



**Theoretical Foundations of Information and Communication Sciences
from a Cybernetic Paradigm
An Analytical Study of a Sample of Publications from Cairn.info**

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Abstract

The establishment of any scientific field requires three fundamental conditions: a clearly defined subject, a specific methodology, and a coherent theoretical framework. These conditions were gradually fulfilled in the field of Information and Communication Sciences during the 1950s. After the identification of media phenomena as a legitimate object of study, attention turned to theory—more specifically to paradigms, which encompass both theoretical perspectives and methodological approaches. During this period, the cybernetic paradigm emerged as one of the most influential frameworks guiding and regulating research in information and communication. This study examines the relationship between the cybernetic paradigm and Information and Communication Sciences by applying an open systemic approach and a content analysis method to a selected sample of cybernetics-related publications available on the Cairn.info platform. The objective is to assess the extent to which this paradigm has contributed to the development of media and communication studies.

The research highlights the significant role played by the cybernetic paradigm in shaping key themes and analytical perspectives within the media field. Through theoretical analysis and content analysis of publications issued by three academic institutions indexed on Cairn.info, the study reveals that although cybernetics is considered a foundational paradigm in Information and Communication Sciences, it no longer receives sufficient scholarly attention or in-depth scientific analysis. This relative neglect has negatively affected research topics associated with the cybernetic paradigm in media studies. Moreover, it has led to the marginalization of its founding scholars across successive generations, from the first to the third, along with a diminished use of the concepts and models developed within this framework. This decline is particularly evident in the nature and orientation of contemporary academic research.

Keywords

Theoretical Foundations; Cybernetic Paradigm; Analytical Study; Cairn.info

Introduction

Despite the profound developments witnessed in the field of information and communication technologies, the cybernetic paradigm continues to occupy a central position in intellectual reflections on communication. This paradigm has long represented a priority for scholars working in the domain of media and communication technologies. From this perspective, an essential question arises: can the cybernetic paradigm be considered an almost exclusive crucible of communication thought?

Bernard Miège addresses this question in his book *Communication Thought: From Its Foundations to the Turn of the Third Millennium*. He argues that answering this question affirmatively would carry a significant implication—namely, the neglect of a wide range of intellectual currents and theoretical contributions that emerged within different frameworks. These currents first appeared and developed in the United States during the 1940s, before later expanding geographically into Europe (Miège, 2000, p. 9).

This observation highlights the major role played by the cybernetic paradigm in the epistemology of Information and Communication Sciences, particularly given that both emerged during the same historical period. This simultaneity fostered a strong and enduring relationship between cybernetics and communication studies. Indeed, scholars affiliated with the cybernetic paradigm were among the earliest to integrate their ideas into the emerging field of communication, as clearly illustrated by Shannon's mathematical model of communication. Despite having been introduced more than six decades ago (in 1948), this model remains widely applied in contemporary media research. Furthermore, some technical scholars continue to recognize Shannon's model as the only legitimate framework for studying Information and Communication Sciences. This stance has significantly influenced the orientation of research within the media field and has contributed to reinforcing a technically driven understanding of communication processes. Cybernetic studies published on the Cairn.info platform provide a clear example of how media research has been directed toward specific epistemological concerns, such as the analysis of communication through the binary logic of inputs and outputs. These elements are treated as measurable and analyzable variables within media studies. However, the validity and relevance of the results derived from such analyses remain closely dependent on the degree of methodological rigor and on the theoretical framework adopted to approach the subject, particularly when communication is treated as a documented theoretical construct.

Research Problem

Humanity's scientific journey has consistently sought to uncover truth, whether in the natural or social and human sciences. Achieving this goal typically relies on three fundamental pillars: theories, methodology, and research subject. Theories aim to interpret, understand, and explain phenomena while reflecting the researcher's perspective on the studied object within their knowledge domain and area of expertise. Methodology serves as a roadmap for theorizing and guiding the research process, providing a structured set of tools to explore

diverse scientific inquiries. Finally, the research subject itself determines the choice of method and shapes the interpretive framework, enabling the researcher to exercise greater control over the study.

As scientific literature expanded and knowledge became increasingly specialized, the emergence of “hyper-specialization” influenced all fields, including Information and Communication Sciences. This discipline began drawing on theories from technical sciences at some stages and from social and psychological sciences at others. By the early 21st century, these studies faced fewer challenges in establishing methodological rigor compared to theoretical frameworks. Consequently, attention shifted to macro-level theoretical frameworks, known as paradigms, which provide overarching structures for understanding and organizing knowledge. Researchers ultimately identified four major paradigms in Information and Communication Sciences: the behavioral, functional, interpretive, and cybernetic paradigms. As highlighted by Saad (2010), these paradigms, each grounded in distinct principles and perspectives, established new rules for studying communication phenomena. They also opened significant avenues for scholars to enrich, critique, modify, and refine theories, facilitating a deeper understanding of media and communication processes. Each paradigm offers a unique approach. The behavioral paradigm focuses on stimulus–response mechanisms, analyzing actions and reactions as measurable events. The functional paradigm emphasizes the societal role of media, viewing media institutions as structures that maintain social stability, and highlighting that failure of these media to fulfill their functions may lead to systemic dysfunction. The interpretive paradigm, in contrast, seeks to understand, explain, and interpret phenomena without generalization, treating each communication event as unique and non-reproducible.

Despite the limited attention given to the cybernetic paradigm by researchers in the field of Information and Communication Sciences, as reflected in the holdings of many academic libraries, this paradigm has maintained significant recognition among scholars in the natural sciences in general and among technical researchers in particular. The foundations of cybernetics were established in the 1940s, primarily within technical fields such as mathematics, ballistics, and early missile science. Shannon’s mathematical model of communication, introduced in 1948, exemplifies the adaptation of cybernetic concepts to media studies. Shannon, a student of Norbert Wiener—the founder of cybernetics—later developed his own model, which laid the groundwork for subsequent research.

Although studies applying the cybernetic paradigm in communication research remain limited, important contributions can be found in specialized databases, particularly Cairn.info, which documents a range of related publications. The paradigm’s significance is further highlighted in foundational works, including Bernard Miège’s *Communication Thought* and Hassan Saad’s *Dominant Paradigms in Information and Communication Sciences and Their Epistemological Issues*, illustrating how cybernetics contributed to the theoretical foundations of Information and Communication Sciences.

Consequently, the central research question guiding this study is as follows:

What theoretical foundations has the cybernetic paradigm provided to Information and Communication Sciences, based on publications from Cairn.info?

Sub-questions

To address this central question, the study is further divided into the following sub-questions:

- a) Does the cybernetic paradigm represent an epistemological rupture or a continuity of knowledge in the field of Information and Communication Sciences, according to publications on Cairn.info?
- b) What specific topics have been studied in detail under the cybernetic paradigm, as evidenced in Cairn.info publications?
- c) Do the studies on the cybernetic paradigm within Cairn.info reflect the actual nature and practice of media research?
- d) What contributions has the cybernetic paradigm made to the development of Information and Communication Sciences, based on Cairn.info publications?

Hypotheses

In response to these questions, the study proposes the following preliminary hypothesis:

Based on publications indexed on Cairn.info, the cybernetic paradigm emerged as the result of an epistemological rupture with prior theoretical approaches in Information and Communication Sciences.

Based on publications indexed in Cairn.info, the cybernetic paradigm primarily examined the mechanisms through which communication processes are controlled and regulated. However, these publications do not fully reflect the actual nature and practice of media research, indicating a gap between theoretical models and empirical realities. Despite this limitation, the cybernetic paradigm has opened new avenues for inquiry in Information and Communication Sciences, providing a conceptual framework for exploring communication phenomena in innovative ways. Notably, these findings reflect a tension between two perspectives: one emphasizing the paradigm's limitations, and the other highlighting its positive contributions.

Study Objectives and Significance

This study aims to achieve several key research objectives:

- a) Clarify the nature and scope of the cybernetic paradigm and resolve ambiguities surrounding its conceptual framework.
- b) Identify theoretical elements that have been neglected in studies associated with the cybernetic paradigm.
- c) Examine the theoretical models proposed within the cybernetic paradigm in Cairn.info publications, with a focus on diverse media topics, supported by practical examples.

- d) Provide the researcher's own conceptual models within this paradigm, while considering the specific characteristics of Information and Communication Sciences and ensuring compatibility with both traditional and cybernetic frameworks.

The significance of this study is closely tied to the historical importance of the cybernetic paradigm for Information and Communication Sciences. Its emergence coincided with the foundational period of the discipline in the 1950s and 1960s. Furthermore, the models offered by the paradigm have been adapted across various media research topics, providing a ready-made epistemological framework for future studies within the paradigm.

Methodology

The methodology reflects the researcher's overall conceptualization of the study and is designed to ensure both rigor and validity. Following Angers (2014), methodology is understood as a structured set of carefully considered procedures that enable the researcher to implement the study systematically. The approach integrates well-considered tools and techniques to ensure reliable outcomes, while also allowing for critical assessment of the research process. This framework ensures that the study's objectives are pursued effectively and that findings are robust and applicable within the context of Information and Communication Sciences. Given that this study concerns the cybernetic paradigm, which is distinguished by its application of the open-system analysis method, this approach was adopted as the core methodological framework. The method relies on the input–output logic, which is governed by a set of principles:

- a) Examining the relationship and boundaries between the system and its broader environment.
- b) Analyzing the nature and effects of inputs on the environment, as well as the resulting outputs (Bouamama, 2012, p. 102).

To operationalize this methodology, the study employed content analysis as its primary analytical tool. The inputs consisted of the language used in the publications, the category of actors involved, and a subsequent classification of these actors according to their specific roles. Additional input categories included the research methodology and the type of source used. The system, or the entity processing these inputs, was represented by the typological category of each study. Outputs were coded under the topic category, which included conceptual units, theories, models, generations of research, and the fields of application of the cybernetic paradigm. Content analysis, as defined by Sankour (2019), is “the scientific analysis of communication messages” (p. 232). It is commonly applied in studies where data collection tools rely on both printed and unprinted documentary sources (Qandilji, 2012, p. 12). In this study, content analysis was supplemented with techniques to ensure the reliability and consistency of the coding form. This was achieved through a process of expert validation involving three judges, following the formula for calculating reliability proposed by Tamar (2012, p. 20):

$$\text{Reliability coefficient} = (N_0 + N_1 + N_2) / M \times N$$

Where:

- a) NNN = number of judges
- b) MMM = average agreement between judges
- c) N0N_0N0 = number of categories coded by the first judge
- d) N1N_1N1 = number of categories coded by the second judge
- e) N2N_2N2 = number of categories coded by the third judge

This rigorous procedure ensured the validity and reliability of the content analysis instrument, allowing for a systematic and scientific examination of the cybernetic paradigm within Cairn.info publications.

Reliability Assessment and Review of Previous Studies

Reliability Assessment

To ensure the consistency of the content analysis instrument, the reliability coefficient was calculated using the previously described formula. The result was 1.92, indicating a very high level of reliability.

A second method was also employed to confirm this result. In this approach, the average agreement among the three judges was calculated and then divided by the total number of coded pairs. The resulting reliability coefficient was 1.93, further confirming the robust consistency of the instrument and the validity of the coding process.

Review of Previous Studies

A comprehensive review of the literature was necessary to identify key concepts and terms related to the study topic. This involved consulting reference books, journal indexes, and other academic sources (Angers, 2014, p. 32). Based on this review, the primary terms relevant to the study were identified as cybernetics and open-system methodology.

Accordingly, previous studies were categorized into two groups:

- a) Studies focusing on the cybernetic paradigm
- b) Studies focusing on open-system methodology

Studies Focusing on Cybernetics

Books

Assar (2012) authored *An Introduction to Social Cybernetics: An Attempt to Control Human Behavior*, published by the National Office of University Publications in Algiers. The book emphasizes the long-standing human effort to control and guide behavior, linking these efforts to cybernetic theory. Assar also explores the conceptual roots of cybernetics, tracing them back to their Greek origins, and distinguishes between mathematical and non-mathematical models within cybernetics. This work provides a foundational framework for understanding how cybernetic concepts have been applied to social and communication phenomena.

Bouajim, J. (2019) authored *La “société de l’information” et son impact sur les pays en développement* [Information institutions and their impact on developing countries], published by Hassnaoui Publications in Algiers. This work examines the ambiguity and multiplicity of meanings associated with terms such as “media,” “information,” and “informatics” in their early usage. Bouajim highlights how cybernetic studies, particularly those initiated by Robert Wiener, helped clarify these ambiguities. The book also discusses communication through cybernetics and Shannon’s mathematical communication model, demonstrating the theoretical foundations of information and communication sciences from a cybernetic perspective.

Oshy, R. (1916) published *Introduction to Automatic Control* through Chapman & Hall in London. Oshy discusses the interest of psychologists, sociologists, and physiologists in adapting principles of automatic control to their respective fields, emphasizing the interdisciplinary relevance of cybernetic theory.

Articles

Several articles provide further insights into the application of cybernetics in organizational and communication contexts.

Espinoza, A., & Leonard, A. (2016) published two studies in the *International Journal of Systems and Cybernetics*, Issue 31, Emerald Group Publishing Limited, Algiers. The first article emphasizes the importance of employee knowledge management, likening employees to DNA codes containing all relevant information about operational mechanisms and potential challenges to optimize system efficiency.

The second article, titled “The Gap: The Contradictory Nature of Organizational Closure (Organizational Gap)”, analyzes organizational gaps by dividing them into levels interconnected through communication channels. These channels implement mechanisms for controlling and monitoring the overall system, a concept referred to as self-regulation.

Other notable articles reviewed include:

- a) Diagnosis (2013)
- b) The Gap: Cybernetic-Automatic Control in Sri Lanka Peace Negotiations (2012) and Sociology
- c) From Systems Analysis to Case Study Analysis
- d) Automatic Control and Networked Systems (www)

Collectively, these studies highlight a central theme: the description and development of automated communication systems as conceptualized within cybernetic frameworks. They illustrate both theoretical and applied aspects of cybernetics in communication research, reinforcing its foundational role in understanding and regulating complex informational and organizational systems.

Dissertations

Bouamama, Z. (2012/2012) completed a doctoral dissertation entitled *The Policy of President Bill Clinton in Rebuilding the European Security System after the Cold War* at the Faculty of Political Science and International Relations, University of Algiers 3. This study facilitated the application of open-system analysis by providing a methodological framework through which a systematic extraction of input–output models could be conducted. The dissertation serves as a key reference for understanding how open-system methodology can be applied to analyze complex political and organizational phenomena, offering guidance for applying similar analytical frameworks in the field of Information and Communication Sciences.

Articles on Open-System Methodology

Ghiali, M. (n.d.) conducted a study titled *Open-System Methodology and Its Applications: An Attempt to Apply the Method to the Study of “The Nation in All Its Controversial Unity and Diversity”* by Dr. Bahjat Qurani. The study begins by examining the origins of open-system methodology and its key proponents. It then explores the concept by connecting it to two theoretical orientations: structural-functionalism and the cybernetic paradigm. These orientations influenced the development of two system-based approaches: the open system and the closed system. Ghiali identifies the five essential components of a system as: manifestation, communication, control, adaptation, and hierarchy. Applying the open-system methodology, the study reached several conclusions:

- a) Open-system analysis fosters a holistic perspective, emphasizing the system rather than individual institutions or the state.
- b) It directs research toward macro-level analysis, rather than intermediate or narrow-scale studies.
- c) The methodology has evolved over time, adapting to societal changes.
- d) Open-system methodology draws upon multiple disciplines—including sociology, anthropology, and mathematics—rather than relying on a single scientific field.
- e) This study highlights the interconnection between the cybernetic paradigm and open-system methodology, demonstrating how the latter serves as a practical tool for analyzing complex phenomena within communication and social sciences.

Paradigm:

A paradigm is a guiding framework that structures research of a particular type, providing mechanisms for conducting, controlling, and interpreting studies. Paradigms are generally grounded in epistemological approaches and can be categorized as quantitative or qualitative.

Cybernetic Paradigm:

The cybernetic paradigm is primarily quantitative and is one of the four major paradigms in the field of Information and Communication Sciences. It focuses on control and regulation in communication processes across multiple levels, typically four, to achieve effective management and understanding. It also examines input–output interactions,

including machine–machine, machine–human, and human–human interactions, reflecting its technical and operational foundations. Key models include Shannon’s Mathematical Communication Model (1948), Beer’s Viable System Model (1972), and the JPR Model by José Peres Ross (2008).

Cairn.info:

Cairn.info is an electronic academic database launched in 2011 through a partnership of four publishers: Belin, De Boeck, Découverte, and Érès, headquartered in Liège, Belgium. It provides publications in the humanities, social sciences, and related disciplines. In 2016, Cairn.info was integrated into the National Library of France, becoming a key resource for researchers.

Results

The study results are presented in two main sections: content analysis outcomes and findings according to the study hypotheses.

1. Content Analysis Results

The content analysis of Cairn.info publications on the cybernetic paradigm revealed several notable patterns:

- a) The term “control” was the most frequently used concept in cybernetic studies of organizations, appearing in 34.60% of the publications, whereas “guidance” was the least used, at 0.14%.
- b) Topics related to the cybernetic paradigm were heavily centered on models and theories, accounting for 21.33% of the studies.
- c) The use of media-related models, such as Shannon’s model and the Black Box model, was very limited, comprising only 2.92% of the analyzed models.
- d) No study discussed Beer’s Viable System Model (VSM).
- e) Attention to closed-system analysis methods was very low, representing only 6.16% of methodological approaches.
- f) Among communication disciplines, public relations was the most frequently addressed in cybernetic studies, accounting for 29.23% of the publications.

2. Results According to Hypotheses

Hypothesis 1: The first hypothesis, suggesting that the cybernetic paradigm emerges from epistemological rupture, was rejected. The analysis indicated that, based on Cairn.info publications, the cybernetic paradigm results from knowledge continuity and interaction with other fields, including military, mathematical, and physical sciences, as well as connections across the three generations of the paradigm.

Hypothesis 2: The second hypothesis, regarding the specific topics studied by the paradigm, was confirmed. Publications focused primarily on human–machine

communication, as well as key cybernetic concepts, including control (34.60%), regulation (24.09%), and guidance (0.14%).

Hypothesis 3: The third hypothesis, questioning whether cybernetics is a true reflection of reality or merely a conceptual construction, could not be conclusively tested due to the lack of an appropriate tool. To address this, the study applied a cybernetic measurement model designed to assess the validity of this question within the research framework.

Hypothesis 4: The fourth hypothesis, concerning the practical contribution of the paradigm to society, was confirmed. Studies demonstrated how cybernetic mechanisms can optimize the use of machines to serve human objectives. This finding was linked to the third hypothesis and further supported through an axiological measurement model, as detailed in the documentation section of the study.

Recommendations and Proposals

During the course of this study, several recommendations and proposals were identified to enhance the quality, direction, and rigor of knowledge-based research in the field of Information and Communication Sciences:

Emphasize theoretical and library-based research:

Information and Communication Sciences are still in their early developmental stages compared to other knowledge disciplines that have advanced over multiple decades. The seven-decade evolution of this field demonstrates the need to strengthen theoretical and conceptual studies alongside empirical research.

Focus on the technical dimension of research:

Universities that integrate both theoretical and technical aspects of communication studies achieve higher global rankings. For example, the University of Missouri leads in media studies due to its balanced combination of theory and technical application, exemplified by its historical connection to Marconi, the inventor of the radio.

Incorporate the concept of entropy into Shannon's model:

While noise negatively affects message transmission, entropy reflects the inherent uncertainty within the message itself. Including this concept provides a more complete theoretical framework for analyzing communication processes.

Introduce new cybernetic terminology:

- a) **Infocybernetics:** Refers to information exchange between machine and human without feedback loops.
- b) **Communicybernetics:** Refers to machine-to-machine or machine-to-human communication with feedback mechanisms.
- c) These terms clarify distinctions between cybernetic processes in communication and other domains, such as sociocybernetics in social sciences.

- d) Propose the fifth system in Beer's Viable System Model (VSM) as a central concept:
- e) The fifth system contains the core cybernetic concepts and can serve as a comprehensive framework. By emphasizing this component, it is suggested to refer to the model as the "Effective System Theory" rather than the traditional VSM, reflecting its theoretical primacy.

Conclusion

This study provided a structured set of cybernetic concepts grounded in the procedural definitions developed for this research. These concepts reflect the key indicators and dimensions that define terms associated with the cybernetic paradigm. The study introduced the terms infocybernetics and communcybernetics to distinguish between automated information processes without feedback (machine-to-human) and with feedback (machine-to-machine or machine-to-human). This distinction represents a significant conceptual contribution compared to previous literature. Additionally, the study applied the concept of entropy dynamically, addressing its prior neglect in cybernetic research and providing a more nuanced understanding of uncertainty in communication systems.

Overall, the research offers a refined theoretical framework for cybernetic studies in Information and Communication Sciences and presents practical terminology and methodological insights that can guide future research in this field. The cybernetic paradigm has provided a fertile ground for a wide range of communication studies. These studies span both theoretical foundations of the paradigm and applied research, facilitating human interaction with machines. In recent years, machines have become a central component not only in daily life but also in the organization of scientific research, guiding studies toward new patterns of human behavior even before influencing broader knowledge frameworks. This has been made possible by the precise conceptual and thematic organization of the cybernetic paradigm, which allows for systematic exploration and application in both theoretical and practical domains.

References

- 1 Bouamama, Z. (2012). The policy of President Bill Clinton's administration in rebuilding the European security system after the Cold War (Doctoral dissertation, University of Algiers). Published doctoral thesis, Algeria.
- 2 Rashti, J. A. (1992). The scientific foundations of media theories (2nd ed.). Dar Al-Fikr Al-Arabi.

- 3 Angers, M. (2014). *Research methodology in the human sciences: Practical training* (S. Bouzid Sahraoui et al., Trans.; 2nd ed.). Dar Al-Qasbah for Publishing.
- 4 Miège, B. (2000). *Communication thought: From foundations to the turn of the third millennium* (A. Al-Qassouar, Trans.). Dar Toubkal.
- 5 Sankour Jbara, S. (2019). *Media discourse between theory and practice* (1st ed.). Dar Osama for Publishing and Distribution.
- 6 Tamar, Y. (2012). *Content analysis for researchers and university students* (1st ed.). Algeria.
- 7 Saad, H. (2011, March 19). *Dominant paradigms in information and communication sciences and their epistemological problematics*. Paper presented at the Research Seminar on Scientific Paradigms for Lebanese Doctoral Students.
- 8 Qandilji, A. I. (2012). *Scientific research and the use of traditional and electronic information sources*. Al-Yazouri Scientific Publishing and Distribution.
- 9 Assar, K. (2012). *An introduction to social cybernetics: An attempt to control human behavior*. National Office of University Publications.
- 10 Cairn.info. (2015, April 14). *Academic publications platform*. <https://www.cairn.info>