Theoretical foundations of Library and Information Science

An epistemological and methodological approach

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The context of an epistemological and methodological approach to LIS

Regarding the theoretical foundations of Library and Information Science (LIS), this paper develops a new epistemological and methodological approach. The aims of this analysis work on several levels: firstly, the scientific features of LIS as a « science » (i.e., language, structure, knowledge, method, activity, ends, and values)1 ; secondly, the analysis of its characterization as an applied science as its scientific orientation during research ; and thirdly, the consideration of its status as artificial2 rather than social3. These aims deepen in the epistemological and methodological configuration of *Library and Information Science*, which in Spain is traditionally called *Ciencias de la Documentación,* or more recently, *Información y Documentación*.

Library and Information Science, which today is commonly called « Information Science », can be understood from two different viewpoints : the broad perspective and the narrow view. The broad perspective involves the disciplines generally working on the aims, processes and results of archives, libraries and documentation centres. Meanwhile, the narrow view focuses on specific information processes such as : creation, acquisition, organization, evaluation, storage, retrieval, and dissemination of information. In this narrow view, there is a particular interest in the users of archives, libraries and documentation centres.

This paper analyzes the first option – the broad perspective – that involves a clear connection to epistemological and methodological issues. In this regard, there are three levels :
1. science in general, which considers any feature present in science (either natural sciences, social sciences, or the sciences of the artificial);
2. applied sciences, which take into account the features that distinguish them from basic sciences;
3. design sciences, which are the core of the sciences of the artificial4, to be considered in the realm of LIS.

Following these three steps, there are several sections. Firstly, the proposal analyzes LIS as involving the features of all sciences (i.e. language, structure, knowledge, method, authority, ends and values). Secondly, there is the study of LIS as an applied science, which involves the consideration of tasks such as cataloguing, indexing, abstracting, etc. Thirdly, there is a reflection on the specific status of these elements, which leads to the consideration of them as « artificial », insofar as they come from a design related to processes and results.

The scientific status of Library and Information Science in the broad sense

When analyzing to what extent a discipline such as Library and Information Science is scientific in the broad sense, the first things to take into account are the features of the science. In this

regard, an inquiry into the nature of what is now called « Information Science » reveals that the following components ratify it as a science[5] :
1. it has a specific language, different from those used in other disciplines ;
2. it appears articulated in theories, whose structures are guided by the solution of concrete problems ;
3. it uses a type of knowledge that has distinguishing features with regard to other disciplines and permits the articulation of the other knowledge contents ;
4. it has a characteristic method, which is directed towards the solution of practical problems[6] and appears as a dynamic reality ; in so far as it moulds the advance of knowledge, and therefore, is affected by historicity ;
5. it is configured essentially as a social action, because science is a plural task (it articulates a set of activities which are controlled and guided in order to obtain aims) ;
6. it is related to several values, either internal (coherence, simplicity) or external (public service, cultural vehicle, etc.) ;
7. it can be evaluated ethically both from an internal perspective (reliability, honesty, etc.) and from an external one (i.e. avoiding undesirable effects or negative consequences for users, etc.)[7].

In accordance with these features, we can recognize that Information Science is actually a science, because it fits the requirements already pointed out. Thus, Library and Information Science – understood in the broad sense – has the features that belong to any scientific activity related to an empirical realm (language, structure, knowledge, method…). The characterization of this discipline can be seen in the contribution of Tefko Saracevic[8]. His focus notes that Information Science has developed in two main areas of knowledge : the cluster domain and the orientation towards information retrieval.

The first, the so-called cluster domain, examines issues as diverse as analytical studies of literature, the investigation of texts as bearers of content, scientific communication, the social context and the use of information. In the second, the field of information retrieval is addressed according to C. Mooers as « the intellectual aspects of the information description, its specification for search and any systems, techniques and equipment used to perform this operation »[9]. This thematic research area has also been called retrieval cluster. It addresses scientific research tasks such as information retrieval theory and carries out practical applications of processes and information retrieval systems, user studies, library systems, OPACs performance, etc.

Tefko Saracevic thinks that there is a shared area limited to certain information processes between Information Science – understood in a restricted sense – and Library Science. Both play a social role and are related to the problem of the effective use of graphic records[10]. However, there are also striking divergences between the two sciences :
1. they differ in how they define and address problems ;
2. they are different in the type of theoretical issues that arise and in the obtained results (i.e. the resulting structures) ;
3. they have different types of theoretical and practical knowledge ;
4. they possess different tools and solutions to problems ;
5. they differ in the interdisciplinary relations that they maintain.

All these elements lead to the conclusion that Library Science and Information Science, strictly speaking, are in fact two distinct fields with strong interdisciplinary relations rather than a single field (or even, that one is a special case of the other).

Thus, from a structural standpoint, the internal articulation of Information Science – in a current broad sense – is configured through its interdisciplinary feature[11]. This feature entails a confluence of common aims rather than the mere overlapping of different knowledge. In fact, there is a set of different knowledge domains that interact according to the previously outlined aims. This is especially evident in Information Science processes such as selection and acquisition of relevant documents, organization, representation, re-identification (retrieval), and in the transfer of the information contained in documents to human agents. However, even though each of these areas can develop their own processes, it happens that they seek to achieve clearly differentiated aims.

From a structural standpoint, there are – in my opinion – a number of features that can be referred to in Information Science – understood in the broad sense :
1. the disciplinary field of Information Science is structurally complex[12] ;
2. it shows a type of organized complexity which is oriented to achieve the aims ;
3. its internal architecture shows features of a hierarchical structure containing components of a first level hierarchy and elements that correspond to a second level hierarchy ;
4. all its components involve dynamicity-historicity (i.e. they are not static elements but rather, are connected to the past and susceptible to future projections) ;
5. there is a feature of adaptability conceived as the ability to adapt to an environment strongly mediated by social and technological factors which are particularly unstable in time ;
6. it involves a clear transmission of values (for example, the insertion of the value of cultural components) ;
7. it holds implicit ethical values that, for example, influence the performance of documentary processes and also contribute to the modulation of the relationship with users ;
8. prediction and prescription also play a relevant role in Information Science (hence the importance of the extensive list of standards, guidelines, and rules provided by this field that contribute to increasing predictive ability, which in turn strengthens its scientific character)[13].

In my view, Information Science – in the present sense, which includes the whole tradition of LIS – is set up as a complex system. It comprises a large number of heterogeneous elements that seek different aims. Its core elements pivot on the research of two major types of components : on the one hand, documents in any format or support (documentary support) related to the processes of creation (representation), organization, re-identification (retrieval), and distribution of information; and moreover, the attention by users / clients to satisfy their information needs.

Information Science as an applied science

Following this analysis of LIS, Information Science – understood in a contemporary way – can be seen as an applied science within the sphere of sciences of design[14]. Thus, it seems clear that this discipline includes several relevant features :
1. Information Science is an applied science, which means that it is always working on aims, processes and results, instead of being a purely professional activity that varies from country to country (from a simple « art » to a « cultural technique »)[15]. Information Science is an empirical science whose aims, processes and results are well established. In contrast, Knowledge Organization (KO) might be considered differently in insofar as it has a narrower scope than Information Science.
2. Information Science is an example of a science of design, which involves the need for the sciences of the artificial. This means that Information Science (and, therefore, the old Library and

Information Science) cannot be merely part of the social sciences : it is a dual science (artificial and social).

Information Science is an applied science. From the beginning, it has focused on problem-solving activity in a concrete sphere of mainly practical issues16. This kind of science has manageability as one central characteristic. It is not a basic science because the primary aim is not directly to achieve true or at least, highly plausible content. Thus, it is not specifically aimed at knowing reality but rather, at solving specific problems in a well-defined domain. For it to be a basic science, it would require the development of a science giving foundation to applications that perform *Information Science* (or *Library Science*).

Usually, this field displays a practical knowledge that acts on a material that does not offer itself initially. It normally works on what has been achieved by other disciplines, whether scientific in the usual sense (i.e. formal sciences, natural or human and social sciences) or where appropriate, in disciplines encompassed within technological knowledge (engineering, etc.). Therefore its concern is the whole spectrum of knowledge, so it is configured as a science of science.

Through both its aims and objectives and their means and results, Information Science is in principle an applied science. First, the aims sought are operational and concrete. It is focused, in effect, to select and acquire materials of interest (information in a broad sense). Then, it structures it in a functional way : analyzing and properly ordering to enable its re-identification (retrieval) and use. Next it tries to get results that promote the spread of what has been achieved (i.e. the task of communication).

Second, in line with these aims the means implemented are also operative both in Library Science and in Information Science : in both cases it expressly seeks to solve concrete problems through specific and usually functional means. Moreover, the solution is the basis for the existence of these disciplines. Thus, to perform the above functions (acquire, process, re-identify (retrieve), and communicate) along with scientific knowledge, Information technologies are increasingly used (to the extent that in the case of admitting the existence of « technoscience », at certain times Information Science could be considered in that way).

And in the third instance, it is noted that the results are also examined according to operational criteria because they are normally evaluated on the basis of the usability and usefulness of the achievements (which are suitable criteria for applied science). Users normally carry this out either expressly or in an implicit way. This explains the importance of the external side of these disciplines, since it is a clear complement of internal components.

As an applied science, Information Science – in the broad sense – deals with two types of components or factors : internal and external. The *internal components* are those that articulate the criteria for acquisition, organization, storage, re-identification (retrieval) and dissemination of information (e.g. rules and guidelines for the execution of documentary analysis tasks as reliable as self-controlled) or the guidelines for the classification of knowledge. The *external components* are those related to the environment of this activity (for example, exogenous factors that have an influence on the design and implementation of the user's services) and in a more general way, includes those factors which, in one way or another, are affected by the socio-cultural context that demands information (cultural trends, social conditions, political influences, user knowledge profiles, etc.).

In its *modus operandi*, Information Science as applied science proceeds inversely to basic science in such a way that it follows guidelines suggested by I. Niiniluoto17. Therefore, at first in applied

science a concrete problem is set up to which a solution should be found instead of disposing of it as with basic science – a direct search of new knowledge based in a theoretical framework[18]. The framework that serves as support comes from a set of disciplines which may include computer science, linguistics, cognitive psychology and philosophy of science[19]. It may be the case that, in the future, the cognitive sciences can develop a basis for a future basic science of information. If this possibility is achieved, then the cognitive sciences can give additional support for Information Science as a design applied science[20].

Information Science as Science of design

Once the aims are indicated, the more relevant features and distinguishing aspects of LIS are as a design science[21]. If we accept that « design, like science, is a tool for understanding as well as for acting »[22], then we could state that Library and Information Science (LIS) is a « design science »[23]. In fact, it enables the better understanding of the information within its field and it promotes a sphere of activity that is guided by the aims that arise from it. It is obvious that, within the set of sciences, Library Science belongs to the social sciences in contrast to the natural sciences. Strictly speaking, it is not a « social science » but rather a science of the artificial. Its purpose of study and its methods are based on the artificial (documents)[24].

Regarding the scope of the term « design », Ilkka Niiniluoto thinks that Herbert Simon is somewhat ambiguous, because he does not clearly distinguish between « design » and « scientific design ». In this regard, he thinks that, « scientific design is a type of design, i.e. the activity of solving design problems by using scientific methods and scientific knowledge. Operations research provides methods to find optimal or satisfactory solutions to design problems (decision theory, linear programming, game theory). In this sense, scientific design is the result of the scientification of an art, a technology or a development »[25].

According to this process, from a chronological point of view we might say that first there would be a professional human activity and then within a context of scientific activity we would obtain a scientific design. In the case of LIS, we are faced with what Simon names a « science of the artificial ». It is presented as science of design and emerges from a process of « scientification » from a professional skill. It is not a purely formal knowledge, like logic or mathematics, nor is it obviously a discipline that arises from nature. Information Science could and might be seen as a social science to the extent that it is the result of social actions in a social context. But within them, it is not comparable to the economy or sociology. The difference is that the proper object and the design are – in a literal sense – artificial. In other words, economy and sociology are intensely rooted in the social nature of human beings, whereas LIS is inserted in further processes of the basic needs.

If applying the approach of H. A. Simon, then both *Information Science* – in a broad sense – as well as *Library Science* are sciences of design and furthermore are empirical (understanding that this author believes that artificial intelligence is empirical)[26]. Indeed, the aims, means and results of LIS can be evaluated empirically. In fact, this is what has been highlighted in recent years by emphasizing for example the role of users whose information needs and degree of satisfaction may be susceptible to empirical comparison. The same happens in the case of bibliometrics or in the evaluation processes of information « retrieval » instruments.

When characterizing the artificial sciences, Simon admits that natural sciences are concerned with knowledge about objects and natural phenomena while the sciences of the artificial deal with what is produced by human operation[27]. Moreover, in his view five features that differentiate the

artificial with respect to the natural can be distinguished. These elements constitute the borders of sciences of the artificial and provide a range of features in the field of study that will now be listed28 :
1. artificial objects are the product of a synthesis process (broadly understood : it is the articulation of a set of elements according to a previously elaborated design)29. Although, the results of a task performed by humans cannot always be prepared with full awareness ;
2. artificial objects can imitate the appearance of natural things, but lack one or more realistic aspects of natural things ;
3. man-made objects can be characterized in terms of aims, functions, and adaptation to the environment ;
4. artificial objects can be studied in imperative-hypothetical terms – that is, how they ought to be to achieve certain aims – and also in a descriptive way such as what specific features characterize them. These two parameters are especially relevant in approaching the design process itself (indeed, engineers and more broadly, designers – certain profiles of IS practitioners too – reflect on how artificial objects should be in order to achieve specific aims and make them work) ;
5. from a functional standpoint, in order to achieve a purpose or to suit an aim, man-made objects require the interplay of three elements :

a) the purpose or aim in which it is directed ;
b) the nature of the artifact – its structure or configuration ;
c) the environment in which it acts.

This multiple perspective characterizes the sciences of the artificial30. In this sense, an artifact – what is artificially produced – can be studied as a meeting point, an interface between an internal level (the nature and structure of an artifact) and an external environment (the context in which it operates). To establish differences between natural sciences and the sciences of the artificial, H. Simon notes that the dichotomy between the normative and the descriptive is relevant. He considers that natural sciences « have found a way to exclude the normative and focus exclusively on how things are »31. That is, the plane of the descriptive. He also believes that the sciences of the artificial always require a normative component.

Within the artificial sciences, Herbert A. Simon specifically highlights the « sciences of design ». He does so cautiously using the term « artificial » in the most neutral sense as used with the meaning « man-made » which is understood as something opposite or different from the natural32. Thus, he highlights the uses of « complex information processes » and « simulation of cognitive processes » against the most common meaning of « artificial intelligence »33. Something genuinely human is relied upon in the man-made : the design is something not found in nature.

The sciences of design arose in the mid-1970s at Carnegie Mellon University, in the city of Pittsburgh (Pennsylvania). For years they have been developed mainly through computer-aided design. This is being done on a regular basis in various degrees (Computer Science Centres, Schools of Architecture and Engineering, as well as in Operations Research Groups) within Business faculties and also in business schools that offer a Master of businnes administration. It is clear that design is a content that relates to a specifically human endeavour34. It is « artificial » and is a human « artifact » in a broad sense (something that can be done by humans). This modulates its aims, means and results. Thus, the concept of « design » is teleological : always looking towards a purpose and in principle, aiming at an activity. As stated by H. Simon, « it is about how things should be ; try to design artifacts to achieve aims »35.

Design activity appears as a task directed toward pre-selected purposes, which involve the decision factor : it is necessary to deliberate and choose what is most appropriate for the intended aim. Particularly due to the selection of aims and human nature, the methods of design are limited since in fact, they don't aspire to do as much as possible, but only to meet specific needs. In other words, the design activity does not seek to maximize – reach an optimal ideal – but only to satisfy[36]. In this case it appears that the number of alternatives is not unlimited.

To have a real design, it is not enough to simply create something that is possible because in fact, the design has only been achieved when a system is discovered where it is feasible on the basis of the rules. On one hand, a field is needed where the process which corresponds to the design can take place ; but, on the other hand, all design is carried out following rules : for example, when designing a bibliographic record that contains a certain amount of information, in order to satisfy a particular profile of users, the steps that can be taken must be known – what rules there are – to represent the necessary information within a previously designed structure. The applicability of design according to the rules implies the existence of limits in the design, and these limits are directly related to its ability to adapt to reality. Consequently, the results are consistent with the existence of limitations.

It should be emphasized that the design activity is not unique to engineers. There are more professions that may design courses of action to change existing situations in order to give rise to others which are preferred. Thus, what H. Simon meant by « design » is directly related to prescribing : it is something done to achieve an aim explicitly sought. In this broad sense, the design « is at the core of all professional learning. It is the main feature that distinguishes professions and sciences »[37]. Its presence seems clearer in engineering, business administration and medicine, but is also considered in law schools or library science studies[38], which is where the theoretical framework that gives meaning to this work is located.

It should be noted that H. Simon is particularly interested in the applied sciences of Design. There are at least two reasons : first, because they arise from a process especially important in professional practice which I. Niiniluoto calls « scientification », i.e. it arose from a search for scientific foundations in a professional practice[39] ; and secondly, because H. Simon always has in mind the need to solve problems and among them, a specific practical problem ; hence, its applied nature. The latter connects with his studies in two applied domains : business administration and computer science.

Final remarks

If Simon's ideas are used for the discipline considered here, then Information Science – understood in a broad sense, which includes Library Science – can be characterized in the domain of the sciences of design. This implies that Information Science (or what used to be called Library and Information Science), in addition to being an empirical science, is also a science of the artificial rather than a social science (even though it has connections with the social aspects through users of the services of archives, libraries and documentation centres). In this regard, Information Science is empirical in a similar way to how Simon considers artificial intelligence to be empirical[40]. The components of Information Science as an applied science (i.e. aims, processes and results) should be empirically tested.

Following this characterization of Information Science, there is a clear novelty. Information Science is an applied science of design rather than a social science as such or a mere technique of librarians. Its realm is the artificial being (documents in whatever format and support), which is

human made. The development of Information Science is built upon professional skills. In addition, this science of the artificial constantly uses information and communication technologies. These are operational tools whereas the core is a human undertaking.

This particular case of Information Science highlights the epistemological-methodological necessity of « applied science » rather than « basic science » in order to understand sciences of the artificial as a group and within them, sciences of design. Without this category of applied science, Information Science cannot be properly understood. Thus, we need the category of applied science as distinct to basic science at least from an epistemological-methodological point of view. According to Niiniluoto, there are many elements needed for this notion of « applied science » ; hence here I have characterized the theoretical foundations of what used to be called Library and Information Science as a case of applied science within the realm of designs41.

- 1. On the features of "science" see W. J. Gonzalez, "The philosophical approach to science, technology and society", in *id.* (ed.), *Science Technology and Society: a Philosophical Perspective*, A Coruña, Netbiblo, 2005, p. 3-49 (especially 8-11). With respect to the question of values in IS, see M. Bates, "The invisible substrate of Information Science", *Journal of the American Society for Information Scienc*e, 50, 12, p. 1043-1050 (1049).
- 2. Regarding IS conceived as a "design science" see A. Bereijo, *Bases teóricas del Análisis Documental* : *la calidad de objetivos, procesos y resultados*, Madrid, Universidad Carlos III de Madrid and Boletín Oficial del Estado, 2002.
- 3. About the sciences of the artificial, there is the pioneer work of Herbert Simon. His classical book is H. Simon, *The Sciences of the Artificial*, 3rd ed., Cambridge, MA, The MIT Press, 1996. The dual status of some sciences – artificial and social – can be seen in cases such as economics, cf. W. J. Gonzalez, "Rationality and prediction in the sciences of the artificial: economics as a design science", in M. C. Galavotti, R. Scazzieri, P. Suppes (ed.), *Reasoning, Rationality and Probability*, Stanford, CSLI Publications, 2008, p. 165-186.
- 4. On the status of the sciences of design, see W. J. Gonzalez, "Configuración de las ciencias de diseño como ciencias de lo artificial: papel de la inteligencia artificial y de la racionalidad limitada", in *id.* (ed), *Las ciencias de diseño: racionalidad limitada, predicción y prescripción*, A Coruña, Netbiblo, 2007, p. 41-69.
- 5. About these aspects of "Science", cf. W. J. Gonzalez, "The philosophical approach to science, technology and society", *op. cit.* p. 8-11.
- 6. On the applied nature of IS, J. Hansson states that "LIS research is not primarily to be seen as a tool for solving practical problems, neither within the library sector nor the information or IT sector": J. Hansson, "The social legitimacy of Library and Information Studies: reconsidering the institutional paradigm", in B. Rayward (ed.), *Aware and Responsible: Papers of the Nordic-International Colloquium on Social and Cultural Awareness and Responsibility in Library, Information and Documentation Studies*, Lanham, MD, Scarecrow Press, p. 49-69 (66).
- 7. With respect to ethical concerns, see G. Benoit, "Critical theory and the legitimation of Library and Information Science", *Information Research*, 12, 4, 2007, p. 1-14 (7).
- 8. Cf. T. Saracevic, "Information Science", *Journal of the American Society for Information Science*, 50, 12, 1999, p. 1055.
- 9. Cf. C. N. Mooers, "Zatocoding applied to mechanical organization of knowledge", *American Documentation*, 2, 1, 1951, p. 20-32.

- 10. Cf. T. Saracevic, *Information Science Revisited: Contemporary Reflections on its Origin, Evolution, and Relations,* Rutgers, New Brunswich, The State University of New Jersey, 1990 (Research Report Series, n. 90-24), p. 24-25.
- 11. What Nolin and Aström call "fragmented nature of LIS" : J. Nolin, F. Åström, "Turning Weakness into Strength: Strategies for future LIS", *Journal of Documentation*, 66, 1, 2009, p. 7-27 (11).
- 12. In the early twenty-first century, R. S. Taylor´s statement about IS still has full value : a territory more than a country with defined borders. *Cf*. R. S. Taylor, "The Information Sciences", *Library Journal*, 88, 1963, p. 4161-4163 (4161). With respect to the question of boundaries in IS see D. Soergel, "An Information Science manifesto : American Society for Information Science Award of Merit Acceptance Speech" (5 November 1997) http://www.dsoergel.com/cv/B64.html . The relationship between IS and bordering disciplines can be seen in P. Ingwersen, *Information retrieval interaction*, London, Taylor Graham, 1992, p. 8 ; R. Summers, "Information Science in 2010 : a Loughborough University View", *Journal of the American Society for Information Science*, 50, 12, 1999, p. 1153-1162 (1159) and S. Webber, "Information Science in 2003", *Journal of Information Science*, 29, 4, 2003, p. 331-330.
- 13. Regarding the role of prediction and prescription in Information Science, cf. A. Bereijo, "Predicción y prescripción en las ciencias de lo artificial : incidencia en las Ciencias de la Documentación", in W. J. González, *Racionalidad e historicidad en H. A. Simon : incidencia sobre la predicción económica*, A Coruña, Netbiblo, 2003, p. 279-309. See also W. J. González, "Rationality and prediction in the sciences of the artificial : economics as a design science", in M. C. Gavalotti, R. Scazzieri, P. Suppes (ed.), *Reasoning, Rationality and Probability*, Chicago, Center for the Study of Language and Information-The University of Chicago Press, 2008, p. 165-186.
- 14. This is a holistic approach that involves the fields of Archival science and Museology.
- 15. S. Briet, *What is Documentation?*, Lanham, Scarecrow Press, 2001.
- 16. A. Bereijo, "The category of 'Applied science' an analysis of its justification from 'Information Science' as design science", in W. J. González (ed.), *Scientific Realism and Democratic Society : the Philosophy of Philip Kitcher*, Amsterdam, New York, Rodopi, 2011 (Poznán studies in the philosophy of the sciences and the humanities, 101), p. 327-351.
- 17. Within the scientific realm, Information Science is an applied science that has been recognized – in an implicit or explicit way – by several authors : cf. P. Vakkari, "Library and Information Science : its content and scope", *Advances in Librarianship*, 18, 1994, p. 1-55 ; A. J. Meadows, "Introduction", dans *id.* (ed.), *The Origins of Information Science*, London, Taylor Graham, 1987, p. 1-10 ; R. Summers, "Information Science in 2010…", *op. cit.* ; F. Åström, "Library and Information Science: the development of scientific fields and their relations to professional contexts", 2004 http://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=579268&fileOId=579269.
- 18. Cf. I. Niiniluoto, "Approximation in applied science", in M. Kuokkanen (ed.), *Idealization VII : Structuralism, Idealization, and Approximation*, Amsterdam-Atlanta, Rodopi, 1994 (Poznán Studies in the Philosophy of the Sciences and the Humanities, 42), p. 127-139.
- 19. Cf. B. Hjørland, "Library and Information Science : practice, theory and philosophical basis", *Information Processing and Management*, 36, 3, 2000, p. 501-531.

- 20. Cf. A. Bereijo, "Racionalidad en las ciencias de lo artificial: el enfoque de la racionalidad limitada", in W. J. Gonzalez, *Racionalidad e Historicidad en H. A. Simon…*, *op. cit.*, p. 131-146.
- 21. Cf. A. Bereijo, "Predicción y Prescripción…", *op. cit.*
- 22. H. Simon, *The Sciences of the Artificial*, 3rd ed., Cambridge, MA, The MIT Press, 1996, p. 164.
- 23. With respect to this question, recently Michael Buckland stated : "If Information Science is a science it is a science of the artificial (Simon, 1996) rather than a natural science (like physics) or a formal science (like mathematics)" : M. Buckland, "What kind a science *can* Information Science be?", *Journal of Information Science and Technology*, 63, 1, 2012, p. 1-7 (draft available at http://people.ischool.berkeley.edu/buckland/whatsci.pdf).
- 24. Conversely, in the domain – analytic paradigm, IS is viewed as a social science : cf. B. Hjørland, H. Albrechtsen, "Toward a new horizon in Information Science : domain-analysis", *Journal of the American Society for Information Science*, 46, 6, 1995, p. 400-425 (400).
- 25. I. Niiniluoto, "The aim and structure of applied research", *Erkenntnis*, 38, 1993, p. 1-21 (8-9).
- 26. H. A. Simon, *op. cit.*, p. 12.
- 27. *Ibid.*, p. 3.
- 28. *Ibid.*, p. 5.
- 29. Marcia Bates limits the operational area of IS and notes that "it is oriented to the world of recorded information produced by human intervention" which is what she calls the "the fourth world" of documentary or "recorded-information universe" : M. J. Bates, "The invisible substrate of Information Science", *Journal of the American Society for Information Science*, 50, 12, 1999, p. 1043-1050 (1048).
- 30. H. A. Simon, *op. cit.*, p. 5.
- 31. *Ibid.*, p. 13.
- 32. *Ibid.*, p. 4.
- 33. *Ibid*.
- 34. The idea of design in the field of IS has a strong presence in authors like Marcia Bates or Dagobert Soergel : M. J. Bates, "The invisible substrate of Information Science", *op. cit.*, p. 1048 and D. Soergel, "An Information Science manifesto…", *op. cit.*
- 35. H. A. Simon, *op. cit.*, p. 12.
- 36. One of the constants of H. Simon has been to insist that human rationality does not seek to "maximize" but only to "satisfy" : H. A. Simon, *Models of Bounded Rationality,* vol. 3 : *Empirically Grounded Economic Reason*, Cambridge, The MIT Press, 1997.
- 37. H. A. Simon, *op. cit.*, 11. With respect to this issue, see I. Niiniluoto, "The aim and structure of applied research", *Erkenntnis*, 38, 1993, p. 1-21.
- 38. H. A. Simon, *op. cit.*, p. 112.
- 39. I. Niiniluoto, *op. cit.*, p. 8-9.
- 40. H. A. Simon, "Artificial intelligence: an empirical science", *Artificial Intelligence*, 77, 1995, p. 95-127.
- 41. A. Bereijo, "The Category of 'applied science', an analysis of its justification from 'Information Science' as design science", *op. cit.*