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## Steps towards a systemic paradigm for information science

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**Abstract**

**Purpose** – The purpose of this paper is the conceptual expansion of the science-theoretical foundations of information science, i.e. to develop new thought schemes for information science.

**Design/methodology/approach** – The design of the paper is as follows: first, the paper will discuss the foundation of the systemic paradigm (SP). Then the authors will consider the history of information science related to the philosophy of science. In the remaining part of the paper, the authors will investigate information science and its relation to the philosophy of science, focusing on SP.

**Findings** – In conclusion, the authors will summarise the seven criteria for the application of SP in information science.

**Research limitations/implications** – Paradigms in information science have rarely reflected upon the use of a SP in information science.

**Practical implications** – The practical use of the seven criteria in information science Criterion 1: make your premises, suppositions, prerequisites and motives explicit. Criterion 2: make your moral/ethical results and consequences explicit. Criterion 3: research should be evaluated in relation to the transcendence of knowledge. Criterion 4: emphasise methodical pluralism, i.e. empirical generalisations and conceptual generalisations. Criterion 5: emphasise proximity and in-depth studies. Criterion 6: look for patterns and patterns which combine. Criterion 7: look for the power behind the patterns.

**Social implications** – The opinion is that scientists to a great extent should seek knowledge on the basis of a belief, a specific way of thinking, and by means of specific methods. To make the authors belief explicit makes the way of thinking visible. What the authors achieve, and possibly the only thing the authors can achieve, is to reaffirm the conscious belief. This does not make reality more real, but it could put the authors in a better position to see through the authors way of thinking when faced with scientific problems. This indicates that a scientific study should emphasise all three entities: "The Context of Discovery", "The Context of Justification" and "The Context of Solution". These three entities, according to SP, make up the unity of the scientific process.

**Originality/value** – The seven criteria entail that Kuhn's argumentative chain (where he tries to find out why theory A is preferred to theory B on a rational pretext) does not concur with SP. This indicates that a scientific study should emphasise all three entities: "The Context of Discovery", "The Context of Justification" and "The Context of Solution". These three entities, according to SP, make up the unity of the scientific process.

**Keywords** Information theory, Philosophy, Knowledge management, Systemic thinking, Philosophy of science

**Paper type** Conceptual paper

## Introduction

In this paper, information science is regarded as the science dealing with structure and properties pertaining to information and communication, in addition to theories and methods for transfer, storage, recovery, evaluation and distribution of information. Also included are information systems, networks, functions and processes and activities

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conveying information from a source to a user and for use in various types of human activity systems and environments related to practice (Luenberger, 2006; Miller, 1978).

Information science is here regarded from two theoretical perspectives:

(1) A structural, functional and process-oriented perspective (Miller, 1978).

(2) A behavioural perspective (Larsen and Olaisen, 2013; Miller, 1978).

The first perspective has, amongst other things, precipitated the development of various control theories. The second perspective has generated various management theories and cognitive theories. Partial disciplines here include information management, knowledge management, information resource management and decision theories. Sub-disciplines are decision support systems and management information systems, etc. Information resource management in this paper refers to the integrated management of various applications of computer systems. Information management and knowledge management is here regarded as strategic management and control of internal information, knowledge and internal communication, in addition to external information, knowledge and external communication (with or without the use of information technology), where increased organisational efficiency is the goal (Bolisani and Handzic, 2014; Johannessen *et al.*, 2001).

Information here refers to the human interpretation of “capta”. Capta are data that provide meaning for the observing system. Data are plural of datum, and is understood here as a collection of terms not necessarily in and of themselves meaningful but still representing some code or other of certain terms or messages. For data to carry meaning, the codes must be understood by the observing system (Laudon and Laudon, 2013). Knowledge is defined here as the systematisation and structuring of information in relation to one or more goals (Johannessen *et al.*, 2001).

The research question in this paper is:

*RQ1.* How can the systemic paradigm (SP) be applied to information science?

The purpose of the paper is a conceptual expansion of the science-theoretical foundations of information science, i.e. to develop thought schemes for information science.

The organisation of the paper is as follows: first, the paper will discuss the foundation of the SP. Then we will consider the history of information science related to the philosophy of science. In the remaining part of the paper, we will investigate information science and its relation to the philosophy of science, focusing on SP.

In conclusion, we will summarise the seven criteria for the application of SP in information science.

## The foundation of the SP

Our basis for the study of SP is Bunge’s systemic philosophy (Bunge, 1977, 1981, 1983a, b, 1985a, b, 1989a, 1996a, 2001a, b, c). Mario Bunge is one of the few system philosophers still active today who bases his philosophy on a systemic foundation. Another is Nicholas Rescher, whose conceptual idealism forms an interesting counterpart to Bunge’s thinking.

The core of systemic thinking is to acquire insight into connections and patterns, and it provides an alternative to both individualism and holism (Bunge, 1996a, p. 44). Consequently, Bunge’s SP is an extension of, and is new in relation to, system thinking. The SP is based on system thinking, but with another approach: its focus is on the actor, a part-whole perspective, emergent phenomena[1], and so on.

The dispute between the naturalist and the anti-naturalist approaches define much of the debate in the field of the philosophy of science. The SP is based on a system-theoretical ontology, where the world is viewed as a system consisting of subsystems, and has an epistemology combining realism and rationalism. The aim of the systemic approach is to understand, predict and control. The methods include analysis as well as synthesis, generalisation and systematisation (Johannessen, 1997a; Johannessen and Olaisen, 2005, 2006).

In classifying positions in the philosophy of science from a historical point of view, Bunge (1985b, p. IX) focuses on five approaches: the logical, the linguistic, the historical, the sociological and the philosophical. The logical approach is related to naturalism, whereas the linguistic, historical and sociological are related to anti-naturalism. The philosophical approach is related to the systemic position.

The systemic position makes a distinction between the epistemological sphere (Bunge, 1985a), the ontological sphere (Bunge, 1983a), the axiological sphere (Bunge, 1989a, 1996a) and the ethical sphere (Bunge, 1989a).

Examples from the epistemological sphere are system, truth, knowledge, meaning theory, model, hypothesis and causality. The epistemological sphere is in turn divided into the logical sphere, where we investigate constructs; the semantic sphere, where meaning, sense and reference are investigated; and the methodological sphere, where the connection between facts, data, and the constructs' interpretation and testability are investigated. Examples of the logical sphere are utility and rationality. Here, among other things, the basis for rationality is investigated.

Examples of the ontological sphere are actions, events, process and artefacts. In the ontological sphere, the nature of society is investigated.

"Axiology, or value theory, is the branch of philosophy that deals with the general concept of value and with the status of value judgements" (Bunge, 1996a, p. 220). In the axiological sphere, the role of the observer observing a system and other things is investigated.

Examples from the ethical sphere are the measure of social equality, freedom, wishes, needs, norms, moral codes, analysis of the link between ends and means and the context of solution (Johannessen, 1997b). Here, the role of conduct of social scientists is investigated. Systemic thinking expresses explicitly that "genuine freedom for all can only be attained together with a good measure of social equality" (Bunge, 1996a, p. 536).

The ultimate goal in all social science, viewed in a systemic perspective, is to find or uncover patterns conducive to explanations and "possibly also predict social facts" (Bunge, 1985b, p. 157). But most social patterns are local in the sense that they appear exclusively in societies of a special type. Universal and cross-cultural patterns are to be found, however, along with local ones.

If we make a distinction in data between intention and behaviour in social science, the systemic approach regards intention categories as having to be understood, whereas behaviour categories can be explained. This distinction can be expressed in the following way: "lifting the head" is different from "the head being lifted". "Lifting the head" is linked to intention, while "the head is lifted" is linked to behaviour. By the distinction between intention and behaviour, the dualism between naturalism and anti-naturalism is transcended. Both angles of incidence become viable and complement each other in the study of social systems. The intention can further be linked to our dispositions to think and act. In order to understand an intention, we must study historical factors, the situation and context, in addition to expectation mechanisms. Behaviour must be explained in the context and situation in which it unfolds, in addition to the broader context of which it is part. What implication does the distinction between intention and behaviour have for the study of social systems and information systems?

(1) The interpretation of meaning becomes an important part of the intention side in the distinction.

(2) Explanation and predication becomes an important part of the behaviour side in the distinction.

The systemic position tries to build a bridge between the classical controversy in social science of methodological individualism vs methodological collectivism (holism) (Bunge, 1996a).

Preconditions on which the systemic position is based are as follows:

- Social facts exist and can be disclosed, even if some social facts only partly and gradually can be made visible.
- Intuition is necessary in social science, but not sufficient in order to understand social and information systems. The sufficient element includes theories, models, rigorous methods and tests against facts (giving data).
- Analysis and synthesis are complementary activities, where the synthesis is the goal, i.e. disclosure of patterns in social systems.
- Observation of social and information systems must be based on theory. If there is no theory, theory development (grand, medium, local) must be the objective of the study of social and information systems. If this does not happen, observations become a collection of data, and rigorous knowledge about social and information systems will become impossible.
- Morals and ethics constitute an important part of the study of information systems.

The philosophy of science is meant to provide guidance for the researcher in a specific discipline, such as information science, sociology, anthropology, psychology, economics, etc. Bunge (1996a, p. 11) points out certain requirements regarding the philosophy of science. Four of these requirements are listed here (Bunge operates with five more, which we hold to be subsumed in the following four):

(1) The relevancy requirement: is it relevant? Does it deal with topical problems of the specific discipline?

(2) Comprehensibility: can it be comprehended by a bright student of the subject?

(3) Internal consistence: is it possible to refine concepts and propositions used in a way that generates greater clarity?

(4) External consistency: is it in accordance with existing knowledge in the specific discipline?

## The history of information science related to the philosophy of science

In social interaction, which constitutes the impact area for the part of information science preoccupied with problems in social systems, there are not only cognitive categories involved but also entities such as domination, power influences, agitation, rhetoric and willpower (Floridi, 2013). Thus, in our opinion, the above mentioned entities should be included in the premises for scientific thinking. Polanyi expresses similar ideas in the following statement: "Theories of the scientific method which try to explain the establishment of scientific truth by any purely objective formal procedure are doomed to failure" (Polanyi, 1962, p. 135).

Social phenomena, subject fields and so on, cannot be regarded as mathematical problems. This thought is also underlined by Quinn and Cameron (1988, p. XIV). Phenomena in social systems can rather be compared to flows of ideas in a whirlpool in continuous motion: they are inter-related and may be regarded as a pattern weaving the whirls together, and not as dependent and independent variables eligible for quantification and empirical testing. This idea is also strongly emphasised by Bateson (1972, 1988), and Ford and Backoff (1988).

Nissen (1985a), Klein and Lyytinen (1985), Ehn (1988) and Galliers (1990), discuss the limitations pertaining to the classical scientific method in the study of information systems. Nissen (1985a) argues in favour of a phenomenological oriented approach to the study of information systems, where the subjective perspective on the part of the actors is included and the social construction of reality is emphasised. Klein and Lyytinen (1985) argue in favour of including a critical perspective in the study of information systems. Ehn (1988) argues strongly against the Cartesian approach, which he juxtaposes with classical scientific rationality. Ehn develops an approach to information science based on linking existential phenomenology, views from Heidegger, critical theory and the later Wittgenstein, in addition to a constructivistical understanding of the object field.

Galliers (1990) emphasises the combination of phenomenological/hermeneutic and action perspectives. However, he makes no distinction between action research and action science as do, for instance, Argyris *et al.* (1985). This distinction is crucial, as the ethical perspective is made more explicit in action research than in action science, according to Argyris *et al.*'s (1985, pp. IX-XV) understanding.

Galliers categorises information science as either empirical or interpretative, and on the basis of this distinction has attempted to build a theory for information science. However, from our point of view, the weakness in his theory is the dichotomy between the empirical and the interpretative, where several angles of incidence are overshadowed when they fall into one category or the other. Another criticism of Galliers is that he classifies the empirical distinction as science, but the interpretative one as being exclusively interpretative (and thus defined outside of pure science). An underlying view of science as a form of logical empiricism thus creeps into his distinctions and concept usage. Our view is that science is not method, but rather that method is part of science. The strength in Galliers' (1990, p. 156) argumentation, however, is his emphasis of the concept "location" with regard to the observers, contrasted to the object system subject to study. This view is also supported by Vogel and Wetherbe (1984). The "location" concept emphasises the fact that the scientist's use of angle of incidence, perspective and aspect seeing, to a greater extent, is located in the environment in which they are tied up, than to the object system that is being studied. This, in our opinion, implies that subjective and communicative processes that take place internally among the scientists carry more weight than what would scientifically be "correct" to use. By this, we mean a pragmatically oriented attitude towards choice of method or a pluralistic view of method. Galliers (1990, p. 168) is method-oriented in his theory building, and as such his classification scheme may be useful if the practicability of his various angles of incidence is to be analysed. But in terms of scientific theory, Galliers' contribution is only interesting with respect to method and coincides to a great extent with logical empiricism, which has gone far in coupling science almost exclusively to method.

Davis (1990) has developed a model designed for studying information systems in organisations. This model explains that organisations are culture as opposed to organisations having a culture, which is the assumption on which Smircich (1983), among others, bases his work. We find this distinction crucial, as information systems often constitute an important element in the manifestation and constitution of an organisation as a culture.

Olaisen (1991) points out that it is the basic suppositions in terms of the philosophy of science which are not being made explicit, which to a great extent characterise information science. This is also underlined by Bubenko (1986), Hirschheim and Klein (1989), Iivari (1986, 1989) and Lyytinen (1987). Visala points out the very reason that we do not make our view of the philosophy of science explicit: "Positivism (is) still prevailing in our field" (Visala, 1990, p. 175). Even if logical positivism or, perhaps more correctly, logical empiricism is the dominant research paradigm in information science (Jønsson, 1990, p. 345), it has met with strong criticism from Ehn (1988), Hirschheim and Klein (1989), Mumford *et al.* (1985), Larsen and Olaisen (2013, pp. 764-774), Bawden and Robinson (2012), Bolisani and Handzic (2014), Floridi (2013), and is reinforced in this paper through the SP.

Blake *et al.* (1980) have attempted to develop a framework for research in parts of information science in order to facilitate accumulative research. One objection to this is that it regards linear causal models as the only conceivable models in terms of scientific thinking; that is, where one can use independent and dependent variables. This is completely in line with logical empiricism.

An alternative philosophy of science appears to be imperative in order to integrate information science in schools of thought other than the positivistic/objectivistic one, or the various schools of logical empiricism.

## Information science, the SP and the relation to the philosophy of science

The remaining part of the paper is structured as follows: first, the objectivistic schools will be discussed. Second, the paper will focus on hermeneutics and phenomenology. Third, the critical school will be discussed. Finally, we will consider realism and the relativistic school. The philosophies of science mentioned above will be related to information science and the SP.

## The objectivistic schools (logical positivism, neo-positivism and logical empiricism)

When we refer to the objectivistic schools in science, we think of scientists who believe in their ability to reflect conditions in nature and social systems by honing specific methods and techniques (Floridi, 2013).

Logical empiricism refers here to mathematically and statistically oriented schools in scientific theory represented by, among others, Suppe (1969, 1970, 1977, 1978), Sneed (1976, 1979), Van Fraassen (1980), Stegmyller (1979) and Kaila (2014).

The criticism against positivism, according to Von Wright (1971), deals particularly with:

- Methodical monism.
- It was based on a method primarily used in the natural sciences, but considered as an ideal for all fields of science.
- The explanation principle; what we here choose to call linear causality.

It was, as expressed by Schøn (1991, p. 37) "[…] World War II that gave a major new impetus both to the Technological Programme and the Positivist epistemology of practice", and "[…] Technical rationality is the Heritage of positivism" (Schøn, 1991, p. 31). What can be understood from Schøn's statement is that objectivism, positivism, neo-positivism and logical empiricism base their epistemology on technical/instrumental rationality.

The objectivists of various shades have turned science into a question of constitutive rules, where procedures and methods are the most important.

The distinction between "The Context of Discovery" and "The Context of Justification" (Popper, 1968) couples rules pertaining to procedure and discussions about method to the latter context, and science is then defined within this context.

Science is, according to SP, the meta-context of "The Context of Discovery", "The Context of Justification" and "The Context of Solution", where all three contexts must be included in a theory of science for information science (Bunge, 1989a, 1998a, b, c). "The Context of Solution" is concerned with the moral, ethical implications of research in the short, medium and longer term (Bunge, 1989a, b).

Regardless of the types of problems treated in information science, the "Hard" and "Soft" systemic (SP) criticism of the objectivistic perspective emphasises that it only problematizes the distinction between the described and the description to a limited extent (Bunge, 1977, 1979). Other criticism is concerned with the way science is turned into a question of procedures, rules and discussions about method. The objectivists are also criticised here for disregarding moral and ethical considerations (Bunge, 1989a, b) in terms of result and consequence ("The Context of Solution").

To take descriptive statements pertaining to the system subject that is studied seriously for SP means to problematise our premises, suppositions, conditions and motives (Bunge, 1983a, b, 1985a, b). In our opinion, this will logically lead to some kind of interpretative activity, which will be a common feature of information science. We are compelled to make ourselves as observers explicit. We have to focus on the constitution of the descriptive statement; that is, our epistemology. This is what the objectivists to a considerable extent shy away from. It is the absence of an epistemological debate which appears to be characteristic of the objectivist school in information science.

After Hanson's attack on the theory/observation distinction, Kuhn's (1970, 1971, 1976) contribution to the historical relativity of the theories, Toulmin's (1961) understanding of scientific theorising as a map/terrain distinction, and Feyerabend's (1962, 1977, 1978, 1987) criticism of method as science, one could have expected the reputation of the objectivists to be tarnished. However, Carnap, perhaps the most distinguished exponent of logical empiricism, expressed great enthusiasm regarding Kuhn's works. In a letter to Kuhn regarding his work with "The Structure of Scientific Revolutions" (of which Carnap was the editor), he writes: "[…] In my own work on inductive logic in recent years I have come to a similar idea: that my work and that of a few friends in the step for step solution of problems should not be regarded as leading to the ideal system, but rather as a step for step improvement of an instrument" (Carnap, 28 April 1962 in Reisch, 1991, p. 267).

In our opinion, it is only when the arguments of Hanson, Kuhn, Feyerabend and Toulmin are linked that an argumentative chain emerges, turning logical empiricism into one of many scientific ways of acquiring knowledge.

Modern positivism, Haag (1988, p. 19) writes quoting Wittgenstein (1973, p. 7), practices its leitmotif: "What one cannot speak of, one has to keep silent about".

The transcendental is thus weeded out of the scientific ideal of the neo-positivists. It is the measurable entities which are focused on (Neurath, 1966, p. 405), and only statements concerning factual elements (Carnap, 1966, p. 52) are declared science. Scientific truth thus becomes a coherence between descriptive statements. Without a problematizing between the described and the description, modern positivist thinking (i.e. neo-positivism and logical empiricism) has abolished reality. Haag (1988, p. 121) writes about this "The traditional thesis about a statement on the basis of its concurrence with reality cannot be allowed by a consistent positivism any longer". The same idea is also expressed by Neurath (1966).

What, then, is science, and what is not science? For logical empiricism, the distinction occurs between meaningful and meaningless statements embodied in the verification principle.

For Popper and the "objectivist school", what distinguishes science from non-science is that the scientific formulations in principle can be falsified. One may ask: How is it possible to falsify the falsification principle? We have reason to believe that Popper bases his falsification imperative on an intuitive (subjective) supposition regarding its validity. The falsification principle does not embody the requirements laid down by Popper for the falsification of scientific statements. When the meta-theory for the falsification requirement is not consistent with the requirements inherent in this theory, the very falsification principle at best is to be regarded as problematic, for the Popperians anyhow!

Within the sociological tradition, Converse (1968, p. 52) expresses a view that can be interpreted as concurring with the views of the objectivist school: "My own view is that science devotes itself to the systematic decoding of observed regularities, and the reduction of the regularities to more parsimonious and general principles that account for wide range of phenotypic detail. As long as one is engaged in such activity, one is doing science". What is implicit in Converse's statement is that to a great extent he couples science to "The Context of Justification". The moral/ethical results and consequences manifested have neither implicitly nor explicitly been pointed out by Converse as belonging to the core of science or its focus.

A common feature for the objectivists is that they set goals for a scientific project, and give criteria for the methodology to be used and the theories to be applied. But when they separate considerations of moral and ethical results and consequences from goals, theory and the selection of methods of the project, the scientific project and the progress of science become self-validating. A belief system is then established aimed at the validation of its own progress. In this way, science, as expressed by Feyerabend (1962), becomes just a family of belief systems among other belief systems.

## Hermeneutics and phenomenology

Husserl's phenomenology emphasises strongly both logic and empiricism (Gruender, 1982; Cristiansen, 1988). There are at least three elements that distinguish logical empiricism from the phenomenological school. According to Mormann (1991, p. 63), these are:

(1) The great emphasis on the empirical tradition from logical empiricism, vs a development towards "idealism" for Husserl's phenomenology.

(2) Rejection of any form of metaphysics in terms of logical empiricism, vs "transcendentalism" in Husserl's phenomenology.

(3) The priority given to formal logic as a scientific foundation for logical empiricism, vs a development towards "transcendental" phenomenology as a foundation for science and philosophy in Husserl's phenomenology.

The logical-empirical tradition is distinguished from hermeneutics in that the logical-empirical tradition can be said to have a conception of "the picture which science gives us of the world is a true one" (Cetina-Knorr, 1981, p. 27). This contrasts sharply with the hermeneutic view.

SP is related to logic and an empirical foundation for science (Bunge, 1974a, b, 1977, 1979), but is also oriented towards ideal requirements and interpretation processes, which will always be of a subjective nature (Bunge, 2014). In addition, research in the SP tradition falls into two main categories: conceptual generalisation and empirical generalisation (Bunge, 1998a, pp. 3-50, 51-107, 403-411. In particular, see Bunge, 1998a, p. 17). Conceptual generalisation concerns an investigation whereby the researcher uses other researchers' empirical findings in conjunction with his or her own process of conceptualisation in order to generalise and identify a pattern. This contrasts with empirical generalisation, where the researcher investigates a phenomenon or problem that is apparent in the empirical data, and only thereafter generalises in the light of his or her findings.

Husserl's project was about freeing rationality from "the deductive model that had come to dominate all discussion of reason from Descartes on and to replace it with the intuitive model" (Caputo, 1987, p. 210). This has also to a certain extent been continued in "Ethnomethodology, the American version of phenomenology" (Alexander *et al.*, 1987, p. 27), which is also linked to the later Wittgenstein, and to symbolic interactionism (Powell, 2014). Symbolic interactionism particularly emphasises that individuals create their environment instead of reacting to it. This is strongly emphasised in SP (Bunge, 1989a, b, 2014) and is linked to the later Wittgenstein, particularly in his emphasis on the importance of everyday language for the constitution of social reality (Wittgenstein, 1953, particularly articles 17, 18 and 19).

Intention, purpose, meaning, action, manifestation of results and more long-term consequences of scientific problems are important entities in SP (Bunge, 1989a, b). In a thought structure of this kind, an intuitive model in Husserl's sense becomes just one of several starting points for reasoning. This is sharply contrasted to the Galilean view of science (Watzlawick, 1984, p. 89), pragmatic reductionism, which is the idea that all phenomena can be understood by reducing them to their basic constituents. This scientific view characterises mainstream scientific thinking, also in the field of information science (Bolisani and Handzic, 2014).

With Gadamer (1975), common sense is released from the regimentation of methodology. He focuses on practical wisdom and common sense which is honed against concrete situations. Common sense is not coupled to algorithmic method techniques.

In "Truth and Method", Gadamer (1975) does not discuss cultural science like economy, political science, sociology, anthropology or information science specifically. Gadamer's research project is understanding and interpretation in art, literature and history. Nevertheless, it is Gadamer's (1975) emphasis on the ontological dimension, the described, which is interesting in relation to SP (Bunge, 1974a, b, 1977). It is Gadamer's coupling of hermeneutics to practice which links SP to this tradition in hermeneutics (Bunge, 1983a, b, 1985a, b).

Hermeneutics as understood in SP (Bunge, 1996a) is a reaction to the fragmentation of knowledge, the reduction of science to methods, and the assignment of ethical questions to the church.

SP does not share the view that the interpretative paradigm, as pointed out by Burrell and Morgan, namely that "it is underwritten by the assumption that the world of human affairs is cohesive, ordered and integrated". For SP it is exactly these haphazard components, the quantum leaps of consciousness, which characterise social life. Therefore, one of the criteria in SP is proximity, and in-depth studies are considered preferable to distance from the problem area (Bunge, 1998a, b, c). This is done, among other things, to uncover possible butterfly effects: the small fortuitous improbable variables capable of precipitating major consequences for social systems and nature. In addition to this, proximity and in-depth studies could reveal emergent phenomena[2], which is emphasised in the SP.

Neither do we share Burrell & Morgan's view of hermeneutics, namely that the impact area is "[…] issues relating to the nature and status quo". For SP and our understanding of the interpretative school, the impact area is more related to the *status quo ante* than to the status quo. It is changes, the prerequisites of change, and consequent considerations which constitute the core of SP (Bunge, 1998b, 1990).

## The critical school

Power and ethics are linked in a way similar to power and science, and also power and language. Therefore, from an SP standpoint it is important to bring the critical dimension represented by, among others, Apel (1976) and Habermas (1977, 1979, 1987) into information science. From the authors mentioned, SP provides the link to criticism of power which is a necessary prerequisite for the unity between science and ethics (Bunge, 1989a, b).

Questions related to context, opinion, interpretation and power are important for information science (Bawden and Robinson, 2012). For SP these are core issues in the distinction between subjective and objective understanding of science (Bunge, 2014). This is also linked to Polanyi (1962, p. 171), who states that: "Science […] simply reflects the fact that it is a system of beliefs to which we are committed and which therefore cannot be represented in non-committal terms".

## Realism and the relativistic school

The entire project of Newton-Smith (1981) is devoted to the defence of "Realism" or "The Strong Program" against attacks from fundamentalists and the relativistic view. But when Newton-Smith argues against Feyerabend, who denies the existence of any precedent for specific scientific methods in the scientific context, Newton-Smith's main argument is that "Quite simply the special fruits of science indicate that there is something special about scientific methods" (Newton-Smith, 1981, p. 269). This argumentation is in line with the Pope attempting to prove God's existence by referring to the existence of churches in Svalbard.

Implicit in Newton-Smith's argumentation is that science is linked to progress. But what instances of progress are we talking about? If it is technological progress, the condition for progress must be defined. The realists must also clarify: progress for whom? If we link technological progress to technical performance, progress has been documented. But if there is anything history can tell us, it is precisely that the increase in technical performance is not necessarily linked to progress for mankind.

If progress is linked to progress for mankind, it is debatable whether science has brought mankind forward. The point is that a distinction has to be made between progress linked to technical performance, and progress linked to ethics and nature (Bunge, 1989a, b, 2014).

The reference of "The Strong Program" to the success of methods as argumentation for their fruitfulness is difficult to understand. What is the benefit of success if it is this very success which is the prerequisite for the possible demise of man? What is the benefit of success if it has a feedback loop to the apocalypse? What is the benefit of success if success leads to crisis? (Bunge, 1989a, b, 2014).

On the other hand, the introduction of "the Role of Judgement" (Newton-Smith, 1981, p. 270) in "The Strong Program" is in line with SP and this is in sharp contrast to the objectivists (Bunge, 2010a, b). To introduce "Judgement" is to introduce a subjective element, in SP referred to as the relation between pre-understanding, presuppositions and research motives (Bunge, 1989a, b; Bunge and Ardila, 1987). To introduce "Judgement" is to introduce a distance to algorithmic procedures and methodological tyranny in information science.

"Judgement" must not only be coupled to scientific methods, but also to the problems focused on by scientists and the context of solutions, i.e. ethics. If "Judgement" only is coupled to the method level, it is tantamount to equipping a blind man with good glasses.

Feyerabend (1962, 1977, 1978, 1987), Taylor (1979), Pitkin (1972) and Bernstein (1985) argue strongly against regarding science as a matter of honing modern methodological tools. Wolin (1972) and Caputo (1987) launch fierce attacks on what can be denoted as methodological imperialism. Caputo (1987) argues that it is Adorno, Derrida, Feyerabend, Kuhn, Heidegger and Foucault who represent the most important milestones against the police forces of rationality.

Popper's (1966) attacks on what he denotes as the subjectivist and relativistic positions in science can be regarded as a masked form of dogmatism, and he is a major exponent of methodological standardisation (Popper, 1961, 1963, 1968, 1972, 1976). It is this very domination of objectivism in science and also information science, which has led to unbridled specialisation at the expense of part-whole thinking, according to Cristiansen (1988, p. 63). SP emphasises the pluralistic and complementarity standpoint both for meta-theory, theory, model and method in scientific work (Bunge, 2001a, 2003, 2009, 2014).

First, if science is turned into a question of method it will become epistemologically ignorant, and this is more than problematic (Bunge, 1983a, b, 1985a, b). Second, science becomes an instrument for technology. Third, ethical problems are defined out of the domain of science and into specific subject areas (Bunge, 1989a, b). Fourth, the ontological domain collapses to a level encompassing only issues in the knowledge domains: "What we know that we know", and "What we know that we do not know". There are, for science and information science at least, two other knowledge domains that need to be understood: "What we don't know, that we know", and "What we don't know, that we don't know". If the two last domains are not taken into consideration, science then becomes a matter of craft comparable to the trade of a carpenter. There is nothing negative in the comparison, only that wielding the saw and hammer has very little to do with science; on the contrary, it has to do with instrumental manipulation and knowledge of methods, not the transcendence of knowledge.

What lies at the core of Feyerabend's works (1962, 1977, 1978, 1987), as interpreted by us, is that the moral/ethical dimension must be integrated into scientific problem topics and problem solutions, which SP emphasises (Bunge, 1989a, b, 2014). The scientific neutrality in terms of ethics is also underlined by Polanyi (1962, p. 154) who states: "We may conclude that empiricism like the moral neutrality of science is a principle laid down and interpreted for us by the outcome of past controversies about the scientific value of particular sets of ideas".

One of the most important intentions of SP is just to make an attempt to re-integrate moral/ethical questions into science, i.e. questions regarding issues of right and wrong, and questions of the type: What are the results and consequences of my scientific problem approaches and problem solutions? (Bunge, 1989a, b; Bunge and Ardila, 1987). In addition, it is an important intention of SP to focus on axiology. Axiology is concerned with the value concept and value judgements that may occur in social science. The conceptual pairing here is good/bad (Bunge, 1996a, p. 219). Bunge states that "Axiology is centrally concerned with the good, ethics with the right" (Bunge, 1989a, p. 5), and for the systemic position the good is prior to the right (Bunge, 1989a, p. 6). For the objectivists and logical empiricism, there is no distinction between ethics and axiology.

Feyerabend (1987, p. 141) maintains that until today there are no scientific results which can justify a distinction between a subjective and an objective world. A lot of research both in elementary particle physics and quantum physics show that it is impossible to distinguish between the observer and the observed. This is expressed in works of Bohm and Peat (1987), Bohm (1980) and Bohr (1963), etc.

If the observer is to describe a reality without his subjective side, this requires:

- That the observer has direct access to the described; i.e., he has no epistemology.
- That the observer can free himself/herself from his/her context. This is an essential pre-condition if reality is to be reflected as it is.

Logical empiricism moves along the edge of a knife against the two preconditions, which has also been stated by Bernstein (1983, p. 8).

Parts of the discourse in the philosophy of science are situated between the notion regarding the incommensurably (incomparability) of theories and the correspondence principle, which holds that old theories become special fields of new larger theories and that the various dimensions of the old theory disappear or lose their interest. Kuhn's (1976, pp. 190-191) notion of incommensurability is as follows: "In applying the term incommensurability to theories, I had intended only to insist that there was no common language within which both could be fully expressed, and which could therefore be used in a point to point comparison between them". Feyerabend (1977, p. 365) expresses about the same concept: "When using the term incommensurability I always meant deductive disjointedness, and nothing else".

For SP, incommensurability in respect of theories remains incomparable in the same sense that it is impossible to compare three litres of water with three buckets of water. This has nothing to do with a lack of a meta-language, as maintained by Kuhn, or "Deductive Disjointness", as declared by Feyerabend. If something is incommensurable, it is at a level where a comparison between quantity and quality is impossible.

SP is related to incommensurability and the correspondence principle in that it couples incommensurability to the period of time which Kuhn (1970) describes between a normal development and a scientific revolution, and connects the correspondence principle to the period of time between a scientific revolution and so-called normal scientific development in Kuhn's sense.

## Conclusion

The research question in this paper was:

*RQ2*. How can the SP be applied to information science?

The answer to this question is developed as a summary of the paper in terms of seven criteria for the SP in information science.

Criterion 1: Make your premises, suppositions, prerequisites and motives explicit.

Criterion 2: Make your moral/ethical results and consequences explicit.

Criterion 3: Research should be evaluated in relation to the transcendence of knowledge.

Criterion 4: Emphasise methodical pluralism, i.e. empirical generalisations and conceptual generalisations.

Criterion 5: Emphasise proximity and in-depth studies.

Criterion 6: Look for patterns and patterns which combine.

Criterion 7: Look for the power behind the patterns.

The seven criteria entail that Kuhn's argumentative chain (where he tries to find out why theory A is preferred to theory B on a rational pretext) does not concur with SP. Kuhn (1970, p. 264) is quite explicit in his view of rationality. He states that his argumentation is "an attempt to show that existing theories of rationality are not quite right and that we must readjust or change them to explain why science works as it does". Kuhn may be expressing this in an attempt to distance himself from Feyerabend in posterity. Kuhn's rational approach is made explicit in the following statement: "Scientific behaviour taken as a whole is the best example we have of rationality" (Kuhn, 1971, p. 144). It is at all times the set of regulations, which Kuhn is looking for, that functions as the basis for rational criteria in the preference of theory A to theory B. Cartesian rationality also appears to have affected the later Kuhn.

Our opinion is that scientists to a great extent should seek knowledge on the basis of a belief, a specific way of thinking, and by means of specific methods. To make our belief explicit makes our way of thinking visible. What we achieve, and possibly the only thing we can achieve, is to reaffirm our conscious belief. This does not make reality more real, but it could put us in a better position to see through our way of thinking when faced with scientific problems. This indicates that a scientific study should emphasise all three entities: "The Context of Discovery", "The Context of Justification" and "The Context of Solution". These three entities, according to SP, make up the unity of the scientific process.

According to SP it is the transcendence of knowledge which is the goal for science, not only a justification of a hypothesis against an object system. The importance of justification is only to confirm/not confirm the validity of this transcendence. To turn science into a matter of justification exclusively would be to make science a purely instrumental technique for craftsmanship and method.

Emphasising the three above mentioned contexts of science will not create more order in the scientific project. On the contrary, it might create a greater degree of complication, not necessarily greater complexity. But wherever an increased degree of complication is generated, it is conceivable that information which previously has not been in touch with each other can be included in couplings where information mutations and new knowledge might result. The scientific project must, according to SP, be oriented towards new knowledge where the results and consequences of scientific problems are problematized. This problematizing must be done accurately by the ones putting the scientific problems on the agenda, not by a subsequent evaluation group.

Knowledge can easily become a form of ignorance, similar to the way silence can be a manner of speaking. This means that this type of knowledge is based on fragmentation and analysis of partial elements generating non-knowledge, which can be directly detrimental for social systems and for nature. What appears here is that rationality is not necessarily sensible, and that there does not at all have to be a link between rationality and reason. This technical/instrumental rationality is in SP replaced by a rationality which takes the consequences of practical application of science into consideration. This presupposes simplicity as a scientific ideal to be replaced by a regeneration of real life complication, and for this to be brought into scientific theories, models and methods.

## Notes

1. "Emergent" is an important concept in systemic thinking. An emergent is if something new occurs on one level that has not previously existed on the level below. By "emergent" we mean here: "Let S be a system with composition A, i.e. the various components in addition to the way they are composed. If P is a property of S, P is emergent with regard to A, if and only if no components in A possess P; otherwise P is to be regarded as a resulting property with regards to A" (Bunge, 1977, p. 97).
2. See footnote 1.

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