

Hipátia: a model for the digital preservation of records and information?

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ABSTRACT

This study investigates whether Hipátia can be characterised as a digital preservation model for records and information. Developed by the Brazilian Institute of Information in Science and Technology (Ibict), Hipátia functions as an infrastructure for integration and automation among information systems, aimed at implementing Trusted Digital Archival Repositories (TDARs). Motivated by the lack of conceptual consensus surrounding the term “model” in scientific literature, the article offers a theoretical and epistemological examination of Hipátia’s relevance to Information Science and Archival Science. It employs a qualitative, exploratory, and descriptive approach grounded in a literature review. Works from Philosophy and Information Science addressing the notion of model were analysed, alongside technical and scientific studies on Hipátia, especially its configuration as a TDAR and its alignment with the Open Archival Information System (OAIS) model. Findings suggest that, although Hipátia does not fully conform to traditional definitions, it can be framed as a Kuhnian exemplar, an analogical model (Hesse), an operational representation (Abrantes), an applied method (Dutra), and a logical structure (Silva). Its databus (BarraPres) and capacity for integrating diverse systems highlight its flexibility, interoperability, and diagnostic potential. The study concludes that Hipátia operates not only as a technical tool but as a multifaceted model.

KEYWORDS

Hipátia; Paradigm; Model; Digital Preservation.

1. Introduction

In scientific literature, there is no consensus on the polysemic notion of “model” (Dutra 2021), even though it is used by all scientific disciplines. Philosophy dictionaries contain a variety of definitions, and one definition related to the idea of paradigm stands out (Japiassú and Marcondes 1996, 184), in which this notion is presented as follows: “Paradigm, ideal form. An object that serves as a parameter for the construction or creation of others”.

These dictionaries also define metaphor as a figure of speech in which a symbolic comparison is made between elements using a word with a transposed meaning. According to Japiassú and Marcondes, a metaphor is a “word used with an altered meaning”, for instance, expressions like “reinventing the wheel” or “push the right buttons” (Japiassú and Marcondes 2001, 128). Although it is not always explored explicitly, the metaphor shares certain cognitive mechanisms of representation with the model and will be analysed in this article based on the distinction proposed by Silva (2010), who contrasts it with the model in terms of its stylistic and interpretative function.

The relationship between the definition of model and the notion of “paradigm” proposed by Thomas Kuhn¹ – a North American physicist who became a philosopher and historian of science (Schulz 2023) – is inevitable in his work *The Structure of Scientific Revolutions*, published in 1962. The study of contemporary science based on scientific ideas and their truths considers “[...] a succession of tradition-bound periods punctuated by non-cumulative breaks” (Kuhn 1970, 208), in other words, the paradigms. From this perspective, Kuhn starts from the history of science, moves on to generalisations about the psychosocial conditions of its development, and arrives at a new proposal for epistemology (Oliva 1994), whose main definitions – scientific community, paradigms, normal science and scientific revolutions – refer to the parameters of development of the Natural Sciences (Physics, Biology, Astronomy, etc.), that is, to what he calls “Normal Science” (Oliva 1994, 81).

Despite being heavily criticised, his work became a reference not only for the Natural Sciences, but also for the Social Sciences (Oliveira 1997), such as Information Science and Archival Science, in which several works take Kuhn’s notions as theoretical references, such as Eugênio, França, and Perez (1996), Nehmy et al. (1996), Sayão (2001), Renault (2007) and Marques (2011).

In a similar exercise of searching for definitions of “paradigm” in reference works, this time in a dictionary limited to the field of Information Science, the notion is understood as a representation for large-scale reproduction or execution (Cunha and Cavalcanti 2008). The definitions listed by Cunha and Cavalcanti address the paradigm in the context of linguistics, positioning it as an element that has at least one common attribute or as a “set of units that are likely to appear in the same context, and are therefore interchangeable and mutually exclusive” (Cunha and Cavalcanti 2008, 271). The authors also fail to mention what is perhaps the most popular meaning of the term “paradigm”, namely the understanding theorised by Thomas Kuhn (Cunha and Cavalcanti 2008). Kuhn’s work is directly and indirectly taken up by other scholars of philosophy, including his con-

¹ Thomas Kuhn was born in Cincinnati in 1922. He read Physics at Harvard and developed an interest in the History of Philosophy through courses in History and Philosophy taken during his undergraduate and postgraduate studies, respectively. In an interview given to Baltas, Gavroglu and Kindi (Athens, 19–21 October 1995), Kuhn remarked: “I wanted to teach myself enough history of science to establish myself there in order to do the philosophy” (Baltas, Gavroglu, and Kindi 2000, 276).

temporary Mary Hesse² (1924–2016), who understands a model as an “imperfect copy” (Hesse 1966), that is, a representation of a reality or phenomenon that seeks to explain or predict its functioning. In the Brazilian context, Abrantes (2020) stands out with his study, which, from a philosophical-epistemological perspective, understands a model as a set of physical entities or linguistic propositions. In turn, his fellow countryman, Dutra (2021) presents different views of models in different areas of knowledge: abstract constructions that serve as cognitive tools to represent and understand phenomena in both the natural sciences and the social sciences.

For a philosophical approach to Information Science, we find in Silva’s work (2010) a more procedural approach in which the model, a map representing the characteristics of its territory, serves for modelling, linking to behaviours that refer to the user’s informational behaviour in the search for information. Silva revisits several studies in philosophy to delimit the definition of “model”, unfolded into “modelling”, and considers the “ongoing paradigmatic transition” (Silva 2010, 322) within the scope of Information Science.

Given the above, this article aims to map definitions of the notion of “model” to support the characterisation of Hipátia, proposed by the Brazilian Institute of Information in Science and Technology (Ibict), as a model for the digital preservation of records and information. To achieve the goal, we chose a qualitative, exploratory, and descriptive approach. It is developed through bibliographic research, which maps authors of Philosophy and Information Science around theoretical references on the aforementioned notion, in addition to studies of Information Technology (IT) and Archival Science on the definitions and characteristics of Hipátia.

The text is divided into four parts: this introduction; section 2, which examines the theoretical references of philosophy and Information Science on the notion of model; section 3, which presents limitations and possibilities of Hipátia as a model; and the final remarks.

2. Literature review: theoretical references surrounding the notion of “model”

As mentioned in the introduction, there is no consensus on the notion of “model” in scientific literature, although it is widely and frequently used across all disciplines. Recognising the limitations of a scientific article, we chose to read Kuhn’s work (1970), considered a fundamental theoretical reference for understanding models based on paradigms.

² “Mary Brenda Hesse, born 15 October 1924, studied first at Imperial College then at University College London, receiving her doctorate for a thesis on electron microscopy in 1948. She lectured on mathematics at Royal Holloway College from 1947 to 1951 and at the University of Leeds from 1951 to 1955, then from 1955 to 1959 on history and philosophy of science at University College. In 1960 she was appointed to a lectureship in history and philosophy of science at Cambridge, from 1968 to a readership and from 1975 to a professorship. [...] Mary’s important philosophical works were marked from the outset (in her pioneering *Forces and Fields*, 1961) by close engagement with the history of the practices and theories of the sciences. Areas in which her studies had major impact include the roles of metaphor and analogy in scientific investigation (*Models and Analogies in Science*, 1963) and the relations and interactions of observation, experiment and theory in the sciences (*The Structure of Scientific Inference*, 1974)”. <https://www.bps.cam.ac.uk/news-events/news-archive/mary-hesse>.

³ The direct citations of the following texts were translated from the original portuguese into english: Abrantes (2020), Braga (2022a; 2022b), Braga, Holanda, and Canelhas (2022), Dutra (2021), Japiassú and Marcondes (2001), Oliveira (1997), Oliveira (2022), Oliveira, Shintaku, and Silva (2022), Renault (2007), Saad and Brito (2024), Sayão (2001), Shintaku, Braga, and Oliveira (2021), Shintaku and Oliveira (2022), Shintaku et al. (2023), Silva, Cardoso, and Brito (2005), and Silva (2010).

2.1. Thomas Kuhn: paradigms, models, and exemplars

Inspired by the presentation of Physics as a science for non-scientists and concerned with the philosophical problems of “historically oriented science”, Kuhn (1970, 15) formulates some fundamental concepts for understanding what he considers to be the “[...] history of scientific ideas”, in a predominantly internalist approach, but one that does not ignore the relevance of factors extrinsic to science. With the aim of “knowing what is true”, that is, “to know what it is to be true” (Baltas, Kostas, and Kindi 2000, 278), the scholar is concerned with the use of meanings associated with changing values and argues that “it’s not only the ideas that change, it’s the structure of the disciplines that are working on them” (290).

Far from traditional epistemological tradition,⁴ Kuhn seeks to understand the construction of scientificity in its historical aspect, in an approach he himself considers conservative, although he does not intend to label what is “science” or “pseudoscience” (Baltas, Kostas, and Kindi 2000).

Although this work falls within the scope of Applied Social Sciences,⁵ it is considered appropriate, as in many studies in this field, to revisit and use as a reference the concepts proposed by Kuhn regarding scientific development and the notion of “paradigm”, which, by imposing practices of observation and theorisation that formulate a tacit worldview, gives rise to the tradition of investigation (normal science), which represents a type of research that differentiates science from non-science (Oliva 1994).

In his classic work, Kuhn (2000) later clarifies some aspects of his initial formulation. According to the author:

- a) the notion of normal science was linked to solving puzzles, by perfecting and extending the correspondence between theory and practice in the development of the field (Baltas, Gravoglu, and Kindi 2000; Kuhn 2000), that is, “[...] is what produces the bricks that scientific research is forever adding to the growing stockpile of scientific knowledge” (Kuhn 2000, 13);
- b) on the other hand, scientific revolutions “[...] involve discoveries that cannot be accommodated within the concepts in use before they were made. In order to make or to assimilate such a discovery one must alter the way one thinks about and describes some range of natural phenomena” (Kuhn 2000, 14-5);
- c) finally, the traditional idea of paradigms was that of models, “[...] particularly grammatical models of the right way to do things” (Baltas, Gravoglu, and Kindi 2000, 298), as well as the notion of exemplars within the structure and that of “[...] hermeneutic basis for the science of a particular period” (Kuhn 2000, 221).

The author turns to the functioning of the scientific community, highlighting the techniques of persuasive argumentation that permeate it. For him, the constitution of a field is linked to the definition of what will be considered an authentic problem or an adequate solution within it (Oliva

⁴ Oliva (1994) recalls that Kuhn was influenced by French epistemology, unlike most Anglo-American philosophers, who focused on the study of logical-empirical reasons, forgetting the factors extrinsic to “scientific reason” that are indispensable for understanding the functioning of scientific communities.

⁵ Considering Information Science and Archival Science in the classification of areas of knowledge of the National Council for Scientific and Technological Development (CNPq), currently in force. Available at: <https://lattes.cnpq.br/documents/11871/24930/TabeladeAreasdoConhecimento.pdf>.

1994). Kuhn conceives of a culture in which the concept of the object to be exemplified/studied is available, that is, transmitted from one generation to another, especially through manuals (Kuhn 2000). He seeks to describe, in the field of Natural Sciences, “[...] the way a tradition worked in terms of consensus” (Baltas, Gravoglu, and Kindi 2000, 299), based on the principle that “[...] the natural sciences of any period are grounded in a set of concepts that the current generation of practitioners inherit from their immediate predecessors” (Kuhn 2000, 221).

Thus, in the afterword to *The Structure of Scientific Revolutions*, published in 1962, Kuhn (1970) redefines the notion of paradigm, emphasising the concept of exemplars as sets of problems and standard solutions that embody the consensus within the scientific community. Exemplars are used to guide the practice of scientists during a period of normal science, thus becoming fundamental in the training of scientists, since they are transmitted through manuals and problem-solving. The expectation is that, through modelling based on these standards, scientists will be able to solve new problems throughout their scientific practice.

Also in the afterword, the scholar replaces the term “theory” with “disciplinary matrix”: “[...] ‘disciplinary’ because it refers to the common possession of the practitioners of a particular discipline; ‘matrix’ because it is composed of ordered elements of various sorts, each requiring further specification” (Kuhn 1970, 182).

Considering Kuhn’s relevant reflections and contributions on scientific development, we revisit some of his main ideas, while recognising their limitations when recontextualised in the social sciences, as Nehmy et al. (1996), Eugênio, França, and Perez (1996), Sayão (2001) and Renault (2007) in the study of Information Science. Although Kuhn defends the existence of only one paradigm in a given period, it is possible to question the coexistence of paradigms and scientific revolutions in the constitution of the scientific community, as discussed by Oliveira (1997) in the field of Anthropology. Given his paradigms and schools, this author interprets Kuhn and presents his definition of “disciplinary matrix”, adapting it to the humanities: “[...] a disciplinary matrix is the systematic articulation of a set of paradigms, the condition of their coexistence in time, with each and every one remaining active and relatively efficient” (Oliveira 1997, 15), a notion that can be appropriated in Information Science.

2.2. Mary Hesse: Analogies and Models in Science and Theology

Hesse defines “model” as a fundamental concept in science, used to represent and explain phenomena through analogies and metaphors. In her approach, models are not merely auxiliary tools, but essential components in the structure of scientific theories. The author argues that scientific models work through analogies between known and unknown systems, allowing inferences about the behaviour of complex systems based on their structural similarities with other systems.

Her definition of model, in the book *Models and Analogies in Science* (1966), appears in a more systematic way at the beginning of the chapter “The Function of Models: A Dialogue”, in a dialogue between two fictional characters: “Campbellian” and “Duhemist”, when the former proposes a distinction between types of analogy (positive, negative, and neutral).

Let us agree that, when we speak of a model in its primary sense (in this discussion let us call it model₁), we are not speaking of another object which can, as it were, be built or imagined alongside

the phenomena we are investigating. The model₁ is the imperfect copy (the billiard balls) minus the known negative analogy, so that we are only considering the known positive analogy, and the (probably open) class of properties about which it is not yet known whether they are positive or negative analogies (Hesse 1966, 9).

By this definition, the model is understood to be a system of structured analogies, involving:

- positive analogies (known valid similarities between the model and the real system);
- negative analogies (known differences);
- neutral analogies (aspects that are not yet known to be similar or not, and in which the heuristic potential of the model lies).

In Hesse's view (1966), it is a representation of a reality or phenomenon that seeks to explain or predict its functioning. Models can be physical, mathematical, or logical, and are used to understand the essential structures of a system, serving as instruments that allow analogies between different areas of knowledge. The author's main ideas about models include:

- Representation and explanation: models are used to represent structures and processes, allowing for a better understanding of the phenomena studied.
- Analogical nature: the correspondence between a model and reality is often partial and based on structural similarities.
- Flexibility and evolution: models are not static; they advance as new information, and experiments modify our understanding of phenomena.
- Limitations and applicability: no model is completely accurate, but it provides useful approximations that must be evaluated in terms of their effectiveness in predicting and explaining data.

2.3. Paulo Abrantes: method and Science

Abrantes⁶ (2020) addresses the ambiguity and conceptual diversity surrounding the notion of a model, both from a philosophical and epistemological perspective, considering logical empiricism. For him, models can be understood as sets of physical entities or as sets of linguistic propositions. In addition, they are often used as representations of real systems and can be symbolic (mathematical equations), iconic (drawings, maps), or material.

Kuhn's ideas about normal science are related to the models mentioned by Abrantes (2020), who considers paradigms as shared models and as exemplars in normal science, which establish guidelines that, in times of crisis, can be questioned and replaced.

In Abrantes' view (2020), scientific models are defined as fundamental tools for applying theories, as well as for explaining, predicting, and controlling phenomena. Thus, they play a crucial role in testing theories and simulating phenomena, allowing for a deeper understanding of the behaviour of

⁶ "Paulo C. C. Abrantes holds a degree in Physics from the University of Brasília (1973), a master's degree in Philosophy from the University of Paris X (1978) and a doctorate in Philosophy from the University of Paris I (1985). He is a retired full professor at the University of Brasília, having worked in the Department of Philosophy and the Institute of Biological Sciences. His research focuses mainly on the areas of Philosophy of Science, Philosophy of Biology, History of Science, and Philosophy of Mind". <https://www.posfil.unb.br/index.php/2-publicacoes/111-prof-dr-paulo-cesar-coelho-abrantes>.

complex systems. Furthermore, models can be differentiated from theories because they are idealised representations of particular physical systems, while theories are more comprehensive and general. In short, his work emphasises that models are fundamental constructs in science, but they have limitations that influence their applicability and interpretation, whether in their choice conditioned by the mathematical tools available, which can lead to forced simplifications, or by mental habits that can influence the design of models, favouring those that have analogies with familiar systems. Considering the ambiguity of the term “model”, Abrantes states: “The term ‘model’ is ambiguous, being used by both scientists and philosophers with a plurality of meanings. An important methodological task is to categorise such models, show the contexts in which they are used, and for what purposes” (Abrantes 2020, 215). He then categorises them into four types, as shown in Table 1.

Table 1. Model types based on Abrantes (2020)

Model types	Definition
Semantic (type 1)	“A model, in this sense of the term, is an interpretation of a calculus, that is, a structure of objects, properties, and relations that satisfy the sentences of a calculus, making them true propositions about a particular world” (p. 216).
Analogical (type 2)	“Familiar, widely accepted and corroborated theories are often the source of analogical models for generating other theories applicable to new domains of phenomena. In this second sense, modelling is a relationship between two representations, for example, two theories” (p. 216)
As representations of real systems (type 3)	“To be a representation of a system, the model must bear some similarity to the system. [...] A model does not represent all the entities that make up a system, with all their properties and interrelationships. If that were the case, the model would be a duplication of the system and would not fulfil its function. The model in this sense is, therefore, an idealised representation insofar as it abstracts characteristics of the system that are considered irrelevant” (p. 217-218).
Abstract (type 4)	“Abstract structures can be purely syntactic (formal, uninterpreted symbolic structures) or interpreted, such as mathematical structures” (p. 219).
Concrete models of real systems (type 5)	“Concrete models and the real system being modelled can be seen as different materialisations, or realisations, of a mathematical structure (and here we return to type 4 models). This type of model is often used to simulate the behaviour of a system. [...] Integrating subtypes 4 and 5 into the more general characterisation I made of the third type of model, modelling is here a relationship between a representation (symbolic, iconic or material) and a real system” (p. 220-221).

2.3. Luiz Henrique Dutra: models in Natural and Social Sciences

Dutra⁷ (2021) discusses the importance of scientific models and their relationship with reality. He presents them as abstract constructions that serve as cognitive tools for representing and under-

⁷ Luiz Henrique de Araujo Dutra holds a bachelor’s degree in Philosophy from the University of São Paulo (USP) and a master’s and doctorate in Logic and Philosophy of Science from the State University of Campinas (UNICAMP). He is a professor at the Federal University of Santa Catarina (UFSC) and teaches in the postgraduate programmes in Philosophy at UFSC and UnB. <http://lattes.cnpq.br/7589426150000881>.

standing phenomena in both the Natural Sciences and the Social Sciences. He employs the notion of the “nomological machine”, a concept developed by Nancy Cartwright (1999, quoted in Dutra 2021, 130), to describe scientific models as structures that exhibit mechanical laws or recurring patterns in the world. In this sense, nomological models are not exclusive to the Natural Sciences and are present in the Humanities and everyday knowledge.

Therefore, among other differences always pointed out between the natural sciences and the cultural sciences is irrelevant, namely, the lack of theories in the cultural sciences. For if there is a theory, the latter is just one more source of models. However, if there is no theory, the models will emerge anyway. And it is with them that we will always work. This modelling activity is the basic and unified methodology of all scientific disciplines, in any field, as well as the methodology of everyday life. Models do in the domain of method what emergence does in the domain of ontology (Dutra 2021, 133).

The scholar emphasises that modelling is an essential activity for human cognition, going beyond the sciences and permeating the way we interact with the world.

2.4. Armando Malheiro da Silva and other Information Science studies on models and modelling

The notion of model is approached from different perspectives in the search for models and modelling for Information Science, undertaken by Silva.⁸ The scholar revisits the origins of the word “model” to define it:

The etymological root of the word is *modus*, which means measure, and, interestingly, this meaning remains alive in the scientific field: a model is a physical, mathematical or logical system that represents the essential structures of a reality and is capable, at its level, of dynamically explaining or reproducing the functioning of these same structures (Silva 2010, 299).

Then, the author explains the difference between model and metaphor:

In any of the categories, it is worth noting that the model is a stylisation, but it should be pointed out that a stylised version of reality is not a metaphor for reality, quite the contrary. [...] Models and metaphors are operations with a common root in thought, but they function in opposite ways – the former empty images to bring them closer to univocity, while the latter fill images with a multiplicity of connections to increase their ambiguity (309)

On this point, Mary Hesse’s (1966) conception of metaphor offers an important counterpoint. For Hesse, metaphor should not be understood merely as a linguistic ornament, but as a fundamental cognitive resource in scientific development. She argues that metaphors operate through the interaction between two domains—the primary domain, which is sought to be explained, and

⁸ He holds a degree in Philosophy from the Faculty of Philosophy and Social Sciences of the Portuguese Catholic University, Braga; in History from the Faculty of Arts of the University of Porto; and in Library and Archival Studies from the Faculty of Arts of the University of Coimbra. He holds a PhD in Contemporary History from the University of Minho. He is currently a professor in the Information Science Degree Programme at the University of Porto.

the secondary domain, the source of the metaphor—allowing the creation of new relationships of meaning that transform the understanding of both domains. Rather than solely generating ambiguity, as Silva (2010) suggests, Hesse highlights the heuristic and explanatory function of metaphor, especially when introducing new theoretical vocabularies.

Although Silva (2010) sees metaphor as a producer of ambiguity, Hesse (1966) demonstrates that its epistemic function can be precisely the opposite: to contribute to the formulation of theoretical models by allowing the conceptual redescription of phenomena. By acting as a preliminary stage of modelling, metaphor plays an essential role in the construction of knowledge, not as an obstacle, but as a path to interpretative innovation. As Hesse states: “the deductive model of explanation should be modified and supplemented by a view of theoretical explanation as metaphoric redescription of the domain of the explanandum” (Hesse 1966, 157).

This reinterpretation reinforces the idea that metaphors and models are not mutually exclusive categories. On the contrary, they operate at complementary levels of scientific production: while the model seeks to logically represent reality, the metaphor contributes to the emergence of new modes of representation. In this sense, metaphor can be understood as a resource that enables theoretical modelling itself, especially in interdisciplinary fields such as Information Science.

According to Silva (2010), a model can be understood as a representation of reality, whether in physical, mathematical or logical form, with a view to explaining or reproducing the essential structures of that reality, either totally (covering a phenomenon in its entirety) or partially (focusing on a specific aspect).

The same author states that, in the Social Sciences, models are used to simplify complex systems and make them amenable to quantitative analysis, as in the study of information behaviour and infometrics. In Information Science, on the other hand, information management models, for example, are often more logical or conceptual than mathematical, being used to solve problems and optimise results in information retrieval.

Within the scope of this discipline and his proposal to distinguish between models and modelling, Silva draws on Paul Otlet’s *Traité de Documentation* (1934) to indicate models and modelling from a cumulative or fragmentary perspective, which, according to him, “[...] consists of not being clear or visible in terms of their theoretical basis” (Silva 2010, 323). In this quest, he draws on the work of González Teruel (2005) to understand models of information behaviour within the scope of information seeking (needs and uses), in which, according to him, “These are examples of modelling, based on the empirical principle that theorisation does not precede the model, but rather it is the model that, by establishing patterns and enabling generalisations, becomes decisive in the development of theory” (Silva 2010, 325).

When presenting the eLit.pt Model and research on information literacy, he refers to the theoretical and methodological tools of Information Science, taking into account information production, organisation and representation, and information behaviour within the scope of information management, “[...] which focuses on problems and solutions, from production to use, covering all stages of the information-communication cycle” (341).

These operational concepts play a decisive role in the development of an Information Science model, in the face of problems, cases, and situations related to information behaviour. According to the author, eLit.pt falls into the category of models that focus on people’s behaviour in relation to the information they seek and communicate for use in specific situations, contexts, and environ-

ments. In this sense, it is a model that represents and diagnoses, as well as guides more practical interventions.

Still within the scope of Information Science, Renault⁹ (2007) recognises the robustness of the paradigm concept proposed by Thomas Kuhn. However, given the particularities of Information Science, he opts for a hybrid approach that starts from epistemology and moves between the humanities and social sciences, based on Ivan Domingues.¹⁰ In this sense, the author points out that the notion of paradigm was inaugurated by Plato, which influences the understanding we have today. Nevertheless, Renault (2007) considers that both the etymology of the term “paradigm”, which “[...] comes from the Greek *paradigma* and means model [...]”, and the Platonic heritage, interpreted imprecisely, which suggests the concept as something “exemplary” or “model”, corroborate the erroneous attribution of a synonymic relationship between “paradigm” and “model” (53).

In summary, Renault (2007) presents the “paradigm” as a lens, that is, a worldview or way of seeing a phenomenon, directly associated with the notion of “theory” and capable of encompassing numerous models. The “model”, in turn, would be a representation of reality or of a system and could be explained by different theories, having a concrete, applied, and operational nature, and therefore being at the methodological level. From this perspective, the model is seen as an integrated part of a paradigm (or theoretical system), simply operating without necessarily promoting structural ruptures, as occurs with paradigms in the sense recognised by Kuhn (1970).

The approach presented by Renault (2007) is close to the concepts of Abrantes (2020) and Dutra (2021) in relating the “model” to the notion of method. Abrantes (2020), in particular, by viewing models as a tool for applying theories, can be drawn closer to Renault’s (2007) epistemological approach.

Sayão¹¹ (2001) discusses models as methodological tools and instruments of abstraction, essential for understanding and representing reality. For the author, a model fulfils descriptive, explanatory, and, in some cases, predictive functions by presenting a heuristic dimension, revealing previously unnoticed aspects of the observed reality. As a representation, a model always implies a reduction

⁹ Graduated in Library Science, Master’s, and Doctorate in Information Science from the Federal University of Minas Gerais (UFMG). “Has experience in the field of Information Science, with an emphasis on Information Theory. He works in the University Libraries segment, participating in activities involving projects, management, and information technology. He is interested in topics related to the Epistemology of Information Science, relationships between Archives, Museums, and Libraries, Reading Mediation, Memory, Culture and Information, and Information and Communication Technologies” (Renault 2023).

¹⁰ See: (Domingues 2004)

¹¹ He holds a degree in Physics and a master’s and doctorate in Information Science from the Federal University of Rio de Janeiro (UFRJ). “He has worked at the National Nuclear Energy Commission (CNEN) since 1980. [...] He was an advisor to CONARQ - National Archives Council and the Technical-Scientific Committee of IBICT. He is currently the leader of research groups in Nuclear Knowledge Management; coordinator of the technological development project Infrastructure to Support the Management and Preservation of Nuclear Knowledge; alternate representative of Brazil at INIS (IAEA/UN); member of CONARQ’s Technical Chamber of Electronic Documents; representative of CNEN at OGP/commitment 4 (Open Government Partnership); permanent professor in the Postgraduate Programme in Information Science at IBICT/UFRJ and collaborating professor in the Postgraduate Programme in Library Science at UNIRIO - Federal University of the State of Rio de Janeiro and the Postgraduate Programme in Memory and Collections at the Casa de Rui Barbosa Foundation; representative of the nuclear area at GO FAIR BRASIL; member of the Steering Committee of FAIR Digital Object” (Sayão 2025).

in complexity, prioritising relevant elements according to the modelling objective.

Modelling, in this sense, consists of the process of constructing these models and entails specific methodological and conceptual choices. According to Sayão (2001), information modelling in Information Science consists of identifying the components of models, their modes of expression, and underlying paradigms, functioning as a useful mechanism for capturing and communicating knowledge about the search, organisation, and use of information.

Furthermore, according to Burt and Kinnucan (1990, quoted in Sayão 2001), a continuous configuration for information models is presented, composed of two extremes: on one side, human beings with their internal, subjective, and idiosyncratic reality; on the other, the information system, with its technical and operational structure. Between these extremes lies the field of representations, an intermediate space in which models seek to build bridges and interpret the relationships between individuals and systems.

In this continuum, models are classified as follows:¹²

Models that closely represent human users and their mental processes in relation to the system are called cognitive models, whereas models that focus on the system itself and attempt to describe its inner workings are better known as data models. In the middle of the continuum are geometrical models that interpret users, the system, and the interaction between them; models that fall into this category are collectively referred to as conceptual models (Sayão 2001, 87).

It should be noticed that most of the definitions of “model” and “paradigm” raised within the scope of Information Science refer, directly or indirectly, to the concept proposed by Thomas Kuhn. The adoption of this perspective serves, for the most part, as an epistemological basis for the three theoretical and methodological perspectives in the field: physical, cognitive, and social, without, however, any evident concern for conceptually unravelling the terms “model” or “paradigm” themselves. This appropriation, often carried out functionally, favours a reading of paradigmatic transformations, while tending to neglect the methodological and representational specificities that distinguish models within each approach. In this context, Capurro (2010) makes a notable contribution by associating these three perspectives with a critique of technical-instrumental paradigms, emphasising the need for a hermeneutic and critical shift in Information Science that considers the cultural, ethical, and ontological mediation of information. Thus, it is understood that the use of the notion of paradigm in Information Science functions as theoretical support to justify changes in scientific orientation but rarely unfolds into more in-depth reflections on the theoretical-methodological status of the models used.

Table 2 presents the definitions of the authors studied on the notion of “model” and related terms.

¹² Reference of the original source cited: (Burt and Kinnucan 1990).

Table 2. Summary of the concept of “model”

Author	Disciplinary approach	Notion of “model”
Japiassú and Marcondes (1996)	Philosophy	“Paradigm, ideal form. Object that serves as a parameter for the construction or creation of others” (184).
Kuhn (1970; 2000)	Philosophy	The traditional idea of paradigms was that of models, “[...] particularly grammatical models of the right way to do things” (Baltas, Gavroglu, and Kindi 2000, 298), as well as the notion of exemplars within the structure and that of “hermeneutic basis for the science of a particular period” (Kuhn 2000, 221).
Hesse (1966)	Philosophy	“Let us agree that, when we speak of a model in its primary sense (in this discussion let us call it model ₁), we are not speaking of another object which can, as it were, be built or imagined alongside the phenomena we are investigating. The model ₁ is the imperfect copy (the billiard balls) minus the known negative analogy, so that we are only considering the known positive analogy, and the (probably open) class of properties about which it is not yet known whether they are positive or negative analogies” (9).
Abrantes (2020)	Philosophy	Scientific models are defined as fundamental tools for applying theories, explaining, predicting, and controlling phenomena. In addition, models play a crucial role in testing theories and simulating systems. “The term ‘model’ is ambiguous, being used by both scientists and philosophers with a plurality of meanings. An important methodological task is to categorise such models, show the contexts in which they are used, and for what purposes” (215).
Dutra (2021)	Philosophy	“This modelling activity is the basic, unified methodology of all scientific disciplines, in any field, as well as the methodology of everyday life. Models do in the domain of method what emergence does in the domain of ontology” (133).
Silva (2010)	Information Science	“[...] a model is a physical, mathematical or logical system that represents the essential structures of a reality and is capable, at its level, of dynamically explaining or reproducing the functioning of those same structures” (299).
Sayão (2001)	Information Science	He defines models as “simplified and intelligible representations of the world, which allow us to glimpse essential characteristics of a domain or field of study” (84), adding that they perform a “descriptive, explanatory, and, sometimes, observable function”, with a “heuristic dimension” that allows “the perception of other aspects not imagined before their elaboration” (83). He then presents the structure of information models as a continuum, based on the definition by Burt and Kinnucan (1990, cited in Sayão 2001, 87), categorising them as: cognitive models, focused on the user’s mind; conceptual models, linked to the system’s point of view; and semantic models, focused on representing the meaning of data.
Renault (2007)	Information Science	“Regarding models, in a more general sense, we can say that they can be employed in various aspects: epistemological, metaphysical, ethical, and aesthetic. However, we are interested in their epistemological meaning, which we understand as a way of explaining or representing reality. [...] First, we would like to make it clear that the concept of paradigm used here is established alongside theory, and its function is to serve as an umbrella under which various theories can be sheltered. [...]. As for models, although they presuppose theory, we could say that they are closer to method, to ‘how to do’ [...] It follows that the same paradigm can shelter several theories, just as a theory can shelter several models.” (54-5)

3. Discussion and results: possibilities and limitations of Hipátia as a model

Inspired by the philosopher Hypatia of Alexandria,¹³ the so-called Hipátia Model of Digital Preservation originated in 2018 as a result of a partnership between the Brazilian Institute of Information in Science and Technology (Ibict) and the Court of Justice of the Federal District and Territories (TJDFT), with a view to adopting a Trusted Digital Archival Repository (TDAR) to improve the Court's Records management process (Braga, Holanda, and Canelhas 2022; Pignataro et al. 2022; Braga 2022a; Brondani et al. 2024). Shintaku and Oliveira (2022, 69) explain it as follows:

Due to the importance of the philosopher Hypatia in science, Ibict, through its General Coordination of Information Technology (CGTI), named the archival digital preservation model after this scientist from the ancient world. Part of this model is BarraPres, a database capable of extracting, applying informational structures, and packaging data packets. Thus, BarraPres/Hipátia is free, open-source software developed and maintained by Ibict, designed to integrate systems following the Open Archival Information System (OAIS) model for preservation.

According to the literature review,¹⁴ studies addressing Hipátia are primarily focused on the digital preservation of records and information (Shintaku, Braga, and Oliveira 2021; Braga and Márdero Arellano 2022; Pignataro et al. 2023; Saad and Brito 2024). These works highlight, above all, its configuration as an TDAR (Braga et al. 2022; Pignataro, Menezes, and Braga 2022; Oliveira, Shintaku, and Silva 2022; Oliveira, Márdero Arellano, and Braga 2022; Braga 2022a; 2022b) and its operation (Braga 2022a; Shintaku and Oliveira 2022; Shintaku et al. 2023; Brondani et al. 2024).

In these works, the concept of Hipátia as a model for digital preservation of records and information predominates, except for Shintaku, Braga, and Oliveira (2021), who view it as software, a tool, or a system. The authors characterise it as a TDAR that complies with archival theory in relation to the chain of custody, a vision corroborated by other scholars (Pignataro, Menezes, and Braga 2022; Braga 2022a; Shintaku et al. 2023) and the authenticity of the preserved records (Braga, Holanda, and Canelhas 2022; Márdero Arellano 2022; Oliveira, Shintaku, and Silva 2022; Braga 2022a; 2022b; Pignataro et al. 2023; Brondani et al. 2024).

Regarding its operation, Braga (2022b, loc. 12) explains that “Hipátia operates based on a record-mass Producer.¹⁵ To date, no restrictions have been found regarding the scope of the Producer, which serves as an indication that Hipátia can adapt to different scenarios”. Its mediating role between the Open Archival Information System (OAIS) reference model and the different Producers for the preservation of their records and information can be observed in Shintaku, Braga, and Oliveira:

¹³ A personality who lived in Egypt during the Roman period. Her achievements in the fields of Mathematics, Physics, Astronomy, and Engineering have been widely documented and are still available (Shintaku, Braga, and Oliveira 2021).

¹⁴ The survey of bibliographic production on Hipátia considered the works available in the Hipátia Digital Collection (Ibict 2025), as well as works mapped in the Information Science Database (BRAPCI - Base de Dados em Ciência da Informação) on 10 March 2025. <https://brapci.inf.br/home>.

¹⁵ “Producer: The role played by those persons or client systems that provide the information to be preserved. This can include internal or external OAIS persons or systems” (CCSDS 2024, 15).

In this sense, the packaging process processes the metadata and files that are in the directory created by the crosswalk, forming a package in OAIS format. With this, the databus can deposit this package in Archivematica. Thus, **if other software meets the same OAIS model, its integration with the Hipátia archival databus can be carried out in a simple manner** (2021, 9; emphasis added).

Hipátia uses Archivematica as software for implementing TDAR, in accordance with the OAIS model. “Hipátia, developed and maintained by Ibict, is a system that functions as an automatic integrator of archival systems, receiving items from one system and packaging them for deposit in another, following the OAIS model” (Shintaku, Braga, and Oliveira 2021, 10).

The possibilities for improving and adapting Hipátia are outlined by Braga, Holanda, and Canelhas:

Hipátia was created to be an open model, constantly evolving. Its adoption by relevant institutions on the national scene suggests that **its conceptual basis has been accepted as a path for implementing TDAR**. Precisely because it is an open model, the incorporation of new elements becomes more fluid as various actors can contribute to this process. It is important to bear in mind the importance of establishing an evolution strategy for the Hipátia model, endorsing its avant-garde character while enabling a wide range of institutions to assert the pillars of preservation (Braga, Holanda, and Canelhas 2022, 10; emphasis added).

In this sense, its flexibility around interoperability (Shintaku et al. 2023) could, in terms of technological application, configure it as a model, at least in these terms:

Considering the diversity of systems proposed for managing records in digital format, it was established that the proposed model should enable its implementation in diverse information environments, regardless of the software and hardware used by the institution that intends to apply it. **This choice of a model with such comprehensive characteristics, although it requires greater effort in the model design process, also brings significant advantages by defining interoperability between technologies and information environments as a characteristic of the primary model** (Braga 2022a, 53-4; emphasis added).

The author then defends the adaptability of Hipátia as a model incorporated into a digital preservation project:

In addition to this definition of standards and technologies, another key requirement identified during the negotiating analysis of the aspects to be covered by the model concerns the possibility of customising the preservation process. Although there are regulations to be considered, as well as various guides and best practice guidelines, **since the intention is to allow the model to be applied to any information system that manages digital records**, there is also a need to enable the customisation of the preservation process to meet the specific needs of each institution. This customisation is important to ensure that fundamental aspects of the digital preservation project supported by the model are covered and that future access to the preserved content is guaranteed (Braga 2022a, 54; emphasis added).

Still on the specifics of applying Hipátia, we can cite Saad and Brito, who state that:

In this context, the Hipátia Model emerges as a system integration platform focused on digital preservation, **standing out for its flexibility and ability to integrate with various records Producers**. This model allows heterogeneous systems to communicate effectively, collecting and depositing data packages in destination systems, such as Archivematica, ensuring the reliable preservation of digital records (Saad and Brito 2024, 3; emphasis added).

The aforementioned characteristics of Hipátia seem to support its claim as a “model capable of adapting to any system that manages digital processes and objects” (Oliveira 2022, 8), as stated by Shintaku and Oliveira in relation to its databus, in a chapter of the same book: “[...] because it is prepared to follow strict archival standards, it is easy to use in other tools that follow the same standards” (Shintaku and Oliveira 2022, 75). Thus, the uniqueness and innovation of Hipátia seem to be linked to its databus: “The Hipátia databus acts as an integrative interface between systems, receiving, collecting, and depositing the packages in the destination system. This allows heterogeneous systems to establish communication, focused on digital preservation” (Oliveira, Shintaku, and Silva 2022, 88). These same authors explain that

Hipátia was designed to integrate with Archivematica, **but it allows for various Producers**, such as EIS [Electronic Information System] and the Electronic Judicial Process (PJe) used in the Court of Justice of the Federal District of Territories (TJDFT). As a result, it meets all system requirements, which, in turn, comply with international standards. **Thus, it can be utilized by various agencies or institutions, regardless of their archives processing system** (Oliveira, Shintaku, and Silva 2022, 82; emphasis added).

Although most of the studies analysed understand it as a model, the characteristics that justify this have not been clearly presented. Thus, we decided to verify, according to the theoretical references of Philosophy and Information Science contained in the previous section, the possibilities and limitations of characterising Hipátia as a model for the digital preservation of records and information.

The definition of the concept of model, by Japiassú and Marcondes (1996), as a paradigm, can be linked to Kuhn’s (1970) concept of paradigm. In the sense of parameter, according to the former authors, it is believed that Hipátia could not be seen as a model. However, in the sense of exemplars, according to Kuhn (1970), Hipátia could provide guidelines for solving problems related to the digital preservation of records and information.

From Hesse’s perspective (1966), Hipátia could also be characterised as a model, an analogy of OAIS in the phenomenon of digital preservation, which provides for its operation through BaraPres and other modules that support the proposal. Thus, it could function as a scientific model, through analogies between known and unknown systems, interfering with the behaviour of complex systems based on their structural similarities with other systems and digital preservation models. It is important to highlight the flexibility of the model in the face of demands surrounding the understanding of the phenomenon, a characteristic that is evident in the functioning of Hipátia.

Amid the ambiguity recognised by Abrantes (2020) and among the types of models listed by the scholar, Hipátia can be viewed both as an analogue model, given its relationship with the OAIS

reference model and the possibility of its application with different Producers, and as a representation of a real system, which, in this case, concerns its interoperability with Producers.

In the relationship that Dutra (2021) establishes between the model and the method, Hipátia could also take a model approach, in which it has OAIS as a reference model for the digital preservation of records and information, serving as a method in the application of that model for the implementation of an TDAR.

Likewise, taking Renault's study (2007) as a reference, from an epistemological perspective, Hipátia could be understood as a model in terms of applicability, based on a theory represented by the OAIS reference model. In this sense, when operationalising the implementation of TDAR, in accordance with the OAIS recommendations, Hipátia would be "[...] then the reality – actual or supposed – that the theory [OAIS reference model] seeks to explain" (Ferrater Mora 2004, 1989, cited in Renault 2007, 54).¹⁶

Moreover, it is worth revisiting Sayão's (2001) concept, according to which models perform descriptive, explanatory, and heuristic functions, i.e., they not only describe a phenomenon, but also make it intelligible and open to evolution and adaptation. The author states that models can be classified, within a continuous configuration, according to their proximity to the user, the system, or the interaction between the two. Thus, Hipátia can be understood as a model and, complementarily, as a "data model," since it approximates the definition of information systems and their technical and functional structures by operating in the integration between Producers and preservation systems, complying with regulatory standards and promoting interoperability between different technological environments.

According to Silva's study (2010), Hipátia could be a logical model representing the record and information preservation structures of the past, that is, those previously dedicated to the preservation of traditional records and which are now reproduced for the preservation of digital records and information (born-digital and digitised records, in addition to their metadata), taking into account the similarities, differences and singularities of the two structures. In addition to the information management model mentioned by the scholar, there are also management models (within the scope of Producers) and preservation models, in which Hipátia operates. Following the example of the model presented by him – eLit.pt – Hipátia diagnoses preservation demands, represents them, and intervenes, as an applied method of OAIS in interface with Archivematica, via BarraPres.

4. Final considerations

The OAIS model postulates essential requirements for the managerial variables that must be considered by organizations undertaking digital preservation initiatives. It does so by identifying the agents involved and defining their respective roles and responsibilities, as well as by classifying the types of information exchanged among these agents. Nevertheless, the model has a referential nature, and for organizations it remains a technological and operational challenge to implement these requirements in order to ensure long-term preservation (Rosenthal et al. 2005).

¹⁶ Reference to the original cited: (Ferrater Mora 2004)

The Hipátia Model, as suggested by the theoretical model analyzed in this study, originated with the aim of operationalizing the functional requirements established by the OAIS model, thereby supporting the implementation of digital preservation strategies by different institutions. Would flexibility, adaptability, interoperability, and reproducibility be sufficient to characterise Hipátia as a model for the digital preservation of records and information? Would the same be true based on its innovative features in relation to its databus?

Taking into account the theoretical references of Philosophy and Information Science studied, Hipátia would not be configured as a model according to the definition of a Philosophy dictionary, but could be characterised from the perspective of an example (aspect of the notion of paradigm linked to model); an analogy of another model (in this case, OAIS, applying it in the context of digital preservation); a method in the model view, again serving as an application of OAIS; and a logical model, which represents other preservation structures (previously physical and now logical).

From the perspective of OAIS as a reference model, from which Hipátia appropriates guidelines for the digital preservation of records and information, it can be seen as an application of that model, that is, a method for implementing a TDAR. This methodological conception does not limit it; on the contrary, it links it to the reference model and enhances the possibilities of its uses in different contexts, through its characteristics of flexibility, adaptability, interoperability, and reproducibility.

Based on the literature review undertaken, it was possible to observe that the notion of model presents itself as a complex, multifaceted epistemological construct, permeated by different theoretical traditions. From the perspective of Philosophy and Information Science, it was found that models fulfil explanatory, descriptive, and operational functions, serving both to represent and intervene in the phenomena they seek to understand.

When applying these benchmarks to the analysis of Hipátia, it was identified that the system has characteristics that qualify it as a model in multiple senses. It can be understood as a model in the sense that Kuhn attributes to exemplary, as an analogical model in the light of Hesse, as an operational representation according to Abrantes, and as a methodological instrument linked to a theory, according to Dutra and Renault. Its function of integration and preservation between heterogeneous systems reinforces its power as an applied model, especially when considering its adherence to OAIS principles and its capacity for diagnosis and intervention, as also analysed by Silva.

In view of the above, it can be concluded that Hipátia can indeed be considered a model for the digital preservation of records and information, provided that a broader and multidimensional understanding of the notion of “model” is adopted. Its relationship with OAIS, its methodological structure based on integration between systems, and its diagnostic and operational function show that Hipátia goes beyond being mere software, taking on a representative and intervening role in digital archival processing. By integrating theory, method, and practice, it contributes not only to the technical consolidation of TDAR, but also to the epistemological maturation of digital preservation in the field of Archival Science and Information Science. Its potential lies precisely in the articulation between its normative bases and its adaptability to the complexity of institutional contexts, which effectively makes it a model with theoretical relevance and practical applicability. Furthermore, it is important to emphasize that digital preservation should not be understood

merely as the implementation of technological solutions, but as a continuous management process involving organizational, technical, and security dimensions. Studies on the long-term preservation of electronic records highlight that the reliability and authenticity of records depend on the establishment of procedural rules embedded in recordkeeping and record-preservation systems and integrated with institutional business processes, ensuring systematic control over the creation, handling, and preservation of records (Duranti 2001; Vermaaten, Lavoie, and Caplan 2012). In addition, preservation environments must ensure the maintenance of the identity and integrity of digital records over time, which requires knowledge of the record's elements and the documentation of any changes occurring during preservation processes (Duranti 2001). At the same time, digital preservation strategies must consider the risks that threaten the long-term accessibility and usability of digital materials, since successful preservation depends on identifying and mitigating threats that may compromise essential preservation properties (Vermaaten, Lavoie, and Caplan 2012). In this context, preservation initiatives must articulate organizational policies, technological infrastructures, and risk-management strategies capable of sustaining trustworthy digital preservation environments and ensuring the continued accessibility, authenticity, and integrity of digital records over time (Rosenthal et al. 2005).

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