

# Towards a New Approach to Communication and Information Theory: Communication Sciences as Sciences of the Artificial

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**Abstract**— Nowadays "Communication and Information Theory" cannot be merely based on the idea of communicative phenomena as social events, because communicative phenomena are directly related to artificial designs that enlarge human possibilities of communication (as it happens with the smartphones, iPads, etc.). This involves that the events of Communication Sciences are not purely in the realm of the Social Sciences but also in the sphere of the Sciences of Design.

The traditional focus of Communication and Information Theory on communicative phenomena as social events is clearly insufficient to characterize the aims, processes and results of the DTT, TV on the Internet, social networks, etc. All of them have a very strong artificial component and worked on designs that are human made. Thus, the Communication and Information Theory should take into account the sphere of the designs related to communicative phenomena. This is the realm of the sciences of the artificial, where designs are used to reach new levels of sophistication.

This new approach regarding the theory requires a novel framework insofar as the Communication and Information Sciences are Science of Design. These disciplines are applied sciences whose aims, processes and results are beyond the social communicative phenomena based on human needs. As applied sciences in the artificial domain, Communication Sciences make predictions about the future and provide prescriptions for solving problems. This new proposal provides a realistic content for Communication and Information Theory within Communication Science.

**Index Terms**—Communication, Information, Sciences, Design, Artificial, Parsimonious factors, Television, Complexity

## I. CONTEXT OF ANALYSIS

When the context of communicative events is the enlargement of human possibilities of communication, then we are in the sphere of the artificial. Thus, due to the human made character of these communicative designs, which are beyond basic needs of communication of humans in a society, Communication and Information Theory has to deal with complexity in a larger level than in the case of the previous

scheme, when the realm of communicative events was mere social phenomena.

The component of complexity to be analyzed by the Communication and Information Theory—and, therefore, by the Communication Sciences—appears in several consecutive levels: as dual sciences, due to the presence of historicity, and because of the links with technology. Firstly, these disciplines study social and artificial events of communicative kind. These sciences have a dual character: social and artificial. The events belong to the empirical field, and the sciences are applied, because they are orientated towards the resolution of specific problems [1].

Secondly, besides the structural complexity of the communicative events—they are dual—the communicative events have historicity. They are in constant expansion, due to the constant interaction between the internal and external dynamics [2]. This dynamical behavior affects the type of contents they transmit as well as the devices used in the process. Because communicative sciences are applied sciences in a dynamical domain, the communication sciences face the presence of the complexity in three successive stages (aims, processes, and results).

Thirdly, and closely connected to the previous one, communication events are in constant interaction with technology. Thus, Communication Sciences have to deal with the complexity issue of the dependence on Information and Communication Technologies. The human made designs for communication require a constant interaction with technological devices. This implies the creativity of the designs, something that goes with Sciences of the Artificial and its beyond the traditional limits of Social Sciences, at the same time that opens to technology innovation. In this regard, it is clear that Communication Sciences interact with the different aspects of Technology: it depends on the technological contributions in the field of Optics, such as digital photography or the 3D image, telecommunications, mobile television, Information, Communication (new computers), etc.

Therefore, when Communication and Information Theory is dealing with complexity in the three levels pointed out, it should consider that the communicative events have a dual

character: social and artificial [3], which are within the empirical field guided to solution of concrete problems. Thus, insofar as Communication and Information Theory analyzes empirical factors, it requires attend to internal elements and external components. In a parallel way, Communication Sciences, directed to solve concrete questions as Applied Sciences, meet the complexity presence in three consecutive levels. These correspond to the aims, processes and results [4].

But the study of complexity in Communication and Information Theory cannot overlook that the different communicative phenomenon have an unmistakable dependence on technologic innovation (in press, television, radio, the internet, mobile phones, etc). Recent History highlights this in many ways. One of the clearest cases, which has taken quite a long time, is the evolution from digital platforms to Digital Terrestrial Television (DTTV or DTT) [5], where technological factors appear together with internal communication factors (programming) and external ones (legal and business).

Within this context, there is firstly an analysis of Communication and Information Theory seen from a philosophical-methodological point of view. Secondly, there is a study of the ways in which complexity is specified in Communication and Information Theory —and, consequently, in Communication Sciences—, which tries to call attention to those aspects of complexity that are typical of this sphere. And, thirdly, there is consideration of complexity in this realm from the viewpoint of the parsimonious factors, because they might be the key procedure to solve the complexity issue in Communication and Information Theory. The criteria of this triple movement are based on Herbert Simon's ideas [6], even though he actually did not work in field. Thus his views are here widened.

## II. COMMUNICATION SCIENCES AS SCIENCES OF DESIGN

All communication media (written press, radio, television or new supports such as the internet) expand the original communicative human resources of a social type. They do this using a series of technologies that are increasingly more innovative. These technologies allow the creation of messages and its posterior diffusion to the public. In a parallel way, the content that these communication media transmit is modulated through several stages. First of all, there is a set of goals, which are intentionally sought. They are orientated towards the achievement of some specific goals through certain processes that are selected. For this reason, the area of Communication and Information Theory — and, in general, the field of Communication Sciences — cannot be reduced to the realm of the Social Sciences. Besides the social elements, there are many factors which are of artificial type. They are related to designs that allow us to extend our original possibilities, which we should analyse.

As a matter of fact, human communication did not go beyond the social sphere for many centuries: It was an expression of human necessity in a social environment. Thus, the established network of relationships was limited to a geospatial setting [7]. But, due to the creativity in the field of

communication, there is a lot of new designs, which enlarge human possibilities and have more ambitious goals than before. In this regard, the Information and Communication Technologies have allowed new processes, which carry out these new ways of communication to completely new possibilities. Gradually, the scientific study of these new phenomena due new designs is located in the area of Sciences of the Artificial. Moreover, it fits quite well on what are now the Sciences of as Design.

This implies three steps: (i) some aims to be pursued due to the designs of communication (accessible goals), (ii) certain processes to be followed in order to solve concrete problems, and (iii) the possibility of achieving some tangible results [8]. These three steps are not something “purely internal,” insofar as the society itself —that where communication media are created— gives a value to aims, processes, and results. In this regard, Communication Sciences are expressions of the human capacity to solve concrete problems, which is feature of the Applied Sciences [9]. Furthermore, from a methodological point of view, the Sciences of Design, such as Communication Sciences, are Empirical Sciences. Thus, they can be studied through observation and experimentation.

But Communication Sciences needs the contribution of technology in order to get their goals. Technology is by definition a creative transformation of reality [10]. Thus, it provides the device that is the instrumental support to achieve the selected aims. Technology gives the operative channels that lead the communicative content [11]. It does so using its different channels as image, sound, signal, etc. When a new communicative phenomenon starts, there is commonly a technological device that operates to look for some chosen aims. These aims have been previously chosen by the professionals, those working on the media. After these aims, there are some processes, which are indispensable to achieve the expected results. In each step there is complexity as an ingredient (in aims, processes, and results), which is normally an organized complexity.

These three consecutive elements — aims, processes and results — involve a practical knowledge. They are directed towards a goal due to the knowledge available. The use of practical knowledge is very common in the Sciences of the Artificial. Moreover, for Herbert Simon knowledge implies action. Thus, he says that “the Design, as Science, is a tool so to understanding as to acting” [12]. Above all, Communication Sciences are “Applied Sciences” [13]: they investigate the solution of specific communicative problems, which can from traditional media or from new emerging (such as those based on the internet).

As Applied Sciences of Design, Communication Sciences uses the theory trying of solving present and future problems. In this regard, within all the solutions given by the professionals in this field [14], these science study which solutions are appropriated, and they seek to “scientific” solution, which includes some action guidelines [15]. Usually, these science work with designs orientated to give an answer to well defined communicative problems. For this reason, they analyse the new digital systems: on the one hand, they are

those of production of communicative contents; and, on the other, they are related to distribution and diffusion. All these aspects belong to a scientific field that is applied and is within an artificial domain.

The subject matter of the Communication Sciences is not in nature but rather in the artificial world: programs, interactive contents, channels, time slots, etc. Thus, these sciences are evaluated according to the criteria related to the usefulness of the processes and the way of achieving results [16]. These are practical criteria, because these disciplines are orientated to the solution of concrete problems, which involves taking into account the audience as well as the business firms. Both the audience and the firms set goals that are practical, such as trying to achieve the best possible audience—an audience identified as target—, the best programming quality, or excellent economic results.

From a methodological point of view, communicative strategies seek well-defined goals within the group of possible aims [17]. Commonly, they do this through the design of absolutely standardized guidelines in their processes. The goals are to achieve results that, to some extent, are conditioned by contextual aspects—social, political, cultural, ...—, legal norms, and technological limits. The communication media strategies have an epistemological basis (a specific knowledge) as well as an axiological component (values that select aims and media). These epistemological and axiological components are relevant in the analysis of complexity.

### III. WAYS OF COMPLEXITY IN COMMUNICATION SCIENCES AND THEIR EFFECT IN TELEVISION PROGRAMMING

The component of complexity can be analysed by the Communication and Information Theory, which can consider its elements (mainly epistemological and ontological). Consequently, complexity can be studied by Communication Sciences and, insofar as they are embedded of complexity, they can be called “Complexity Sciences”. In this regard, it is clear that Herbert Simon [18] has studied in depth the problem of complexity. He has focused on organized complexity, which includes an internal structure with some hierarchy.

Regarding the features of complexity in The Sciences of Artificial, Wenceslao J. Gonzalez offers a wider perspective than Simon’s approach. His analysis points out the presence of complexity in the Sciences of Design in several ways: “i) The requirement of the intentional developing according to a design (that requires interaction between their parts—holism— and, in principle, some hierarchical relation); ii) the character itself of artificial objects, which are products that are obtained from natural elements, and the human social action directed to specific goals; iii) the orientation of the designs towards “sophisticated” aims for human life (the solution of specific problems of practical character—pharmacological, economic, of information recovery, etc.—), which involve a developed socio-cultural context [19]; iv) the growing difficulties for computation as the design is more ambitious or when the studied behaviour is chaotic, etc.” [20].

These features can be found in Communication Sciences and can be analysed by Communication and Information

Theory. De facto, there is an intentional development according to a design, where a relation between their parts and even a certain hierarchy level exist. This communicative system is not a chaotic one, and their objects are artificial. The audiovisual products come from the social human action in order to achieve specific aims. At the same time, the communication media have direct connection with specific problems originated by the society where these media are located. Their advance depends on a developed social and cultural context. The more ambitious is the design, the bigger are the difficulties to deal with, as has happened with the Digital Terrestrial Television (DTT) or in the television in movement.

### IV. MODES OF COMPLEXITY IN NICHOLAS RESCHER

If we looked deeper into the modes of complexity, we can find many aspects pointed out by Nicholas Rescher [21]. He has highlighted that the modes of complexity are multiple. His analysis insists on the epistemic complexity and the ontological complexity. The first modes of complexity are related with knowledge, which involves formulaic complexity, and the second modes are connected to reality itself, which has three different elements (the compositional complexity, structural complexity, and functional complexity) [22].

Among the epistemic modes Rescher sees three kinds of complexity: 1) descriptive complexity (its degree of complexity depends on the extension of explanation that has to be given to provide an appropriate description to the system at issue); 2) generative complexity (that it is measured according to the minimum number of instructions to generate a sequence, or what is the same, to give place to the system at issue), i.e., this category tries to measure the complexity according to the minimum required elements to generate a sequence; and 3) computational complexity (that it is directly proportional to the quantity of necessary resources, time or efforts, involved in resolving a problem).

Rescher mentions three main modes of ontological complexity: (i) compositional complexity, which deals with the number and variety of elements that constitute the subject to analyse; (ii) structural complexity, which deals with how the different subsystems of a complex system are structured (the connections can be reciprocal, perfectly coordinated or a hierarchical connection with subordination connection); and (iii) functional complexity, which can be of an operational kind (the one that deals with the variety of ways or types of working) or nomic (that studies the gradual complication of the laws that rule the phenomenon to study) [23].

Taking into account these epistemic and ontological modes of complexity, we can see them in the communicative processes. These modes are in the observed communicative processes among the human beings. These processes involved an interaction between transmitters (with the elaboration processes and the contents transmission) [24] and receptor agents, with the resulting feedback. Besides the modes of complexity of the communicative contents, which is the subject matter of the Communication and Information Theory, there is another crucial component to be considered: the complexities

that come from the use of Information and Communication Technologies. In this regard, an account of the complexities of the technological component is needed, because the sophistication of devices used are those that make possible higher levels in the communicative processes.

#### V. CATEGORIES OF COMPLEXITY IN COMMUNICATION SCIENCES: THE CASE OF TELEVISION PROGRAMMING

Following Rescher's typology of the modes of complexity it is possible to analyse the categories of complexity in Communication Sciences. Thus, through Communication and Information Theory we can think of complexity regarding knowledge in the communication media — mainly, in television — and complexity of the phenomena themselves of these media. If the focus is on the television programming, then the level of descriptive epistemic complexity is high. In effect, there is a big number of parameters in programming that should be considered in order to their full description. On the one hand, this requires to specify the sequence of the elements involved (of every day, every week or every month); and, on the other, this needs to include countless variations or combinations of those elements, to be taken into account as well.

Besides the descriptive complexity, there are many factors related to the generative complexity. This category measures the complexity according to the minimum elements required to generate a sequence. In the case of communication phenomena, there are components of internal type that specifically affect to the development of programs. But there also are some factors of external type (as the audience acceptance) to be considered. Both of them combined can make that a program (or even the whole program schedule of a channel) can be maintained or to force the introduction of changes (in the short, medium or long term).

Some of these decisive elements in the generative complexity are of a comparative kind: they depend on what other television channels show at that same time, if the channel is the first one offering this specific type of contents, etc. Others are ingredients of a relational type: the season, the day of the week or the time slot where its showed, the contents that go immediately before or afterwards, the blocks of advertisements, etc. In addition, there are others that are in straight connexion with the environment of the receiver of the television offer, where the efficiency of the promotion campaign takes part. All that affects to the computational complexity, that is, to the number of resources to deal with the internal type and the external type factors.

If the focus is on the ontological complexity, then it is better observed from the organized point of view. In this regard, to a large extent, complexity of the communicative phenomena — and, in particular television programming — is related to ontological complexity in terms of compositional complexity and structural complexity. The television programming, in particular, has a complexity concerning composition because television programming is composed by a number of programs that cover the 24 hours emission. This

involves heterogeneity, which is an element of the taxonomical complexity.

Within the structural level is where the ontological complexity increases. The organizational complexity is clear: on the one hand, there are a large number of elements related to the television programming itself; but, on the other, there are legal factors (international, national, autonomic or local) that intertwine with the business elements (with the consequent profitability search). In addition, in order to have the proper communicative elements, there is the technological component that also affects the organizational complexity. All this can be seen clearly in the case of DTT [25].

Regarding the proper communicative aspect, it should be emphasized that is the area where the television programming shows a higher level of structural complexity. This organizational complexity is more noticeable in the new digital environment. Before this new stage, during the time where analogue programming were in place, there were certain programs whose main structure of the program schedule was complex to some extent. In that period, the complexity was related to the news programs, which had to have fixed times. These programs were mainly either informative ones or entertainment programs, which require a unified configuration in an organized schedule.

But, after the digitalisation of television, there are more channels available than in the analogue period. This has increased complexity not only from point of view of the number of channels but also because of the diversity of channels. Thus, the difference from the previous unified configuration in an organized schedule is very noticeable. Following this increase in the number and variety of channels, the programmer has to look for the maximum profitability possible in quantitative and qualitative aspects. Moreover, he or she should be aware of it in each channel that depend on him or her.

Some of these channels can share certain specific programs. The choice that is made regarding the contents of each channel takes involves a set of factors such as the following: (i) age the program is addressed, (ii) gender towards it is addressed, (iii) the status or social class, and (iv) type of program (entertainment, formative, informative). In this regard, it might noticed a functional complexity. This takes place in two directions: an operational mode and a nomic mode. They move within a context of a spatial and temporary frame that it is well defined.

Therefore, there is functional complexity in television programming, which related to the way of operate and to the norms available. They are attached to criteria such as profitability and level of audience. Thus, number of viewers that are in front of the television screen in a specific moment is relevant. If two programs might compete between two channels that belong to the same company, then they will never be put together in the same time slot. These phenomena happen commonly and involve many elements, what means an enlargement in the complexity of the task of those professionals making the programming.

On the one hand, the professional must take into account sociological questions, thinking of the acceptance of the audience. On the other, the reality of the existence of different program schedules should be accepted. These program schedules should not compete among them if they seek an economic benefit and the position of a specific company. Thus, they must work as an unit to achieve the aims. Here appears a “nomic complexity”. The norms are of several kinds: external and internal. The regulator gives guidelines that should be followed, and there internal rules of the company regarding the communicative phenomena. If the level of operative freedom of a communicative system is high, then the level of complexity is bigger [26].

In addition to all the previous elements of complexity, which have a scientific interest — a central part of the Communication Sciences —, there is another element to be considered: the complexity that comes from Technology. This technological component goes with the decisive steps in the communicative processes, and should be added to those already pointed out: the legal factor, the business approach and the proper communicative ingredients. All together are developed within the context of a society.

This contemporary demands each time more use of audiovisual contents using technologically devices that are more complex than before. This kind of support can be seen in the case of the internet diffusion. The Internet brings about a new kind of support and a type of audience whose habits condition completely the programmers work. Now the viewer wants to be the owner of his spare time, choosing what he or she wants to see, in which support and in which moment. Thus, the programmer needs to allow the visibility of this product all the time.

This situation does not mean that the communicative system is all together disorganized or that remains at random. What it happens is that programming policies are different. Consequently, they must adapt to the new environment. This involves paying attention to the proper consumption dynamics of general channels, to thematic channels viewers and a la carte, as to the network users. Each one of these supports requires a differentiated guideline for programming, communicating and making the promotion.

## VI. PERSPECTIVE ON PARSIMONIOUS FACTORS TO FACE COMPLEXITY

Commonly, it is a usual human procedure to start to explore simple phenomena and, then, gradually try to look for an explanation to the complex events. The Sciences of Design, such as Communication Sciences, need to deal with increasing levels of complexity. They are Sciences of the Artificial and, therefore, they are human made. The systems that conform the Sciences of Design can be analysed until finding other more basic ones, those that allow us to study the system in its whole. This idea is in the core of the methodological idea of factors parsimony: there might be some factors allow us to embrace the whole system starting from some elementary elements of the system. These elements are not always the more simple ones [27].

When the analysis is made in the field of the Science of the Artificial, we need to look for the patterns that modulate the aims, processes and results. This task, when is focused on the Sciences of Design, such as Communication Sciences, we have to go to a limited number of factors. These parsimonious factors must be representative inside the studied system as a whole (in this case in the network of relations of communication in television). Thus, parsimony expresses the austerity according to the elements that must serve to explain and forecast the complexity of the whole, instead of searching for the clue in the simplicity to face the aims, processes and results.

The Sciences of Design start paying attention to the media running, in general, and the programming television study, in particular. They need to combine the theoretical approach and the empirical one when they analyse the complex phenomena of television. In this regard, they can be seen as a case of the Sciences of the Complexity insofar as they involve a type of organized complexity (they are not strictly disorganized). Moreover, they present the possibility of being able to divide the communicative system into subsystems. They can show a dependence relation on their interaction inside the system.

These Sciences of Design are Applied Sciences, because they want to solve specific problems within the sphere of the human made realities. Communication Sciences exemplifies this situation and requires the task of making predictions that are good as a basis to guide prescriptions. In this way we cannot simply remain on the descriptive phenomenological level. De facto, action patterns are needed, and the number of possibilities to decide cannot be limitless. The key is in the epistemological domain: the variables that allow predictions must be carried out from known values of some of the variables. The predictions can be used at the same time to carry out the wished functions [28].

Following the combination of prediction and prescription, what is sought here is not the simplicity in itself but factors parsimony. We need knowledge of the phenomena that, from a number of key elements, allow us to predict actions. Seen like this, parsimony is the relation between two series of facts: one represents the general whole and the other a formula to which the behaviour of that whole is adapted. In the measure that a whole of facts can be represented on a parsimonious way, we consider it follows a pattern. That pattern is exactly the formula that represents it. Thus, it is a parsimonious description which is more concise than the facts themselves. In other words, we do not seek the “law” or the absolutely most simple regularity. We are looking for but “law” or regularity that is more parsimonious in relation with the phenomena that explains, which is the most parsimonious [29].

Sometimes, as it is the case with television programming, it happens that we must be able to get conclusions from the theories before we can contrast them with the facts we have. But this must be approached from the bounded rationality and not from a rationality that maximizes [30]. Thus, we must be able to develop theories about programming, about certain programs rightness at specific times and to predict these contents behaviour competing directly with other audiovisual

offer. All this before having information about audience, which is the posterior confirmation to the viewers backup to a specific programmatic strategy.

But the possible behaviour of a communicative or programming strategy in specific conditions can be significantly modified by the fluctuation of an only variable. This could be a new channel turning up in the offer, a change in the programming distribution in the competition, the appearance of a new agent in the television scenario, etc. The number of elements that can affect to programming and to the obtained results gives this a high level of complexity.

#### ACKNOWLEDGMENT

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