Systemic Practice and Action Research (2023) 36:479–504
https://doi.org/10.1007/s11213-022-09610-2

REVIEW ARTICLE

A comprehensive and systematic study on the cybernetics management systems

Bo Yang[1] · Joane V. Serrano[2] · Markus A. Launer[3] · Lulu Wang[4] · Kamran Rabiei[5]

Accepted: 10 August 2022 / Published online: 27 October 2022

Abstract
Cybernetics covers many traditional disciplines, including technology, philosophy, biology, mathematics, and social sciences. So, studying and understanding cybernetics systems and their management are essential concepts in all aspects of life. But, as far as we know, a perfect and profound discussion about the topic of cybernetic systems is rare. In order to address the emerging challenges of the information society, this paper will cover recent developments in the development of cybernetic systems with particular reference to management applications. Selected articles were analyzed in 7 main groups: historical evolution of cybernetics systems, system dynamics, dialogic design science, complexity theory, artificial intelligence, cybernetics, and management optimization). In order to advance research and development, the study showed the multi- and trans-disciplinary nature of cybernetics, systems, and the management sciences. According to the findings of our analysis, most papers were released in 2007. We also found that the IEEE Journals had the largest number of published articles. It suggests that the researchers' attention to research in this field has diminished over time. Also, the results showed that cybernetics might render a conceptual-philosophical aid and a functional instrument in control and managerial planning.

Keywords Cybernetics Systems · Management Systems · Knowledge Management · Systematic Literature Review

✉ Lulu Wang
lulu88868@126.com

[1] Beijing Open University, Haidian District, 100859 Beijing, China

[2] The University of the Philippines Open University, 4030 Los Baños, Laguna, Philippines

[3] Ostfalia University of Applied Sciences, Herbert-Meyer-Straße 7, 29556 Suderburg, Germany

[4] China Business Executives Academy (Dalian), 102218 Dalian, Liaoning Province, China

[5] Faculty of Entrepreneurship, University of Tehran, Tehran, Iran

Introduction

Feedback, a core property in cybernetic systems, refers to data that moves from one system via its environment and back to that system (Martelaro and Ju 2018a; Stvilia et al. 2019). Other central concepts in cybernetics include equilibrium, disturbance, isomorphism, black box, constraint, transmission, homomorphism, and requisite difference (Chapman 2019; Mobus and Kalton 2015). Cybernetics has facilitated a better understanding of how things work across many disciplines and contributed tangibly to changes in the world. It has served as a platform that brings together mathematicians, biologists, engineers, anthropologists, sociologists, designers, and economists (Martelaro and Ju 2018b), facilitating discussion and exchanging ideas. With time, second-order cybernetics has become more important in science. Eventually, it evolved into a promising science and facilitated social action (Biggiero 2018). Cybernetic systems serve to control organizations and machines (Vahidi et al. 2019). Cybernetics is also used to generate "ideas for thinking" in any subject, such as how to think about philosophies and theories.

Contrarily, complexity is a phrase used to describe systems that make it difficult for us to understand their internal links. Self-organization follows laws that have been discovered by chaos theory. It appears that both structured dialogic design and the sciences of chaos/complexity have relevant things to say about social complexity, albeit from distinct perspectives. As far as feasible, Chaos/Complexity relies on observer-independent data to explain how complex systems change. They provide us with hints in this way, allowing us to intervene when systems are about to tilt. To determine the most desirable and effective ways to alter current circumstances, SDDP (SDDP is a prescriptive science) relies on observer-dependent data. (Bausch 2008). Additionally, in psychotherapy, we view behavior as crazy when we do not learn from experience. For example, when continuing down a specific path results in repeatedly failing to attain our goals, we may question our behavior (Glanville 2002). Also, Kyriazis (2017b) claimed that models based solely on discrete physical interventions are ineffective in managing the aging process. These interventions have all the drawbacks of a reductionist mindset, overlook emerging events, and fail to view the human body as a dynamic adaptive system. The experience suggests that aging can be eliminated from certain human groups (Kyriazis 2016), but this is impossible with bio-medical technologies or pharmaceutical interventions. Instead, aging must be eliminated after specific occurrences reliant on human evolution, the nature of natural laws, and the intensifying connection between humans and contemporary technology (Kyriazis 2017a).

On the other hand, the sharp development of institutions and the relations between them simplified by the Information Technology (IT) revolution makes the appreciation of such systems more possible at this moment (Chen & Kent, 2020; Jnr 2019; Robb 1989). Since academia, research communities, and industry study a problem that offers powerful solutions to the synergy between our three pillars of technology, science, systems engineering, human-machine, and cybernetics (Keating and Katina 2019; Tunstel 2018). Cybernetic defines phenomena in a traditional method and supplies us with prognostications about subsequent phenomena like other sciences: it does not supply an unparalleled or universal definition of all possible phenomena. Leaders can manage very correctly now, but they may take a novel viewpoint of their function to glance at this relevantly novel science. Cybernetics states that all social, biological, or mechanical systems share the same properties (Robb 1984). Also, the design of management information systems should consider

organizational effectiveness problems (Ghosh et al. 2021; Gorichanaz 2019). For this purpose, it is argued that we need to understand the conditions internal to the organization that is limiting its learning and adaptation; that is, we need to understand the organization's cybernetics (Espejo 1979). The objectives of cybernetics are learning and adjusting to the system requirements. Cybernetics is a diverse way of thinking about smart systems or systems that can operate against an aim. Thus, cybernetics prepare an effective framework for augmenting designers in creating human-centered interactive artificial intelligence-enabled products (Martelaro and Ju 2018a). In this section, we examine the motivation and goals of the research.

What is the motivation for research?

We mainly discuss the limitations of some previously published articles due to the literature gap derived from conducting this work.

Andrew (2005) examined cybernetics systems on the Web. His study aimed to examine growths on the Internet. Particularly those that are of public interest in cybernetics. One part of the article that has a hoax paper is discussed in general, with the implications of the article being judged and published. Many sources of data on nanotechnology have been reviewed. These sources have applications in medicine. He found that a hoax paper was admitted, which casts doubt on the procedure of review. However, the condition is not explicit. Also, the utility of mammoth conferences was asked. It proved that nanotechnology is poised for basic developments. A convincing hoax paper's generation has been absorbing technical prosperity in itself.

Rudall (2005) reviewed running inventions in neuron/silicon chips' progress and in biomimetics. This review chose from a universal database and considered this research and progressing inventions. An extended summary, chosen study checking, and progressive topics showed the Trans and multi-corrective relevancies of systems and cybernetics. It attained to further study and progressive activity.

Andrew (2005) examined the systems and cybernetics on the Web. He examined advice on combating spyware and other malware forms. It also talked about silencing the computer during operation and turning it off during use. His aim was to review progress on the Internet, mainly those of public cybernetics concerns. He found that some of the expansions reported have study value, while others touch experimental sights of computer utilization and internet accessibility.

Choices from subjects studied the CybCom list over a specially dynamic term in early 2006 were reviewed by Andrew (2006). He determined autopoiesis communication to sociology and instruction courses on cybernetics. Cybernetics appealed to social theory, the "ethical imperative" of von Foerster, and günther's "polylogic." His aim was to review the progress on the Internet, mainly those of public cybernetics concerns. He found that the connection of autopoiesis to sociology was doubtful. Also, he found that different instruction courses were available, but cyberneticists have to try to elevate visibility, and data flowing in social systems had beneficial communications to those in living organisms.

Andrew (2013) examined the systems and cybernetics on the Web, "wet" neurophysiology, CYBCOM list subjects, and carbon calculation. He aimed to review progress on the Internet, mainly those of public cybernetics concerns. He found that the list of CYBCOM remains precious, despite the unlucky description for "wet" neurophysiology. The excep-

Table 1 Comparison of the considered papers about cybernetics systems

Publication year	Classification	Comparing	Future work	Open issue	Paper
2005	NO	NO	YES	NO	(A. Andrew)
2005	NO	NO	YES	NO	(Rudall)
2005	NO	NO	YES	NO	(A. M. Andrew)
2006	NO	NO	YES	NO	(Andrew)
2013	NO	NO	YES	NO	(Andrew)
2019	YES	YES	NO	NO	(Umpleby et al.)

tion suggested that nervous terminals should not be recognized as transducers. A case of nerve plasticity was also discussed, depending on the utilization of stem cells. Significant advances in computing technology were reported. This improvement was due to the use of carbon nanotubes as an alternation for silicon.

The new progress in cybernetics, from recognition to social systems, was examined by Umpleby, Medvedeva, and Lepskiy (2019). A team of researchers in Europe and the United States had done much research into cybernetics. It was an effort to increase the science concept. So this science can be more successful in the social sciences. Umpleby et al. (2019) explained a lot about this effort. Additionally, the paper indicated Russia's endeavor to produce reflexiveness theory into a universal theory of deliberate, self-progressive systems. Comprehension of eastern and western strategies to cybernetics was hard due to the diverse histories and rational customs of cybernetics in Russia and the United States. The paper concluded by comparing the features of two approaches to cybernetics. These diversities showed enormous potential for western and Russian scientists' opinions to enrich further cybernetics improvement and scientific progress in the west and the east.

According to the review of articles in this section, we observe that various subjects in this field are developments on the Internet, development of neuron/silicon chips and biomimetics, combating spyware, recent developments in cybernetics, and scientific trends cybernetics, and the underpinning rules. However, there have been few reviews on this topic. While review summaries are more critical for a helpful review, these studies did not indicate a perfect review of the cybernetics systems to analyze their taxonomy and future challenges. A summary of the reviewed research and its basic features are provided in Table1. The investigated papers' weak point is that most papers do not contain rational ranking and open issues. Additionally, comparing articles and analyzing them in detail are other significant weak points. So, we have been try to solve the problems mentioned above and prepare an up-to-date review paper that is analytical in this field for the rest of this article.

What is the purpose of this article?

We may want to ask to what extent the past progress in cybernetics has assisted knowledge leadership. However, comprehensive and systematic study in this field is very rare despite the importance of managing cybernetics systems. Thus, this article aims to examine the role of cybernetics systems mechanisms in Knowledge Management (KM) and define the types of essential challenges. Briefly, the objectives of the paper are:

- Suggesting methodical and systematic review of cybernetics systems;
- Suggesting an inductive summary of the selected article;
- Looking for some basic questions in this domain and indicate the guidelines to encounter the available challenges;
- To outline the important areas where the cybernetics mechanisms can be applied.

Finally, the structure of the article is as follows. The next section examines the research background and motivation of this study. Section3 considers the article choosing procedure. In Sect.4, the selected article is reviewed. Section5 discusses open discussion and research issues. Also, we have ended the article in the last section.

Methodology

Since article reviewing via Systematic Literature Review (SLR) is impartial, replicable, fair, systematic, complete, and transparent, it is the first choice to review the related papers in a specific area (de Araújo Lima, Crema, & Verbano, 2020; Heidari and Navimipour 2021). Also, it can detect and synthesize all the evidence of adequate quality relating to a particular topic (Ermel, Lacerda, Morandi, & Gauss, 2021; Mostafaie et al. 2020). The best accessible information for doctors may come from systematic reviews and meta-analyses of relevant studies (Esmailiyan et al., 2021; Vahdat 2021; Zadeh, Bokov, Yasin, Vahdat, & Abbasalizad-Farhangi, 2021). This section refers to the SLR considering current research on cybernetics systems.

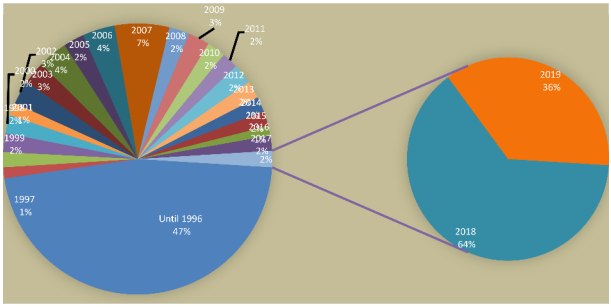
Step1. Research questions

The creation of a primary research topic as part of the research procedure is the first stage in carrying out a systematic review (Doewes et al., 2022; Torgerson 2003). Creating a research procedure will enable the creation of the review's questions and techniques before the literature search (Vahdat and Shahidi 2020). As a result, bias is reduced. A well-thought-out process and well-crafted research topic improve the review's efficiency by reducing the time and expense required to find and acquire pertinent material. This research aims at addressing the following research questions:

- RQ1: What is the definition of cybernetics systems?
- RQ2: What is the importance of cybernetics systems?
- RQ3: What are the main features of the cybernetics systems mechanism?

Step2. The research protocol and paper selection process

The research protocol is created when the research question has been established. To reduce bias before beginning the literature search, the techniques for literature searching, filtering, data extraction, and analysis should be documented in a written document. It is essential to establish strict inclusion and exclusion standards for studies. This step focuses on experimental design. The search was conducted in two major databases: the Web of Science



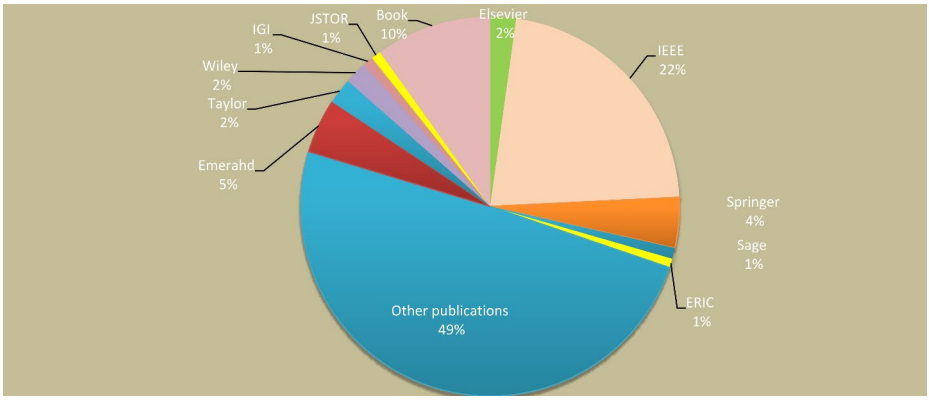


Fig. 1 Percentage of published articles based on years

Fig. 2 Published papers standing on database sources in percentage

and Scopus to discover the proper papers standing on some clues, including "cybernetics systems", "cybernetics management systems", and "cybernetics knowledge management systems". These were picked because they offer easy access to the primary citation databases worldwide and include clever tools for monitoring, analyzing, and visualizing research (Gauss, Lacerda, & Cauchick Miguel, 2021). Additionally, from 1900, they cover more than 21,000 titles and more than 73million records of research output in engineering, computer science, natural sciences, and materials sciences. Besides that, to ensure the quality of the primary studies, only articles published in peer-reviewed international journals have been considered. The language was therefore employed as an inclusion criterion. (Matthews 2021). 1821 papers from journals, conferences, books, etc. have been located as of this point (see Figs.1 and 2). As shown in Figs.1 and 87% of printed papers were published until 2011, and only 13% of articles were published from 2012 to 2019. Additionally, we found that most publications in the IEEE with 22%, as well as the Emerald with 5% in Fig.2. It suggests that over time, the researchers' attention to research in this field has diminished.

Step3. Quality appraisal

The evaluation of the included studies' quality is a crucial stage in a systematic review. To help with this process, a number of quality measures and checklists have been created. Overall rankings, however, might not adequately reveal the specific advantages and disad-

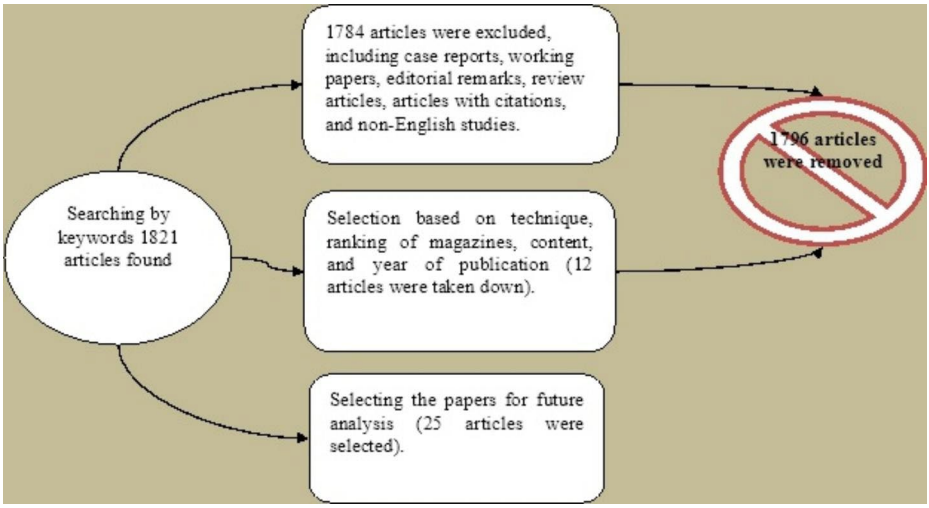


Fig. 3 The paper selection process in each category

vantages of the investigations. A few requirements are included at this level to guarantee that only qualified diffusions are selected. This stage involved the removal of condition reports, application papers, editorial remarks, review papers, citations, and non-English documents. 1784 articles have been deleted in this filter.

Data extraction, synthesis, reporting, and dissemination

Data analysis and study outcomes should be conducted after incorporating and omitting research depending on the quality assessment. This procedure begins with a straightforward descriptive assessment of each study (Egger, Smith, & Altman, 2008). To confirm the importance of the paper, they are examined carefully. The subject, the classification of journals, and the year of publication are essential to determine whether to exclude or include the papers. Relevant papers are chosen after using these filters. Then they are published by 10 famous publishers. Figure3 shows an abstract of the selecting articles procedure. Therefore, 12 papers are excluded. Finally, 25 papers have remained. These remaining papers are separated into 7 parts. Also, Table2 shows the details of the selected articles.

Background and Review the Selected Work

Wiener (1948) invented the word cybernetics when world war II was finishing. A range of novel phenomena appeared to be adaptive, intricate, and independent and divided into a circular form of organization. In the past years, forms like these forms contain a lengthy background (Krippendorff 2019). Complex problems have become joined with the soft sciences' hard competence by the mediating role of cybernetics. Therefore, the three theories of entropy retardation, regulation, and computation constitute an interlaced conceptual network: the cybernetics nature (Schandorf and Schandorf 2019). "There is not legislation without communication; there is no aim without legislation; and the meaning of "system" or

Table 2 The details of the selected articles

Paper	Publisher	Journal	Cited	Name of paper
(Majumder 1979)	Emerald	Kybernetes	25	Cybernetics and general systems—a unitary science?
(Umpleby 1997)	Taylor & Francis	Cybernetics & Systems	92	Cybernetics of conceptual systems
(Umpleby & Dent, 1999)	Taylor & Francis	Cybernetics & Systems	135	The origins and purposes of several traditions in systems theory and cybernetics
(Vallee 2003)	Emerald	Kybernetes	31	Cybernetics and systems, from past to future
(Vahidi, Aliahmad, et al., 2019)	Springer	Systemic Practice and Action Research	8	Evolution of management cybernetics and viable system model
System dynamics				
(Scala et al. 2006)	Emerald	Journal of Manufacturing Technology Management	36	Application of cybernetics to manufacturing flexibility: a systems perspective
(Vahidi et al. 2019a)	Emerald	Kybernetes	14	Researches status and trends of management cybernetics and viable system model
Complexity theory				
(Kuhn 2002)	Ingentaconnect	Cybernetics & Human Knowing	18	Complexity, cybernetics and human knowing
(Hipel, Jamshidi, Tien, & White III, 2007)	IEEE	IEEE Transactions on Systems, Man, and Cybernetics, Part C	102	The future of systems, man, and cybernetics: Application domains and research methods
(Kandjani et al. 2013)	IEEE	Hawaii	31	Enterprise architecture cybernetics and the edge of chaos: Sustaining enterprises as complex systems in complex business environments
(Mobus and Kalton 2015)	Springer	Principles of Systems Science	2	Cybernetics: The role of information and computation in systems
Dialogic design science				
(Cisneros et al. 2013)	-	Atlanta: Institute for 21st Century Agoras	2	Strategic articulation of actions to cope with the huge challenges or our world: A platform for reflection
(Bausch and Flanagan 2013)	Wiley	Systems Research and Behavioral Science	22	A Confluence of Third-Phase Science and Dialogic Design Science
(Kyriazis 2017b)	Imrpress	Frontiers in Bioscience-Landmark	7	Third phase science: defining a novel model of research into human ageing
Ai				
(Negoita 2009)	Emerald	Kybernetes	3	Fuzzy systems and cybernetics
(Seising 2010)	Elsevier	Information Sciences	80	Cybernetics, system (s) theory, information theory and fuzzy sets and systems in the 1950 and 1960s
(Martelaro and Ju 2018a)	ACM	Interactions	8	Cybernetics and the design of the user experience of AI systems
Cybernetics				

Table 2 (continued)

Paper	Publisher	Journal	Cited	Name of paper
(Rosenblueth 1981)	Elsevier	In The Quality of Life: Systems Approaches	0	SYSTEMS, CYBERNETICS, AND SUBJECTIVITY
(Scott 2000)	Emerald	Kybernetes	7	The cybernetics of systems of belief
(Dunbar-Hester 2010)	Sage	Science, technology, & human values	46	Listening to cybernetics: Music, machines, and nervous systems, 1950–1980
(White 2012)	IEEE	In 2012 IEEE International Systems Conference SysCon	4	Using cybernetics with soft systems methodology in complex system development
(Fay, Bagotyriute, Urbach, West, & Dawson, 2019)	Psycnet.apa	International Journal of Stress Management	25	Differential effects of workplace stressors on innovation: An integrated perspective of cybernetics and coping.
Management optimization				
(Porvazník and Ljudvigová 2016)	Elsevier	Procedia-Social and Behavioral Sciences	16	General theory of systems, cybernetics and evaluation of human competence by solving present crisis problems of civilisation
(Evstegneev et al. 2019)	IOP	In IOP Conference Series: Materials Science and Engineering	-	Improvement of technological solutions of wood processing based on cybernetics and automation methods
(Vahidi and Aliahmadi 2019)	Springer	Systemic Practice and Action Research	25	Describing the necessity of multi-methodological approach for viable system model: case study of viable system model and system dynamics multi-methodology.

"society" becomes invalid without an aim (Von Foerster 2003). Considering the managerial principle, markets' economic reality has inflicted numerous leadership issues and targets upon leaders. Managerial preparation must contain advanced environmental assessment and prognostication of competitors' reflex to an impressive primary action by the institution (Oliva and Kotabe 2019). A significant philosophical incitement has been prepared by cybernetics concepts in the endeavor of leading scientists trying to extract organizational objectives in conditions specified by monopolistic competition. Therefore, cybernetics has transformed some philosophical contributions to leadership in the region's target creation and relevant procedures (Zannetos and Wilcox 1969).

New progress in biomedical cybernetics permitted understanding of Anticipatory Learning Systems (ALS) as an instrument for prosperous security leadership, maximizing ultimate results, and minimizing environmental disorder (Letiche 2019). Therefore, the implantable human medical set can collaborate with biological peers without host destruction (Fiorini and Santacroce 2013). On the other side, plenty of employees in biological sciences (psychologists, physiologists, and sociologists) are concerned about cybernetics. They would have regard for utilizing its procedures and methods to their proficiency. Despite this, they might not contain a high amount of information on the way of utilizing cybernetics. Managerial function in trading establishment contains arranging and controlling perspectives. On the whole, the literature summary has illustrated that management is a complicated

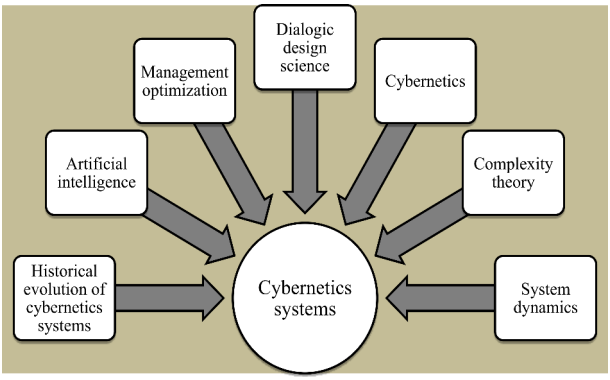


Fig. 4 Categorization of cybernetics systems

task. Various researches have illustrated that holding a reductionist sight is not adequate for executing alterations more expeditiously. A more comprehensive method should be discovered that particularly allows cooperation, connection, and control, and can manage high volatility in the work method and be pliable adequate for reacting to better impressions. So, the scheme and control of complicated and active systems as a fundamental administration issue is an outlook of the system-oriented administration viewpoint. Cybernetics supplies the foundation as a systemic method to do so (Schwaninger 2004). At last, available systems pattern obtained from administration cybernetics has been thought out as the most suitable method to meet such cooperations and connection problems (Elezi, Maier, & Lindemann, 2013). In the continuation of this section, authors have divided the essential factors of cybernetics into 7 segments historical evolution of cybernetics systems, system dynamics, dialogic design science, complexity theory, Dialogic design science, Artificial Intelligence (AI), cybernetics, and management optimization (See Fig.4), and we have collected their key points.

Historical Evolution of Cybernetics Systems

Systemics and cybernetics can be seen as a growing and far from stabilized metalanguage of concepts and models for transdisciplinary usage (François 1999). In this section, the articles that studied the historical development of cybernetics systems have been analyzed.

Majumder (1979) studied cybernetics and general systems. He categorized cybernetics into four courses. The historical perspective of the emergence of cybernetics as the role of control science, communication, and computation in machines and living tissues, and integrated and complex man-machine systems as a unitary discipline of general systems theory was presented. In the second section, both the public systems and cybernetics theories showed to be the same in necessities, motivation, characteristics, attributes, and behavior. The third section establishes cybernetics systems like limited state machines as a subclass of general dynamical systems. The last section presented cybernetic systems as a universal theory containing social activities to understand technical and ethical applications. His study provided comprehensive information on the history of cybernetics. However, this study is very old.

Umpleby (1997) examined the cybernetics of conceptual systems. They identified three courses that cybernetics evolved. The first stage of cybernetics captured an experimental

approach to the nervous system; the second stage of cybernetics developed a philosophy standing on physiological neuroscience research discoveries. In the third stage, the cybernetics of perceptual systems stares at the association that makes and maintains opinions and that community member's motivations.

Umpleby and Dent (1999) discussed the books, people, conferences, and technology that impacted the systems movement. General systems theory, the systems approach, operations research, system dynamics, learning organizations, total quality management, and cybernetics were the schools of thought that were discussed. Total quality management was a recent addition to the list, but because of how extensively it uses systems concepts, they believe it fits. The topics of complexity theory, family therapy, and artificial intelligence are not covered in this essay.

Vallee (2003) investigated cybernetics and systems from the past to the future. He discussed the originators of systems and cybernetics among them. Some forerunners uttered from archaism to the 20th century. The actor and the observer's tasks were emphasized. He considered the future in three directions: epistemology and praxeology improvement, the role of requisite diversity in the survival of humankind, and man and machine symbiosis.

Vahidi, Aliahmad, et al. (2019) investigated VSM recorded and late research patterns. This paper examined presenting and creating a verifiable pattern of this model. At that time, the 1000 most significant works based on Google Scholar rank were reviewed to investigate late dissemination trends. Here, Beer introduced the VSM operating model. Reviewing the top 1000 cited publications shows that this topic has reached maturity and that further growth is generally ongoing.

In this section, the authors analyzed 5 articles on the evolution of cybernetics systems. As we have seen, various researchers have each grouped the development of cybernetics systems from different perspectives. In Table2, the authors summarized the most important goals of the relevant articles.

System Dynamics

Recent advances in the study of non-linear, dynamic systems, as described in complexity science, suggest to a solution for the dualistic nature of classical models. In this section, the articles that studied the system dynamics have been analyzed.

A theoretical model of the firm, based on cybernetics, was proposed by Scala et al. (2006) construction. The proposed model related adjustability to the cybernetics idea of difference and analyzed a dynamic system in aspects of its work configuration. The proposed model was helpful in dispersing some wrong ideas about adjustability and offering functional perceptions about problems of flexible construction structures. Their paper presented a way through which discrepancy can be quantified. They found that the required adjustability at a node is not steady; instead, it depends on the relation with other nodes. Furthermore, often diminishing difference was a better solution compared to increased difference management. The firm's hypothetical model can easily explain the abnormal finding that can be almost adjustable comparatively in adjustable nodes in mixing.

Vahidi and Aliahmadi (2019) developed a framework based on the VSM and the System Dynamics (SD) that dynamizes and simulates VSM. This study developed a novel multimethodological approach built on VSM and SD. In this setting, both a dynamic model that maintains knowledge across the organization and a broad SD framework that simulates orga-

nizational problem-solving have emerged. An examination of the VSM literature revealed that such dynamic, knowledge-based corporate design and diagnosis methodologies were in demand. The multi-methodological approach created allowed for creating dynamic complexity handling structures and the processes that go along with them in any organization. This study's conclusion offered a more appropriate and thorough method since it dynamizes VSM and addresses both the SD and VSM's limitations. After that, a management consulting firm used a multi-method approach, presenting the findings. The results of applying the multi-methodology and recommended policy show improved organizational problem-solving skills in terms of speed and manageability.

Complexity Theory

With society becoming increasingly complex, managers in business and policy must understand the distinction between complicated challenges (like sending a man to the moon or constructing a power plant) and complex problems (such as raising a child). Everything is interconnected in complex problems, so rather than calling for straightforward, linear top-down solutions that can be developed with great expertise, complex problems call for more subtle, more "complex" approaches in which involved stakeholders can engage themselves creatively and collectively (with all their expertise and good-will) to optimize the evolution of the "problem" in the desired direction. Complex challenges call for integrated strategies that allow for flexibility rather than turning to final structures and outcomes that can be entirely damaging for some stakeholders (Nijs, 2014). Complexity is primarily an issue of interpretation, particularly in the social sciences, and not just a calculation problem (modeling). This results from the advent of postmodern viewpoints in the social sciences at this particular historical juncture. (Kuhn 2002). Interpreting complexity only as offering new metaphors for seeing the world differently 'carries with it the ghost of old ways of thinking' (Liapakis et al. 2008). Metaphors just scratch the surface of complexity, especially in the humanities and social sciences. Several articles that investigated the complexity theory have been examined in this area.

In considering the applications of the sciences of complexity, such as first-order cybernetics and general systems theory (and to a much lesser extent, second-order cybernetics), to social research, Kuhn (2002) was concerned about the assumptions held regarding the knowledge generated. Additionally, he was concerned in how these frameworks make us perceive ourselves as knowledge producers (or attract). His study raises concerns about how these cybernetic frameworks are approached and what that means for humanness. Additionally, the potential for complexity theory to promote intellectual acuity, sincerity, and humility by emphasizing uncertainty and the illusory nature of truth is discussed.

Hipel et al. (2007) considered several areas of significant usage that will have systems have become more and more elaborate. Any critical system is needed to get the subsequent result or performance using proper criteria. Products and facilities become more individualized and changing environments. The proposed model re-elucidated the Stafford beer viable system model and made 27.

Kandjani et al. (2013) offered a joint-development path model using cybernetics rules to investigate and plot how organizations handle complicacy about environmental changes. Cybernetics reflection incorporated a 'path of joint-development for defining businesses' co-evolution with their use of Conant and Ashby's theory of "proper regulator," explaining

the way of mixing different hypotheses of complicacy handling in a cybernetics hypothesis of business architecture which gives information about the processing of methods for preserving correspondence between the development of the business as a system and its environment development. The proposed model showed that creating complete models of large-scale, intricate systems or the environment is not likely, and used them to control the system completely.

Mobus and Kalton (2015) investigated basic cybernetics and control theory. They offered an examination of problems related to information because it is applied in systems and handling of systems. They also investigated how intricate systems have intricate regulatory sub-systems that unbelievably create a series of special control or handling purposes. The sub-systems process information to handle the system's material procedures and set the system responses due to the environment. They found that they could only make forward deductions based on viewing the apparition and development pattern many times before in lower levels of an organization.

Dialogic Design Science

The Warfield group (Warfield 1973, 1976; Warfield and Cárdenas 1994) is credited for the inception of Generic Design Science (Warfield, 1994), which led to the development of a methodology called Interactive Management (IM). IM was grounded on previous concepts from Systems Engineering (Sage 1977). Early 1970s policy and planning, as well as transportation planning and urban budget planning in the Dayton City Council, were the first "real-world" uses. (Fitz and Troha 1977). The Agoras Group expanded the theory and the practice, also renaming the methodology to Structured Democratic Dialogue Process (SDDP; for details and description (Christakis & Bausch, 2006; Flanagan & Christakis, 2010; Laouris 2012).

Cisneros et al. (2013) provided a holistic perspective for comprehending the Web from the perspective of the Global Challenges described by the team of the Millennium Project. Other systemic properties of the Web can be worked with the holistic approach from different angles, such as the proper functions of the Web's sub-systems or their collateral (non-intended) effects. The methodology employed is reproducible in its fundamental procedures. A systematic dialogic approach, which promotes boundary-spanning processes, collective intelligence, intra-, multi-, and trans-discipline viewpoints, and the creation of progressive and more encompassing discoveries, could, however, augment it. Additionally, many current events compel us to keep thinking about the Web and our interventions on it. However, the prospect of a workable global strategy gives people hope for new approaches to harmonizing sub-systems with the web and its environment and evolutionary process. Their current study's primary goal was to map out a trajectory for advancement toward sustainability. Another trajectory arc is testing the outcomes after putting Actions into practice.

In 1997, Gerard de Zeeuw coined "Third Phase Science." An effective way to apply third-phase science to comprehend and respond to complicated social problems is illustrated by the deliberative approach known as dialogic design science. Bausch and Flanagan (2013) explained De Zeeuw's concept in non-specialist language and expanded on the historical context of third-phase science to address current needs. It demonstrated how dialogic design science transforms third-phase science into an essential design methodology and completes it as an axiomatic science. It should be underlined that third-phase science is not the founda-

tion of dialogic design science. It was developed as a philosophy and a process for creating sound designs in challenging circumstances. Building on common sense and systems science principles, a methodology was proposed. Through practice under challenging circumstances, it was examined and enhanced. The language of mathematical reasoning and the language of common social interactions are visibly combined in interactive management. It lists actions that can be taken to reduce the barriers to democratic design.

Kyriazis (2017b) discussed some of the shortcomings of a reductionist view of research to find treatments against aging degeneration. He outlined three areas where potential primary age-related degeneration treatments could face harsh criticism. He suggested that if theories for managing to age are based solely on discrete physical interventions, they cannot be effective. These interventions have all the drawbacks of a reductionist mindset, overlook emerging events, and fail to view the human body as a dynamic adaptive system. The experience suggested that aging can be reversed in some human populations, but this cannot be done through scientific or pharmaceutical interventions. Instead, aging must be eliminated after a series of events based on human evolution, the nature of natural laws, and human engagement with contemporary technology.

In sum, hundreds of SDD processes grounded on the principles of cybernetics have been implemented worldwide over the past 3–4 decades. The applications addressed diverse socio-technical complex problems. Notable applications' domains include significant Global Challenges faced by humanity at the dawn of the new millennium (R. T. Cisneros & Hisijara, 2013; Glenn, Gordon, & Florescu, 2009), sustainability (Ferri et al., 2018), vision building in tribal communities (Broome 1995) conflict resolution (Broome 1997, 2004; Laouris, Erel, et al., 2009; Laouris and Laouri 2008; Laouris, Michaelides, et al., 2009), the importance of access to broadband technologies (Laouris 2015; Laouris et al. 2008, 2017; Laouris and Laouri 2008; Laouris and Michaelides 2007). The SDD methodology has recently been admitted to the weaponry of Operations Research as a promising (complex) Problem Structuring Method (Laouris and Michaelides 2018).

Artificial Intelligence

The use of a computer to simulate intelligent behavior with little to no human involvement is known as artificial intelligence (AI). The development of robots is widely regarded as the beginning of artificial intelligence. The word "robot" comes from the Czech word "robota," which refers to bio-engineered devices used for forced labor. In 1956, artificial intelligence (AI), also known as machine learning, was formally introduced. The word covers a wide range of medical concepts, including human biology, robotics, medical diagnosis, medical statistics, and cybernetics systems, as well as today's "omics." (Hamet and Tremblay 2017). The articles that examined AI have been reviewed in this section.

Negoita (2009) studied fuzzy systems and cybernetics. His purpose stimulated thinking and talk about postmodernism and its less known roots. He addressed the relation between postmodernism and the evolution of incoherent sets theory in the 1970s. He showed how cybernetics, with the managership of Dr. J Rose, has the first worldwide magazine to receive articles in this new field. His paper caught the attention of individual recollection and abstract of 30 years of fuzzy systems topic.

Seising (2010) reviewed the relation in these areas, which showed the impacts of cybernetics, systems theory, and information in the 1950s and fuzzy sets and systems theory. He

focused on non-specialized but philosophical features of information theory. He showed some useful ideas of weaver regarding semiological thinking. He advocated a "fuzzy information theory," which should be proper for including a "semiotic concept of information." Finally, he presented methodological thoughts in historical aspects about the notion of "information" as a "constantly changing object," which they have chosen as a fuzzy notion. He showed that the idea of information changed throughout the history of communication technology and its methodological practice in the 20th century.

Martelaro and Ju (2018a) investigated the cybernetics and user experience scheme of AI systems. Their research results indicated that even though cybernetics reflection has roots in the past, they have believed that it may be the design solution, mainly because their products increasingly manifest types of intelligence. One merging pattern from their conversation was incorporating cybernetics reflection into the design process and tools. They believed they needed to design meta-systems capable of creating the product's interactivities. It proposed a requirement for new tooling to develop these meta-systems. They discussed that more designers should be aware of cybernetics. More importantly, developing design tools must improve their tools with feedback systems that can support designers both in terms of the design project available and the design process.

Cybernetics

Physiologists, psychologists, and sociologists are among the many biological scientists interested in cybernetics and would like to use its methodologies and approaches in their field (Ashby, 1957). In this section, 5 articles that studied cybernetics have been analyzed.

Rosenblueth (1981) discussed subjectivity, cybernetics, and system roles. He focused on two important facets of cybernetics and the theory of systems: likelihood and making decisions. Taking decisions was about two points of view: decision measure and procedure. He found that outside of subatomic events, there is no space for talking about the likelihood and features of things, such as duration and mass.

Scott (2000) reviewed the suggestion of (Stewart) regarding the worldview of cybernetics, in which by adding the third field, that is, "disparities valued by the viewer," one has been bounded to two ontological fields regarding "energy" and "information." A connection is suggested among Stewart's suggestions and primitivistic methodology of subsequent cybernetics that create this necessity for the viewer to accept the duty for the world that he/she is making, like resolutions regarding opinions and goals. Furthermore, he offered a type of "knowledge" as a system of opinions. He concluded that cybernetics could help develop academic systems and contribute to subsequent automatic recognition as a central part of program content.

Dunbar-Hester (2010) studied the actual way that artists used cybernetics. He examined relations between cybernetics and hypothetical music from 1950 to 1980, testing time with electronic methods in recording, combining, changing, and producing sounds. Examples were instrument builders, engineers, musicians, composers, and investigators with the cooperation of musicians who used cybernetics themes in their works. These cybernetics' uses were more different compared to the cybernetics that the scientists suggest, which creates a problem in speaking about cybernetics as a heterogeneous or large discourse. Especially, cybernetics discourse in music usually showed subjects of nakedness and indeterminateness instead of "command and control" of the "closed world."

White (2012) investigated the usage of cybernetics notions in issue description, which is usually regarded as a project that is the most critical and challenging phase. He discussed cybernetics opinions about modeling and cybernetics notional models. These were inferential models that can be a response to incentive or goal-driven. Five cybernetics rules were detected, explaining the kinetics of LAS systems and issues regarding the development of LSA systems, which save LAS from disorder. These rules were related to dedicated modeling and detecting all likely behaviors and discrepancies necessary for regulation, response, and postponement. The soft systems methodology, a goal-driven inferential notional structure incorporating a restricted set of cybernetics rules, defines the LAS development. If a single supervisory mechanism were made better with cybernetics rules suggested in his article, it would be more effective. Adding cybernetics rules can result in making current problem definition methods more effective.

Fay et al. (2019) designed cybernetics and a transactional vision, a coping-based viewpoint, and stress to suggest contrasting influences of stressors on creative execution. They indicated that work requirements positively impact creation execution, while role-based stressors negatively affect it. They conducted survey-based, time-lagged research in the health care part from 235 nurses in the United Kingdom. The execution of novelty was evaluated two years after the examination of stressors. To support their ideas, work requirements were affirmatively relevant to the future execution of novelty, while obscurity of the role and appropriate agreement were negatively relevant to the next innovation execution. Together, they examined the organization's obligation as a mediator, but there was just sectional aid for mediation. To evaluate the finding's generalizability, they repeated the research from 138 workers of various works. There was not any aid for strain as a mediator. The outcomes offered work requirement differential influences and role stressors on the execution of innovation, for which the underlying mechanism still requires to be revealed.

Management Optimization

Cybernetic ideas link the management theories that have so far developed. A few concepts that help managers comprehend the nature of management are homeostasis, the law of necessary variety, the relativity of time, the nature of growth, heuristics, holism, synergy, and autopoiesis. Applying general systems theory to management tasks provides prospects for creating intelligent machines, decision-making automation, and the emergence of systems that replicate "style," use common sense, and display emotion after intelligent systems (Robb 1984). In this section, the articles that studied management optimization have been analyzed.

Porvazník and Ljudvigová (2016) examined the general hypothesis of cybernetics, systems, and assessment of human eligibility using solving present civilization issues. They found that globalization movements in the global environment lead to indeterminate emergency problems, which management subjects cannot sustainably preserve in the long term. Thus, developing comprehensive management has worked to solve the common tasks and issues of the environment. The use of scientific information regarding conditions of stableness and state of balance between particular types of unit, cooperation and emergency made during common interactivity of parts, regarding rules of equilibrium, response and many others, would help to create solutions from current crisis issues not only in Europe but also worldwide. Furthermore, they found that if a balance in Europe is preserved, the societal system has to be merged or adjusted. Based on parity rules, it is the only solution to make

Europe a universal power, collaborating or becoming a rival for the USA and more competing Asian countries, mainly China and India.

Evstegneev et al. (2019) improved technological ways for solving wood procedures depending on cybernetics and automation procedures. Their goal was to improve a procedure and algorithm for raising a cylindrical quantity during dumping by identifying the ideal whip-cutting model and applying successive approximations to find the ideal solution. The input parameters are stated, and the whip model was justified. The method for creating test cutting patterns and the idea behind selecting the best scheme is discussed in light of the cutting zone restriction and the potential quantity of logs. The algorithm can be seen as one of the key components of suitable systems for automated management of the process of bucking and accounting of timber volumes because it significantly decreased the number of computations compared to the sequential enumeration of all available possibilities for cutting. Without considering every potential chopping option, the proposed optimization technique enabled the efficient determination of the cutting scheme with the largest output of the cylindrical volume and/or maximum usage of the length of the cutting area. Further algorithmic development can consider the qualitative and financial parameters for gaining commercial. This technique should therefore become a fundamental component of models for automated management of the bucking process and timber volume accounting.

Vahidi et al. (2019b) reviewed the underpinning principles and scientific trends of cybernetics and the VSM. Both qualitative and quantitative methodologies were used in the writing. First, historical patterns in management cybernetics were reviewed and analyzed using a descriptive and qualitative approach. Following that, a quantitative frequency analysis was carried out on the first 1,000 articles in the field. They discovered that cybernetics appeared in Josiah Macy's conversation in 1946. Afterward, Wiener presented the Ashby and cybernetics field, McCulloch and Von Foerster extended this notion regularly. The field of management cybernetics, which Beer presented, is a mixture of control, system, and management sciences. Beer introduced VSM as a functional pattern in the current field. The analysis of 1,000 top-ranked publishings has illustrated that the presentation of the existing domain attained adolescence and more progress became relevantly mature.

In this section, we analyzed 25 articles. Researchers and scientists have come up with various ideas about cybernetics systems. Some researchers have recognized cybernetics systems as the mainstay of planning and strengthening organizations. Others have considered the flexibility and dynamism of cybernetics systems as their main advantage. Some other scientists have said that cybernetics systems are becoming more complicated.

Results

Table 3 provides an overview of the most important goals of the cybernetics systems articles. According to the reviewed studies in this section, most studies have discussed the following issues:

- Studying the evolution of cybernetic systems;
- Division of cybernetics systems into different courses by different researchers from the start to the present;
- Providing different opinions on creating or evolving models and frameworks in this field;

Table 3 Side-by-side summarization and comparison of the essential goals of the cybernetics systems

Articles	years	Main Goals
Historical evolution of cybernetics systems		
(Majumder)	1979	Dividing the history of cybernetics into four evolutionary periods
(Umpleby)	1997	Identifying and classifying the stages of cybernetics evolution into 3 courses
(Umpleby & Dent)	1999	Discussing the origins and purposes of several traditions in systems theory and cybernetics
(Vallee)	2003	Dividing the future of cybernetics into three courses
(Vahidi, Aliahmad, et al.)	2019	Investigating the evolution of management cybernetics and VSM
System dynamics		
(Scala et al.)	2006	Proposing a theoretical model of the firm based on cybernetics
(Vahidi & Aliahmadi)	2019	Describing the necessity of a multi-methodological approach for VSM
Complexity theory		
(Kuhn)	2002	Examining the complexity of cybernetics and human knowing.
(Hipel et al.)	2007	Examining and identifying important areas of interest in Systems, Man, and Cybernetics (SMC)
(Kandjani et al.)	2013	Providing a model for discovering how to manage organizations
(Mobus & Kalton)	2015	Discussing the theory of basic cybernetics and control theory
Dialogic design science		
(R. Cisneros et al.)	2013	Providing a holistic perspective for comprehending the Web from the perspective of the global challenges described by the team of the millennium project.
(K. C. Bausch & Flanagan)	2013	A confluence of third-phase science and dialogic design science
(Kyriazis)	2017	Third phase science: defining a novel model of research into human ageing
AI		
(Virgil Negoita)	2009	Stimulating thought and discourse toward postmodernism and its less known roots
(Seising)	2010	Their aim to soften the structure using the Theory of Fuzzy Sets and Systems to reach a "Fuzzy information theory."
(Martelaro & Ju)	2018	Focusing on learning more about cybernetics systems
Cybernetics		
(Rosenblueth)	1981	Discussing the role of systems, cybernetics, and subjectivity
(Scott)	2000	Providing a framework for help to use cybernetics in psychology and social sciences
(Dunbar-Hester)	2010	Discovering the relationship between cybernetics and music
(White)	2012	Reviewing the cybernetics views, models, and frameworks for problem-solving
(Fay et al.)	2019	Providing a cybernetics view on a transactional, coping-based aspect with stress to propose differential effects of stressors on innovation implementation
Management optimization		
(Porvazník & Ljudvigová)	2016	Examining the general theory of systems, cybernetics, and evaluation of human competence by solving present crisis problems of civilization
(Evstegneev et al.)	2019	Developing a method and algorithm for maximizing a cylindrical volume during dumping by identifying the optimal pattern of cutting a whip by the process of successive approximations to the optimal solution
(Vahidi, Aliahmadi, et al.)	2019	Researching status and trends of management cybernetics and VSM

- Providing different views on improving the management of organizations that use cybernetics systems.

Discussion and Open Issue

This study provides a comprehensive overview of cybernetics management systems. Although there has been some recent research on cybernetic systems analytics, there isn't much in the literature focusing on KM and cybernetic systems. This study compiles, analyzes, and categorizes a large number of pertinent literature. We have highlighted certain difficulties and possibilities for cybernetics systems, and some recommendations have been made. At first, a choosing procedure was applied for impressive studies. A broad range of papers is chosen from an online database. Due to conducting a review of the cybernetics systems until 2020, we showed that published papers were high until 2012. Finally, 25 articles have been analyzed. The papers were separated into 7 main core groups.

1. Historical evolution of cybernetics systems.
2. System dynamics.
3. Dialogic design science.
4. Complexity theory.
5. AI.
6. Cybernetics.
7. Management optimization.

The results of the studies reviewed indicate that cybernetics play a key role in management, but that until now, a high amount of its pledge is still unrecognized. It is particularly right in sphere planning, just in the operational control region containing this pledging domain's influence, illustrating perceptible outcomes. Currently, so-called cybernetics controls manage or help manage massive chemical procedures, schedule freight cars, make traffic flows easy, supply automatic quality control, and multiple other functioning procedures. There is evidence that the cybernetics effect sphere is slowly increasing (March, 1958).

The discoveries of the paper provide the contributions below. They prepare a visible sign of cybernetics management systems research total direction. While the current study has supplied a summary of cybernetics system location and recognized the hot-accomplishments, a systematic follow-up summary could evaluate more profound into precise regions. This summary can deal with the publication pace. Additionally, the current study indicates the research outcomes and practice as a subsequent research way for decision-makers. The presented article supplies the vision to aid investigators in comprehending better how requirements might influence the decision to adopt cybernetics systems. As a result, there is an elevating requirement for IT investigators to evaluate and comprehend the executions of cybernetics systems and contribute to this field's theoretical advancement and real-world success.

We encountered some problems in this review. For example, resources were rare to find cybernetics ideas in specific areas. It can be a research field for future studies. Also, most studies have generally been discussed and not addressed in detail. Addressing the details of issues and problems is still an open field.

On the other hand, cybernetics has the potential to contribute to the solution to problems, but the path towards this goal is not straightforward. We found that the utilization of cybernetics is strong in comprehending systems of managed difficulty. Cybernetics is interacting with the semiotics of the components of the system. In order to incorporate and integrate those methods outside of science and engineering, SMC researchers must broaden their systems, man, and cybernetics. A cybernetic system should give itself instructions to reconstruct and reorganize itself to achieve its maximal potential goals. In order to handle and manage the stresses of their internal evolution, cybernetic systems need to be equipped with predictive and attentive capacities. As a result, it might serve as a guide for writers and managers in management cybernetics and educate them about the history, present, and potential future trends in this field.

Cybernetics is a solid basis for transdisciplinary management education and research (Schwaninger 2001). Unfortunately, there are real situations in which traditional risk analysis techniques are unable to manage successfully (Yang and Lee 2020). On the other hand, unpredictable changes will determine the long-term future of an organization.

In Table4, we summarize and compare the critical material to which the relevant articles were addressed. The bright rectangles indicate that the proper research has investigated the appropriate feature, and the dark rectangles indicate that the relevant research has not investigated the corresponding feature. As can be seen from the table, we have found that researchers in this field are more concerned with the complexities of cybernetics systems and believe that management, construction, and knowledge systems will become more complex over time. So cybernetics should consider ways to solve these complexities.

Conclusion and Limitations

This paper has examined cybernetics systems for management. The authors have done a review of related articles. This study has attempted to analyze the cybernetics systems' strengths and weaknesses as applied to management. Most articles until 2010 have been published on this subject. Since 2010, the proportion of published articles has declined; in other words, researchers have paid less attention to cybernetics systems. IEEE has also published the most significant number of cybernetics articles. Comprehensive reviews of some mechanisms are conducted in order to contrast and identify promising areas for further investigation. This article analyzed 31 selected articles (6 articles analyzed in Sects.3 and 25 in Sect.5). In addition, we comprehensively reviewed what topics were investigated and the results were collected. This paper addresses the challenges of these methods to develop more efficient cybernetics systems in the future. In the end, some interesting lines for future research are provided. Comprehensive reviews of some mechanisms are conducted in order to contrast and identify promising areas for further investigation.

Comprehensive reviews of some mechanisms are conducted to contrast and identify promising areas for further investigation. Secondly, this study has only surveyed the extracted articles based on a keyword search of cybernetics systems, cybernetics management systems, and cybernetics KM systems. The cybernetics systems may not be published with defined keywords.

Table 4 Comparison of the relevant articles

Papers	Cybernetics evolution	Likelihood	Taking decisions	Helping in designing academic systems	Helping to the adjustability of construction	The complexity of cybernetics systems	Fuzzy systems in cybernetics	Cybernetics in hypothetical music	Cybernetics in innovation	Optimization in cybernetics systems
Historical evolution of cybernetics systems										
(Majumder 1979)	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
Umpleby (1997)	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
(Umpleby & Dent)	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
(Vallee 2003)	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
(Vahidi, Aliahmad, et al., 2019)	×	✓	✓	✓	✓	✓	✓	✓	✓	✓
System dynamics										
(Scala et al. 2006)	✓	✓	✓	✓	×	✓	✓	✓	✓	✓
(Vahidi, Aliahmadi, et al., 2019a)	✓	✓	✓	×	×	✓	✓	✓	✓	✓
Complexity theory										
(Kuhn 2002)	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
(Hipel et al. 2007)	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
(Kandjani et al. 2013)	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
(Mobus and Kalton 2015)	✓	✓	✓	✓	✓	×	✓	✓	✓	✓
Dialogic design science										
(Cisneros et al. 2013)	✓	✓	✓	×	✓	✓	✓	✓	✓	✓
(Bausch and Flanagan 2013)	✓	✓	✓	×	✓	✓	✓	✓	✓	✓
(Kyriazis 2017b)	✓	✓	✓	×	✓	✓	✓	✓	✓	✓
AI										
(Negoita 2009)	✓	✓	✓	✓	✓	✓	×	✓	✓	✓
(Seising 2010)	✓	✓	✓	✓	✓	✓	×	✓	✓	✓
(Martelaro and Ju 2018a)	✓	✓	✓	✓	✓	✓	×	✓	✓	✓
Cybernetics										
(Rosenblueth 1981)	✓	×	×	✓	✓	✓	✓	✓	✓	✓

Table 4 (continued)

Papers	Cybernetics evolution	Likelihood	Taking decisions	Helping in designing academic systems	Helping to the adjustability of construction	The complexity of cybernetics systems	Fuzzy systems in cybernetics	Cybernetics in hypothetical music	Cybernetics in innovation	Optimization in cybernetics systems
(Scott 2000)	✓	✓	✓	✕	✓	✓	✓	✓	✓	✓
Dunbar-Hester 2010)	✓	✓	✓	✓	✓	✓	✓	✕	✓	✓
(White 2012)	✓	✓	✓	✓	✓	✕	✓	✓	✓	✓
(Fay et al. 2019)	✓	✓	✓	✓	✓	✓	✓	✓	✕	✓
Management optimization										
(Porvazník and Ljudvigová 2016)	✓	✓	✓	✓	✓	✕	✓	✓	✓	✓
(Evstegneev et al. 2019)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✕
(Vahidi and Aliahmadi 2019)	✓	✓	✕	✓	✓	✕	✓	✓	✓	✕

Data Availability All data are reported in the paper.

Declarations

Conflict of interest The authors declare no conflict of interest.

References

Andrew AM (2005) Cybernetics and systems on the web: internet newsletters. Kybernetes 34(7/8):1278–1281
Andrew AM (2006) Topics in ASC discussion: Cybernetics and systems on the web. Kybernetes 35(7/8):1293–1296
Andrew AM (2013) Cybernetics and systems on the web: Topics in CYBCOM list,"wet" neurophysiology, carbon computing. Kybernetes 42(2):349–351
Andrew AM (2005) Cybernetics and systems on the web: hoax paper, nanotechnology. Kybernetes 34(9/10):1656–1658
Ashby W, Ross (1957) An introduction to cybernetics
Bausch K (2008) *Negotiating social complexity.* Paper presented at the Proceedings of the 52nd Annual Meeting of the ISSS-2008, Madison, Wisconsin
Bausch KC, Flanagan TR (2013) A Confluence of Third-Phase Science and Dialogic Design Science. Syst Res Behav Sci 30(4):414–429
Biggiero L (2018) Providing sound theoretical roots to sustainability science: systems science and (second-order) cybernetics. Sustain Sci 13(5):1323–1335
Broome BJ (1995) Collective design of the future: Structural analysis of tribal vision statements. Am Indian Q 19(2):205–227
Broome BJ (1997) Designing a collective approach to peace: Interactive design and problem-solving workshops with Greek-Cypriot and Turkish-Cypriot communities in Cyprus. Int Negot 2(3):381–407
Broome BJ (2004) Reaching across the dividing line: Building a collective vision for peace in Cyprus. J Peace Res 41(2):191–209
Chapman J (2019) Why Cybernetics? Why Love? Taylor & Francis
Chen J, ChengChiang, Kent S (2020) Task engagement, learner motivation and avatar identities of struggling English language learners in the 3D virtual world. System 88:102168
Christakis, Alexander N, Bausch KC (2006) Co-laboratories of democracy: How people harness their collective wisdom to create the future. IAP
Cisneros, Reynaldo T, Hisijara BA (2013) A social systems approach to global problems. *Institute for 21st century agoras, createspace Independent Publishing Platform*
Cisneros RT, Hisijara BA, Bausch KC (2013) Strategic articulation of actions to cope with the huge challenges or our world: A platform for reflection. *Atlanta: Institute for 21st Century Agoras*
de Araújo Lima P, Ferreira, Crema M, Verbano C (2020) Risk management in SMEs: A systematic literature review and future directions. Eur Manag J 38(1):78–94
Doewes RI Gharibian, Ghazal, zadeh, Firoozeh Abolhasani, Zaman, Burhan Abdullah, vahdat, Sahar, & Akhavan-Sigari, Reza. (2022). An updated systematic review on the effects of aerobic exercise on human blood lipid profile.Current Problems in Cardiology, 101108. doi: https://doi.org/10.1016/j.cpcardiol.2022.101108
Dunbar-Hester C (2010) Listening to Cybernetics: Music, Machines, and Nervous Systems, 1950–1980. Sci Technol Hum Values 35(1):113–139
Egger M, Altman D (2008) Systematic reviews in health care: meta-analysis in context. John Wiley & Sons
Elezi F, Lindemann U (2013) *Engineering change management challenges and management cybernetics.* Paper presented at the 2013 IEEE International Systems Conference (SysCon)
Ermel AP, Cardoso, Lacerda D, Pacheco, Morandi, Maria Isabel WM, Gauss (2021) Literature reviews: modern methods for investigating scientific and technological knowledge. Springer Nature, Leandro
Esmailiyan M, Sundram Y (2021) Effect of Different Types of Aerobic Exercise on Individuals With and Without Hypertension: An Updated Systematic Review. *Current Problems in Cardiology*, 101034. doi: https://doi.org/10.1016/j.cpcardiol.2021.101034
Espejo R (1979) Information and management: the cybernetics of a small company. Manage Res News 2(4):2–15

Evstegneev IA, Nikonchuk AV, Popov AA, Dolmatov SN, Krasikov NA (2019) *Improvement of technological solutions of wood processing based on cybernetics and automation methods.* Paper presented at the IOP Conference Series: Materials Science and Engineering

Fay D, Bagotyriute, Ruta, Urbach, Tina, West MA, Dawson J (2019) Differential effects of workplace stressors on innovation: An integrated perspective of cybernetics and coping. Int J Stress Manage 26(1):11

Ferri F (2018) Dwyer, Ned, Raicevich, Saša, Grifoni, Patrizia, Altiok, Husne, Andersen, Hans Thor,… Silvestri, Cecilia. *Governance and sustainability of responsible research and innovation processes: Cases and experiences*: Springer

Fiorini R, Santacroce GF (2013) *Economic competitivity in healthcare safety management by biomedical cybernetics ALS.* Paper presented at the International Symposium The Economic Crisis: Time For A Paradigm Shift ~ Towards a Systems Approach

Fitz R, Troha J (1977) *Interpretive structural modeling and urban planning.* Paper presented at the Proceedings of the International Conference on Cybernetics and Society, USA

Flanagan, Thomas R, Christakis AN (2010) The talking point: Creating an environment for exploring complex meaning. IAP

François C (1999) Systemics and cybernetics in a historical perspective. Syst Res Behav Science: Official J Int Federation Syst Res 16(3):203–219

Gauss L, Lacerda, Daniel P, Cauchick Miguel PA (2021) Module-based product family design: systematic literature review and meta-synthesis. J Intell Manuf 32(1):265–312

Ghosh T, Banna A, Hasan Md, Rahman Md, Sazzadur, Kaiser M, Shamim M, Mufti, Hosen ASM, Sanwar, Cho, Gi Hwan (2021) Artificial intelligence and internet of things in screening and management of autism spectrum disorder. Sustainable Cities and Society 74:103189

Glanville R (2002) Doing the right thing: the problems of… Gerard de Zeeuw, academic guerilla. Syst Res Behav Science: Official J Int Federation Syst Res 19(2):107–113

Glenn JC, Gordon, Theodore J, Florescu E (2009) 2009 State of the Future

Gorichanaz T (2019) Information experience in personally meaningful activities. J Association Inform Sci Technol 70(12):1302–1310

Hamet P, Tremblay J (2017) Artificial intelligence in medicine. Metabolism 69:S36–S40

Heidari A, Navimipour NJ (2021) Service discovery mechanisms in cloud computing: a comprehensive and systematic literature review.Kybernetes

Hipel KW, Jamshidi, Mo M, Tien, James M, White III, Chelsea C (2007) The future of systems, man, and cybernetics: Application domains and research methods. IEEE Trans Syst Man Cybernetics Part C (Applications Reviews) 37(5):726–743

Jnr BA (2019) A developed software agent-knowledge-assisted procurement management tool for retailing enterprise.VINE Journal of Information and Knowledge Management Systems

Kandjani H, Bernus P, Nielsen S (2013) *Enterprise architecture cybernetics and the edge of chaos: Sustaining enterprises as complex systems in complex business environments.* Paper presented at the 2013 46th Hawaii International Conference on System Sciences

Keating CB, Katina PF (2019) Complex system governance: Concept, utility, and challenges. Syst Res Behav Sci 36(5):687–705

Krippendorff K (2019) The cybernetics of design and the design of cybernetics *Design Cybernetics*. Springer, pp 119–136

Kuhn L (2002) Complexity, cybernetics and human knowing. Cybernetics & Human Knowing 9(1):39–50

Kyriazis M (2016) Opinion paper: A cognitive-cultural segregation and the three stages of aging. Curr Aging Sci 9(2):81–86

Kyriazis M (2017a) Re-thinking ageing: a cross-disciplinary perspective (A New Era for Ageing). Mech Ageing Dev 163:1–1

Kyriazis M (2017b) Third phase science: defining a novel model of research into human ageing. Front Bioscience-Landmark 22(6):982–990

Laouris Y (2012) The ABCs of the science of structured dialogic design. Int J Appl Syst Stud 4(4):239–257

Laouris Y (2015) Reengineering and Reinventing both Democracy and the Concept of Life in the Digital Era. The onlife manifesto. Springer, Cham, pp 125–142

Laouris Y, Emiliani P-L, Roe P (2017) Systemic evaluation of actions toward developing practical broadband applications for elderly and people with disabilities. Univ Access Inf Soc 16(1):247–255

Laouris Y, Christakis (2009) Aleco. Exploring options for enhancement of social dialogue between the Turkish and Greek communities in Cyprus using the Structured Dialogic Design Process. *Systemic Practice and Action Research, 22*(5), 361–381

Laouris Y, Laouri R (2008) Can information and mobile technologies serve to close the economic, educational, digital, and social gaps and accelerate development? World Futures 64(4):254–275

Laouris Y, Michaelides M (2007) What obstacles prevent practical broadband applications from being produced and exploited.Towards an inclusive future Impact and wider potential of information and communication technologies,281–299
Laouris Y, Michaelides M (2018) Structured Democratic Dialogue: An application of a mathematical problem structuring method to facilitate reforms with local authorities in Cyprus. Eur J Oper Res 268(3):918–931
Laouris Y, Christakis A (2009) A systemic evaluation of the state of affairs following the negative outcome of the referendum in Cyprus using the structured dialogic design process. *Systemic Practice and Action Research, 22*(1), 45–75
Laouris Y, Michaelides M, Sapio B (2008) A systemic evaluation of obstacles preventing the wider public benefiting from and participating in the broadband society. Observatorio J 5:21–31
Letiche H (2019) Cybernetics and Systemicity'. *The Emerald Handbook of Management and Organization Inquiry. Emerald Publishing Limited*, 183–195
Liapakis IE, Korkolis D, Papadopoulos O, Kokkalis G, El-Shazly M, Golematis BC, Vassilopoulos PP (2008) Reconstruction of the chest wall. J BU : Official J Balkan Union Oncol 13(2):185–191
Majumder DD (1979) Cybernetics and general systems—a unitary science? *Kybernetes*
March J, Herbert GSIMON, Organizations A (1958) New York: New York:John Wiley and Sons
Martelaro N, Ju W (2018a) Cybernetics and the design of the user experience of AI systems. interactions 25(6):38–41
Martelaro N, Ju W (2018b) *A Panel on Cybernetics and the User Experience of AI Systems.* Paper presented at the 2018 AAAI Spring Symposium Series
Matthews T (2021) LibGuides: web of science platform: web of science: summary of coverage. *clarivate. libguides. com*
Mobus GE, Kalton MC (2015) Cybernetics: The Role of Information and Computation in Systems. Principles of Systems Science. Springer, pp 359–455
Mostafaie T, Khiyabani F, Navimipour NJ (2020) A systematic study on meta-heuristic approaches for solving the graph coloring problem. Comput Oper Res 120:104850
Negoita CV (2009) Fuzzy systems and cybernetics. *Kybernetes*
Nijs, Diane Elza Lea Winie (2014) Imagineering the butterfly effect. Eleven international publishing
Oliva F, Kotabe M (2019) Barriers, practices, methods and knowledge management tools in startups.Journal of Knowledge management
Porvazník J, Ljudvigová I (2016) General theory of systems, cybernetics and evaluation of human competence by solving present crisis problems of civilisation. Procedia-Social and Behavioral Sciences 230:112–120
Robb FF (1984) Cybernetics in management thinking. Syst Res 1(1):5–23
Robb FF (1989) Cybernetics and suprahuman autopoietic systems. Syst Pract 2(1):47–74
Rosenblueth E (1981) SYSTEMS, CYBERNETICS, AND SUBJECTIVITY. The Quality of Life: Systems Approaches. Elsevier, pp 1–4
Rudall BH (2005) Contemporary systems and cybernetics: New initiatives in the development of neuron chips and in biomimetics. Kybernetes 34(9/10):1651–1655
Sage AP (1977) Methodology for large-scale systems. McGraw-Hill College
Scala J, Purdy L, Safayeni F (2006) Application of cybernetics to manufacturing flexibility: a systems perspective. J Manuf Technol Manage 17(1):22–41
Schandorf M, Schandorf M (2019) Information & Meaning: The Semiotics of Cybernetics', Communication as Gesture (Digital Activism and Society: Politics, Economy And Culture In Network Communication. Emerald Publishing Limited
Schwaninger M (2001) System theory and cybernetics: A solid basis for transdisciplinarity in management education and research. Kybernetes 30(9/10):1209–1222
Schwaninger M (2004) Methodologies in conflict: achieving synergies between system dynamics and organizational cybernetics. Syst Res Behav Science: Official J Int Federation Syst Res 21(4):411–431
Scott B (2000) The cybernetics of systems of belief. Kybernetes 29(7/8):995–998
Seising R (2010) Cybernetics, system (s) theory, information theory and fuzzy sets and systems in the 1950s and 1960s. Inf Sci 180(23):4459–4476
Stvilia B, Wu S, Lee DJ (2019) A framework for researcher participation in research information management systems. J Acad Librariansh 45(3):195–202
Torgerson C (2003) Systematic reviews. Bloomsbury Publishing
Tunstel E (2018) Systems, Man, and Cybernetics Society Synergies [President's Message]. IEEE Syst Man Cybernetics Magazine 4(1):4–4
Umpleby SA (1997) Cybernetics of conceptual systems. Cybernetics & Systems 28(8):635–651
Umpleby, Stuart A, Dent EB (1999) The origins and purposes of several traditions in systems theory and cybernetics. Cybernetics & Systems 30(2):79–103

Umpleby SA, Medvedeva, Tatiana A, Lepskiy V (2019) Recent Developments in Cybernetics, from Cognition to Social Systems. Cybernetics and Systems 50(4):367–382
Vahdat S (2021) Association between the Use of Statins and Mortality in COVID-19 Patients: A Meta-Analysis. Tob Regul Sci 7(6):6764–6779
Vahdat S, Shahidi S (2020) D-dimer levels in chronic kidney illness: a comprehensive and systematic literature review. *Proceedings of the national academy of sciences, india section b: biological sciences*, 1–18
Vahidi A, Aliahmad A, Teimouri E (2019) Evolution of management cybernetics and viable system model. Systemic Pract Action Res 32(3):297–314
Vahidi A, Aliahmadi A (2019) Describing the necessity of multi-methodological approach for viable system model: case study of viable system model and system dynamics multi-methodology. Systemic Pract Action Res 32(1):13–37
Vahidi A, Aliahmadi A, Teimoury E (2019a) Researches status and trends of management cybernetics and viable system model.Kybernetes
Vahidi A, Aliahmadi A, Teimoury E (2019b) Researches status and trends of management cybernetics and viable system model. Kybernetes 48(5):1011–1044
Vallee R (2003) Cybernetics and systems, from past to future. Kybernetes 32(5/6):853–857
Virgil Negoita C (2001) Fuzzy systems in cybernetics. Kybernetes 30(9/10):1149–1151
Von Foerster H (2003) Cybernetics of cybernetics *Understanding understanding*. Springer, pp 283–286
Warfield JN (1973) Participative methodology for public system planning. Comput Electr Eng 1(2):187–210
Warfield JN (1976) Societal systems. *Planning, Policy and Complexity*
Warfield JN (1994) Science of generic design: managing complexity through systems design. Iowa State Press
Warfield JN, Cárdenas AR (1994) A handbook of interactive management. Iowa State University Press Ames
White SM (2012) *Using cybernetics with Soft Systems Methodology in complex system development.* Paper presented at the 2012 IEEE International Systems Conference SysCon 2012
Wiener N (1948) Cybernetics or Control and Communication in the Animal and the Machine. Technology Press
Yang C-H, Lee K-C (2020) Developing a strategy map for forensic accounting with fraud risk management: An integrated balanced scorecard-based decision model. Eval Program Plan 80:101780
Zadeh F, Abolhasani, Bokov D, Olegovich, Yasin, Ghulam, Vahdat S, Abbasalizad-Farhangi M (2021) Central obesity accelerates leukocyte telomere length (LTL) shortening in apparently healthy adults: A systematic review and meta-analysis.Critical Reviews in Food Science and Nutrition,1–10
Zannetos ZS, Wilcox JW (1969) The management process, management information and control systems, and cybernetics