). We assume that scholars applying a meta-model like the VSM usually refer to previous studies doing the same mainly for the following reasons: Differentiating between previous studies and the own approach helps to emphasize the contribution and to avoid already documented potential problems. Moreover, reflecting previous studies helps to improve the rigor of one’s own approach. Otherwise, a study might partially lack a sound research approach.

As stated by Weber [39] more than a decade ago, IS research is in need of general theories that are powerful and recognizably belong to the IS discipline, also referred to as grand theories [40]. Cybernetics and systems theory, embodying a high degree of generalization and being relatively unbounded in space and time, can be assigned to this class of theory [41]. Also, “cybernetics and systems theory study essentially the same problem, that of an organization independent of the substrate in which it is embodied.” [17, p. 48]. “[…] research exhibiting a high degree of systems thinking tends to encounter the challenges to rigor, relevance, and research mentioned by Hirschheim and Klein [42]” [25, p. 767]. Grounded on cybernetic, systems principles, and testable propositions, the VSM has the high potential contributing to both, IS research and grand theories in general.

6. Conclusion and implications

With our systematic review and qualitative content analysis of VSM applications to real-world settings in IS research, we strengthen researchers’ awareness of six benefits to exploit when applying the VSM. Analyzing eleven studies that describe, diagnose, or design real-world settings in terms of the VSM and its five subsystems, we reveal the lack of interrelations between these studies. Our comparison of applied research methodologies and analysis of exploited benefits provide a common ground for applying the VSM to real-world settings. We thus guide future studies towards a more formalized and integrative approach. Based on our findings and theoretical considerations, we derive the following implications. (1) Researchers should consider different alternatives of applying the VSM to avoid unsystematic approaches which threaten validity and appropriateness of research. (2) To improve rigor and exhaustively exploit potential value, future research needs to refer to and stronger reflect on already conducted studies and identified benefits (cf. section 4.2 and 5). (3) IS researchers should explicitly report benefits derived from applying the VSM to inform other researchers and potentially extend the set of benefits identified in this study. (4) IS research is in need of approaches to deal with complex real-world systems. Relying on systemic approaches like the VSM is a viable and advisable strategy.

7. References