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INTERSYSTEMIC COMMUNICATION BETWEEN LAW AND SCIENCE ABOUT RISK, ITS IMPROBABILITY AND THE SUSTAINABLE DEVELOPMENT OF NANOTECHNOLOGIES

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The task is not so much to see what no one has seen, but to think what no one has yet thought about what everyone sees." (Arthur Schopenhauer)[1]

1. SCHOPENHAUER, A. **Parerga uns Paralipomena**. Porto Alegre: Zouk, 1851.

Abstract: Today we are experiencing the effects of the Fourth Industrial Revolution, where more and more technological innovations are consumed, but Planet Earth is overloaded and has shown numerous symptoms of a depletion of reserves. It is still necessary to discuss the production and consumption patterns of a large majority of Earth's inhabitants, a behavior that has caused serious and irreversible consequences for human and environmental health. The expansion of the use of nanotechnologies is one of the novelties that has been occurring in the production sector, bringing a series of concerns about risks to health and the environment. The observation of the communicational improbability between the system of Law and Science about nanotechnological risks and how this affects the responsible and sustainable management of innovation is necessary. It demonstrates the indispensable immersion of the Law System in the observation of nanotechnological risk, contributing to the discussion of the possibilities and challenges that the use of nanotechnologies is already generating for current and future generations, especially with regard to human and environmental health.
Keywords: Nanotechnologies, Risk, Inter-systemic communication, Development, Sustainability

INTRODUCTION

We are facing a global crisis. We are totally dependent on the natural world. It supplies us with every oxygen-laden breath we take and every bite we eat. But we are currently damaging it so deeply that many of its natural systems are now on the verge of collapse.

It can be said that, today, in order to achieve the objective of living in a more sustainable world, we need to discuss, study and question our current patterns of production and consumption, as humanity. Since the 1970s, we have been discussing what it is and how to make sustainable development possible, uniting economic, environmental and social aspects, with the care of the planet, our exhaustible source of natural resources. However, it is obvious that we have failed... As humanity... Just look at the countless and catastrophic consequences of changes caused by climate change (for those who believe in the system of science).

The socioeconomic development that has been taking place with the advent and implementation of new technologies in the most diverse production processes cannot fail to consider ethical, legal and social aspects, as well as sustainability, always promoting the ideals of planetary responsibility and non-retrogression. environmental.

These technologies are no longer just futuristic promises and are incorporated into the daily routine of society at the beginning of the 21st century, therefore demanding attention from the Law. But many of these new technologies are accompanied by scientific uncertainties about their effects and future damage to the environment and human life.

The world on the nano scale has always existed as part of nature, but only from the middle to the end of the 20th century, the human being was able to access this order of magnitude, visualizing the billionth part of a meter. It is observed in the daily life of human life the increasing consumption of countless new products with nanotechnology, in the most diverse areas. The products and sectors where nanoparticles can be found are: food; household appliances; medicine; Petroleum; printers; renewable energy; sport and fitness; textiles; agriculture; automotive; construction; cosmetics; electronics, as well as use for environmental purposes (INTRODUCTION, 2017). Even this broad

list is open due to the continuous process of development of nanotechnologies. Such products bring the promise of benefits and utilities never thought of before, arousing curiosity in consumers and society in general. This way, the consumption of these nano-scale creations has been increasing, with a universe of novelties poured into the market daily.

The wider the use of nanoscale in industry, the greater the amount of products made available to the consumer. What is the concern? By means of specialized equipment, able to interact with the atomic level, products with physical-chemical characteristics different from those found in their similar on the macro scale are generated. Allied to this aspect, there is no specific regulation for nanotechnologies throughout the life cycle of a nanomaterial. The Exact Sciences, among which the following stand out: Engineering, Chemistry, Physics, Biology and others, have not yet managed to calibrate the methodology for evaluating the safety of products developed on the basis of the nanoscale; the number of nanoparticles already produced by human action, the so-called engineered nanoparticles, is unknown.

The risks are largely unknown and the future damages uncertain, but the decision needs to be made in the present, through the use of these new tools arising from the incorporation of the idea that knowledge can no longer be imprisoned within the hermetic limits of each field. of knowing. This way, it is at this time that legal models must be observed and built permeated by both certainty and uncertainty regarding social expectations that are continually frustrated / satisfied through social complexity in permanent increase (ROCHA, MARTINI, 2016).

Thus, the advancement of nanotechnologies, in a growing set of applications, begins to integrate the daily life of Brazilian and global society. On the other hand, the research and products that will come from this human intervention in natural forces will require the performance of different systems, with the assessment of emerging social, ethical and regulatory impacts, supported by an innovation model that must be responsible and sustainable, as there is uncertainty about the nanotechnological risks.

The transformations of today's society are greater than can be predicted, and even more profound and faster than at any other time. Thus, the current scenario presents itself as a challenge for new analyses, studies and research.

A critical law is needed, capable of reading reality and able to provoke the necessary changes in this reality, otherwise it will remain isolated from other areas of knowledge, which will use the empty spaces left by law to act, including on regulatory issues. . The research that will result from the use and implementation of new technologies will require the performance of different systems, with the assessment of emerging social, ethical and regulatory impacts, supported by an innovation model that must be responsible and sustainable.

Regarding the objective, we can mention the observation of the question of communicational improbability between the system of Law and Science about nanotechnological risks, as well as how much this affects the responsible and sustainable management of innovation.

To develop this work, the systemic-constructivist methodological perspective will be used, in order to observe how the legal bases can be developed and communicated regardless of their connection with the Legislative Power, promoting inter-systemic communication with the Science System.

The systemic-constructivist method considers reality as a construction of an observer, analyzing all the peculiarities involved in observation. It is a method that starts from a complex second-order observation, presupposing reflections that are established from a set of theoretical categories, typical of the Pragmatic-Systemic Matrix, which maintain a self-referential theoretical coherence. It is an autopoietic strategy of legal reflection on the very conditions of meaning production, as well as the possibilities of understanding the multiple differentiated communicative dynamics in a complex environment, such as that generated by nanotechnologies.

Furthermore, this approach presupposes the understanding of Law as an autopoietic social system, whose operations are communicative, developed through decision-making processes elaborated within a certain legal organization. A system that constitutes itself as a part of the environment of society, also understood here as an autopoietic system.

This way, the research problem that we intend to answer can be defined as follows: under what conditions can the Law System deal with the improbability of inter-systemic communication between Law and Science, in the face of the challenge that nanotechnological risks represent for sustainable management of nanotechnology innovation?

NANOTECHNOLOGIES: AFTER ALL, WHAT IS IT ALL ABOUT?

Nanotechnology is the set of research, development and innovation actions, obtained thanks to the special properties of matter organized from structures of nanometric dimensions. The term nanotechnology derives from the Greek prefix nános, which means dwarf, techne, which means craft, and logos, which means knowledge. Currently, nanoscale technology brings with it many uncertainties, especially concerning the highly harmful risks to health and the environment (DURÁN, MATTOSO, MORAIS, 2006). Thus, a textual configuration on nanotechnology is necessary, one of the types of technological innovation of post-modernity, highlighting its origin, what it really is, its uses today, the productive sectors involved and the current global investments in this field of innovation.

Nanotechnology exhibits a high degree of interdisciplinarity. Biologists, chemists, physicists, doctors and engineers contribute their experiences and ideas to generate innovative applications and products for society.

Nanotechnology is a fundamental and general-purpose field of science and technology for all sectors of the economy dealing with matter and biosystems, as information technology is a general-purpose technology for communication and computing. Two other fundamental technologies emerging in the early 21st century are biotechnological and cognitive technologies. These are the four fundamental megatrends in science and engineering in the first quarter of the 21st century. New specific fields of science and technology are continuously created at the confluence, by the spin-off and recombination of the four fundamental fields of nano-bio-info-cognitive (ROCCO, 2016).

Nanotechnology can be defined as the science of manipulating matter at the nanometer scale in order to discover new properties and thus produce new products. Over the past 30 years, a considerable amount of scientific interest and research and development funding dedicated to nanotechnology has led to rapid developments in all areas of science and engineering,

including chemistry, materials, energy, medicine, biotechnology, agriculture, food, electronic devices. and consumer products. In the US alone, the federal government has spent over $22 billion on nanotechnology research since 2001 (CHENG, 2016).

The Organization for Economic Co-Operation and Development (OECD) defines nanotechnology as a "[...] set of technologies that allow the manipulation, study or exploration of very small structures and systems (generally less than 100 nanometers)". (OECD, 2017).

Advances in the fields of nanoscience and nanotechnology have resulted in numerous possibilities for consumer product applications, many of which have already migrated from laboratory benches to store shelves and e-commerce sites. Nanomaterials have increasingly been incorporated into consumer products, although research is still ongoing on their potential effects on the environment and human health (VANCE, 2015).

Currently, in addition to a very large increase in products with each passing month, nanotechnology is being inserted daily in society's life, from cosmetic products (sunscreen, anti-wrinkle cream), shampoos, even household products (drinking fountain, 'water) and medicines, the war industry, among other areas (INTRODUCTION, 2017). The field of nanotechnologies is advancing rapidly and is expected to impact virtually every facet of global industry and society. International standardization in nanotechnologies must contribute to the realization of the potential of this technology through economic development, improvement of the quality of life and for the improvement and protection of public health and the environment. Many newly manufactured nanomaterials can be expected to enter the market and workplaces (ISO, 2017). This rapid transition from laboratories to factories and, from large-scale production, to the consumer market, lies an important focus of the possibility of risks not properly evaluated and known. That is to say: it is a face to be observed by the System of Law.

WHAT ABOUT THE RISKS? THEY EXIST?

The current moment experienced by the human community brings news and challenges, many of which are unprecedented and, therefore, with incalculable consequences - positive and negative. Undoubtedly, the human creative imagination enables the projection and development of artifacts that can be very useful, enabling a more comfortable life. However, the engine of imagination - which has been called innovation - has led human beings to enter fields that have always existed in nature, but accessible to human beings precisely as a result of disturbing human nature.

Although today the benefits of nanotechnologies dominate our thinking, the potential of this technology for undesirable results in human health and the environment must not be overlooked, since, due to the size of the materials, they are governed by physical laws very different from those with which science is used to, opening possibilities for nanoparticles to present a higher degree of toxicity than in larger sizes, this is the reason why there is a need to assess the risks that exist arising from the manipulation, development and application of these new technologies, noting toxicity, appropriate methods for toxicity testing, as well as impacts on human and environmental health (HOHENDORFF, ENGELMANN, 2014).

The sooner it is possible to develop robust technology assessments on products with nanomaterials, with the participation of

engineers, biologicals, soil scientists, farmers and concerned citizens, the sooner it will be understood what nanotechnology can do well and safely, and that it cannot do well and safely for our planet. Nanoscale materials may be biologically more active than macro-sized materials, and have a unique ability to interact with proteins and other essential biological functional elements.

So far, no long-term adverse health effects have been observed in humans. This may be due to the recent introduction of nanomaterials, the precautionary approach to avoiding exposure, and ethical concerns about conducting studies in humans. This means that, with the exception of some materials where human studies are available, health recommendations must be based on extrapolation of evidence from in vitro, animal or other studies from fields involving exposure to nanoscale particles such as air pollution, to assess possible effects on humans (WHO, 2017).

The field of nanomaterials is moving rapidly, with new materials, new applications for existing materials and new methods for producing nanomaterials. However, the assessment of the risk associated with exposure to nanomaterials and the characterization of risks have not kept pace with advances in nanotechnology. That is to say, there are more questions than answers (BUZBY, 2010). The harmful impacts and potential risks to human and animal health, the environment and even human behavior are still poorly understood. For the evaluation of these aspects, tests that seek to identify: a) their physical-chemical properties must be improved and developed; b) its potential for degradation and accumulation in the environment; c) its environmental toxicity; and d) its toxicity towards mammals (ABDI, 2010). As there is a growing interest in the production of nanomaterials, the potential of these materials as environmental contaminants must be considered.

There is a pressing need to assess the risks associated with the manipulation, development and application of new nanotechnologies. Among the various existing doubts, the following stand out: What is the toxicity of these materials, which can be very different from the toxicity of the same materials on a larger scale? What are the appropriate methods for toxicity testing? What are the health impacts of those who will eventually manipulate a nanoparticle? And for those who will receive drugs that are made with nanoparticles? What is the extent of translocation of these particles in the body? What is the effect of products and their waste in contact with the environment? How to safely handle, transport, store and dispose of nanomaterials?

Knowledge of the characteristics of larger-sized substances does not provide comprehensive information about their properties at the nano level, since the same properties that change the physical and chemical characteristics of nanoparticles can also cause unintended and unknown consequences when in contact with the human organism. . The absence of studies on the interaction of the application of nanotechnologies with the environment (air, water and soil) exposes the possibility of occurrence of environmental risks and also risks in relation to human beings.

Since the Science and Law Systems do not have the same understandings about risk and danger, the issue of nanotechnological risks, precisely because of their characteristics, makes communication between these systems, on this topic, even more unlikely. This way, the improbabilities of inter-systemic communication between the Systems of Science and Law and the challenges for the management of nanotechnological risks in a

sustainable way will be characterized.

COMMUNICATION BETWEEN THE SYSTEM OF LAW AND THE SYSTEM OF SCIENCE: ITS IMPROBABILITIES AND THE CHALLENGES OF NANOTECHNOLOGICAL RISKS TO SUSTAINABILITY

Risk can be considered a kind of link with the future, but one cannot fail to understand that the alternative in relation to risk is not security, but another risk. This way, the observation of the improbability of inter-systemic communication (Science and Law) about risk is a way of meeting the need for legal research to be concerned and observe risk in today's society.

According to Luhmann (2006), the technique is by no means the only case of a risky decision. Undoubtedly, in the case of high technologies (and here obviously Luhmann did not envisage the issue of nanotechnologies and their risks, considering that the text was written in 1991) it is evident that the risk becomes something reflexive. This is precisely what, in the context of risk communication, gives technique its exemplary and paradigmatic meaning. The simplification and isolation procedure that contains the risk of non-operation is again used to eliminate or weaken these risks.

Making a decision implies the possibility that the consequences will occur differently. This way, decision-making needs to "[...] work on the risk, work on the decision process, work on anticipation, strategies, planning, economy, that is, it is necessary for legal operators to know that, the risk".(ROCHA, 2001, p.136).

It is interesting to notice that decision-making is a characteristic of the Law System, notably when it is seen from the perspective of Procedural Law, from the perspective of litigation, but, on the other hand, with a growing emphasis, the decision that is taken extrajudicially , in order to avoid entering the Judiciary.

Again, when analyzing the role of law and risk, Rocha (2013) makes his opinion explicit in the sense that he agrees with Luhmann about the need for legal research to be directed towards a new conception of society, centered on the postulate that risk is one of the fundamental categories for observation, as already exposed throughout this work.

Concern about the risks of new technologies became an object of public concern only when these risks began to be communicated to society, especially about uncontrollable damage. Risks are always threatening events. Without visualization techniques, without symbolic forms, without means of communication, etc., the risks are nothing (ENGELMANN, 2017). It must be noted that the risks/hazards of nanotechnologies are greater, more comprehensive than the ecological risks/hazards, since they can generate resonances in the most different social systems, in countless different ways.

It is necessary to mention that in the current moment of knowledge of the Science System, there is a lack of knowledge of the possible reactions of nanoparticles in the environment, and it is precisely in the interaction between the environment and its variables (which are controlled in in vitro and in vivo studies developed in laboratories) that the nanoparticles may present characteristics of greater toxicity.

The use of nanotechnology and advanced materials promises to revolutionize many areas of technology and improve our daily lives, with many positive effects on the environment being expected, either directly, by developing new technologies for remediation of environmental pollution, filtration or power generation techniques, or indirectly, for example, saving resources due

to lower consumption of raw materials, or lower consumption of energy and fuel due to the lower weight of vehicles. However, the beneficial effects of new technologies are often matched by concerns about the safety of new substances or materials.

On risk and risky behavior and also on risk communication in today's society, De Giorgi (1991, p. 247-248) also addresses the issue of decision makers

> In modern industrial society there is no choice between risky behavior and safe behavior, only the choice between different forms of risk with a distribution of advantages and disadvantages and of recipients of advantages and recipients of disadvantages. The fundamental problem of risk communication, therefore, is not a problem of determining rational or even safe forms of behavior; it is rather about exhausting the difference between those who make the decisions and those who have an interest in those decisions. For the person who takes a decision, the risk is unavoidable, provided that one does not want to renounce all the advantages that derive from a commitment to action: for those who are interested in the decision, who do not participate in the decision, it is a matter of , on the contrary, of a danger that comes to them from outside. As research conducted, in general, on the perception of risk demonstrate, the attitude towards uncertain future damages is very different when considering the damage as a possible consequence of the behavior itself and that it is attributed to the other party.

From all the above, the communication of risks stands out, remembering that communication is the central element of society and only exists as a social system and only within social systems as didactically explains Luhmann (2010, p.83).

> Social systems are made up of communications. Communication is that autopoietic operation that recursively refers to itself, retrospectively and prospectively, and thus produces social systems. Communication, then, only exists as a social system and only in social systems. Sociability is not a given fact, independent of communication (for example, as a property of the human being).

Thus, society as a social system is constituted and sustained through communication, which depends on language, functions, differentiation and structures, thus generating social evolution (ROCHA, 2013).

For Luhmann (2006, p.40) social analysis is solely concerned with communication: "Communication and no other thing is the operation with which society as a social system is produced and reproduced autopoietically".

Only a fraction of what is scientifically possible is realized. Most are not economically, legally or politically viable and therefore depend on inter-systemic communication, so that decision-making on these topics can occur within each system responsible for each area, functionally differentiated, therefore, and according to your own codes. Here, in relation to the communication of nanotechnologies, it is worth remembering what Drexler (2013) mentions: What is possible, however, will depend on the state of opinion, and opinions, as they are formed, are shaped by conversation. An agenda for action, therefore, starts with conversation.

According to Luhmann (1989), the effects of contingency propagation and, in addition to the problems they create by themselves, other systems are not yet in a position to have to want what is technically possible. In this situation, the ability to reject what is technically possible takes on great importance. It can be used against creating ecological risks as well as in selecting corrective measures. It is more likely, however, to be practiced in economics with a view to economic profitability, in law in accordance with criteria of existing law, and in politics for reasons of political expediency. This way, once again the functional differentiation of the systems and their operational closure

is clear, which is only viable in terms of each binary code, of each system.

About the system of science and risk, Luhmann (2006, p.269) explains that

> Science speaks about itself as if it were a third party. It will be recorded that he is perceived as something risky and dangerous, as if it were none of his business. For this reason, he also sees no reason to question whether risk research itself is ultimately either risky or dangerous, providing, for example, arguments for future research better be suspended or, at least, regulated. and thus limit themselves, at the cost of the autonomy of the scientific system. And this can have the consequence that true knowledge (including knowledge about the danger of true knowledge) is not available if necessary and that one is then forced to improvise or, alternatively, to make an impressionistic decision.

It will be through a second-order observation that risks can be observed that cannot be foreseen by another system. The risks of scientific progress are well worked out (prognosticated) by ecology, but for the Legal System these risks cannot be observed except through the observation of ecology observations (SIMIONI, 2011).

Bearing in mind here that nanotechnological risks will involve something greater than ecological risks, as they may have resonance in numerous systems, with consequences still perhaps not even imagined, neither by the science system, nor by the economy and law.

Luhmann (2006) explains society through the existence of social systems that are autonomous, with their own rationalities and that operate according to these rationalities, so that they are autonomous and self-sufficient in relation to the environment, without direct relationships with other social systems. (operational closing). Systems may suffer irritations, which will be processed according to the system's internal functionality, giving rise to so-called resonances (result of irritation from the surroundings and other partial systems).

Regarding environmentally relevant inter-systemic communication and anticipation of the possible negative results of human actions, communication is needed in which a kind of balancing of collective interests is carried out (which also involve the preservation of the environment, sustainability and intergenerational equity) and the pressures of an economy (WEYERMÜLLER, 2010).

It happens that this communication beyond the system of Science, as well as the one that is intended, beyond the system of Law, that is, inter-systemic communications need, in addition and above all, to reduce the improbabilities of communication, well presented by Luhmann (2001) and later also addressed by Rodrígues Mansilla and Opazo Bréton (2007).

Luhmann (2007, p. 45-146) explains that communication is a synthesis of three selections: a) information; b) make the information known; and c) understand the information. Information is a difference that produces a difference in a system. Why is it that and not other information that makes a difference in the system? Why was this chosen and not other information to make known? Why must anyone bother to make something like this known to someone and why someone and precisely why that person? Why was it chosen to make the information known this way? Why must anyone pay attention to the other person making them known and also try to understand the information they want to express?

Thus, communication is the result of three selections that bring together: information, the way to make it known and an understanding, based on the relationship between Alter and Ego. This way, full communication is the union, the synthesis of these three selections

and only occurs when the Ego selects understanding, which naturally includes incomprehension. This way, the explanation by Rodríguez Mansilla (2010, p.14-15) helps to elucidate the parts that make up the communication process:

> Communication does not consist in a transmission from someone to someone, as the persistent theory of action claims, but rather the synthesis of three choices that takes place in the presence of alter and ego, but does not consist of their actions. Communication, therefore, is an emerging phenomenon that characterizes the passage from the individual psychological level to the social level in which individuals remain an essential part of the environment.
>
> The three selections whose synthesis configures the communication are:
>
> a) Selection of information: Alter must select from the information available which one he wishes to share with Ego. [...].
>
> b) Selection of a way of making it known: Alter selects the medium - oral, written, digital - in which the selected information is going to be made known. [...].
>
> c) Selection of an understanding: Ego selects what he understands from what he has heard or read. [...]. (author tap).

After overcoming and understanding the three selections necessary for communication to occur, the three improbabilities of communication occur are analyzed. There are problems and difficulties that communication needs to be able to overcome in order to become possible. Thus, there are 3 (three) communication improbabilities that need to be overcome: a) improbability that the other will understand. It is unlikely that anyone understands what the other means, behold, each one uses some form of interpretation of what comes to him. As there are countless ways of understanding, it is always necessary to choose one of them, and, therefore, it is very unlikely that this version coincides exactly with what the speaker wanted to make known; b) the impossibility of reaching beyond the circle of those present. Communication that takes place in the physical presence of the interlocutors is unlikely to reach more people. Even though the advancement of technology in contemporary society has tried to contribute to the reduction of this improbability, but, paradoxically, it has increased (DAMACENA, HOHENDORFF, 2016). Even if the communication takes place with mobile transmitters, it is unlikely to receive due attention, as each individual has his own interests; and c) the improbability that the other will accept the proposal contained in the communication is the last of the three stages of the improbability of communication (LUHMANN, 2001) The decision to accept or not a message is linked to making a selection and making a decision. These three improbabilities are mutually reinforcing, so that when one becomes less improbable, the others increase its improbability: if the other is understood, the reasons for refusing to accept increase; if you can reach people who are not present, the probability of their misunderstanding and rejection increases. In addition, by improving the probability of reaching those who are not present, the conditions for moving away increase and thus, the second improbability increases (RODRÍGUES MANSILLA, OPAZO BRÉTON, 2007).

Society is communication, so everything that is communicated is part of society or is society. It has a self-referential closure, and thus, everything that must be replaced or changed, within it, must occur from within. This is how society communicates, transforms and becomes more complex. Thus, there is no way to think of society without communication. It is only communication that

differentiates society from its surroundings and, therefore, from other systems.

Thus, Luhmann (2001, p.71) mentions that communication can only be understood as the dissemination of information within a system - as a dissemination that uses information to lead to information and this way changes the information as well as the state of the system. medium in which information creates forms. Communication is the creation of an emerging reality, namely of society, which, in turn, is based on the continuous reproduction of communication through communication. This can be the cause of binding effects on individual conscious systems as well as of temporary or permanent irritations, dissociations and rejections. Returning then to the issue of communication between systems, and to the fact that all serious research must have this transdisciplinary character, it is worth remembering that "[...] it is not easy to analyze Law from a transdisciplinary point of view. Law seems to be something very different from Physics, from Biology, being far from these issues more focused on the Earth, nature". (ROCHA, 2006, p. 181). Rocha (2006, p. 189) also explains that one cannot observe Law only as Law

> But to observe the Law, I cannot observe it only as Law, I have to see it imbricated, enveloped with the other areas of knowledge. However, it is necessary to observe this, not as in a chaotic situation, where I do not know well the limits of what is Law, biology or politics. An observation must be made with certain criteria. In other words, it is necessary to observe the Law within a complex society. If the law is not observed within a complex society, nothing is observed. And I say more, there is no other alternative.

Regarding the necessary transdisciplinary, knowledge belongs to everyone and no one, it is built by the contingency of historical, social, cultural, life, everyday moments, and that is where all its beauty and intensity lies.

This way, the search for answers to the challenges arising from the use of nanotechnologies and nanotechnological risks. "[...] it will necessarily and inevitably involve different areas of knowledge, always guided by constitutional principles, placing the protection of man and the environment as a priority" (ENGELMANN, FLORES, WEYERMÜLLER, 2010, p. 131).

For Luhmann, communication is a fundamental element of society, but it is also considered highly unlikely, depending on the act of communicating, information and understanding to be carried out. The difficulty of communication between systems is due to the fact that each one reorients its operations according to its code and its own autopoiesis. The information emitted by a system is different from the code of the receiver. Thus, a legal communication may not mean anything to the system of Science or the economy. Normally, communication from the legal system only has effect and meaning for the system itself, unless it achieves a resonance capable of being understood from the code of another system, which can be made possible by structural coupling. This way, the Law does not communicate directly with politics, with education, with science, behold, they do not speak the same language.

Since communication between systems is unlikely and there are difficulties in adapting to nanotechnological risks, the systemic closure that makes these resonances between systems difficult, at the same time guarantees a specific operation for each system and thus preserves its identity (ROCHA, WEYERMÜLLER, 2014), it is necessary to create mechanisms that enable this communication between systems, aiming at greater sustainability of nanotechnological innovation.

Also, according to Rocha (2006, p. 192-193)

> A biologist has to communicate within his own system. Therefore, the problem can be addressed in the search for a new type of communication: biological and legal. Hence the proposal for a biolaw, for example. The concept of biolaw is being elaborated as a symbolic bridge with this objective. In the same way, the concept of de-paradoxization is already being invented. The invention is relevant. Therefore, biolaw is an intelligent word in this sense, because it opens to the symbolic construction of something that would be impossible, therefore possible. Biolaw, from a traditional, dogmatic interpretation, is not possible, being impossible. Only from an autopoietic point of view is biolaw possible, it would also be possible to speak of bioethics.

In the same way that Rocha mentions that the construction of biolaw is impossible and therefore possible, it is intended to observe that practices concerned with sustainability, such as risk management during the decision process, may be a possible structural coupling between the system of Science and Law, in order to allow a more adequate management of nanotechnological risk, communicating risk ideas between systems, in order to think, sustainably, about the future of nanotechnologies. As Law and Science are autopoietic systems, functionally differentiated, the communication between them is complex and involves structural couplings.

A structural coupling would be a kind of bridge, between two systems, a common connection, allowing the coupling of subsidies from one system to the other, when necessary, that is, "[...] different, which maintain their specificity". (LUHMANN, 2005, p. 36) Thinking about nanotechnological risks, this idea would be extremely important, as it would enable a two-way path between the system of Law and Science regarding risks, and would allow the collective creation of mechanisms, in front of the lack of regulation, for the sustainable development of new nanoproducts.

Still on the concept of structural coupling, Luhmann (2006, p. 13) clarifies that

> The autopoietic model is circular, so it makes no sense to talk about causes or effects. Everything that happens in a system is determined by its own organization and not by disturbances from the environment. The autopoietic system is not teleological - it does not operate according to an end -, it is associated with a mutual history of changes consistent with the environment. This procedure is called 'structural coupling'.

Communication between systems is an extremely complex phenomenon in society and, it can be said that it is a communication as contingent as the number of social systems. Regarding this communication, in relation to the system of law, the issue permeates both the means through which the legal system produces information to the environment and the way in which this information is assimilated to the social environment (SIMIONI, 2011).

Law, together with technical areas, needs to design ways for scientists to perceive and be concerned not only with current risks but also with risks for future generations, in relation to the development and applications of new technologies. Law does not determine what happens in society, it only stimulates the other systems that make up its environment by issuing information and, these, in order to achieve the success desired by the legal system, need to cause adequate resonance, especially in the Economic System and, considering in nanotechnological risks, even more, in the Science System.

Regarding the necessary inter-systemic communication between Law and Science, especially in relation to new technologies, Haack (2009) mentions that science now

permeates almost all aspects of modern life. All aspects of modern life, including, of course, the legal system. He further explains that court proceedings now often rely significantly on scientific testimony, and scientific advisors contribute significantly to regulatory decision-making. Also, regarding decisions about the risks of making this or that drug or pesticide available, or the long-term effects of damming that river or relying on this energy source rather than this one; he understands that they are not scientific questions themselves, but to be decided by other systems. He ends by stating that what the system of science wants is, as far as possible, to prevent dangerous things from entering the market and to do so without discouraging the production of useful and harmless material; and, furthermore, to ensure that if dangerous things are brought to market and people are harmed, victims will be cared for and the danger of future injury quickly avoided.

This fits perfectly into the discussion established here about the inter-systemic communication of nanotechnological risks and the need to seek a possible solution by uniting these two systems. Thus, in relation to nanotechnological risks, the "[...] technical areas involved must make use of the Human Sciences, among which Law, to bridge the gap between investigations at the nano scale and the final recipient, which are people. ". (ENGELMANN, FLORES, WEYERMÜLLER, 2010, p. 130).

This way, in search of greater sustainability in the development of nanotechnologies and in order to reduce the communicational improbabilities between the different systems, it is necessary to manage the risks of nanotechnologies throughout their entire life cycle, from their development. until the final destination, thus aiming that the investigation and early detection of risks can be applied as a tool that facilitates communication, as well as the production of nanomaterials in an ecological and innovative way. A more tangible example of this application of risk management is that it is in the name of the precautionary principle that, for example, in the case of nanotechnologies, it is possible to establish that studies are carried out over time, so that more reliable data are produced about the risks. and effects.

CONCLUSION

Today there are stronger and lighter aircraft, self-repairing cement capable of changing color, self-cleaning crystals and materials that mimic the internal structure of living beings and, although they seem like science fiction products, they are a reality thanks to nanotechnology, a science that is expanding the horizon of materials to unknown places.

Ending, but not exhaustively ending the necessary immersion of the Law System in the discussion about nanotechnological risk, remembering the words of Ost (1995, p.389) who mentions that it is necessary "[...] above all, not to conclude, resisting the temptation from the last word, that stroke made at the end of accumulated pages. To reject this desire for closure that reassures, judging everything to gather". Thus, this work is another step towards the discussion of the possibilities and challenges that the use of nanotechnologies may generate.

Nanotechnologies have been highlighted as an innovative area with numerous potentials, including to contribute positively to the pursuit of sustainability and thus, attract more and more investments, but, at the same time, doubts and uncertainties about nanotechnological risks remain. These are beneficial promises of advancement in medicine, environmental remediation, and so many other areas. The benefits are high,

however, there are several research results published by the Science System that light up a warning signal with regard to human health and the environment. Thus, against this positive bias, the risk scenario is observed, with warnings from the scientific community that bring to the debate the risk of damages never seen in the interaction of nanoparticles with the ecosystem, so that it is necessary to impose a certain degree of precaution, and establish minimum safety guidelines in order to protect present and future generations. The scenario of nanotechnologies will require decision-making with a view to the present and the future.

The impossibility of external intervention by each system, in the case of Law, demonstrates the great challenge of inter-systemic communication that passes through multiple communication interactions. Still, regarding the inter-systemic communication of risk, between the systems of Science and Law, it is necessary to deal with the management of risks during the decision process in the complex environment of today's society, including with due regard to the need to evaluate the risks throughout the entire life cycle of nanomaterials, from the cradle to the grave, on a case-by-case basis, so that a sustainable production of these materials is made possible, also concerned with the future of the environment, with the quality of life and with the intergenerational equity.

Since the knowledge available to define all possible risks associated with nanomaterials is still little explored, risk management is essential so that decisions can project their reduction. Therefore, the analysis of products throughout their entire life cycle, from birth to the grave, is absolutely necessary to generate the necessary data for the most complete environmental assessment possible, within the current state of the art of knowledge.

This way, the research problem presented: under what conditions can the Law System deal with the improbability of inter-systemic communication between Law and Science, in the face of the challenge that nanotechnological risks represent for the sustainable management of nanotechnological innovation, responds that, only in the face of an adequate risk management, which necessarily requires work carried out between different areas of knowledge (transdisciplinary), will it be possible to reduce the improbability of communication and, this way, a greater, more intense and fruitful communication between the systems of Science and Law, aiming at the development of nanotechnological innovations in a sustainable way.

Any action will need to reflect on today's global socio-economic landscape and support, among other things, the push to: a) direct scientific efforts more towards dealing with complex, systemic and unknown challenges and complementing this with professional, lay, local and traditional; b) rebalance the prioritization of economic and financial capital in social, human and natural capital; and c) develop greater adaptability and resilience in governance systems to deal with multiple threats and systemic surprises (HANSEN, 2013), and, thus, it is necessary to continue building possible alternatives so that humanity can reap the best fruits of technologies, in a sustainable way. and don't leave anyone behind.

And the system of law? What is your role here?

To think, they follow the wise placements of François Ost (1995, p. 21-22). Ah, the Law... the one that is about to "[...] affirm the meaning of life in society", which has the task of "[...] connecting the bonds and demarcating the limits"... The artist "[...] to decide the irresolubility fund" (OST, 1995, p. 21-22).

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