

THEORETICAL AND METHODOLOGICAL CONTRIBUTIONS OF THE KNOWLEDGE ECONOMY: The applicable "steps" in Brazilian recycling¹

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Abstract

With the emergence of new paradigms in social and labor relations, before the property or assets of a company are valued. However, today, in addition, it is also considered that knowledge (in innovations, technology, experience, trade secrets, among others) adds value to an institution. Therefore, this research seeks to detail the phenomenon of the knowledge economy, in job prospects, education, environment and innovation, in addition to relating this concept to the collection of recyclable materials. The problem question developed to initiate the reflections was: How is the knowledge economy related and positively influences work activities such as the collection of recyclable materials? The general objective, on the other hand, is to understand how knowledge, experience and innovations are configured as fundamental for the improvement of processes and work in industries and organizations,

¹ Initial words: The social production of work in the Recycling Network of the State of Rio de Janeiro. This article is part of the research THEORETICAL AND METHODOLOGICAL CONTRIBUTIONS OF THE KNOWLEDGE ECONOMY: The applicable "steps" in Brazilian recycling, in progress in the Doctoral Program in Geography - Doctoral Program in Geography at the Institute of Geosciences of the Federal University of Minas Gerais -, in the line of research of Space Production, Ecology, Politics, Culture and Education in Geography. We thank FAPEMIG for granting the research grant.

here, specifically, the recycling industry. The specific objectives are focused on: detailing the emergence of the concept of the “Knowledge Economy”; understand how the knowledge economy relates to aspects of education, labor and the environment; understand the concept of social innovation and how it applies to third sector organizations; and learn about the “Steps of knowledge” applied to the activity of recycling materials. The methodology was an analysis of the recurring literature related to the topic of the knowledge economy and the recycling industry. It is concluded, therefore, that the workers of this branch make up the large group of Brazilians in conditions of informality and social exclusion and rights, and that is why the discussion addressed here is so important. For believing that the condition of these recyclers continues to be highly undervalued, despite being so important, both for society and for the environment.

Keywords: Knowledge Economy. Recycling. Informal Job.

1. Introduction

Globalization has motivated profound economic and social transformations that ended up being incorporated by society and studied in detail, over the years, so that they could be better understood. New paradigms have also emerged in labor relations, as well as a consumer market with new requirements. If before what was mainly valued was related to the material goods or assets of a company, as well as a professional with knowledge formalized by the diploma, today, in addition to these aspects, what adds more value to a company is the knowledge that provides possibilities for profit, financial advantages and procedural improvements, through innovations, technology, experience, trade secrets, among others.

In this sense, nowadays the importance of knowledge is already recognized for the execution of any labor activity, where the worker offers, in addition to the manual labor force, their intellectual strength and their knowledge based on experiences. This phenomenon, as will be detailed in this book, is called Knowledge Economy and also attributes an essential role to innovations and technologies, demonstrating how these aspects can positively influence management and work processes in companies or any other institution.

Then, this research seeks to detail the phenomenon of the knowledge economy, from the perspectives of work, education, environment and innovation, demonstrating how they are inseparable issues, functioning as a mechanism, which requires each component to act in a certain way so that the apparatus works effectively. In addition, it relates this concept to the activity of recycling materials, which, even though it is so current, is still in a precarious position and needs urgent intervention by this intellectual capital.

In this sense, to support the reflections proposed here, the question of the problem was developed: How does the knowledge economy relate and positively influence work activities such as the collection of recyclable materials? Therefore, the general objective of this work is to understand how knowledge, experience and innovations are configured as fundamental for the improvement of processes and work in industries and organizations, here, specifically, the recycling industry.

The specific objectives are focused on:

- Detail the emergence of the concept of the “Knowledge economy”;
- Understand how the knowledge economy relates to aspects of education, work and the environment;
- Understand the concept of social innovation and how it applies to third sector organizations;
- Know the “Steps of knowledge” applied to the activity of recycling materials.

Regarding the methodology, it is stated that the main path followed was an analysis of the recurrent literature related to the theme of the knowledge economy, based on readings of articles and materials found in the main publications. Thus, from this bibliographic review, a compilation of information was made by important authors in the field, such as: Lodi's material (1968) [27], which analyzes the works of the precursor to the Knowledge Economy, Peter Drucker; Gouveia (2018) [19], who explains several concepts about work relating them to the knowledge economy, in the view of authors such as Lundvall; Karolczak and Souza, (2017) [22] who approach the Human Capital Theory; among other aspects, including the most important and the most related to the researched area, which is the work of Bunchaft and Oliveira Filho (2015) [33] concerning the steps of knowledge in the scope of the recycling industry.

The discussion of this article is divided into two parts. The first part seeks to introduce and contextualize the idea of the Knowledge Economy. It mentions the works of Peter Drucker, from the perspective of Lodi (1968) [27], demonstrating how his ideas were fundamental for the understanding, nowadays, of the importance of considering knowledge as a fundamental part within an organization or work activity.

Then, he relates the work to the concept of the Knowledge Economy, demonstrating the profound changes in labor relations in the globalized world, arising from new ways of seeing entrepreneurship, based on innovation and the valorization of knowledge / experience in the market.

It also seeks to reaffirm the importance of education for the practice of the knowledge economy and how it provides an essential differential in improving labor and business processes. In addition to education, it also seeks to detail the role of innovations in this context and how they can ally with the environment, aiming at the creation of new but responsible ways of using natural resources. So, it is about Social Innovation, which refers to those innovations that do not aim at profit, but rather improve the quality of life and the well-being of people and workers, a concept more present in third sector organizations.

Finally, the second part relates the concept of the Knowledge Economy to the recycling activity, detailing the knowledge steps in which each type of waste picker fits, and making a qualitative and quantitative analysis of its main aspects and assumptions. It is observed that these steps follow an order that begins with the one where more knowledge is invested, as is the case of recyclers who organize themselves in cooperatives that use more technologies and innovations to improve work processes. This order ends with

those workers who are not organized, and therefore work alone, having greater difficulties in leaving their condition of vulnerability.

It should also be noted that the importance of this work lies in the fact that it raises reflections on a group of workers in need of public policies, a view of the political authorities, so that they can provide them with access to social welfare, through a greater appreciation of their workforce and especially his work, which, despite being of such importance, is not seen that way by society.

2. The knowledge economy: Contextualization

As mentioned in the Introduction, this new dynamic, or new way of thinking about management, is called the “Knowledge Economy” and advocates, in general terms, that the most important asset of an institution is knowledge. In this context, it is essential to mention the works of the researcher and philosopher Peter F. Drucker, who was a precursor of the idea of the Knowledge Economy, in the light of the analyzes of João Bosco Lodi (1968) [27].

2.1 The work of Peter Drucker

Tracing a path in relation to Drucker's works, Lodi (1968) [27] begins by mentioning his first works, written before the end of the second war, which did not yet directly address the theme that would be part of his most important legacy: the Knowledge Economy, being influenced mainly by his career in the area of public and international law, with reflections on the legality of power and the status system in a society considered industrial (LODI, 1968) [27].

These works have as premise that society is increasingly represented by industrial corporations, represented not in the sense of quantity, but in relation to the characteristics and essence of an era (LODI, 1968) [27]. Lodi (1968) [27] further states that Drucker believed, however, that the rise of these corporations “will not be complete until they represent values widely recognized by today's man. One of these values is the belief in freedom and equal conditions” (LODI, 1968, p. 84) [27].

In this sense, the author also states that Drucker considered profit as a trivializer of human behavior, in a free and capitalist society, while socialism would be that same society, however without classes, under conditions of equality. Nonetheless, industrial society meant that neither of these two ideals (freedom and equality) prevailed, and then another economic model was generated (LODI, 1968) [27].

Thus, this new society is based on the following characteristics: every subject has they function in society, linked to their occupation, in addition to a recognized social status and legitimate social power (LODI, 1968) [27]. So, it is possible to affirm that his first works discussed the aforementioned issues, as well as the new social and power relations involved in the "industrial company", as Drucker calls it.

Some time later, Drucker published *The Concept of the Corporation* (1946), which dealt specifically with

large corporations, using General Motors as an example and arguing how decentralization was important to strengthen the management process of a large company. Decentralization would then be a large corporation that carries out the entire production process, without delegating to other small companies, whose administration is divided into sectors, according to each activity, with each sector managed by a professional (LODI, 1968) [27].

Thus, in summary, according to Lodi (1968, p. 88) [27], the book was divided into three parts, namely:

In the first part, entitled "The Corporation as a Human Effort", the author analyzes the organization of General Motors, its decentralization and its marketing problems. In the second part, entitled "The Corporation as a Social Institution", the author analyzes the various social levels of the organization, focusing more on the level of foreman and supervision. The corporation is identified with the American class system and especially with the social values of the middle class. In the third part, whose title is "Economic Policies", the author analyzes several related problems: the question of size, monopoly, production objectives and the problems of full employment policy.

It is observed how Drucker sought to reflect and discuss about the management processes of the time, considered innovative, and also about the intellectual resources necessary for the dynamics to be successful. By intellectual resources, it is understood that it would be the knowledge, talent and experience of the professionals, that is, a set of skills necessary to achieve the proposed result (LODI, 1968) [27]. From there, then, the idea of the knowledge economy begins to take shape, when intellectual knowledge becomes more valued, due to its ability to improve processes and innovate, consequently generating economic advantages.

Since then, Drucker has developed this concept in publishing other works such as *The New Society* (1950) [15], which discusses basically two themes:

The first is that the industrial society of the twentieth century is an entirely new and peculiar society of worldwide more than Western or capitalist. The second is that this new society has a specific institution: the industrial company, with its administration, its manufacturing community and its twin brother, the labor union (Drucker, 1950) [15].

Another interesting point to be observed in this work is when the author talks about a certain "administrative attitude", and how it is able to increase the efficiency and productivity of the work. Its basic premise is to encourage employees to feel that they are part of the company as a whole, integrating them to their main objective, so that they can fight for the proposals and work more motivated.

It should be noted, still according to Lodi (1968) [27], that the book had been released before the Korean War, so Drucker had to reissue it a few years later, due to the changes that took place in society after the war, which gradually became increasingly "restless and tormented".

In 1954, Drucker published one of his most important contributions to management theory, *Business*

Administration Practice. The book deals with, among other secondary aspects, the technique of management by objectives, which consists of “a method of planning and administrative control, based on the premise that in order to achieve results the company needs to define what business it is and where it intends to reach” (LODI, 1968, p. 104) [27].

In addition, the work is considered an important guide for the professional behavior of the manager of a company, with precise instructions and reflections on how a manager should act and act, in general, and in certain situations, in order to achieve the goals of an institution, without the need to act only in emergencies or through campaigns (LODI, 1968) [27]. The author still works with the hypothesis that management by objects would be a philosophy that “is based on the principle of motivation of human behavior, applies to every manager and ensures genuine freedom for the executive” (LODI, 1968, p. 108) [27].

Shortly thereafter, with the publication of *Frontiers of Tomorrow*, in 1959, Drucker shifted the focus of his discourse a little, continuing on the path to potentiate the idea of the Knowledge Economy, by addressing the changes that occurred in the postmodern world, mainly those related to technological innovations and the revolution in the educational area. In other words, the main concern is no longer with managerial efficiency, but with transforming aspects outside this process.

In 1964, the author returned to the theme of business administration, with the publication of *Administration for results*, however, bringing new ideas, complementary to the others, more enlightening and compatible with the moment of transformations that the world was going through, at the time. He changes the focus on efficiency in processes, for the analysis of results: “[...] the company needs to introduce an economic system of marketing planning and evaluation that allows it to replace the focus of work with that of results” (LODI, 1968, p. 120) [27].

In addition, Drucker makes a market analysis, proposing: that the products are observed, according to several categories, so that the company can decide which products are worth, or not, to keep in a company's catalog; that customers and non-customers are analyzed, according to different parameters, in order to discover how to attract more customers or compete in other markets (LODI, 1968) [27].

The author also proclaims what, for this work, can be considered fundamental for the practice of a knowledge economy, where know-how and expertise, then, become one of the most valuable capital of a company. As follows:

As a consequence of the analysis of these "market realities", the company must evaluate the capital formed by its knowledge. See the things he did well and the things he did poorly. Asking: what is our business? What are we able to do well? "Knowledge is a perishable good. It needs to be reaffirmed, relearned, reprized all the time. A person needs to work constantly to regain his own specific leadership. All knowledge becomes wrong knowledge. It becomes absolute. The

question should be: What else do we need? Or, do we need something different? " (DRUCKER, 1964) [16].

Finally, it is important to mention the work in which the author introduces the idea of the Knowledge Economy, *The Effective Executive*, from 1967, which focused mainly on the efficiency of the work of the manager / administrator / executive. In the Introduction, the author seeks to demonstrate that having knowledge and intelligence does not guarantee the efficiency of the manager's work: "it is common to find executives of good intelligence, solid knowledge of the function, bright and imaginative people. However, few of these people are efficient" (LODI, 1968, p. 127) [27].

In the book, Drucker mentions and details the five basic principles of efficiency, namely:

- Know where to spend your time;
- Focus efforts on results rather than work;
- To be based on the strongest personal qualities;
- Focus on key tasks;
- Make effective decisions (DRUCKER, 1967) [15].

Among these principles, the most important is the one that speaks of the focus on results, to the detriment of the work itself:

The focus on contribution turns the executive's attention away from their specialty, from his limited skills, from their department, towards the whole. They turn their attention to the outside, the only place where there are results (DRUCKER, 1967) [15].

In this sense, Drucker's basic premise is that efficiency is a habit, something you learn, not atavistic. For him, administrators focus a lot on graphs, tables, numbers and quantitative analysis, when in reality, they should look outside, acquire a more subjective and qualitative view of what happens with their product when they leave the company, also a view of the transformations of the market, and, as mentioned earlier, acquiring this vision takes time, experience, discussions, learning, and that is exactly how a manager becomes efficient (LODI, 1968) [27].

Lodi exemplifies this by citing thalidomide, showing that many lives would have been harmed if they had waited for the statistical results instead of listening to a physician who did a more subjective analysis of the problems that this medication was causing (LODI, 1968) [27].

Therefore, it is worth mentioning how Drucker was essential for the idea of the knowledge economy to be built, especially when he mentions how valuable knowledge and experience is for the management of a company. In this sense, now thinking along the lines of contemporary society, it is worth stating that the knowledge economy also includes, in addition to knowledge and experience, scientific research, technological innovation, knowledge that turns to sustainability, etc., which is possible to observe in the work of Roberto Mangabeira Unger, who proposes a new knowledge economy.

This author can be considered as one of the most important scholars on the knowledge economy, in the current context, and highlights the great potential that exists in this model of transforming human life and promoting strong changes in economic and social organizational dynamics. However, his vision also addresses another side of this theme, which is the fact that the knowledge economy as it is practiced today, “ends up accelerating the deterioration of working conditions worldwide, restricting the benefits of productive innovation and concentrates capital and power [...]” (MANZATTO, 2020, p. 1) [31], therefore having an exclusionary character.

In addition, the author reaffirms the need for changes to be made to current educational models, so that the practice of the knowledge economy can be truly effective and inclusive. For him, it is necessary to transform that view that education serves as a simple transmitter of knowledge, for a view of education as that tool that teaches how to think, know how to do, find answers to questions and solutions to problems (MANZATTO, 2020) [31].

[...] argues that educational methods incorporate teaching practices that prioritize the development of the analytical, synthetic and creative capacities of students and teachers. In this proposal, teaching ceases to privilege the direct transmission of content, which is now transmitted only as a context that facilitates the acquisition of specific skills (UNGER, 2018, p. 92-95) [42].

This type of thinking is connected to Drucker's thinking, in believing that that content knowledge, and formalized, does not necessarily guarantee the efficiency of the work. What this effect can bring is much more related to the skills of analyzing a situation and adapting to it, making decisions based on more subjective experiences and analyzes, than on that theoretical and often cast knowledge, which is recommended in most of the school institutions. Another important point mentioned by the author as a factor in recovering the healthiness of the knowledge economy is the recovery of values such as cooperation and solidarity (MANZATTO, 2020) [31].

Therefore, it should be noted, from all that has been said so far, that the Knowledge Economy has emerged as a possibility of transforming values, being part, today, of the many reflections and research related to business administration and the industrial environment, where new ways of producing with less expense, more efficiency, less impact on the environment are sought every day, thus using technological and innovative resources derived from knowledge that come from scientific research and empirical experiences. Thus, as a way of illustrating and exemplifying this perception, the next section will deal with the Knowledge Economy, from the perspective of the recycling industry.

2.2 Work and the Knowledge Economy

As previously mentioned, modernity has brought profound changes in labor relations, with new ways of looking at entrepreneurship based on innovation and the valorization of knowledge / experience in the market. Thus, the expression “knowledge economy” emerged, which, roughly speaking, is configured as a process of recognizing the importance of knowledge for the performance of any work function, adding

not only the manual labor force, but also the intellectual and the expertise. Within this context, other concepts such as knowledge worker, living work, Theory of Human Capital, material and immaterial work, among others, will also be addressed.

According to Carmo (2008) [8], the knowledge economy could already be observed from the end of the twentieth century, bringing several changes in the industrial, commercial, economic and social sectors. For Izerrougene (2010) [21], it was encouraged due to labor conflicts that intensified since the 1970s, showing a certain crisis in profit rates and in the Fordist model of production and accumulation.

Carmo (2008) [8], also observes that, in this context, innovations and technology play an essential role, and their practice should be constantly encouraged through learning and training. In addition, “[...] Productive activity, in this new form of capitalist accumulation, is subject to knowledge, whereby the worker must be creative, critical and thinking, prepared to act and adapt quickly to changes [...]” (CARMO, 2008, p. 188) [8].

The author also mentions the concept of "knowledge worker", who has the skills “[...] to establish relationships and to assume leadership, [...] they are people capable of allocating knowledge to increase productivity and generate innovation” (DRUCKER, 1997; ASSMANN, 2005) [18] [3], thus being a strategic tool that combines learning, reflections, experiences, experiments and the creation of new concepts (CARMO, 2008) [8].

Izerrougene (2010) [21] points out that in order to better understand the nature of the knowledge economy, it is necessary, first, to understand how knowledge produces knowledge, also creating economic value, a process that gives greater value to intellectual work. Marx himself, as pointed out by Izerrougene (2010) [21], has already spoken about the importance of valuing the intellectual capacities of creation and the social capital of individuals.

Next, it should be noted that “[...] innovation is not just a matter of investing in capital goods and creating new products. This specificity is in the priority given to the place of human intelligence in the process of production and reorganization of social relations in communication networks (IZERROUGENE, 2010, p. 689) [21]. In other words, innovation is valued not only for its ability to be transformed into something tangible, but also for the fact that it is the most expressive representation of human intelligence and knowledge.

According to Carmo, this new process:

[...] of capitalist accumulation emphasizes that the recognition of this productive increase is based on the capacity to deal effectively with information and transform it into knowledge. This consists of valuing tangible and intangible resources in the economy, in their way of managing knowledge and learning for work. The intensification of the relevance of intangible resources in the economy, such as information and communication technologies, point to the development of new ways of

generating and distributing information that make it possible to increase the exchange of information and enable the interaction between different units within a company (CARMO, 2008, p. 189) [8].

Therefore, it is worth stating that all these changes in the forms of production, in the relations between capital / labor, etc., ended up generating a disarticulation in the social and productive bases of the capitalist system, in the path of new parameters of accumulation, where what is explored is the ability to produce. It then becomes more relevant “the acquisition of knowledge and its objectification in the material element for its production and construction as a true productive force, a reason for exploitation and a source of valorization, linked in a diffuse network of devices that directly regulate labor practices” (IZERROUGENE, 2010, p. 689) [21].

In view of this, the concept of “cognitive capitalism” emerged, which, according to Costa (2008) [11], is based on the activity that converts information and knowledge into wealth and / or economic values, depending, also, on a relationship of intellectual cooperation between the subjects. This model of capitalism thus characterizes a new way of developing capital that uses knowledge from collective and cooperative labor forces. “[...] this form of capitalism promotes active, collective, social (social capital) and abstract work, so that the production of intangible goods occurs, where the basis is information for the production of knowledge (GOUVEIA, 2018) [19].

That is why it is so important to consider the learning element in this context of the knowledge economy, since it causes a great demand for training and specialization, in order to meet the growing needs of the market in terms of technologies and innovations, whether in products or in the processes. Carmo (2008) [8] highlights how the knowledge economy needs investment in research, since learning is important for the generation and diffusion of knowledge, and consequently, for the growth of the current economy.

The author also states that the learning process consists mainly of developing a set of cognitive skills, such as: the know-how, represented by practical, technical and scientific studies of the work, from courses, training and even from professional experience.; knowing how to be, which is related to the social behavior of work, such as communicative and leadership skills, among others; and knowing how to act, which relates to the ability to make decisions or intervene appropriately.

In this same sense, Gouveia (2018) [19] points out that:

[...] knowledge is formed through formal education, but not only, the knowledge acquired through a routine that is unique to each individual, the tacit way of doing things, is also a source of knowledge. More than that, there is also the role played by cognition in the transformation of information into knowledge. Therefore, knowledge is the result of an individual's interaction with society, the result of their way of doing and thinking things and also the result of educational and informational opportunities, which he has / had access to” (GOUVEIA, 2018, p. 63.) [19].

The author also presents 4 types of knowledge, based on the work of Lundvall and Nielson (2006) [29], namely: the “know-what”, which is the knowledge of facts and information; know-why, which is the knowledge of the principles and laws that govern any sphere of life; the "know-how", which is related to the skills that an individual has to perform any activity; and, finally, the “know-who”, which is the knowledge about who can solve or help solve a certain type of situation (GOUVEIA, 2018) [19].

Regarding the ways of transmitting knowledge, Gouveia (2018) [19] mentions three: symbolic communication, imitation and incorporated knowledge. The first refers to the transmission of the set of symbols, that is, it represents that knowledge acquired in schools, training courses, etc.; the second demands an environment totally shared by others, where some learn from each other through observation and imitation; finally, the incorporated knowledge is that which is materialized in goods or services that are commercialized, that is, every final product contains some level of incorporated knowledge (GOUVEIA, 2018) [19].

Within this context, the Human Capital Theory (TCH) also emerged, which seeks to quantify and parameterize the levels of knowledge and skills of individuals in certain professional functions, that is, “The greater the investment in training, the greater the specialization and, consequently, the greater the stock of human capital”(KAROLCZAK and SOUZA, 2017, p. 67) [22]. The authors further argue, based on Schultz (1961), that investing in the acquisition of people's skills and knowledge and in education is a factor that confers a certain degree of superiority to some capitalist countries, with the ability to produce for humans an aspect that goes beyond all other possibilities of wealth (KAROLCZAK and SOUZA, 2017) [22].

According to Schultz (1961) [37] and Becker (1962) [4], individual capital occurs through the acquisition of knowledge and skills, thus forming the stock of human capital that, in itself, can be considered a return on investment made in this capital by generating more productivity and, consequently, more profit or resource savings. Thus, the influence of theory is perceived in the behavior of the labor market with an impact on the availability / shortage of qualified professionals.

The theory also explains that the subjects have independence in relation to their qualifications and can seek them internally or externally, however, in the second case, the professional may end up not returning to the company, that is, they do not return to the company, in the form of work and knowledge, the investment that was made in it (KAROLCZAK and SOUZA, 2017) [22].

For this reason, measuring the value of human capital is something so complex and Schultz (1961) [37], motivated by this difficulty, proposed some examples of activities that could better qualify human capital, such as: access to health services, which guarantees more vitality; formal education at all levels; training in and out of the work environment; immigration to adjust to the job opportunity (KAROLCZAK and SOUZA, 2017) [22]. Some time later, Schultz (1973) [38] created new parameters for these measures, arguing that “although human capital, as such, cannot be bought or sold, it is comparatively easy to

estimate the value of the production services of this capital, as they are expressed in prices in terms of wages in the labor market” (SCHULTZ, 1973) [38].

In addition to the Human Capital Theory, there is also a lot of talk about “Live work” and “Creative work”, or “Manual work” and “Intellectual”, or “Material work” and “Immaterial”, as explained below. Gouveia (2018) [19], shows how the practice of an economy based on knowledge has significant differential aspects in relation to more traditionalist capitalism, which occurred through an expenditure of energy, material work, for the generation of surplus value, the so-called “Living work”. However, in this new paradigm the exploitation of capital is modified, giving way, still, to creative work, where “the use of the technical tool depends on the performance of concrete, heterogeneous and shared living work, where creativity and the capacity for invention present themselves as an immediately intersubjective action”(IZERROUGENE, 2010, p. 694) [21].

Also, for Izerrougene (2010, p. 695) [21]:

In the cognitive activity of creating, transforming information and incorporating it into the knowledge of living work, the extraction of surplus value presupposes the reproduction and preservation of complex work as living work and not as a capital good. Capitalist appropriation is determined by the conditions of subjugating living work in the totality of the realization process, as living work that reproduces itself throughout the process as living work independent of dead work.

The author also states that this antagonistic and even conflicting relationship ends up causing an imbalance in the connection between capital and labor, since the success of an investment is linked to the ability to work creatively, in an increasingly autonomous way, still demanding a transformation in the professional molds, since creativity is unpredictable and can generate unexpected results in comparison to live, or mechanical work (IZERROUGENE, 2010) [21]. Precisely for this reason, this capacity can be considered innovative, in addition to adding high value to organizations that invest in education, training, research, that is, they invest in the acquisition of knowledge of their workforce.

Sicsú and Bolaño (2004) [39], on the other hand, use the terms Manual and intellectual work to refer to live work and creative work, as previously mentioned. For the author, there is a very fine border between these two types of work, however, both constitute the collective intelligence that acts in favor of capital.

The author also explains that there was a rupture between these two modules and, in addition, functions such as those of communication or coordination started to have a much greater relevance, that is, the new forms of consumption also demand that there is an intensification in the level of knowledge of the interested public, which ends up reinforcing the mediation character of intellectual work (SICSÚ; BOLAÑO, 2004) [39].

In this sense, Gouveia talks about material and immaterial work, as can be seen below:

Social capital, which comes from the way in which economic actors interact and organize themselves, by acting in the exchange of knowledge and information through social networks, to generate growth and development, is a source of value based on work immaterial that produces "material" wealth.", And immaterial, knowledge that generates more knowledge. (GOUVEIA, 2018) [19].

Therefore, the difference that exists between these two extremes is highlighted, which consists of the limit imposed by material work, which does not occur in immaterial work, since it is not palpable and can be infinite (GOUVEIA, 2018) [19]. However, the author considers this assertion that relates material work with merchandise to be radical, detaching it from the knowledge that was used for its creation, stating that knowledge can also be represented by material wealth, such as innovations (GOUVEIA, 2018) [19], like the New Information and Communication Technology (NTIC's), "which have the particularity of being both an object of consumption and a work tool" (IZERROUGENE, 2010, p. 689) [21].

For Sicsú and Bolaño (2004) [39], the emergence of information and communication technologies was a remarkable fact for the tendency to erase the boundaries that exist between manual and intellectual work, "it manifests so much in what I have been calling the subsumption of intellectual work, as well as in the general intellectualization of work processes in industry and in the service sector" (BOLAÑO, 1995) [5].

Therefore, in this context of the knowledge economy, it is essential to deepen the approach on the role of technologies and innovation in contemporary labor relations, as is the case with the innovations that are put into practice in the recycling industry, which serve to improve and to optimize the work processes and the life of the professional who picks up recyclable materials, in addition to generating more financial advantages and reducing unnecessary expenses, as will be discussed later on.

2.3 The transformations of education and its importance in the knowledge economy

Understanding and applying the concepts of the knowledge economy also caused major changes in the area of education and learning, especially with regard to the ability to generate innovation. For Lundvall (2001) [28], finally "it was admitted that knowledge is a good characterized by economic values and uses in its production and employment and that its use produces positive results" (p. 201) [28].

For Guile (2008) [20], higher education could be seen as the axis of the knowledge economy, despite encompassing different conceptions, such as traditionalist, utilitarian and postmodern. The first asserts that there is a certain level of fundamental scientific and literary knowledge to be transmitted by universities, and should therefore be part of the curriculum. "It also consolidates the foundational and canonical status of the disciplines by accepting that they and the scientific method constitute the only basis for conducting research (GUILLE, 2008, p. 630) [20].

The most updated view, from the point of view of Dowbor (2010, p. 3) [14], emphasizes that “In our university area, instead of locking up our knowledge, imitating the outdated behaviors of the private company, we have to become vectors multiplication and dissemination of knowledge.

Thus, although formal education is not mandatorily the main necessary premise in the knowledge economy model, it also represents an important part in the new ways of acting economically, together with the knowledge derived from expertise, practice, among others, known as “tacit knowledge”.

Also for the author, practical and analytical knowledge can be acquired through experience and the exchange between people in relationships, in general, through imitation, cooperation and communication. When problems are solved together, there is a sharing of knowledge, and this type of learning, where the social context is also relevant, is an important part for the understanding of tacit knowledge (LUNDVALL, 2001) [28].

The classic examples of tacit knowledge in the literature are typically practical skills of individuals (such as cycling, climbing, etc.) that cannot be made explicit and that cannot be transmitted, for example, by network telecommunication. However, it is worth mentioning that there are other types of tacit knowledge that are more at the center of economic dynamics. Managers use experiences based on tacit knowledge when making complex decisions and less experienced scientists would not be able to do it (LUNDVALL, 2001, p. 202) [28].

In other words, tacit knowledge can also be described as that which is acquired through a process of incorporation, even with a certain level of unconsciousness. A person who works in a team and incorporates the knowledge of several team members through practice and coexistence. Another person who, as a manager, made several wrong decisions and, learning from mistakes, created new, more satisfactory protocols. And so on.

For Dowbor (2010) [14], the incorporated knowledge occupies a primordial position in the creation of value for the goods and services that are currently produced. Knowledge, the raw material of the educational process, is at the center of innovations and technological changes, however, it still retains some ideals of the past, based on the formality of education, on the added importance of the diploma, the classroom, the disciplines. “Education faces a profound transformation, in the sense of being less a teacher of classes, and more articulating of the multimodality that characterizes knowledge management today. The change is just beginning” (DOWBOR, 2010, p. 1) [14].

Lundvall (2001) [28] explains that the relevance of tacit knowledge for economic success directly influences the aspects that foster innovation policies. “This is why innovation policies need to have a social dimension in which the quality of the exchange between people and organizations is important and in which the search for competence on the part of companies becomes a legitimate objective” (LUNDVALL, 2001, p. 203) [28].

The author also considers two factors as fundamental in the educational process linked to the knowledge

economy. The first of them would be the creation of innovation networks that include other companies and other subjects, competitors or customers, as a way to cooperate for the appropriation and propagation of knowledge. For him, this collective effort is necessary, since companies do not individually master all aspects of product design, or even processes and services (LUNDVALL, 2001) [28].

The other factor concerns the five areas that need special attention, in order to intensify the effectiveness of the practices of a learning knowledge economy, as explained below:

- The development of human resources: Private companies need to invest in training the skills of their employees through formal training and courses. Public initiative needs to train those unskilled workers. That is, public and private in search of professional improvement for individuals.
- New forms of organization: which intensify the exchange of knowledge and experiences between the different sectors of a company and society.
- The establishment of innovation networks: that relate to each other internally and externally, always seeking to update themselves in relation to innovations and avoid stagnation in the market.
- Assignment of a new role for the service sector: transformed into key parts for the innovation process, based on their analysis and results, and through mediation between customers and producers, in a process of knowledge sharing.
- Integrating research institutions and innovation systems: that is, promoting the effective engagement of universities in innovation processes (LUNDVALL, 2001) [28] .

In conclusion, it is clear that knowledge has become the main source of value creation, it is something that does not rival for being infinite, for not having reduced its stock (DOWBOR, 2010) [14]. The author also mentions examples of MIT's free access actions, which he did in exchange for visibility and image improvement in the market. However, for him:

Education today needs to modernize quickly, as it manages an area, knowledge, where interests are increasingly fierce, in the countless MBAs, corporate colleges, distance education systems, integrated systems of privatized school management, and the broad industry of University Degree. New technologies and the knowledge economy are welcome, it is about ensuring their utilization and democratic use (DOWBOR, 2010, p. 6) [14].

Therefore, it is worth mentioning that, according to Lundvall (2001) [28], contributing to the training of workers in general, as well as promoting training in companies and educational institutions, should be the primary focus of innovation policies. Especially with regard to the improvement of people, the formation of networks and the new social and business configurations, in relation to sustainability and the environment, aspects that, currently, cannot be unrelated to the economic / political context.

2.4 The environment in the context of innovations

Andrade (2012) [2] has already pointed out that the economy and the environment are inseparable, since everything that is produced through economic activity and the full functioning of society comes from external environments, from natural systems. Therefore, it is natural that any study on economic theories

also consider in its theoretical framework the dimensions of sustainability and the impacts that human actions cause to the environment.

Thus, Cavalcanti (2010) [9] questions how much it would be acceptable to remove from natural systems in favor of economic processes, that is, how much it would be possible to extract from the environment so that there would be the least possible impact. Then, the author, when making an analogy with a boat that, when it exceeds the load limit, is full, mentions the term “optimal load”, which in the interpretation for the environmental issue would be the use of natural resources to their maximum limit. However, thinking of a macroeconomics of the environment, still making an analogy to the boat, the carrying capacity would have an important role, in this case, the carrying capacity would be the limit of the environment in supporting human actions on it. Anyway, it is this limit that will guide the dynamics of sustainable development or sustainable growth (CAVALCANTI, 2010) [9].

Andrade (2012) [2] classifies the economy focused on sustainability in two phenomena, which will be delimited below. The neoclassical environmental economy arose due to pressure from current society, to the economic branches, to start considering ecological issues in their actions and decision-making processes, since it is the sector that most extracts and causes damage to the environment.

Also in this model, the ecosystem is passive and impartial, and It is only analyzed what are the harmful impacts caused by the economy. Its convenience revolves around people and not the condition of environmental exploitation. In other words, the ecosystem is only a supplier of the economic system, not taking into account that in the future, the risk of resource depletion would also be harmful to human beings (ANDRADE, 2012) [2].

In this branch of neoclassical environmental theory, we seek to answer questions regarding the optimal pattern of use of these resources, what is the proper management of renewable resources and what is the optimal rate of depletion of non-renewable resources. Ultimately, the central question underlying the analytical structure of the natural resource economy is whether its finite character can become an obstacle to the expansion of the economic system (ANDRADE, 2012, p. 11) [2].

Another phenomenon, more recent than the neoclassical environmental theory, is Ecological Economics, which started from a meeting held in Barcelona, in 1987, which highlighted a criticism of the way neoclassical theory conducted solutions in defense of the environment, despite its enormous potential for doing so, “claiming that the disregard of the biophysical-ecological aspects of the economic system leads to a partial and necessarily reductionist analysis of the interfaces between economics and the environment” (ANDRADE, 2012, p. 3) [2]. Thus, the main argument of this new model would be that such a complex subject should be analyzed and studied from the perspective of several disciplines, and not only from science or ecology (ANDRADE, 2012) [2]. So:

Being based on a biophysical-ecological analysis of the economic system, ecological economics combines concepts from the natural sciences (biology, ecology, thermodynamics) and the social sciences (economics, politics) with the aim of providing an integrated analysis of the interfaces between the economic system and the environment, overcoming the reductionist character present in neoclassical analyzes. Thus, it is considered that the ecological economy offers an analytical tool more consistent with the criteria of sustainability and with the preservation of life on the planet (ANDRADE, 2012, p. 27) [2].

For Cavalcanti (2010) [9]:

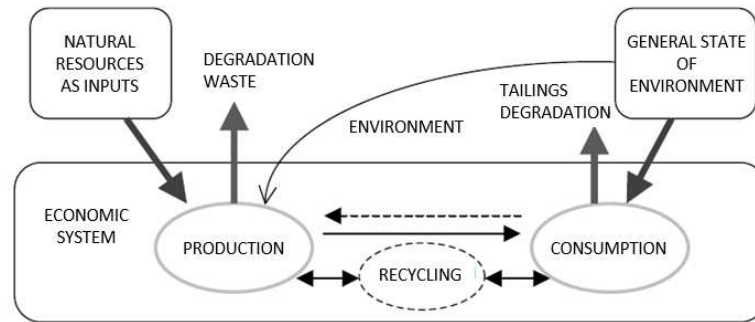
When realizing, in both cases, the need to overcome the disciplinary narrowness that prevents an overview of the ecological-economic problem as a whole, EE appears without disciplinary dependence, be it on the economy or on the ecology, resulting, in reverse, in an attempt to integration of both. Their worldview would therefore have to be transdisciplinary, focusing on the relationship between ecosystems and economic systems in the broadest possible sense (CAVALCANTI, 2010, p. 60) [9].

Cavalcanti (2010) [9] also points out that the intensification of the threat perception of the natural system was preponderant for the formulation of the ecological economy. For him, there is an endless struggle between the environment and the economy, which delimits new actions and attitudes that no longer take into account only financial issues.

It is also important to emphasize that this model is not completely opposed to the use of available natural resources, however, what “recriminates is the irresponsible use of these resources and the disregard for the finitude of the physical base that sustains the economic system” (ANDRADE, 2012, p. 21) [9]. In short:

“[...] conventional economics excludes nature as an externality of the economic process; the environmental economy is concerned with giving nature a price, with the tendency to see it as an amenity (an idea implicit in the common notion of “green”); and ecological economics attributes to nature the condition of irreplaceable support for everything that society can do”(CAVALCANTI, 2010, p. 63) [9].

For Mueller (2007) [32], it is necessary to think about this relationship between economic system and natural system, the first being an apparatus of strong complexity, which is supported by the second. Both interact with each other, the economic system extracts natural resources from the environment, however, it returns only waste, as can be seen in the figure below.

Figure 1: Chain of the relationship between the Economic System and natural resources

Source: Mueller (2007) [32]

Therefore, it is undeniable that the growth of the economy and its global spread, whether by countries or by diverse sectors, have a huge impact on nature, even if they are essential aspects for the lifestyle and consumption patterns of today's society. (ANDRADE, 2012) [2]. Hence the need to create innovation policies that favor the environment, in an attempt to generate a balance between maintaining the contemporary / globalized lifestyle and reducing the impacts caused by it.

According to Corazza (2003) [10], it is an extremely important and difficult task for leaders to develop technologies that respect the environment, as well as the incentive, knowledge, evaluation, choice and adoption of them. Public authorities must move in this direction, aiming that it is finally possible to arrive at what the author calls “desirable situation”, which:

[...] it involves a value judgment, because it implies establishing certain values or norms to guide actions and decision making, especially in the public sphere. In terms of environmental protection, it would therefore be necessary to resort to a normative approach. Even before answering questions such as "what should be done?", It would be necessary to look for an acceptable answer to the following: "which situation is desirable?". In other words, it would be necessary to establish a reference and a criterion (or a set of them) to assess the possible social states: it would be necessary to establish a normative framework (CORAZZA, 2003, p. 481) [10].

Lundvall (2001) [28] outlines what would be necessary to establish innovation policies that are socially and environmentally sustainable. The author states that there are three key elements for the success of environmental innovation:

- Determine criteria in relation to interactions between customers and producers, based on the development of specific markets and consumers for environmentally friendly products. In addition, the government can create measures to encourage companies to adopt other quality standards for their products and services.
- Choose institutions for an analysis of the most important parameters of the environment and encourage interdisciplinary training and research initiatives.
- Interconnect policies for the environment, innovation policies and economic policies (LUNDVALL, 2001) [28].

In conclusion, these measures and analyzes represent a major challenge to the planet's status quo, when it comes to pollution and environmental degradation. However, the development of non-polluting or more “environmentally friendly” innovations and techniques is still valid for industry and other sectors. Innovations considered social, which positively interfere in society's lifestyle, are configured as fundamental components in the dynamics of sustainable growth (LUNDVALL, 2001) [28], as it will be possible to observe in the topic that follows.

2.5 Social innovation

Before getting into the concept of Social Innovation, that matters most in the context of this work, it is important to briefly introduce how innovation is key to understanding the dynamics of the knowledge economy. For Lastres and Ferraz (1999) [24], technological innovations refer to the process of using knowledge to develop new modes of production and commercialization of goods or services. These innovations can also be organizational, as they interfere with company processes, such as logistics, supply, etc.

An example of the result of current innovation would be the diffusion of Information and Communication Technologies (ICTs), which are composed of a set of innovative technologies in the fields of computing, software engineering, telecommunications, among others, which have achieved a radical reduction in operational costs with the adoption of this type of tool (LASTRES AND FERRAZ, 1999) [24].

For Lastres (1999) [24] the performance in networks and systems can also be seen as a form of innovation, since it reproduces a new pattern of strategic organizational behavior, regardless of being a small, medium or large company. This new standard is based on cooperation and interaction between the elements, in order to make the “generation, acquisition and diffusion of knowledge and innovations” more effective (p. 189) [24]. Also for the author:

Additionally, remember that the appropriation of knowledge and information has specificities that cannot be ignored, as they are intangible resources that can be used - even simultaneously - by several people, without problems of exhaustion. Contrary to what happens with material goods, the consumption of information and knowledge does not destroy them, just as its disposal generally leaves no material traces. Giving them away or selling them does not cause them to be lost (LASTRES, 1999 p. 190) [24].

However, it is worth considering that the constant investment in innovations also requires investing in education, that is, in training, stimulating continuous learning (LASTRES AND FERRAZ, 1999) [24]. In addition, Lastres (1999) [24] points out that not having enough knowledge to know how to use innovations and new technologies or not being able to put into practice what has been learned, turns out to be more harmful than not being able to access these resources, i.e, it is essential that before the learning process there is also the opportunity to use that knowledge that has been acquired.

Thus, Almeida (2006) [1] argues that the main function of an innovative system would be to develop,

transmit and make use of innovations. However, it also talks about the institutions of the third sector, considering them naturally without efficiency and with a limited capacity to innovate, which is the reason for the lack of interest of the science of politics in the government to invest in developing innovation policies, constituting, therefore, the impediment to the practice of the knowledge economy.

It happens a lot that economic issues and political interests are taken into account, leaving aside the social aspect and its importance in the innovation process. In other words, innovation is considered to be only those that confer economic advantages or profit in the face of the market, relegating those forms of non-profit organization that contribute to social aspects, such as cooperatives or associations. As is the case, for example, of companies that produce free software, which, according to Tigre and Marques (2009) [41] is:

The main alternative for software users who do not want to be subject to the licensing conditions and technical restrictions imposed by proprietary software providers is free or open software. Business models based on this type of license assume that the value is in the service and not the product TIGER; MARQUES (2009, p. 562) [41].

This is also the case for third sector institutions, which are composed of private initiative organizations, which are not profitable and in addition provide services that are advantageous or beneficial to the public in general. According to Almeida (2006) [1]:

The third sector arises, during the 19th century, as a result of a social movement against the situation of disadvantaged social classes, affected by the Industrial Revolution. In the twentieth century, after the golden age of world capitalism, its revival is observed, in the context of the crisis of the welfare state and Fordism. Contrary to the classic social economy, the new social economy, as some call it, is not intended to be an alternative to the capitalist system, but rather a complementary one. (2006, p. 62) [1].

However, the dominant theory does not recognize that the third sector can be a promoter of innovations, mainly because its central objective is not to generate profit. Other factors that lead to this devaluation also involve the fact that the institution belongs to a group, and not to an individual subject, as for example in the case of cooperatives; and the guarantee of goods and services that are usually not very profitable, underestimated by the market and the government (LÉVESQUE, 2005, p. 9) [25].

Almeida (2006) [1] also highlights other factors that represent the weakness and limits of innovation in the third sector:

Firstly, social economy organizations cannot succeed in all sectors, especially in those cases that need strong capitalization. Second, its capacity to face different social problems has limits, since its principle of operation is often based on reciprocity. Third, there are highly bureaucratic organizations that have a weak capacity for change. Last but not least, innovative capacity is not always up to date. The creation phase is usually the moment to innovate, but in the following stages of diffusion and development, it often tends to become trivial (LÉVESQUE, 2005;

LÉVESQUE, 2006) [25] , [26].

Therefore, the potential for innovation in that sector, based on a social economy, is closely linked to its ability to sustain itself, still depending considerably on the public sector, although it is seeking more independence and other forms of financial aid (ALMEIDA, 2006) [1]. The OECD (Organization for Economic Cooperation and Development) defines that Social Innovation:

[...] seeks new answers to economic and social problems, through the identification and distribution of new services that improve the quality of life of individuals and communities. This involves the design and implementation of new labor market integration processes, new skills, new jobs and new forms of participation. Social innovations thus contribute to the well-being of communities and individuals, whether consumers or producers. OECD (2003: 299) [35].

Therefore, social innovation has several forms of association, interaction and mobilization of people, still highly diversified, with companies linked to philanthropy, Free software, information vehicles, among others (ALMEIDA, 2006) [1]. This is mainly about the cooperative institutions that bring together workers who collect recyclable materials from Brazil, as will be discussed in the next chapter.

Finally, it is worth mentioning that social innovations help to mitigate the problems caused by technological innovations, contributing also to the new dynamics of society. For this reason, third sector companies are so important for the consolidation of the knowledge economy as they seek other alternatives and even innovative answers to social and economic problems (ALMEIDA, 2006) [1].

3. The knowledge economy in the context of recycling

The constant growth of capitalism and, consequently, of industrialization, caused a considerable increase in consumption, mainly of industrialized products that generate a huge amount of common waste and solid waste. Thinking beyond the environmental issue, it is also possible to notice how all these economic changes have also brought about profound transformations in social and labor relations, encouraging the appearance of new professional activities, indispensable in this specific context, as well as accentuating the fragility that already exists in these relationships.

This is the case of individuals involved in the recyclable material collector profession, an activity that emerged in the context mentioned above and also from the high unemployment rate in the formal sector, which, for Bosi (2008) [7], it leads workers, especially those with little study and qualification, to look for other possibilities to support themselves, finding this alternative in informal job, such as in recycling cooperatives, scrap dealers, garbage dumps. “It is, above all, about surviving and ensuring the family's daily life [...]” (SANTOS, 2008, p. 46) [36].

According to Lussari (2016) [30], this industry / market arose due to several factors, among them, the environmental factor, which focuses on the concern for the unrestrained use of natural resources,

encouraging raw materials to be reused in the production process. In addition, there was a great opportunity to make a profit from less expensive material and a less valued workforce. In this sense, the author also points out how recycling is constituted as an extremely ambiguous market, being, on the one hand, an environmentally correct practice, while, on the other hand, it fuels the profit possibilities of companies in this capitalist² model (LUSSARI, 2016) [30].

Therefore, it is concluded that the activity in question involves several subjects that differ according to the social and power relations that each one occupies in this context. Hence the importance of cooperatives for workers in this niche, since, for Silva (2017) [40], this organization may represent a possibility for the empowerment of waste pickers³. Also, according to Lussari (2016) [30], cooperatives promote strengthening and give voice to waste pickers, in front of politicians and those who are at the upper levels of the pyramid⁴. Other authors such as Costa & Chaves (2012) [12] and Bosi (2008) [7], citing Dagnino and Dagnino (2010) [13], also state about the visibility that cooperatives give to the collector's struggles, promoting representativeness before the public power and the application of labor rights.

Thus, it is possible to observe that the cooperative is basically the union of a group of people who perform a specific labor activity. Its main objectives would be the organization of the groups, the improvement in the work processes and the representation of these workers before the government, businessmen, possible customers, among others. Thus, cooperatives benefit the life of waste pickers, guaranteeing more quality of life and helping to reduce the marginal condition of waste pickers. However, it is also important to note that not all waste pickers benefit from this cooperativism. A considerable portion is still unnoticed and operating in extremely precarious conditions, in exchange for survival.

With this in mind, the focus of this chapter is to analyze the research work of Bunchaft and Oliveira Filho (2015) [34], which links the recycling industry to the knowledge economy, qualifying recycling activity as an empirical object in this area of research, due to the transformations brought about in the activity through the knowledge acquired in the aspects of organization, logistics and commercialization, observed mainly in those cooperatives that are already more advanced.

For researchers, knowing and understanding the knowledge levels of this group becomes essential for the development of public policies aimed at their social inclusion (BUNCHAFT; OLIVEIRA FILHO, 2015) [34]. The scorn of the waste picker does not only happen on the financial side, but also because of the lack of recognition of the activity as worthy or important, as well as being praised by doctors, lawyers, businessmen, etc. Informality, the exploitation of labor, the lack of conditions for waste pickers to move within social classes and the vulnerability of this portion of the population, gives them the tone of

² Who sees the work of the collector as a way to save on costs related to licenses, qualified professionals, planting large areas to obtain raw material.

³ The formalized picker represents only 10% of this social group. In other words, 90% cannot even reach work in cooperatives.

⁴ Working crowded in the physical space of a waste pickers' cooperative ideologically represents a right place of work, fixed, with headquarters, possibility of coexistence with other workers. Place to go and return, ideologically this is very important for the Brazilian worker. Mainly, the society that sees the worker as the one who "left home" to work. Who works at cooperative X, which is at that address.

marginality. When there are no possibilities for formal work, subjects are also denied access to education, health, representation, rights and, even, visibility, voice. And this often happens, even when the worker is cooperative.

Thus, Bunchaft and Oliveira Filho (2015) [34] sought to develop in their research, Integrated Knowledge Modules (MIC's) that articulated scientific and practical research, and could be replicated in different contexts (transport; sorting; pressing; marketing, organization, logistics, production etc.) with an assessment of physical, economic and market efficiencies, thus being transformed into a knowledge economy. For him, establishing these analytical bases should contribute to the identification of acquired knowledge and its dissemination, which serve for the development of new businesses and partnerships, including with the private sector.

The research established several parameters for the knowledge economy, relating them to the recycling industry. First, the levels of knowledge present in the recycling activity were identified, through technologies, innovations, new ideas related to the production processes, etc. In addition, the efficiency of the operation of these tools in the context of the referred activity was evaluated. Then, based on these data, Bunchaft and Oliveira Filho⁵ (2015) [34] determined 4 levels, which he calls "Steps of acquired knowledge" (SK1, SK2, SK3 and SK4), according to the structural and productive organization of waste pickers' organizations recyclable materials. Of these 4 degrees, the latter is represented by groups that are not yet properly organized, as will be better described below:

a) Sk1 - Step of knowledge 1: High level of knowledge acquired

It consists of groups formally organized into associations or cooperatives, and which have all the necessary equipment for the optimization of work processes (presses, scales, trolleys, own warehouses, among others). They have the capacity to increase their physical structures and high potential to spread their acquired knowledge to other less prepared groups.

Its highest level of organization, provides efficiency in physical, economic and market, with a consequent pay higher and higher quality of life. They also have sanitary facilities, bathrooms and adequate levels of hygiene, as well as kitchens and cafeterias for the preparation and timing of meals. Some cooperatives of this level even have classrooms and computers, for training, literacy and other studies.

At this level, the institutions are already prepared to verticalize the production of recyclable materials. They have a work pattern, with equal and uniform equipment for workers, as can be seen in the images that follow:

⁵ Prof. Dr. João Damásio and Antonio Bunchaft, friendship built over 14 years of work at the Center for Social and Environmental Studies - Pangea.

Figure 2: Photograph of the conveyor, trolleys and uniformed workers



Source: Bunchaft, Oliveira Filho and by the author (2015-2020).

Figure 3: Photograph of the equipment in a SK1 recycling warehouse



Source: By the author (2020).

b) SK2 - Step of knowledge 2: Medium level of knowledge acquired

It is made up of groups also formally organized into associations or cooperatives. However, with less equipment and needing financial support for the purchase of machinery and its growth. It has some acquired knowledge, being, however, direct beneficiaries of the spread of knowledge at the SK1 level.

At this level, the cooperatives are in an intermediate phase because of the lack of some equipment and knowledge so that they can increase production. In this case, it is necessary to reinforce the infrastructure, both physical and personnel, to expand the collection. As seen in the photos below, it has a rudimentary structure and little influenced by technology.

Figure 4: Photograph of a recycling truck, warehouse and materials



Source: Bunchaft, Oliveira Filho and by the author (2015-2020).

Figure 5: Photograph of a SK2 recycling warehouse



Source: Bunchaft and Oliveira Filho (2015).

c) SK3 - Step of knowledge 3: Low level of knowledge acquired

It is composed of groups still in the process of organization. They have little equipment, many belonging to the group itself, and they need financial assistance to acquire almost all the necessary equipment, in addition to their own warehouses. They have very little acquired knowledge and need a lot of support to get adequate training and new knowledge.

In general, they have difficulties including knowing where to look and requesting financing and technical support. For this reason, the formalization of its cooperative would mean inclusion, the rise to a higher level of knowledge, in addition to a slight departure from the conditions of vulnerability, marginality and invisibility. As seen in the photos below, the shed is not organized and has a precarious structure, which is also reflected in the work of the waste picker (Figures 6 and 7).

Figure 5: Photograph of SK3 recycling warehouse



Source: Bunchaft, Oliveira Filho and by the author (2015-2020).

Figure 6: Photograph of SK3 level worker with his trolleys



Source: By the author (2020).

d) SK4 - Step of knowledge 4: Very low level of knowledge acquired

It consists of disorganized groups or individual workers, who work on streets or dumps. They do not have any equipment, often working in extremely precarious conditions and selling their materials to middlemen and scrap dealers, who pay prices well below the market. They have only that basic knowledge related to the collection and selection of materials.

For the complete assembly of the physical infrastructure and purchase of equipment, they need financial support, which would also enable them to begin to acquire more knowledge. As in the case of the SK3 level, the formalization of a cooperative would mean inclusion and ascension to a higher level of knowledge, in addition to a slight departure from the condition of marginality.

Figure 7: Photograph of workers looking for recyclable materials in a “dump”



Source: By the author (2020).

Figure 8: Photograph of the picking work at a “dump” and on the streets



Source: Bunchaft, Oliveira Filho (2015).

After the establishment of these levels of knowledge, other types of analysis are also carried out, which are also important, of the work of BUNCHAFT, OLIVEIRA FILHO (2015) [34], such as the number of collectors and cooperatives and the level of knowledge in which they find themselves. As shown in the table below:

Table 1: Number of waste pickers and cooperatives

Knowledge Steps	No. of Waste Pickers	%	No. of Cooperatives	%	Pickers by cooperative
SK1	1.381	4 %	24	7 %	57.5
SK2	2.753	8 %	70	21 %	39.3
SK3	5.720	16 %	122	37 %	46.9
SK4	25.783	72 %	115	35 %	224.2
Total	30.131	100 %	331	100 %	91

Source: PANGEA / BUNCHAFT, OLIVEIRA FILHO (2015), J. op.cit. p.85.

Thus, according to the table, it is possible to state that only 7% of the cooperatives, 24 out of a total of 331, have knowledge and infrastructure adequate to the SK1 level, that is, it is an extremely small portion of the sample surveyed, which demonstrates that most waste pickers, even those who are already organized, still do not work under conditions considered ideal.

Considering a junction between the levels SK1 and SK2, which are the levels where the best knowledge and basic infrastructure are found, it is observed that the value of 28% (or 94 of a total of 331), remains much lower, compared to the others levels (SK3 and SK4), which together represent a total of 237 cooperatives, out of a total of 331 in the sample, or 72%. Therefore, it is concluded that the two groups that represent more cooperatives and, thus, more workers, are those where the levels of acquired knowledge are lower and the working conditions are more precarious and unequal.

These differences are even clearer, and better understood, when comparing the total number of waste pickers, which is 35,637, to the number of waste pickers belonging to the SK3 and SK4 groups, which is 31,503. In other words, there are 31,503 individuals working precariously and failing to see possibilities for improvement, also due to the lack of acquired knowledge.

About this, BUNCHAFT, OLIVEIRA FILHO (2015) [34] questions how to create public policies for this population, without promoting the maintenance of their structural conditions. In short, financial investments and the creation of new jobs are of no use unless there is a strong educational process that enables waste pickers to make a real change in their lives, in addition to independence, based on effective and lasting knowledge that can be practiced in the scavenging activity.

Other possible analyzes concern the region and the levels of knowledge in which the cooperatives of the sampled are located, as shown in the table below:

Table 2: Regional distribution of cooperatives, according to knowledge levels

Region	Total in the region	SK1	SK2	SK3	SK4
North	2	0	0	1	1
Midwest	25	3	6	8	8
North East	58	2	7	14	35
Southeast	112	14	47	35	16
South	47	6	10	22	9
Total	244	25	70	80	69

Source: PANGEA BUNCHAFT, OLIVEIRA FILHO (2015), J. op.cit. p.132 – Table 7.11

According to Table 2, it is observed that most of the cooperatives are in the Southeast, followed by the Northeast, South and Midwest. The North region has the fewest cooperatives (2), both of which belong to the SK3 and SK4 levels. This demonstrates a certain delay in the North region in relation to the knowledge needed to improve the work processes of a cooperative of waste pickers. It also points to a

deficiency in the region in relation to the treatment given to solid waste and recyclable materials.

The Southeast region has a total of 112 cooperatives, which mostly belong to the SK2 and SK3 levels, respectively. These data show that the region, despite already having a certain level of knowledge, still needs to make much progress in its dissemination, so that most cooperatives can achieve an ideal level (SK1) in recycling work.

In the Northeast region, which has a total of 58 cooperatives, most (35) are at the lowest level of knowledge acquired SK4, 14 at the SK3 level, 7 at the SK2 level and only 2 at the SK1 level. These data demonstrate, then, that the majority of waste pickers still work in precarious conditions, despite all the innovations and technologies that exist today. This decrease points to a deficiency in the region in terms of acquired knowledge and the potential dissemination of that knowledge, a fact that could, little by little, cause the cooperatives to climb the steps, so that they could reach the ideal level.

Almost the same can be seen in the South region, which has a total of 47 cooperatives and most (22) are at the SK3 level, with 9 at the SK4 level, 10 at the SK2 level and only 6 at the SK1 level. Data from the South region point to a slight improvement in the level of knowledge acquired, as there are 6 cooperatives at the SK1 level and most of them are in SK3, despite still having a low potential for disseminating the acquired knowledge.

Finally, the central-west region has only 25 cooperatives, and most of them (16) are at the lowest levels of knowledge acquired (SK3 and SK4), with 3 being at the SK2 level and only 3 at the SK1 level. These data point to a similarity in relation to the other regions, which demonstrate a lack in the dissemination of the acquired knowledge, since there are a large number of cooperatives at the lowest levels of this item.

Therefore, in general, it is concluded that, even with all the technological and innovative apparatus that already exists today, including in relation to the processes and the organization, there is a lack of sufficient knowledge, and the transmission of them, to be applied and carried out in the practice. What can be seen by the huge number of collectors and cooperatives that are still at the lowest levels of knowledge acquired.

Thus, after all this analysis, it is important to highlight how the research by Bunchaft and Oliveira Filho (2015) [34], specifically, Marketing Networks Uilmer, Cruz (2015) [33], is configured as a social rescue, according to the words of the author himself, since it represents the possibility of solving the problem of the lack of knowledge of one of the most excluded social groups in society. The idea is to be able to identify all the faults that need to be remedied, especially those related to the knowledge necessary to provide a healthier work environment and better quality of life for workers. Thus, the dissemination and sharing of knowledge applied in cooperatives that belong to the SK1 level, to cooperatives at other levels, would be the ideal way to transform the current paradigm of the scavenging activity in the recycling market.

Oliveira Filho et al. (2020) [34] still mention some parameters of knowledge that would be fundamental to acquire for there to be a change in this scenario, which are:

a) Knowledge economy applied to techniques for sorting recyclable materials: the production chain of recycling is defined as the set of substrings that operate on specific types of recyclable materials. According to Oliveira Filho et al. (2020) [33], these substrings deal with the diversity of plastics - PET (polyethylene terephthalate), HDPE (high density polyethylene), LDPE (low density polyethylene), PVC (vinyl polyethylene), PP (polypropylene), PS (thermoplastic polystyrene) and plastic film, among others -, papers - white paper types 1, 2 and 3, magazine paper, newsprint, catalogs, cardboard etc. - ferrous scraps, styrofoam, aluminum, Tetra Pak (a mixture of aluminum and cardboard), among other solid wastes that are often found in the consumer market. In addition to this variety of recyclable materials, one cannot lose sight of the color variation of the waste. Each of them has a different productive purpose within the substrings⁶.

Oliveira Filho et al. (2020) [33] state that, for each type and color of recyclable, there is a specific purchase price by the recycling industry. It reports to its supply chain based, as a rule, on intermediation structures, on the first step, and on the recyclable material collectors themselves, on the second step, which feed the entire production chain through their work of sorting the collected waste. However, according to the authors, it is essential to consider the so-called opportunity cost by sorting, that is, it is essential to take into account which recyclable is worth investing in a specialized sorting, since some add more value than others.

In this segment, it can be said that building systematic knowledge about the diversity of recyclable materials and their forms of sorting makes it possible to add value to the price practiced by the product. It is noteworthy that the surpluses generated in the commercialization stage of the recycling production chain - that is, between the collection carried out by the collectors and the sale to the intermediation structures, until they reach the industry - can exceed 500%⁷. Most waste pickers are not aware of this. It follows that a properly systematized knowledge about this technique can influence the increase in the per capita value of the material collected by the collectors without increasing production, increasing the income of this social segment. It allows a conscious and specialized sorting process, organized and efficient, according to the diversity of recyclable materials that exist, adding value and enabling the practice of better prices.

b) Knowledge economy applied to the identification and characterization of the players in the recycling process markets along the productive networks of recyclable materials: it addresses the different forms of production, appropriation of values, relative gains and characteristics of existing market structures along the chain. It also deals with “Commercialization Networks”, which incorporates

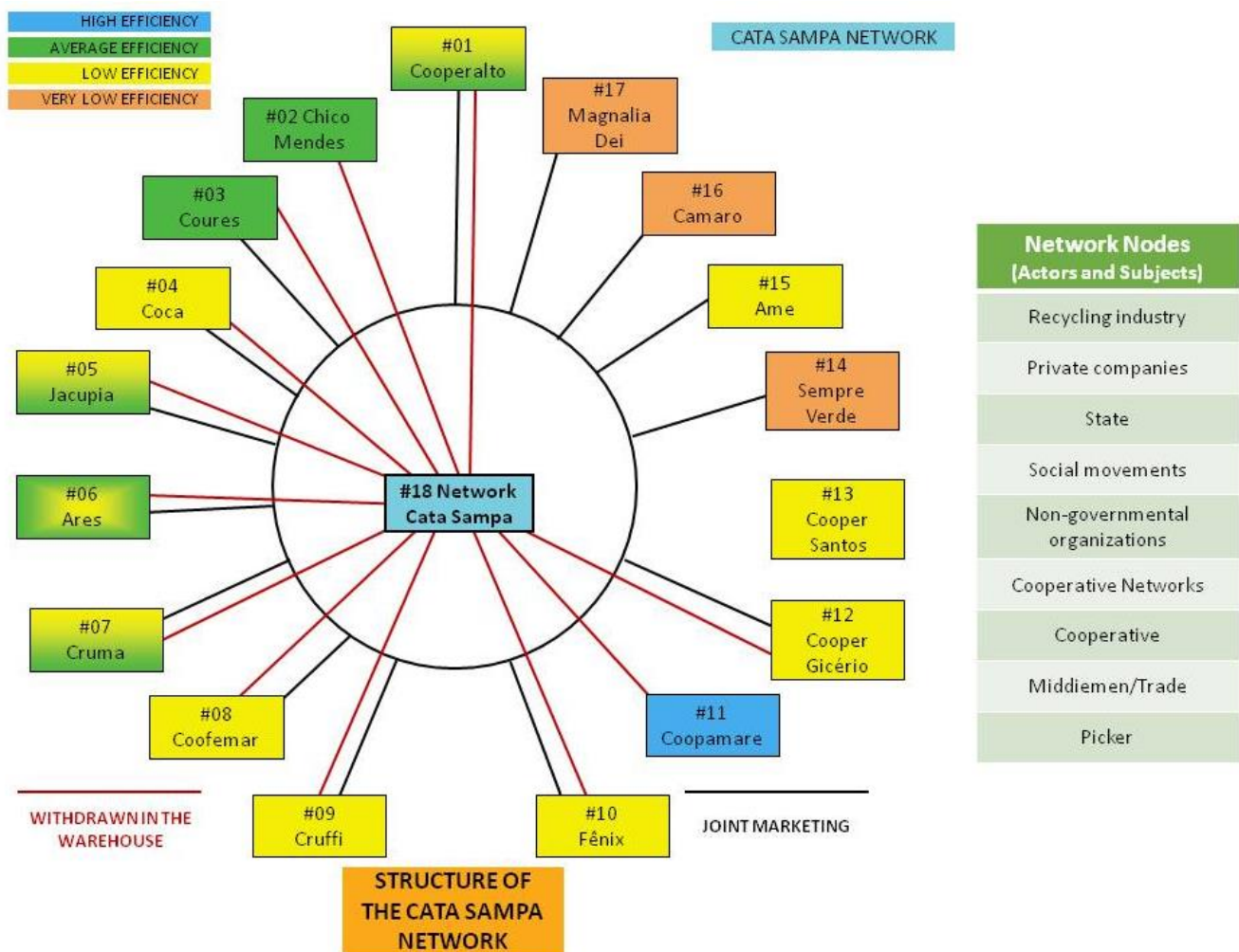
⁶ As a demonstration, recycling white LDPE can result in a multitude of recycled products of different colors. On the other hand, only dark colored products can be derived from recycling dark colored LDPE. Obviously, the recycling of the first case adds significantly more value to the product than that of the second.

⁷ The pickers' survival horizon implies the daily sale of the material, which prevents the formation of stock and reduces the price they could charge.

new organizational and logistical strategies, such as the practice of Joint Marketing, which allows some types of materials to be collected in several cooperatives that do not have a productive scale that allows better prices: the objective is to gather and, if necessary, stock up on recyclable materials until the necessary volume is obtained to meet demands at levels of commercialization higher than those that would be obtained by decentralized individual commercialization.

The following figure illustrates, with the example of the Cata Sampa Network, how a Marketing Network can be structured. The blue lines connected to the circle show the cooperatives that benefit from joint marketing. The red lines indicate that there is some participation by the respective cooperatives in the “withdrawals” from the processing of materials collected from large generators and fairs and events. The colors that fill the rectangles of each cooperative indicate their relative efficiencies.

Organization Chart 1: CATA SAMPA Marketing Network



Source: Oliveira Filho et al. (2020), adapted by the author.

In this sense, knowledge about how a marketing network is constituted allows for a more global analysis of the consumer market for recycled materials, being able to generate advantages through efficiency and the great potential for disseminating knowledge improving the standard of living of waste pickers from

institutions linked to these networks.

In addition to proper sorting, scale of production and regularity of supply are fundamental to being able to directly sell recyclable materials to the recycling industry. As Oliveira Filho et al. (2020) [33], such an industry cannot live with minute quantities and irregular supplies, under the risk of jeopardizing its production process.

For being disorganized economically, the waste pickers work, usually in isolation, rescuing the streets and dumps waste on which they operate, selling them by day and in small quantity for intermediation structures. Even though they organize themselves into cooperatives or associations, they continue to collect a very small volume of materials, which keeps them hostage to the intermediation.

In this sense, Oliveira Filho et al. (2020) [33] point to the so-called marketing networks, a recent phenomenon in Latin America, almost restricted to Brazil. These are unique networks, still experimental and, because of that, unknown among academics, which consist of a business strategy in the midst of poverty - a strategy that constitutes an intelligence center capable of articulating small, medium and large organizations of waste pickers with a view to a single and instantaneous marketing in order to achieve considerable monthly volumes and regular supply, thus succeeding in overcoming the intermediation structures, selling directly to the recycling industry. Such networks are also capable of analyzing the market on a regional and national basis, building an information system on current and future trends in the production chain, observing medium and long-term movements, allowing strategic positions by waste pickers.

Although they are an interesting strategy for the emancipation of the intermediation structures, the marketing networks are not yet able to build productive stocks to face the market's seasonality. It so happens that they do not have enough information to understand how the formation of stock occurs in the market by sub-chain, nor what are and how the categories of analysis that affect the formation and variation of the price over time operate⁸.

In view of this, we can say that these networks lack a knowledge articulated with the empirical experience, perhaps even due to the fact that it has not yet been the target of so many studies. Building this knowledge can mean a shift in the positioning of waste pickers in the production chain, moving from mere individual suppliers to regional and national economic organizations that supply raw materials to the industry⁹.

⁸ The price of Nafta in the international market impacts on virgin PET resin, which, in certain situations, can be cheaper than recycled resin, however paradoxical this may be.

⁹ The CATABAHIA Network, the object of research, is the first national network to introduce this strategy, being a benchmark for Brazil. In 2007 it was considered by the United Nations as one of the 50 best experiences of achieving the Millennium Development Goals, in the category of combating poverty. As an experience, it is an empirical knowledge that has been successful. Here an attempt is made to analyze the experience and systematize it together with a set of other techniques, with the aim of constituting a KIE (recycling equipment) that can be reproduced in other experiences in Latin America.

c) Knowledge economy applied to logistical techniques for the collection, processing and transportation of recyclable materials: as a rule, the recyclable material has little weight and a lot of volume. In this sense, paying to “load air” is very common in selective collection processes. Oliveira Filho et al. (2020) [33] state that the density in the distribution of collectable waste in a territory is due to three fundamental factors, namely the income of the community that inhabits the territory, the size of the local population and the presence of large companies in the surroundings. From this it can be said that the higher the income of the community, the more waste it will produce. Among these residues there will be a higher incidence of recyclable materials than of organic materials, and the added economic value per capita will also be higher. It is also possible to infer that the larger the local population, the greater the territorial density of existing waste, and that the more companies are established in the vicinity, the greater the density of waste concentrated in small territorial spaces.

The proper modeling of capturing recyclable materials through the distribution, within a territory, of a certain numerical set of warehouses strategically located until the arrival at a central warehouse consists of a type of empirical knowledge that, many times, is not systematized, either linked to scientific knowledge. In addition, the adequate modeling for a consortium between collection trolleys, by means of human traction, and trucks, with the intention of obtaining a larger volume within the lowest possible economic cost, is also seen as an empirical experience that does not systematize or aggregate to the scientific framework. This shows, as Oliveira Filho et al. (2020) [33], that the records of assembly of systems for capturing recyclable materials are erratic, considering, at once, the variables of weight, volume and irregularity of the waste in the territorial and income distribution. It also shows that the records of formulations of mathematical equations for logistical purposes are mistaken through computerized systems that take into account the same variables, managing to build mere models of intercropping between depository, warehouses, human traction and trucks.

Such issues affect the increase in costs for waste pickers, who often either suffer from inhumane collection systems or, when they have trucks, do not use them rationally. For this aspect, the aforementioned issues give rise to the need to build a structured knowledge on which models of arrangement of selective collection logistic circuits are economically sustainable and operationally viable for diversified situations, in which the variables have different intensity in each territory. Structured knowledge about the logistical processes in the selective collection, which are sustainable and viable in different situations such as differences in territory, time of year, materials, etc.

d) Knowledge economy applied to production verticalization techniques and the articulation of new energy and environmental opportunities: the value added to recyclables through production verticalization requires, as we have already mentioned, volume and regularity. From this it can be deduced that there are more chances of success in the aggregation in collectors' structures organized in commercialization networks¹⁰. However, it is not inopportune to ask in which substring more value is

¹⁰ The CATABAHIA Network is implementing a plastic recycling industry that will also produce bleach bottles with the formulation of water, which will be marketed in the Wal-Mart chain of supermarkets across the country. This is an unprecedented feat for waste pickers who left the dump to become industrialists.

added and up to what level of verticalization it is worth reaching.

New windows of opportunities have opened in Brazil with biofuels. As Oliveira Filho et al. (2020) [33], cooking oil became an input for biodiesel plants. However, because it is a liquid waste, the logistical structure of adequate collection is not properly matured on a large scale. The levels of added value to cooking oil for sale with the Brazilian oil company (Petrobrás) are also not mature, because the whole process is very recent.

Petrobras is currently the fourth largest company in the Americas, having recently started an aggressive oil purchase strategy for waste pickers' cooperatives. However, it still does not know the market and its nuances. Although the collectors have the potential to collect organic waste that could be worked on a scale aiming at the construction of biodigesters for the production of compost and energy generation, these products could be commercialized or absorbed in the collectors' production plants. This is an expressive potential, on which pilot projects for the implementation of biodigesters already exist. The experience in biodigester collector cooperatives is basically India and Brazil. Therefore, it is essential to accompany and articulate the experience with scientific knowledge¹¹.

This whole system of collecting recyclable materials, adding value and generating energy is perfectly quantifiable in terms of saved environmental resources, namely: water, trees, bauxite, iron, copper, aluminum, sand, etc. This process opens windows of opportunity to build a methodology for framing these experiences so that they receive resources from the Kyoto Protocol, which today, however, has only benefited large business organizations.

It adds additional value to recyclables through vertical production, with more chances of success in cooperatives and associations of waste pickers organized in networks for the sale of recyclable materials. In addition, it seeks to link this process to issues of sustainability and energy generation.

Regarding education, it is important to consider the knowledge economy, in the scope of recycling, not only in those processes that cause improvements and financial profits, but also in the changes that this knowledge causes in the personal life of the collectors and how it influences in all their decisions from day to day, including attempts to “improve your life” or “raise” the levels of knowledge steps. An example of this would be the participation of waste pickers in the electoral process through voting.

What is observed is that those workers less organized and with a lower level of knowledge, end up voting for populist candidates and with empty promises, representatives of parties that respond to the interests of the elite and of big businessmen, including those involved in recycling. On the other hand, more organized workers who have higher levels of knowledge, end up reflecting on their conditions with more awareness, better observing those candidates who really intend to fight for the needs of their class.

¹¹ The CATABAHIA Network has been assembling a biodigester to generate energy that will be directed to the plastic industry of the network itself. This is an innovative experience in the world, with full use of organic and recyclable waste.

Finally, it is worth stating, then, that knowledge, when acquired, provides an increase in the collectors' income, in addition to improvements in quality of life and working conditions, with the acquisition of new equipment, adequate and hygienic environment, use of uniforms, training, education etc. All of this turns recycling workers into protagonists in decision-making and administrative processes, further reducing their condition as invisible and marginal. However, still according to the words of Oliveira Filho et al. (2020) [33], the knowledge acquired only has value when it is disseminated to those who do not have it, as would be the case of the dissemination of knowledge from cooperatives SK1 and SK2 to those SK3 and SK4.

4. Conclusion

It was possible to observe, from the reflections proposed in this research, how globalization caused great changes in the relationships that exist between man and work, science and the environment. In the beginning, what prevailed were material and financial assets, related to profit, in a gross way. However, over time, it was observed that there are other points that are so important and that they could also provide profit and improvements in the processes of the institutions. It is the case of an appreciation of knowledge and experience, which came into force in the main contemporary management and labor practices.

It was sought to understand, in the light of the researcher and philosopher Peter F. Drucker, how the "Knowledge Economy" defends that the most important asset of an institution is knowledge. This knowledge includes innovations, technology, science, formal knowledge, experience, that is, everything that can create more effective ways of operating in today's markets.

In addition, the recycling industry was related to this concept, determining 4 levels of knowledge steps and demonstrating how the knowledge acquired in relation to logistics, organization, equipment marketing - observed mainly in those cooperatives that are already more advanced - it can be promordial in improving the quality of life and work, in addition to better earnings, for cooperatives and waste pickers.

In this sense, it is stated how this work was fundamental to reflect on what was asked in the question problem: How does the knowledge economy relate and positively influence work activities such as the collection of recyclable materials?; when it was understood that knowledge, represented by technologies, new equipment and process improvements, is essential to improve the work of recyclable material collectors, such as the cooperatives belonging to SK1 and SK2, which have equipment for the processing of collected material, in addition to more standardized and organized processes, as already mentioned. As well as the problem question, the general objective and the specific objectives were also achieved, in this same perspective.

It is concluded, then, that the collectors of recyclable materials are part of a large number of Brazilians

whose work occurs in the condition of informality and social exclusion and rights. That is why the discussion addressed here is so fundamental, as it is believed that this study can integrate a rich material for reflection on the condition of recycling workers, who are so important, both for society and for the environment, but even so, they continue to be extremely devalued socially and financially. Finally, here it was also possible to systematize the activity of scavenging, on the steps of knowledge, in order to encourage new possibilities to improve and value these subjects, so that they can get rid of this marginal condition.

5. Acknowledgement

To FAPEMIG, for granting a research grant.

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Appendix



THEORETICAL AND METHODOLOGICAL CONTRIBUTIONS OF THE KNOWLEDGE ECONOMY: The applicable "steps" in Brazilian recycling

SK1

SK2

**Uilmer Rodrigues
Ricardo Alexandrino Garcia**

SK3

SK4