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# The Pyramid of Information - criticism and opportunity

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***Keywords*— DIKW, Data, Knowledge, Representation.**

***Abstract*—** *The Information Pyramid has been used in technical and academic texts for a long time. Its origin is still uncertain, and it is likely to remain so, but the structure established by Russell Ackoff in 1989 has been the basis for most of the representations found in articles and books. This pyramid has been the subject of criticism from several authors in different research fields. In this theoretical essay, some of the pyramid's development trails are retrieved. Different expressions of the pyramid are discussed, comparing and contrasting its elements, assumptions and implications, in search of a more comprehensive understanding of these elements and their intertwining. To make the exposure more fluid, the reviews were grouped into categories; these, however, should not be taken in isolation, since the focus of attention is the representation, its premises and its implications. It is concluded that the hierarchical representations of the relationships between data, information, knowledge and others are unable to adequately represent, even in a simplified way, the complex processes it intends to subsume. However, it is considered that this representation can still be an instrument of learning, since used critically, supporting discussions about the complexity and circularity of the phenomena that this representation expresses.*

## I. INTRODUCTION

Robinson and Bawden (2014) claim that information is a notoriously slippery and multifaceted concept, which has had many different meanings over the years and is used with different connotations in various domains. For them, almost every scientific discipline employs a concept of information within their particular context, to deal with phenomena that are specific to them. In the field of information sciences, where there have been debates about the concepts of data, the differences and the relationship between this concepts, this is a constant concern. Still according to Robinson and Bawdenm (2014), these debates led to two main classes of models. The first, based on Popper's objective epistemology, uses the expression 'knowledge' to denote what Popper called "World 2", the universe of psychic and mental experiences, the subjective knowledge in a person's mind. The expression 'information' denotes the knowledge communicated, registered or directly exchanged between people, Popper's 'World 3' - that of critical problems, theories and arguments - necessarily codified in a document or physical communication of 'World 1', which is the set of concrete, organic and inorganic experiences. For Popper, information is knowledge in transit (Robinson & Bawden, 2014; Neiva, 1998) The second class of models treats information and knowledge as being of the same type of entity, knowledge being 'refined information', established within some broader structure. In this class of models, these concepts are usually represented in a linear progression or in a pyramid, starting with data and eventually culminating in 'wisdom'. Pyramids of information have been widely used in books and academic papers and many professionals in the fields of science and information technologies are 'literate' having this instrument as support. The question is: is the information pyramid an appropriate instrument for the formation of these professionals?

## II. REVISITING THE PYRAMID OF INFORMATION

The Information Pyramid is a common figure in texts of Information Management and Knowledge Management. It is called by several names: Pyramid of Information, Pyramid of Knowledge, Pyramid of Wisdom and, less commonly, Hierarchy of Information or Hierarchy of Knowledge. It should not be surprising to realize that researchers of Science or Information Management, including the ones in Information Systems, opt for 'Information', while those from Knowledge Management opt for 'Knowledge' (Rowley, 2007). The variety of interpretations seems to match the amount of presentations. The concepts associated with each layer of the pyramid are usually presented and commented, and it is easy to identify different considerations by different authors. Nevertheless, few authors advance in discussing the processes underlying each layer, or in the processes that lead from one to the next. It is not questioned whether it is a pyramid. This shape seems attractive to management models, appearing in the Maslow Needs Hierarchy, in the representations of the hierarchy of information systems, in the representation of the hierarchical levels of an organization or in the conceptual representation of the dimensions Governance and Management in the Cobit 2019 model, for example. This form is also very common in sacred texts and esoteric literature, in which it is associated with the figure of the Creator and, by association, with knowledge and wisdom, forming the figure of the Eye of Providence. According to Berbert (2019), the use of the triangle contains a range of symbolisms, starting with religious aspects, as seen in triangular perfection that, according Plutarch, led Plato to say that god geometrizes, but also in the Holy Trinity of Christianity or Hamsá of Islamic belief.

## III. THE ORIGIN OF THE PYRAMID OF INFORMATION

Despite its popularity, the origin of the Information Pyramid is not clearly established (Wallace, 2007). Several authors attribute its creation – or at least its popularization – to Russel Ackoff, in an article published in 1989 (Hey, 2004; Bellinger et al, 2003; Rowley, 2007; Sharma, 2008; Weinberg, 2010; Schumaker, 2011; Robertson, 2013; Ronquillo et al, 2016). Wallace (2007) mentions Boulding as having proposed a hierarchy composed of signals, messages, information and knowledge as early as 1955, recognizing, however, that Nicholas L. Henry made the first reference to this hierarchy associated to knowledge management in a 1974 article. Sharma (2008), in turn, identified origins in independent works by Milan Zeleny and Michael Cooley, both published in 1987. These two authors constructed hierarchical representations linking data to knowledge. Zeleny (1987) builds his proposal by associating data, information, knowledge and wisdom with successive stages of learning ("know nothing", "know what", "know how" and "know why", respectively). Cooley (1987) does so by discussing tacit and explicit knowledge. Schumaker (2011) recovers the Lectures of Frances Wright, american social reformer who proposes that objective knowledge should be constructed from the verification and investigation of facts, as opposed to the uncritical acceptance of the opinion of the majority or common sense, even when regarding to religion and morality (Wright, 1829).

However, the oldest reference to the pyramid of knowledge, in a text dedicated to the discussion of information, is by Harlan Cleveland, in an article published in 1982. In this article – which is not the case with the previous ones – Cleveland (1982) presents a source of inspiration: the poem "The Rock", published in 1934 by the English poet T.S. Elliot, which contains these three verses:

> Where is the Life we have lost in living?
>
> Where is the wisdom we have lost in knowledge?
>
> Where is the knowledge we have lost in information?
>
> (Elliot, 1934, pp.1)

It is common for only these three verses to be presented, decontextualizing them. Note that Elliot does not mention Data. Nor has Cleveland cast Data as an element in its hierarchy, which has only Information, Knowledge, and Wisdom. Elliot, for his part, associated knowledge with endless cycles of ideas and action. It's a deeply religious text that Kennedy (1973) explains considering that, for Elliot, the Word (the Logos, Christ, the Second Person of the Trinity) is an “untalking baby” whose exact meaning had become wadding or adulterated in darkness.

If Sharma's work shed some light on the origin of the Pyramid of Knowledge, other origins may be considered. For example, Ronquillo et al. (2016), dealing with informatics for nursing, mention that this area of knowledge was established by Graves and Corcoran in a 1989 article, in which they define it as

> a combination of computer science, information science and nursing science designed to assist in the management and processing of nursing data, information and knowledge to support nursing practice and nursing care (Gaves and Corcoran,

1989 apud Ronquillo, Currie, & Rodney, 2016, p. 2).

These authors incorporate in their definition the data-information-knowledge structure established by Blum in 1986. Table 1 shows Blum's definitions.

*Table 1 – Data, Information and Knowledge*

| Element | Definition |
|---|---|
| Data | Uninterpreted elements that are provided to the problem solver. For example: the name of a patient, a test result, or a diagnosis. Most mathematical calculations operate only with data. Using a formula to calculate the body surface from the patient's height and weight is a simple example of an application that operates only with data. |
| Information | A collection of data that contains meaning. Data processing usually ends with a view of information. The data (and information) must be stored in a permanent and accessible database. Example: online patient medical records that includes name, laboratory results, and diagnosis. |
| Knowledge | It is the formalization of the relationships between information elements and data. The formulation can be descriptive (e.g. a textbook) or it can be processed by computer. In the second case, knowledge can be expressed as a formula (as in the case of the body surface problem) or as a set of rules. The use of knowledge usually suggests the ability to infer data or information from those already present. |

Source: adapted from Blum (1986, p. 35)

Also on this trail it is not clear the origin of the data-information-knowledge model, but the addition of Wisdom, proposed by Nelson and Joos (1989), defines a pyramid that is consolidated in the field of informatics for nursing. For Nelson and Joss (1989) wisdom is knowing how to use knowledge in to manage a patient need or problem (Nelson & Joss, 1989).

Despite his predecessors, it is common to attribute to Russell Ackoff, if not the initial proposition of the pyramid, at least the merit of having highlighted it. His inaugural address as president of the International Society for General Systems Research (ISGSR) in 1988, later published as an article in the Journal of Applied Systems (Ackoff, 1989), is the origin usually cited in articles and books (Rowley, 2007). Less known, or less cited, is the fact that the aforementioned speech was written for an audience of engineers, having as its theme the distinction between what can be executed by computers and what can only be delt by humans.

The hierarchy originally proposed by Ackoff - but not represented in pyramid format - is Data-Information-Knowledge-Understanding-Wisdom. Data is defined as symbols that represent the properties of objects, events, and their environment. They are the result of observations, but they are not useful if they are not in the proper format; only after organized they become relevant. Relevance, therefore, is given by the organization of the data. Information is contained in descriptions, answers to questions about what is observed, in the pattern xWyH (what, who, when, where, how, how long, how many, how far ...). Knowledge is know-how: it is the possibility of transforming information into instructions, defining procedures. Knowledge answers questions such as 'how to', and allows control. Wisdom, in turn, is the ability to increase effectiveness. Between Knowledge and Wisdom there is Understanding, which allows to increase the efficiency of knowledge in terms of its construction as procedures. Intelligence optimizes the use and questions the applicability of Knowledge; it allows diagnosis and prescription, but does not alter knowledge. Wisdom requires capacity for judgment, which involves ethical and aesthetic values. According to Ackoff (1989), Information ages fast, Knowledge lasts a little longer, Understanding has an aura of permanence, vague and ethereal, but no more than an aura; only Wisdom can remain. The temporality of the Data is not questioned. It is possible to consider that Data only exists, in accordance with the etymology of the word; it may be possible to consider that data can be more permanent than Wisdom because if knowledge changes, then data can be revisited and reinterpreted without losing its condition of Data. Ackoff doesn't take care of it. Ackoff's definitions may be relatively adequate representations from the perspective of information systems, and it is not correct to expect from his conceptualizations more than he proposed to offer. It would not be correct to attribute to Ackoff the responsibility for the many "translations" that his proposal received or to affirm that these fully represent the thought of this author.

Information systems - even non-computer-based ones - organize data, making it accessible to those who need it. Knowledge allows to use this data in specific tasks, which, being logical can be programmed and automated. Thus, computers use data, which is processed by algorithms that embody a knowledge of how to process this data for a specific purposes. For them to be processable, relevant,

data needs to be properly structured, organized. Nicklaus Wirth, creator of the Pascal programming language, summed up this idea in the title of one of his most influential books: Algorithms + Data Structures = Programs (Wirth, 1976). The difference between Data and Information is functional; in a somewhat simplistic way, it can be said that Data is what is used as input for computational processes, and Information is the output. Intelligence is the ability to build other and better algorithms. It is an algorithmic view of knowledge production. Only wisdom escapes the attraction of information systems, because it is something that may exist only in the human, and so expressing leaves, if not clear, at least strongly indicated that what he had previously placed referred to the computable by automatons.

Wisdom-generating systems are those that man will never be able to attribute to automatons. It may well be that wisdom, which is essential for the effective search for ideals, and the very search for ideals, are the characteristics that differentiate man from machines (Ackoff, 1989, p.9)

For Ackoff (1989), Wisdom is the pursuit of ideals. Somewhat similar idea appears in the last layer of Zeleny's proposal (1986). If knowledge is "knowing why", Enlightenment is achieving a sense of truth, of what is right and what is wrong. However, if for Ackoff (1989) Wisdom is individual, for Zeleny (1986) it is socially built – the sense of truth, right and wrong, is what was socially accepted, respected and sanctioned. Ackoff (1989) does not question the correction of the data, how much "truth" they express. In addition, ethical and moral issues do not apply to them. From the perspective expressed by Ackoff (1989), discussions on ethical and moral aspects "add up" only at the level of Wisdom. The current debate on ethics and the 'Data Era', in its various expressions (social networks, big data, scientific research, artificial intelligence algorithms, ...) shows that, on the contrary, all activities related to data and information must deal with ethical considerations (Richterich, 2018; O'Keefe & O Brien, 2018). O'Keefe and O Brien (2018) affirm that, even when computer science and business management curricula have modules about ethics, these courses often do not provide the tools necessary for information management professionals to work according to and to apply robust ethical concepts in the execution of their daily roles. This leads to the "law of unintended consequences" (O'Keefe & O Brien, 2018, p. 20), with technologies or analysis being deployed in the real world without an adequate analysis of the ethical implications or impacts.

There are, then, ontological and epistemological differences between the positions of Ackoff (1989) and Zeleny (1987). It is noteworthy to note that Cleveland (1982), Zeleny (1986) and Ackoff (1989) defy what Elliot wrote, suggesting "gains" where Elliot (1934), perhaps foreseeing a world in which data is flooding (Ornes, 2013), attention runs out (Simon, 1997), information generates anxiety (Wurman, 2001), tensions (Choo, 2006) or overload (Sutcliffe & Weick, 2008), or are irrelevant (Gaeth & Shanteay, 2000), saw losses. Elliot's poem makes to think, literally questioning. The pyramid states several things without effectively stating any, but inducing a way of thinking. This induced way of thinking – more directly, think about the definition and relationship between data, information, knowledge, intelligence, wisdom; and indirectly, the individual relationship and society; the context of interaction; explicit knowledge and tacit knowledge; values and ideals - has been the subject of relevant criticism made by researchers from different areas. Razzolini Filho (2020, p. 170), for example, to emphasize the inversion of information structures at the beginning of the 21st century, with the emphasis on information technologies in the use of data, which stand out from other structures, flips the pyramid. Particularly striking are the criticisms related to the definition of a linear, hierarchical model of knowledge construction and the epistemological narrowness in which it is sustained. Difficulties in operationalizing the model have also produced important criticism.

## IV. CRITICISM

In the next sections, some criticisms of the information pyramid are presented and commented on. The reviews were grouped into categories; these, however, should not be taken in isolation, since the focus of attention is the representation, its premises and its implications.

Linearization, Hierarchies and Value Judgments

In the Pyramid of Information, Data is understood as the most abundant element. They are the fundamental level on which the other concepts are based. The decreasing widths of the upper levels suggest lower abundance, lower amount, while the upward movement suggests an increase in "power" to support appropriate action. It is up to the reader's imagination to identify an appropriate unit to "measure" the "quantities" and "powers" of data, information, knowledge, intelligence and wisdom. Take, for example, a list of data regarding the age and height of students of a particular class. Statistical analyses and derived reports may take up much more disk space than the original data.

Thus, even with regard to infrastructure information systems this characterization needs to be revisited. Jennex and Bartczak (2013, p.22) proposed an inverted pyramidal

representation, keeping data at the base and wisdom at the top, because, considering that information is a combination of data, the several possible combinations generate much more information than data; according to them, the same goes for the other layers, in which elements as ethics, culture and religion generate different interpretations. But this pyramidal representation serves more to the purpose of assigning value to concepts in the model, characterized by dominance or importance, proposing a consolidation of power in the higher levels in relation to the lower levels – information "worth more than" data, wisdom "worth more than" knowledge.

Poore and Chrisman (2006) describe the problematic nature of this hierarchical representation, stating that "the pyramid of information incorporates and normalizes theories of power, reflecting the hierarchical social structures of the old industrial economy" (Poore & Chrisman, 2006, p. 511) and suggesting that the value of concepts in the Information Pyramid has the potential to overflow and be seen as applicable to individuals and professions , "with manual workers at the base and knowledge workers and bosses at the top" (Poore & Chrisman, 2006, p.511). Stating that literature rests on two metaphors - that of invariance, derived from Shanon's works, and that of the hierarchy of refinement, originated in the 19th century's utopian movements - consider that both prevent the important social and ethical issues involved.

Desrosières (1998) suggests that these representations derive from the taxonomic ideas of nature of the seventeenth century, which later led to the classification of populations for the construction and stabilization of the social order, the constitution of a common language that allows the coordination of individual acts so that systems are able to guide and trigger actions. Although authors such as Choo (2006) or Beal (2006) present non-pyramidal representations, their conceptions are also hierarchical, with unidirectional flows. As aforementioned the similarities of forms creates mechanisms of reinforcement and reciprocal legitimation, and induces belief in causal links, naturalizing a construct and legitimizing social structures. This leads to another possible criticism of such representations.

Teleology

The pyramidal representation explains the movement towards wisdom as the ultimate goal, to which the lower levels are subordinated. There is something teleological about this. For a moment, we return to Plato. In Plato, dialectics is a dialogue that gradually elevates the soul beyond the sensitive world, allowing discovering the essences that are beyond the transience of the world. Platonic dialectics is the method that allows to lay down the practical life in the idea of Good — the *Summum Bonum*, the final destiny of all things, which Medieval Philosophy will associate with God. The constitution of the ethical subject implies the understanding of this *Summum Bonum*, and inspired by the strength of this Good, one can manage to overcome the excesses that threaten existence that is governed by balance and harmony. In Plato's ethics, The Beautiful and the Good articulate themselves - a form is beautiful if it constitutes in itself a perfectly harmonious whole. The Beautiful is the manifest form of the Good. In a world in which fake news and post-truth exert important – and harmful – influence, we can recover Protagoras of Abdera, who, denying the possibility of a universal criterion that allows man to know the truth and separate it from what is false, states that " of all things the measure is Man, of the things that are, that they are, and of the things that are not, that they are not ". Protagoras also stated that "everything can be true, depending only on the quality of the observation". The idea of knowledge as coming from experience arose with sophist philosophers, giving rise to currents of thought that led, for example, to empiricism and the various forms of pragmatism, from which the studies that focus on practices derive. Nelson (2018), revisiting the work of Nelson and Joss (1989), returns to the original question of Blum (1986) and questions whether the scope of the practice is defined by the functionality of technology or by the use of technology by the practitioner. This is not a simple question. The pyramid of information brings in itself a tension between the sophist empiricism of its base and the socratic ideals at its apex, between sensory experiences and transcendent truths, between discovery and revelation.

Outdated conception of science

The very concept of Data, as expressed in these models, is difficult to accept. Anyone who has ever created a data collection tool will have walked in the opposite direction, starting from their knowledge to "produce" the data that their work requires. Popper (1963) wrote that it is absurd to belief that we one can start with pure observations, without a theory to guide the research.

This conception of data that is "given" reflects – or induces – outdated ideals about science and its development. Frické (2009) suggests that this pyramidal representation is reminiscent of the inductivist model of growth by absorption of science, which was largely abandoned in favor of accepting that 'observational facts' are open to the possibility of revision, such as the "observational fact that the Earth that we stand on is stationary, which we can all plainly see and feel" (Frické, 2009, p. 136). According to him, one should not suppose that there is a special category of 'data', which can serve

as a foundation for everything else (Frické, 2009). Fricke (2009) also notes that notably absent from Ackoff's (1980) proposal is "why". If one is to answer such question, it will be necessary "to penetrate beneath the surface, to go beyond the 'data'; and that is exactly what the hierarchy approach forbids" (Frické, 2009, p.5). Information seeking questions are, to a great extent, why questions, typically answered by a mix of facts and slices from the causal nexus tailored to the context and pragmatics of the question.

Uncritical view of technology

Even in the field of information systems, the linear data-information-knowledge relationship is not valid. Every algorithm is knowledge, which, for Ackoff (1989), is the ability to turn information into instructions. Thus, an algorithm is knowledge, as can be seen from Blum (1986). If as said by Wirth (1966), Algorithms + Data Structures = Programs, then a computer program is knowledge that produces information from data. Gadomski (2008), discussing artificial agents, reaches to similar considerations, stating that, for an assumed application domain D, an algorithm or other processing expression is considered knowledge, the data is individual information and preference relationships are used for choosing an appropriate expression of knowledge. This leads to the formula Information 'D = Knowledge D (Information D), which is valid in a Domain D where the choice of Knowledge D depends on the goal, objective or purpose of the intervention given the preferences related to the state of D,

Gadomski's proposition (2008) does not differ significantly from Brookes' (1980) fundamental equation of Information Science, whose domain, Brookes believed, is the study of the interaction between World 2 and World 3, as per Popper's definitions (Todd, 1999).

For Frické (2009), the Information Pyramid can encourage inadequate methodologies in information systems. The view that previously collected data will be promoted to information, allowing answering future questions encourages the irrational collection of data, a preventive acquisition (often not informed to users). In addition, by directing attention to the data, it disregards the importance of treatment methods. Austin and Goldwasser (2008), for example, using data from residents of Ontario, Canada, verified that residents born under the astrological sign of Pisces were significantly more likely to be hospitalized with a diagnosis of heart failure than residents born under the remaining 11 astrological signs combined. (Austin &Goldwasser, 2008, p. 298). This erroneous conclusion, they wrote, was because post hoc comparisons of the proportions of successes across different levels of a categorical variable can result in incorrect inferences. This result, according to the authors, contributes to the growing body of statistical literature that demonstrates that data-based analysis methods can lead to misleading inferences (Austin & Goldwasser, 2008). Dealing specifically with information systems, Austin et al. (2006) and Frické (2009) consider that the conclusions obtained from data mining should deserve a degree of skepticism.

Unclear transitions and transformations

How do the transitions between levels occur? What defines and drives movement from Data to Wisdom? Is there an innate inertia that moves, consolidates and transforms Data into something that is "beyond" the Data, without contributing elements other than those that exist only in the Data themselves, until Wisdom? Data definitions do not allow this 'something else', and the model, as usually proposed, does not provide clues as to where it may be. For Georgiou (2002), the computer model postulates a linear and oversimplified progression of data for information and knowledge, and if health informatics may involve the dissemination of information, this should be seen as just a step, not the equivalent of the complex process of generating knowledge.

As already commented, it is necessary to question whether the movement is unidirectional, starting from data, seen as the layer supporting the model. Tuomi (1999) suggests that the direction of movement between concepts in the model depends on user activity. Knowledge researchers put data in context to create information; knowledge workers start with knowledge to create information, required to create data; knowledge and information must exist as prerequisites for creating specific contexts, structures and semantics that facilitate data creation. For this author, Data are more important than Knowledge, proposing an inversion of the hierarchy, in line with Rowley (2006) and opposite to Frickè's considerations (2009). Valuing knowledge as something to be mobilized or created is a means of shaping "how we know what we know" and understanding what types of knowledge are possible. In addition, the diversity of definitions and conceptualizations of the hierarchy suggests that values play an important role. There is undoubtedly an inextricable connection between epistemology - the nature of knowledge - and axiology - the ways in which values are attributed -, in the formation of perceptions for creation and use of knowledge.

Not all knowledge is born from data

As Frické (2009) states, all knowledge is propositional in form and, given an adequate expressive language, can be written and recorded, and can be stored in databases, which may even be called Knowledge Bases. The know-

how is different. If certain expressions of know-how can be articulated as procedural rules, usually in the "if-then" format, other expressions do not. It does not seem reasonable for anyone to learn how to ride a bicycle following instructions written in a textbook or operations manual. Tacit knowledge can be explained, but it cannot be infered from this statement that what has been recorded is knowledge, as can be seen in the excerpt below, which documented perceived benefits of the adoption of Knowledge Management practices at Itaipu Binacional, a brazilian-paraguayan company which operates the world's largest power plant:

> Greater transfer of tacit and explicit knowledge among employees, through electronic knowledge bases (e.g., repositories of best practices and lessons learned, knowledge map of employees), communities of practice, and discussion groups associated with the generation of knowledge in a production environment, without relying on the formal teaching process. Activities related to dam safety, for example, involve eminently technical knowledge and "learning takes place much more in the work field than in training" (Moreno & Lima, 2013, p. 12)

If the data-information-knowledge sequence is worth, then tacit knowledge should be translated into data, starting the cycle. The excerpt makes aware that this may not be an appropriate method.

## V. THE UTILITY OF THE PYRAMID

Should the Information Pyramid be set aside? Maybe that is a hasty conclusion. As a representation of the varied relationships between the elements it presents, the pyramid leaves much to be desired. Man and society, for example, are lacking, despite the attempts of authors such as Barreto (1994, 2002) or Choo (2006). As a schematic representation of the treatment of information, the original subject of Ackoff (1989), it disconsiders the knowledge that "enters" - as an algorithm - in the process of transforming data into information.

However, it can be an instrument of reflection. If developing the capacity for reflection is one of the main objectives of the teaching-learning process, it can have a role to play in the professional training of managers and information scientists. In the early years of undergraduate courses, with students still unprepared for further discussions, this simplicity is timely.

There are numerous variations of this pyramid. A comparative study of variants can help to understand different perspectives of both the elements/concepts and the underlying processes/transformations and even the application context. As Rowley's (2007) work attests, if there are genuine and possibly substantial differences in representations and concepts, there is an important core and similarities.

Be the case with Data. Although usually the pyramids presented in articles or books start with 'Data', there are divergences. Choo (2006), in a semiotic approach, places "Signs" as the basis of his representation. It is from these signs that derive the Data, through the pathways of perception and selection (as mental processes), these influenced by previous learning and the beliefs of individuals, and physical structuring (material environment and/or technical requirements)

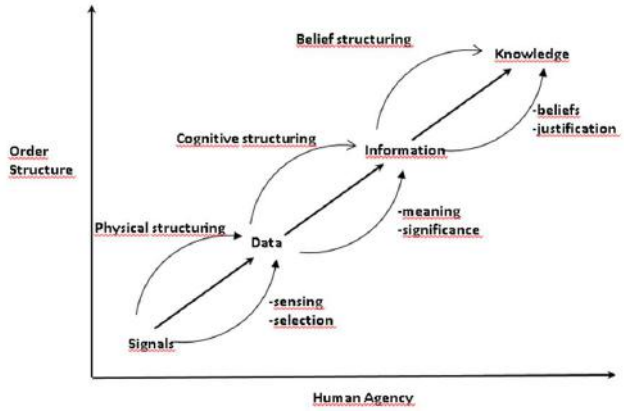


*Fig.1: The hierarchy of knowledge according to Choo (2006)*

Source: adapted from Choo (2006, p.132)

If both Choo (2006) and Barreto (2002, 1994) speak of the human, the human dimension is different in each case, which is more evident when observing the top of the hierarchy. If Choo stop in Knowledge, Barreto (2002) goes to Wisdom. Choo (2006) builds a model appropriate to management. Management implies command and control, according to Fayol (1989, p. 26). It also implies a collective process – which does not mean that it is a democratic, fair or egalitarian process. Barreto (2002) focuses his model on Man - not for any other reason he anchors his proposal in Hanna Arendt's The human condition (Barreto, 1994). Even though this man or woman lives in community, Barreto speaks to the individual. Juxtaposition and comparison of these different representations allows relevant discussions about information and knowledge as an individual and/or social process, about technology and society, but also about facts, values and ethics, usually understood as dissociated, in a positivist position not always explicit that authors such as Putnam (2008) and Sen (1999) criticize.

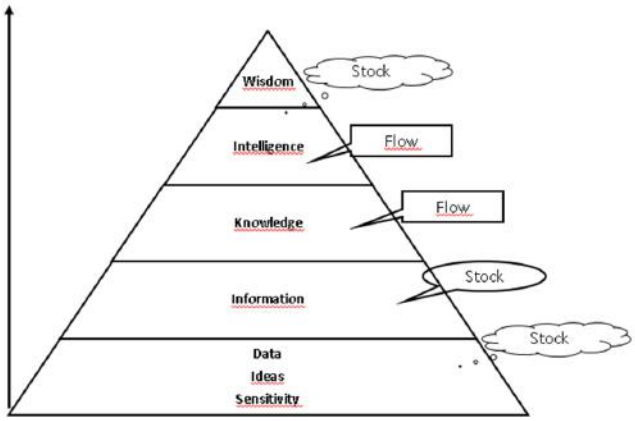


*Fig.2: The pyramid of flows and stock of Barreto*

Barreto (1994) – whose reading of the pyramid is not exempt from some of the criticisms that arise here – considers that the definitions relating information to the production of knowledge associate this phenomenon with the development of the freedom of the individual, his group and society. Information is a modifying instrument of individual and collective consciousness. We return to the platonic ideal, to *Summum Bonum*, to Wisdom and to issues such as values, ethics and ideals, which are foundations of action. Cornelius (2014) links ethical decisions to informational processes by questioning: how can we determine how we should act. He considers that this is usually posed as a question of ethics, of determining what constitutes good behavior, but it also requires answering associated questions, which are information questions.

> The question 'should I steal to give to the poor?' It's an ethical issue. The question 'how should I steal?' may be an ethical question, but it is also a question of information, and the answer would include much of what we commonly call 'information' about the means, which can be quite general, and also about very particular things that relate to the opportunities I may have to steal (Cornelius, 2014, p. 181).

These considerations arise also in Zeleny (2006). According to him, it is not only important to consider an integrated and mutually enhanced system of the autopoietic self-production cycle of information and knowledge, but that one considers the connection action, knowledge and information, echoing a pragmatic proposal, for those who know and act are inseparable (Outhwate &ore, 1996, p. 598). It also considers that a process can include its entries, but no single entry can include its process; and that the goal is to produce more knowledge, not more information; it concludes that knowledge management should include information management, but that information management cannot include knowledge management. Zeleny's (2006) goal is to establish a pragmatic, practical and useful definition of wisdom, wishing that "wisdom becomes – such as knowledge and information – a manageable resource for corporate efficiency, effectiveness, explainability and ethics". These discussions, and several others, can be instigated by a critical discussion of the Pyramid of Information. Thus used, critically and carefully, the pyramid serves the purpose of learning, perhaps addressing Ackoff's (1989) wishes.

## VI. CONCLUSION

Data, Information and Knowledge are incorporated into the discourses of the most diverse actors. They are now part of the most varied scientific models, assuming a central role in governance and management models, inducing behaviors in organizations of various types. They often appear in the media, often in superlative statements. They are key to flourishing market for products and services and are the subject of discussions about public policies. It is important to not only discuss these concepts, but also try to understand how they are incorporated into the daily practices of people and organizations. Unlike genes, atomic particles or mathematical conjectures, data, information and knowledge are intertwined in acting and are elements of the simplest or the most complex activities and decisions in the everyday life of individuals and organizations.

The hierarchical representations of the relationships between data, information, knowledge and others elements, when present, are unable to adequately represent, even in a simplified way, the complex processes it intends to subsume. However, this representation can still be an instrument of learning, since used critically, supporting discussions about the complexity and circularity of the phenomena that this representation tries to expresses.

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