# THEORETICAL AND METHODOLOGICAL CONTRIBUTIONS OF THE KNOWLEDGE ECONOMY: THE APPLICABLE "STEPS" IN BRAZILIAN RECYCLING

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## ABSTRACT

With the emergence of new paradigms in social and labor relations, material goods or the assets of a company were previously valued. However, today, in addition, it is also considered that knowledge (in innovations, technology, experience, trade secrets, among others) adds value to an institution. Thus, this research seeks to detail the phenomenon of the knowledge economy, from the perspectives of work, education, environment and innovation, in addition to relating this concept to the activity of collecting recyclable materials. The problem question developed to start the reflections was: How does the knowledge economy relate to and positively influence work activities such as the collection of recyclable materials? The general objective is to understand how knowledge, experience and innovations are fundamental for the improvement of processes and work in industries and organizations, here, specifically, the recycling industry. The specific objectives focus on: detailing 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; and to know the "Steps of Knowledge" applied to the activity of recycling materials. The methodology was an analysis of the recurrent literature related to the theme of the knowledge economy and the recycling industry. It is thus concluded that workers in this field make up the large group of Brazilians in the condition of informality and social exclusion and rights, and that is why the discussion addressed here is so important, believing that the condition of these recycling workers continues to be extremely devalued, despite being so important, both for society and for the environment.

**Keywords:** Knowledge Economy. Recycling. Informal Work.

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## INTRODUCTION

Globalization was the motivator of 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 demands. 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 most adds value to a company are the knowledge that provides possibilities of profit, financial advantages and procedural improvements, through innovations, technology, experience, trade secrets, among others.

In this sense, today the importance of knowledge for the execution of any labor activity is already recognized, where the worker offers, in addition to the manual workforce, his intellectual strength and his 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 the managerial and labor processes in companies or any other institution.

Therefore, this research seeks to detail the phenomenon of the knowledge economy, from the perspectives of work, education, the environment and innovation, demonstrating how they are inseparable issues, functioning as a gear, which needs each component to act in a certain way for the apparatus to work 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 problem question developed was: How does the knowledge economy relate to and positively influence work activities such as the collection of recyclable materials? Thus, the general objective of this work is to understand how knowledge, experience and innovations are fundamental for the improvement of processes and work in industries and organizations, here, specifically, the recycling industry.

The specific objectives focus on:

- To 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;
- To know the "Steps of knowledge" applied to the activity of recycling materials.

Regarding the methodology, it is stated that the main path taken 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 from important authors in the area was made, such as: the material of Lodi (1968), which analyzes the works of the precursor of the Knowledge Economy, Peter Drucker; Gouveia (2018), who explains several concepts about work by relating them to the knowledge economy, in the view of authors such as Lundvall; Karolczak and Souza, (201) who address the Theory of Human Capital; among other aspects, including the most important and most related to the researched universe, which is the work of Bunchaft and Oliveira Filho (2015) on the steps of knowledge within the recycling industry.

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

Then, it relates work to the concept of the Knowledge Economy, demonstrating the profound changes in labor relations in the globalized world, arising from the 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 the improvements of labor and business processes. In addition to education, it also seeks to detail the role of innovations in this context and how they can be allied with the environment, aiming to create new, but responsible, ways of using natural resources. So, it deals with Social Innovation, which refers to those innovations that do not aim at profit, but rather to improve the quality of life and well-being of people and workers, a concept most present in third sector organizations.

Finally, the second part relates the concept of the Knowledge Economy to the recycling activity, detailing the degrees of knowledge in which each type of waste picker worker fits, and making a qualitative-quantitative analysis of its main aspects and assumptions. It is observed that these steps follow an order that begins with the one where the most knowledge is invested, as is the case of the waste picker workers who are organized 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 stated that the importance of this work lies in the fact that it provokes reflections on a group of workers who need public policies and a look from the political authorities, which provide them with access to social welfare, through a greater appreciation of their labor and especially their work, which even though it is of such importance, It is not seen that way by society.

## THE KNOWLEDGE ECONOMY: CONTEXTUALIZATION

As already mentioned in the Introduction, this new dynamic, or new way of thinking about administration, is called the "Knowledge Economy" and advocates, roughly speaking, that the most important asset of an institution is knowledge. In this context, it is essential to mention the works of researcher and philosopher Peter F. Drucker, who was a precursor of the idea of the Knowledge Economy, in the light of the analyses of João Bosco Lodi (1968).

### THE WORK OF PETER DRUCKER

Tracing a path in relation to Drucker's works, Lodi (1968) begins by mentioning his first works, written before the end of the Second World War, which did not yet directly address the theme that would be part of his most important legacy, that of 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).

These works have as a 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). Lodi (1968) also 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 equality of conditions" (LODI, 1968, p. 84).

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

Thus, this new society is based on the following characteristics: every subject has his or her function in society, linked to his or her occupation, in addition to a recognized social status and legitimized social power (LODI, 1968). Thus, it is possible to say that his first

works discussed the aforementioned issues, as well as the new social and power relations involved in the "industrial enterprise", as it is called by Drucker.

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 about how decentralization was important to strengthen the administrative process of a large company. Decentralization would then be a large corporation that carries out the entire production process, without delegating it to other small companies, whose administration is divided into sectors, according to each activity, with each sector being managed by a professional (LODI, 1968).

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

> In the first part, entitled "The Corporation as Human Effort", the author analyzes the organization of General Motors, its decentralization and its market problems. In the second part, which is 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, entitled "Economic Policies", the author analyzes several related problems: the question of size, monopoly, production objectives and the problems of the policy of full employment.

It is observed how Drucker sought to reflect and discuss 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). From there, then, the idea of the knowledge economy begins to take shape, when intellectual knowledge becomes more valued, for its ability to improve processes and innovate, consequently, generating economic advantages.

From then on, Drucker developed this concept by publishing other works, such as The New Society (1950), which basically discusses two themes:

> The first is that the industrial society of the twentieth century is an entirely new and peculiar society, world-wide rather than Western or capitalist. The second is that this new society has a specific institution: the industrial company, with its management, its manufacturing community and its twin brother, the labor union (Drucker, 1950 apud LODI, 1968, p. 93).

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 work efficiency and productivity. Its basic premise is to foster in employees the feeling that they are part of the

company as a whole, integrating them into its main objective, so that they can fight for proposals and work more motivated.

It should be noted, also according to Lodi (1968), that the book had been released before the Korean War, so Drucker had to republish it a few years later, due to the changes that occurred 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, *Practice of Business Administration*. The book deals, among other secondary aspects, with 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 in and where it intends to go" (LODI, 1968, p. 104).

In addition, the work is considered an important marker for the professional behavior of a company's manager, with precise instructions and reflections on how a manager should act and act, in general, and in certain situations, so that the goals of an institution are achieved, without having to act only in emergencies or through campaigns (LODI, 1968). The author also works with the hypothesis that administration by objects would be a philosophy that "is based on the principle of motivation of human behavior, applies to every administrator and ensures genuine freedom to the executive" (LODI, 1968, p. 108).

Shortly thereafter, with the publication of Frontiers of Tomorrow, in 1959, Drucker changed the focus of his discourse a little, continuing on the path of enhancing the idea of the Knowledge Economy, by addressing the changes that occurred in the post-modern world, especially 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 transformative 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 others, more enlightening and compatible with the moment of transformation that the world was going through at the time. He changes the focus from efficiency in processes to the analysis of results: "[...] the company needs to introduce an economic system of planning and market evaluation that allows it to replace the focus of work with that of results" (LODI, 1968, p. 120).

In addition, Drucker makes a market analysis, proposing: that the products be observed, according to various categories, so that the company can decide which products are worthwhile, or not, to keep in a company's catalog; that customers and non-customers

are analyzed, according to various parameters, in order to discover how to attract more customers or compete in other markets (LODI, 1968).

The author also proclaims what, for this work, can be considered fundamental for the practice of a knowledge economy, where know-how and expertise become, then, one of the most valuable capitals 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. To see the things you did well and the things you did poorly. Ask: what is our business? What are we in a position to do well? "Knowledge is a perishable good. It needs to be reaffirmed, relearned, repracticed all the time. A person needs to constantly work to win back his or her 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 apud LODI, 1968, p. 125).

Finally, it is important to mention the work where 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 with good intelligence, solid knowledge of the function, brilliant and imaginative people. However, few of these people are efficient" (LODI, 1968, p. 127).

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

- Know where to spend your own time;
- Focus efforts on results more than work;
- Be based on the strongest personal qualities;
- Focus on key tasks;
- Make effective decisions (DRUCKER, 1967 *apud* LODI, 1968, p. 129).

Among these principles, the most important is the one that talks about focusing on results, to the detriment of the work itself:

> The focus on contribution turns the executive's attention away from his specialty, his limited skills, his department, and toward the whole. He turns his attention outwards, the only place where there are results (DRUCKER, 1967 apud LODI, 1968, p. 130).

In this sense, Drucker's basic premise is that efficiency is a habit, it is something that is learned, and not atavistic. For him, managers 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 to their product when it leaves the company, also a view of market transformations, and, as mentioned earlier, acquiring this view requires time,

experience, discussions, learning, and this is exactly how a manager becomes efficient (LODI, 1968).

Lodi exemplifies this by citing thalidomide, demonstrating that many lives would have been harmed if they had waited for statistical results instead of listening to a doctor who made a more subjective analysis of the problems that were being caused by this drug (LODI, 1968).

Therefore, it is worth mentioning how Drucker was essential for the construction of the idea of the knowledge economy, especially when he mentions how valuable knowledge and experience are for the management of a company. In this sense, thinking now about the molds of contemporary society, it is worth stating that the knowledge economy also encompasses, in addition to knowledge and experience, scientific research, technological innovation, knowledge that turns to sustainability, etc., as can be seen in the work of Roberto Mangabeira Unger, who proposes a new knowledge economy.

The aforementioned author can be considered one of the most important scholars on the knowledge economy, in the current context, and emphasizes the great potential that exists in this model to transform human life and promote strong changes in economic and social organizational dynamics. However, his vision also addresses another side of this theme, which lies in the fact that the knowledge economy in the form in which it is practiced today, "ends up accelerating the deterioration of working conditions around the world, restricts the benefits of productive innovation and concentrates capital and power [...]" (MANZATTO, 2020, p. 1), thus having an exclusionary character.

Furthermore, the author reaffirms the need for changes to be made in the 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, to 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).

> [...] It advocates that educational methods incorporate teaching practices that prioritize the development of analytical, synthetic, and creative capacities of students and teachers. In this proposal, teaching no longer privileges 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 apud (MANZATTO, 2020, p. 2).

This type of thinking is connected to Drucker's thinking, believing that that content and formalized knowledge does not necessarily guarantee the efficiency of the work. What can bring about this effect is much more related to the ability to analyze a situation and adapt to it, to make decisions based on more subjective experiences and analyses, than to

that theoretical knowledge, and often plastered, that is recommended in most school institutions. Another important point mentioned by the author as a factor that recovers the healthiness of the knowledge economy would be the rescue of values such as cooperation and solidarity (MANZATTO, 2020).

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

## WORK AND THE KNOWLEDGE ECONOMY

As previously mentioned, modernity has brought with it profound changes in labor relations, with new ways of seeing 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 execution of any labor function, adding not only the manual workforce, but also the intellectual strength and expertise. Within this context, other concepts such as knowledge worker, living labor, Human Capital Theory, material and immaterial labor, among others, will also be addressed.

According to Carmo (2008), the knowledge economy could already be observed from the final decades of the twentieth century, bringing several changes in the industrial, commercial, economic and social sectors. For Izerrougene (2010), it was encouraged due to the labor conflicts that intensified from the 70s onwards, demonstrating a certain crisis in profit rates and in the Fordist model of production and accumulation.

Carmo (2008) also observes how 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 ).

The author also mentions the concept of "knowledge worker", which is one who has 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 *apud* CARMO, 2008, p. 188), thus being a strategic tool that combines learning, reflections, experiences, experiments and the creation of new concepts (CARMO, 2008).

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

Next, it is necessary to observe that "[...] Innovation is not just a matter of investing in capital goods and creating new products. This specificity lies 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.). 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 what Carmo states, this new process:

> [...] of capitalist accumulation emphasizes that the recognition of this productive increase is based on the ability to deal effectively with information and transform it into knowledge. This consists of valuing tangible and intangible resources in the economy, in its form of knowledge management and learning for work. The intensification of the relevance of intangible resources in the economy, such as information and communication technologies, points to the development of new forms of information generation and distribution that enable the increase of information exchange relations and enable interaction between different units within a company (CARMO, 2008, p. 189).

Therefore, it should be stated 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 exploited is the capacity to produce. Thus, "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 to a diffuse network of devices that directly regulate labor practices" (IZERROUGENE, 2010, p. 689) becomes more relevant.

In view of this, the concept of "cognitive capitalism" emerged, which, according to Costa (2008) apud Gouveia (2018), is based on the activity that converts information and knowledge into wealth and/or economic values, also depending on a relationship of intellectual cooperation between the subjects. This model of capitalism thus characterizes a new way of developing capital that uses the knowledge derived 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).

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 processes. Carmo (2008) emphasizes how the knowledge economy needs investment in research, since learning is important for the generation and dissemination of knowledge, and consequently, for the growth of the economy today.

The author also states that the learning process consists mainly of developing a set of cognitive skills, such as: know-how, represented by practical, technical and scientific studies of work, based on courses, training and even professional experience itself; 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 is related to the ability to make decisions or intervene appropriately.

In the same sense, Gouveia (2018) points out that:

> [...] Knowledge is formed through formal education, but not only, the knowledge acquired through a routine of 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 interaction between the individual and society, the result of his way of doing and thinking about things and also the result of the educational and informational opportunities to which he has/had access" (GOUVEIA, 2018, p. 63.).

The author also presents 4 types of knowledge, based on the work of Lundvall and Nielson (2006), which are: "*know-what*", which is the knowledge of facts and information; the "*know-why*", which is the knowledge of the principles and laws that govern any sphere of life; "*know-how*", which relates 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).

Regarding the forms of knowledge transmission, Gouveia (2018) mentions three: symbolic communication, imitation, and embodied knowledge. The first refers to the transmission of the set of symbols, that is, it represents that knowledge acquired in schools, training, etc.; the second demands an environment totally shared by other people, where one learns from the other through observation and imitation; finally, embodied knowledge is that which is materialized in goods or services that are sold, that is, every final product contains some level of embodied knowledge (GOUVEIA, 2018)

Within this context, the Human Capital Theory (HCT) 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). The authors also 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 of humans to produce being an aspect that surpasses all other possibilities of wealth (KAROLCZAK and SOUZA, 2017).

According to Schultz (1961) and Becker (1962) *apud* Karolczak and Souza (2017), 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 the investment made in this capital by generating more productivity and, consequently, more profit or saving resources. Thus, the influence of the 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 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, he does not return to the company, in the form of work and knowledge, the investment that was made in him (KAROLCZAK and SOUZA, 2017).

For this reason, measuring the value of human capital is so complex and Schultz (1961), 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 the work environment itself and outside it; immigration to adjust to the job opportunity (KAROLCZAK and SOUZA, 2017). Some time later, Schultz (1973) 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 services of production of this capital, since they are expressed in prices in terms of wages in the labor market" (SCHULTZ, 1973 *apud* KAROLCZAK and SOUZA, 2017, p. 70).

In addition to the Theory of Human Capital, there is also a lot of talk about "Living Labor" and "Creative Labor", or "Manual Labor" and "Intellectual", or "Material Labor" and "Immaterial", as will be explained below. Gouveia (2018) emphasizes how the practice of an economy based on knowledge has significant differential aspects in relation to capitalism of a more traditionalist nature, which occurred through an expenditure of energy, material

labor, for the generation of surplus value, the so-called "Living Labor". However, in this new paradigm, the exploitation of capital is modified, giving way 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 are presented as an immediately intersubjective action" (IZERROUGENE, 2010, p.694).

Also for Izerrougene (2010, p. 695):

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

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, also demanding a transformation in the professional molds, since creativity is unpredictable and can generate unexpected results compared to live work, or mechanical (IZERROUGENE, 2010). Precisely for this reason, this capacity can be considered innovative, in addition to adding high value to organizations that invest in education, training, training, research, that is, invest in the acquisition of knowledge of their workforce.

Sicsú and Bolaño (2004), on the other hand, use the terms Manual and intellectual work to refer to living work and creative work, as mentioned above. For the author there is a very tenuous border between these two modalities 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 communication or coordination began to have a much greater relevance, that is, the new forms of consumption also demand an intensification in the level of knowledge of the interested public, which ends up reinforcing the mediating character of intellectual work (SICSÚ; BOLAÑO, 2004).

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

> Social capital, which comes from the way economic actors interact and organize themselves, when they act in the division of knowledge and information through social networks, to generate growth and development, is a source of value from immaterial labor that produces "material" wealth, and immaterial, knowledge that generates more knowledge. (GOUVEIA, 2018)

Thus, the difference between these two extremes is highlighted, which consists of the limit imposed by material labor, which does not occur in immaterial labor, since it is not palpable and can be infinite (GOUVEIA, 2018). However, the author considers radical this assertion that relates material labor to the commodity, 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), such as the New Information and Communication Technologies (ICTs), "which have the particularity of being, simultaneously, an object of consumption and a tool of work" (IZERROUGENE, 2010, p. 689).

For Sicsú and Bolaño (2004), the emergence of information and communication technologies was a remarkable fact for the tendency to erase the boundaries that exist between manual work and intellectual work, "manifested both in what I have been calling the subsumption of intellectual work, and in the general intellectualization of work processes in industry and in the service sector" (BOLAÑO, 1995 *apud* SICSÚ; BOLAÑO, 2004).

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

## THE TRANSFORMATIONS OF EDUCATION AND ITS IMPORTANCE IN THE KNOWLEDGE ECONOMY

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

For Guile (2008), higher education could be seen as the axis of the knowledge economy, despite encompassing different conceptions, such as traditionalist, utilitarian and postmodern. The first states that there is a certain level of scientific and literary knowledge that is fundamental 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 (GUILE, 2008, p. 630).

The most up-to-date view, in the view of Dowbor (2010, p. 3), 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 of multiplication and dissemination of knowledge.

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

Still for the author, practical and analytical knowledge can be acquired through experience and 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 of the understanding of tacit knowledge (LUNDVALL, 2001).

> The classic examples of tacit knowledge contained 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 telecommunication of networks. 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 so (LUNDVALL, 2001, p. 202).

In other words, tacit knowledge can also be described as that which is acquired by a process of incorporation, even with a certain level of unconscious. A person who works in a team and incorporates the knowledge of various team members through practice and living together. 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), embodied 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 preserves some ideals of the past, based on the formality of education, on the importance added to the diploma, the classroom, the disciplines. "Education has a profound transformation ahead of it, in the sense of being less of a teacher of classes, and more of an articulator of the multimodality that characterizes knowledge management today. Change is just beginning" (DOWBOR, 2010, p. 1)

Lundvall (2001) 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).

The author also considers two factors as fundamental in the educational process linked to the knowledge economy. The first of these would be the creation of innovation networks that include other companies and other subjects, competitors or customers, as a way of cooperating for the appropriation and propagation of knowledge. For him, this collective effort is necessary, since companies do not individually master all aspects of the conception of a product, or even of processes and services (LUNDVALL, 2001)

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 will be explained below:

- The development of human resources: Private companies need to invest in the training of their employees' skills through formalized training and courses. The public initiative needs to train those unqualified workers. That is, public and private in search of professional improvement for individuals.
- New forms of organization: that intensify the exchange of knowledge and experiences between the various sectors of a company and society.
- The constitution 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.
- Attribution of a new role to the service sector: transformed into key pieces for the innovation process, based on their analysis and results, and through mediation between customers and producers, in a process of knowledge sharing.
- Integrate research institutions and innovation systems: that is, foster the effective engagement of universities in innovation processes (LUNDVALL, 2001).

Finally, it is clear that knowledge has become the main source of value generator, it is something that does not rival because it is infinite, because it has not reduced its stock (DOWBOR, 2010). The author also mentions examples of MIT's free access actions, which did so in exchange for visibility and improvement of the image in the market. However, for him:

> Education today needs to modernize rapidly, as it handles an area, knowledge, where interests are increasingly fierce, in the numerous MBAs, corporate colleges, distance education systems, integrated systems of privatized school management, and the broad diploma industry. New technologies and the knowledge economy are

> welcome, it is a matter of ensuring their use and democratic use (DOWBOR, 2010, p. 6).

Therefore, it is worth mentioning, according to Lundvall (2001), that contributing to the training of workers, in general, as well as fostering 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 detached from the economic/political context.

## THE ENVIRONMENT IN THE CONTEXT OF INNOVATIONS

Andrade (2012) 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 considers in its theoretical framework the dimensions of sustainability and the impacts that human actions cause to the environment.

Thus, Cavalcanti (2010) questions how much it would be acceptable to extract 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. So, 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 about a macroeconomics of the environment, still making an analogy to the boat, the carrying capacity would play an important role, in this case, the carrying capacity would be the limit of the environment in supporting human actions on it. In short, it is this limit that will guide the dynamics of sustainable development or sustainable growth (CAVALCANTI, 2010).

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

Still in this model, the ecosystem is passive and impartial, and only what would be the harmful impacts caused by the economy are analyzed. 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).

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

Another phenomenon, more recent than neoclassical environmental theory, is Ecological Economics, which began with a meeting held in Barcelona in 1987, which highlighted a critique of the way neoclassical theory conducted solutions in defense of the environment, despite its enormous potential to do so, "advocating that the disregard of the biophysical-ecological aspects of the economic system leads to a partial and necessarily reductionist analysis of the interfaces between economy and environment" (ANDRADE, 2012, p. 3). Thus, the main argument of this new model would be that such a complex theme should be analyzed and studied from the perspective of several disciplines, and not only the sciences or ecology (ANDRADE, 2012). Like this:

> Because it is 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 objective of providing an integrated analysis of the interfaces between the economic system and the environment, overcoming the reductionist character present in neoclassical analyses. Thus, it is considered that ecological economics offers an analytical instrument more consistent with the criteria of sustainability and with the preservation of life on the planet (ANDRADE, 2012, p. 27).

For Cavalcanti (2010):

> By verifying, in both cases, the need to overcome the disciplinary narrowness that prevents an overall view of the ecological-economic problem, EE emerges without disciplinary dependence, either on the economy or on ecology, resulting, on the contrary, in an attempt to integrate both. Their worldview would therefore have to be transdisciplinary, focusing on the relationships between ecosystems and economic systems in the broadest possible sense (CAVALCANTI, 2010, p. 60).

Cavalcanti (2010) also points out that the intensification of the perception of the threat of the natural system was preponderant for the formulation of ecological economics. 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.

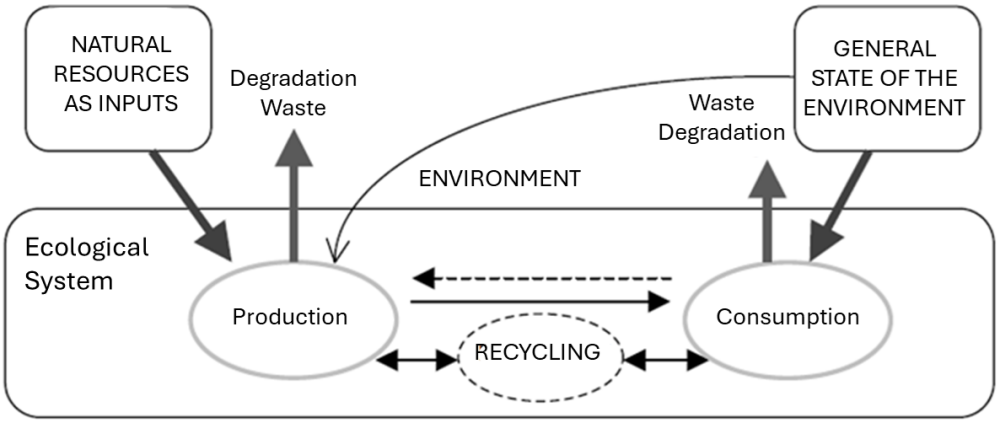
It is also important to emphasize that this model is not completely opposed to the use of available natural resources, however, what "recriminates is the irresponsible use of these

resources and the disregard of the finiteness of the physical base that sustains the economic system" (ANDRADE, 2012, p. 21). In summary:

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

For Mueller (2007) *apud* Andrade (2012), it is necessary to think about this relationship between the economic system and the natural system, the former being an apparatus of strong complexity, which is supported by the latter. Both interact with each other, the economic system extracts natural resources from the environment, but only returns 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) *apud* Andrade (2008, p. 17)

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

According to Corazza (2003), it is an extremely important and difficult task for leaders to develop technologies that respect the environment, as well as to encourage, knowledge, evaluate, choose and adopt them. The public power must move in this direction, aiming to make it possible to finally reach what the author calls a "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 use a normative approach. Before even answering questions such as "what should be done?", it would be necessary to look for an acceptable answer to the following: "what situation is desirable?". In other words, it would be necessary to establish a reference and a criterion (or a set of them) to evaluate the possible social states: it would be necessary to establish a normative framework (CORAZZA, 2003, p. 481).

Lundvall (2001) outlines a draft of what would be necessary to establish innovation policies that are socially and environmentally sustainable. The author states that there are three key elements to 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).

In short, these measures and analyses are a great challenge to the status quo of the planet, when it comes to pollution and environmental degradation. However, it is still valid for industry and other sectors of the economy to develop innovations and techniques that are non-polluting or more environmentally friendly. Innovations considered social, which positively interfere in society's lifestyle, are configured as fundamental components in the dynamics of sustainable growth (LUNDVALL, 2001), as will be observed in the following topic.

## SOCIAL INNOVATION

Before delving into the concept of Social Innovation, which is of most interest to the context of this work, it is important to briefly introduce how innovation is a key element for understanding the dynamics of the knowledge economy. For Lastres and Ferraz (1999), technological innovations refer to the process of using knowledge for the development of new modes of production and commercialization of goods or services. These innovations can also be organizational, as they interfere in the processes of companies, 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, telecommunication, among others, which have obtained a radical reduction in operating costs with the adoption of this type of tool (LASTRES AND FERRAZ, 1999).

For Lastres (1999), 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 whether it is 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 dissemination of knowledge and innovations" more effective (p. 189). Still for the author:

> In addition, it is remembered 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. Unlike what happens with material goods, the consumption of information and knowledge does not destroy them, just as their disposal generally leaves no material traces. Giving them away or selling them does not cause them to be lost (LASTRES, 1999, p. 190).

However, it is worth considering that the constant investment in innovations also demands that investment be made in education, that is, in training, stimulating continuous learning (LASTRES AND FERRAZ, 1999). In addition, Lastres (1999) 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, ends up being more harmful than not being able to have access to these resources, that is, it is essential that in the learning process there is also the opportunity to use that knowledge that has been acquired.

Thus, Almeida (2006) argues that the main function of an innovative system would be to develop, transmit and make use of innovations. However, it also talks about third sector institutions, considering them naturally inefficient and with a limited capacity to innovate, which is the reason for the lack of interest of science in public power policy in investing in the development of innovation policies, constituting, therefore, the impediment to the practice of the knowledge economy.

It happens a lot if it takes into account economic issues and political interests, leaving aside the social aspect and its importance in the innovation process. In other words, only those that confer economic advantages or profit in the market are considered innovations, relegating those non-profit forms of 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) is:

> The main alternative for software users who do not want to submit to the licensing conditions and technical restrictions imposed by proprietary software vendors is free

> or open source software. Business models based on this type of license assume that the value is in the service and not in the TIGRE product; MARQUES (2009, p. 562).

This is also the case of third sector institutions, which is composed of organizations of private initiatives, which are non-profit and also provide advantageous or beneficial services to the public, in general. According to Almeida (2006):

> The third sector emerged, during the nineteenth century, as a result of a social movement against the situation of the disadvantaged social classes, affected by the Industrial Revolution. In the twentieth century, after the golden age of world capitalism, its rebirth can be observed, in the context of the crisis of the welfare state and Fordism. Unlike the classical social economy, the new social economy, as some call it, does not claim to be an alternative to the capitalist system, but rather as a complementary one. (2006, p.62).

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 in the case of cooperatives, for example; and the guarantee of goods and services that are usually unprofitable, despised by the market and the public authorities (LÉVESQUE, 2005, p. 9 *apud* ALMEIDA, 2006, p. 62).

Still, Almeida (2006) highlights other factors that represent the fragility and limits of innovation in the third sector:

> Firstly, social economy organisations cannot succeed in all sectors, especially in those cases that need strong capitalisation. Secondly, its ability to tackle the various social problems has limits, since its operating principle is often based on reciprocity. Thirdly, there are highly bureaucratised organisations that have a weak capacity for change. Last but not least, innovative capacity is not always updated. The creation phase is usually the time to innovate, but in the following stages of diffusion and development, there is often a tendency to trivialize (LÉVESQUE, 2005; LÉVESQUE, 2006 apud ALMEIDA, 2006, p. 65).

Thus, the potential for innovation in this sector, based on a social economy, is closely linked to its ability to sustain itself, still depending considerably on the public sector, despite seeking more independence and other forms of financial aid (ALMEIDA, 2006). The OECD defines Social Innovation:

> [...] It 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 labour 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 they are consumers or producers. OECD (2003: 299) apud ALMEIDA, 2006, p. 60

Therefore, social innovation has several forms of association, interaction and mobilization of people, still strongly diversified, with companies linked to philanthropy, free *software*, information vehicles, among others (ALMEIDA, 2006). Here we are mainly dealing with cooperatives, institutions that bring together workers who collect recyclable materials in 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 to a new dynamic of society. That is why third sector companies are so important for the consolidation of the knowledge economy since they seek other alternatives and even innovative answers to social and economic problems (ALMEIDA, 2006).

## THE KNOWLEDGE ECONOMY IN THE CONTEXT OF RECYCLING

The constant growth of capitalism and, consequently, of industrialization, has caused a considerable increase in consumption, especially of industrialized products that generate a huge amount of tailings and common solid waste. Thinking beyond the environmental issue, it is also possible to note how all these economic changes have also caused profound transformations in social and labor relations, encouraging the emergence 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 profession of recyclable material collector, an activity that emerged in the context mentioned above and also from the high unemployment rate in the formal sector, which, for Bosi (2008), leads workers, especially those with little education and qualification, to look for other possibilities to support themselves, finding this alternative in informal work, such as recycling cooperatives, scrap dealers, dumps. "It is above all a matter of surviving and ensuring the daily life of the family [...]" (SANTOS, 2008, p. 46).

According to Lussari (2016), this industry/market arose due to several factors, among them, the environmental factor, which focuses on the concern for the unbridled use of natural resources, encouraging raw materials to be reused in the production process. In addition, there was a great opportunity to make profits from less expensive material and a less valued labor force. In this sense, the author also points out how recycling is an extremely ambiguous market, being, on the one hand, an environmentally correct practice,

while, on the other hand, it feeds the profit possibilities of companies in this capitalist model[3] (LUSSARI, 2016).

Therefore, it is concluded that the activity in question involves several subjects who differ according to the social and power relations that each one occupies in this context. This is where the importance of cooperatives for workers in this niche comes from, since, for Silva (2017), this organization can represent a possibility of empowerment of the waste picker worker[4]. Also, according to Lussari (2016), cooperatives promote strengthening and give voice to waste pickers, in front of politicians and those who are at the upper levels of the pyramid[5]. Other authors such as Costa & Chaves (2012) and Bosi (2008), citing Dagnino and Dagnino (2010), also affirm the visibility that cooperatives give to the struggles of waste pickers, promoting representativeness before the public authorities and the application of labor rights.

Thus, it is possible to observe that the cooperative is nothing more than the union of a group of people who perform a specific labor activity. Its main objectives would be the organization of groups, the improvement of work processes and the representation of these workers before the government, entrepreneurs, potential customers, among others. Thus, cooperatives benefit the lives of waste pickers, ensuring a better quality of life and helping to reduce the condition of marginality of waste pickers. However, it is also important to note that not all waste pickers enjoy this cooperativism. A considerable portion is still unnoticed and working 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), which relates the recycling industry to the knowledge economy, qualifying the recycling activity as an empirical object of this research area, due to the transformations caused 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 the researchers, knowing and understanding the levels of knowledge of this group becomes fundamental for the design of public policies aimed at their social inclusion (BUNCHAFT; OLIVEIRA FILHO, 2015). The devaluation of the professional waste picker does not occur only on the financial side, but also due to the lack of recognition of the

[3] 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 materials.
[4] The formalized collector represents only 10% of this social group. In other words, 90% cannot even reach work in cooperatives.
[5] Working crowded in the physical space of a waste pickers' cooperative ideologically represents a certain, fixed workplace, with headquarters, the possibility of coexistence with other workers. A place to go back and forth, ideologically this is very important for the Brazilian worker. Mainly, the society that sees the worker as the one who "left home" to work. That he works at cooperative X, which is located at such an address.

activity as dignified or important, as well as doctors, lawyers, businessmen, etc. Informality, the exploitation of labor, the lack of conditions for waste pickers to move in social classes and the vulnerability of this portion of the population, it gives them the tone of marginality. When there are no possibilities for formal work, subjects are also denied access to education, health, representation, rights, and also visibility, to voice. And this often occurs even when the worker is a cooperative.

Thus, Bunchaft and Oliveira Filho (2015) sought to develop in their research, Integrated Knowledge Modules (MIC's) that articulate scientific and practical research, and could be replicated in various contexts (transportation; sorting; pressing; marketing, organization, logistics, production, etc.) with an evaluation 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 the knowledge acquired and its dissemination, which serves 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 production processes, etc. In addition, the efficiency of the operation of these tools in the context of this activity was evaluated. Then, based on this data, Bunchaft and Oliveira Filho[6] (2015) determined 4 levels, which he calls "Steps of acquired knowledge" (DC1, DC2, DC3 and DC4), according to the structural and productive organization of the organizations of recyclable material collectors. Of these 4 degrees, the last is represented by groups that are not yet properly organized, as will be better described below:

**A) DC1 - STEP OF KNOWLEDGE 1: HIGH LEVEL OF KNOWLEDGE ACQUIRED**

It is composed of groups formally organized into associations or cooperatives, and which have all the necessary equipment for the optimization of work processes (presses, scales, carts, their own sheds, 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 higher level of organization provides efficiency in the physical, economic and market part, with a consequent higher remuneration and higher quality of life. They also have adequate sanitation, bathing and hygiene facilities, as well as a kitchen and cafeterias

[6] Prof. Dr. João Damásio and Master Antonio Bunchaft, friendship built over 14 years of work at the Center for Socio-Environmental Studies - Pangea.

for the preparation and timing of meals. Some cooperatives at this level even have classrooms and computer rooms, for training, literacy and other studies.

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

**Figure 2:** Photograph of the belt, trolley and uniformed workers

Source: Bunchaft, Oliveira Filho & Uilmer Rodrigues Xavier da Cruz (2015-2020).

**Figure 3:** Photograph of the equipment in a DC1 recycling shed

**Source**: Uilmer Rodrigues Xavier da Cruz (2020).

**B) DC2 - KNOWLEDGE STEP 2: MEDIUM LEVEL OF KNOWLEDGE ACQUIRED**

It is composed 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. They have some acquired knowledge, but they are direct beneficiaries of the spread of knowledge at the DC1 level.

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

**Figure 4:** Photograph of a recycling truck, shed and materials


**Source**: Bunchaft, Oliveira Filho & Uilmer Rodrigues Xavier da Cruz (2015-2020).

**Figure 5:** Photograph of a DC2 recycling shed

**Source**: Bunchaft and Oliveira Filho (2015).

## C) DC3 - KNOWLEDGE STEP 3: LOW LEVEL OF ACQUIRED KNOWLEDGE

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

In general, they have difficulties even knowing where to look and requesting financing and technical support. Therefore, the formalization of their cooperative would mean inclusion, ascension to a higher level of knowledge, in addition to a slight distancing from conditions of vulnerability, marginality and invisibility. As can be seen in the photos below, the shed is not organized and has a precarious structure, which is also reflected in the work of the collector (Figures 6 and 7).

**Figure 6:** Photograph of DC3 recycling shed

**Source**: Bunchaft, Oliveira Filho & Uilmer Rodrigues Xavier da Cruz (2015-2020).

**Figure 7:** Photograph of DC3 level worker with his trolley

**Source**: Uilmer Rodrigues Xavier da Cruz (2020).

## D) DC4 - STEP OF KNOWLEDGE 4: VERY LOW LEVEL OF KNOWLEDGE ACQUIRED

It is composed of unorganized groups or individual workers, who work in streets or garbage dumps. They do not have any equipment, often working in extremely precarious conditions and selling their materials to middlemen and scrap dealers, who pay values well below the market. They only have 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 start acquiring more knowledge. As in the case of the DC3 level, the formalization of a cooperative would mean inclusion and ascension to a higher level of knowledge, in addition to a slight distancing from the condition of marginality.

**Figure 8:** Photograph of workers looking for recyclables in a "dump"

**Source**: Uilmer Rodrigues Xavier da Cruz, Ricardo Alexandrino Garcia (2020).

**Figure 9:** Photograph of the waste picker work in a "garbage dump" and on the streets

Source: Bunchaft, Oliveira Filho (2015).

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

**Table 1:** Number of waste pickers and cooperatives

| Steps of Knowledge | No. of Tasters | % | No. of Cooperatives | % | Tasters by cooperative |
|---|---|---|---|---|---|
| DC1 | 1.381 | 4 % | 24 | 7 % | 57.5 |
| DC2 | 2.753 | 8 % | 70 | 21 % | 39.3 |
| DC3 | 5.720 | 16 % | 122 | 37 % | 46.9 |
| DC4 | 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 adequate knowledge and infrastructure at the DC1 level, that

is, it is an extremely small portion of the surveyed sample, which demonstrates that most of the waste pickers, even those who are already organized, still do not work in conditions considered ideal.

Considering a junction between the DC1 and DC2 levels, which are the levels where the best knowledge and basic infrastructure are found, it is observed that the value of 28% (or 94 out of a total of 331), remains much lower, compared to the other levels (DC3 and DC4) which, together, represent a total of 237 cooperatives, out of the total of 331 in the sample, or 72%. Therefore, it is concluded that the two groups that represent more cooperatives and, therefore, 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 DC3 and DC4 groups, which is 31,503. In other words, there are 31,503 individuals working precariously and unable to see possibilities for improvement, also due to the lack of knowledge acquired.

In this regard, BUNCHAFT, OLIVEIRA FILHO (2015) questions how to create public policies for this population, without fostering the maintenance of their structural conditions. In short, there is no point in financial investments and the creation of new jobs if there is no strong educational process that enables waste pickers to make a real change in their lives, as well as independence, based on effective and lasting knowledge that can be practiced in the activity of waste picking.

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

**Table 2:** Regional distribution of cooperatives, according to the steps of knowledge

| Region | Total in the region | DC1 | DC2 | DC3 | DC4 |
|---|---|---|---|---|---|
| North | 2 | 0 | 0 | 1 | 1 |
| Central-West | 25 | 3 | 6 | 8 | 8 |
| Northeast | 58 | 2 | 7 | 14 | 35 |
| Southeast | 112 | 14 | 47 | 35 | 16 |
| Sul | 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 Chart 2, it is observed that most of the cooperatives are located in the Southeast region, followed by the Northeast, South and Midwest regions. The North region is the one with the fewest cooperatives (2), both of which belong to the DC3 and DC4 levels. This demonstrates a certain delay in the North region in relation to the knowledge necessary to improve the work processes of a waste pickers' cooperative. 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, most of which belong to the DC2 and DC3 levels, respectively. These data demonstrate that the region, despite already having a certain level of knowledge, still needs to advance a lot in its dissemination, so that most cooperatives can reach an ideal level (DC1) in the work of recycling.

In the Northeast region, which has a total of 58 cooperatives, most (35) are at the lowest level of acquired knowledge (DC4), with 14 at the DC3 level, 7 at the DC2 level and only 2 at the DC1 level. These data demonstrate, then, that most 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 potential dissemination of this knowledge, a fact that could, little by little, make the cooperatives climb the steps, so that they could reach the ideal level.

Almost the same can be observed in the South region, which has a total of 47 cooperatives and most (22) are at the DC3 level, with 9 at the DC4 level, 10 at the DC2 level and only 6 at the DC1 level. The data from the South region point to a slight improvement in the level of knowledge acquired, because there are 6 cooperatives at the DC1 level and most of them are in DC3, although they still have a low potential for dissemination of the knowledge acquired.

Finally, the Midwest region has only 25 cooperatives, and most of them (16) are at the lowest levels of acquired knowledge (DC3 and DC4), with 3 at the DC2 level and only 3 at the DC1 level. These data point to similarities in relation to other regions, which demonstrate a lack in the dissemination of acquired knowledge, since it has 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 processes and organization, there is a lack of sufficient knowledge, and the transmission of it, to be applied and put into practice This can be seen by the huge number of waste pickers and cooperatives that are still at the lowest levels of acquired knowledge.

Thus, after all this analysis, it is important to emphasize how the research of Bunchaft and Oliveira Filho (2015), specifically, Redes de Comercialização Cruz (2015), is configured as a social rescue, according to the author's own words, since it represents the possibility of solving the problem of lack of knowledge of one of the most excluded social groups in society. The idea is to be able to identify all the flaws that need to be remedied, especially those related to the knowledge necessary to provide a healthier work environment and more quality of life for workers. Thus, the dissemination and sharing of knowledge applied in cooperatives that belong to the DC1 level, to cooperatives at other levels, would be the ideal path for the transformation of the current paradigm of the waste picking activity in the recycling market.

Oliveira Filho *et al.* (2020) also mention some parameters of knowledge that would be essential to acquire for a change in this scenario, which are:

a) **Knowledge economy applied to techniques for sorting recyclable materials**: the recycling production chain is defined as the set of sub-chains that operate on specific types of recyclable materials. According to Oliveira Filho et al. (2020), these subchains 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 of types 1, 2 and 3, magazine paper, newsprint, catalogs, cardboard, etc. — ferrous scrap, 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 variation in the colors of the waste. Each of them corresponds to a different productive purpose within the sub-chains[7].

Oliveira Filho et al. (2020) state that, for each type and color of recyclable, there is a specific purchase price by the recycling industry. This reports to its supply chain based, as a rule, on intermediation structures, on a first step, and on the recyclable material collectors themselves, on the second step, who 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 per sorting, that is, it is essential to take into account which

[7] By way of demonstration, recycling white LDPE can result in a multitude of recycled products of different colors. In turn, only dark-colored LDPE can be derived from the recycling of dark-colored LDPE. Evidently, the recycling of the first case adds significantly more value to the product than that of the second.

recyclable is worth investing in a specialized sorting, since some add more value than others.

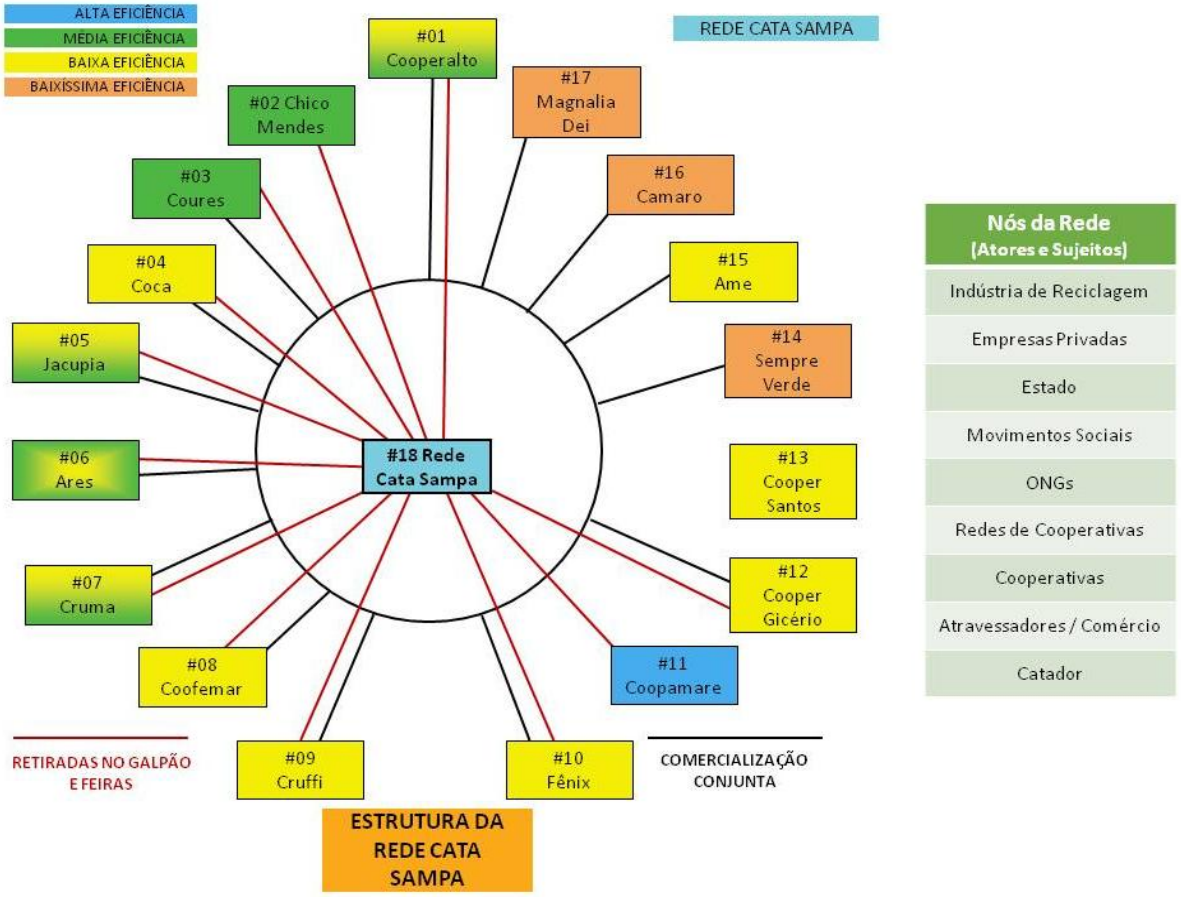
In this regard, it can be said that building systematized knowledge about the diversity of recyclable materials and their forms of sorting makes it possible to add value to the price charged by the product. It is noteworthy that the surpluses generated in the commercialization stage of the recycling production chain — that is, between the collection carried out by the collectors and the sale to the intermediation structures, until it reaches the industry — can exceed 500%.[8] Most waste pickers are not aware of this. From this it can be inferred that a properly systematized knowledge about this technique can affect 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 actors in the markets of the recycling process along the production networks of recyclable materials:** addresses the various forms of production, appropriation of values, relative gains and characteristics of the existing market structures along the chain. It also deals with the "Commercialization Networks", which incorporates new organizational and logistics strategies, such as the practice of Joint Commercialization, 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 to stock – recyclable materials until the necessary volume is obtained to meet the demands at levels of commercialization higher than those that would be obtained by decentralized individual marketing.

**c)** The Figure below illustrates, with the example of the Cata Sampa Network, how a Commercialization 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 of the respective cooperatives in the "withdrawals" from the processing of materials collected in large generators and fairs and events. The colors that fill the rectangles of each cooperative indicate their relative efficiencies.

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

**Organization chart 1:** CATA SAMPA Marketing Network




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

In this sense, the knowledge about how a Marketing network It enables a more global analysis of the consumer market of recyclates, being able to generate advantages due to efficiency and the great potential for dissemination of 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 essential to be able to sell recyclable materials directly to the recycling industry. As Oliveira Filho et al. (2020) underline, such an industry cannot live with minute quantities and irregular supplies, under penalty of compromising its production process.

Because they are economically disorganized, the collectors of recyclable materials generally work in isolation, rescuing the waste on which they operate from the streets and dumps, selling them by the day and in small quantities to the intermediation structures. Even if they organize themselves into cooperatives or associations, they continue to collect a very small volume of materials, which keeps them hostage to intermediation.

In this sense, Oliveira Filho et al. (2020) 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 this, unknown among academics, which

consist of a business strategy in the midst of poverty — a strategy that consists of an intelligence center capable of articulating small, medium and large organizations of waste pickers with a view to a unique and instantaneous commercialization to achieve considerable monthly volumes and regularity of supply, thus managing to overcome the intermediation structures, selling directly to the recycling industry. Such networks are also capable of analyzing the market regionally and nationally, building an information system on current and future trends in the production chain, observing medium and long-term movements, allowing strategic positioning by waste pickers.

Although it is an interesting strategy for emancipation from intermediation structures, marketing networks are not yet capable of building productive stocks to face market seasonality. It turns out that they do not have enough information to understand how the formation of inventory in the market by sub-chain takes place, nor what are and how do the categories of analysis that affect the formation and variation of the price over time operate[9].

In view of this, we can say that these networks lack knowledge articulated with empirical experience, perhaps even because 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 them from mere individual suppliers to regional and national economic organizations that supply raw materials to the industry[10].

d) **Knowledge economy applied to logistics techniques for the collection, processing and transport of recyclable materials**: asa rule, recyclable material has little weight and a lot of volume. In this sense, paying to "charge air" is very common in selective collection processes. Oliveira Filho et al. (2020) state that the density in the distribution of collectible 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 vicinity. From this it can be said that the higher the income of the community, the more waste it will produce. Among these wastes there will be a higher incidence of recyclable materials than organic materials, and the economic value per capita added is also higher. It is also possible to infer that the larger the local population, the greater the territorial density

[9] The price of Naphtha in the international market impacts the virgin resin of PET, which, in certain situations, can be cheaper than recycled resin, as paradoxical as this may be.
[10] The CATABAHIA Network, the object of research, is the first national network that introduced this strategy, being a reference for Brazil. It was considered in 2007, 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. It is a matter of analyzing the experience and systematizing it together with a set of other techniques, aiming to constitute a KIE reproducible in other experiences in Latin America.

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 adequate modeling of the capture of 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 is often not systematized, nor articulated with scientific knowledge. In addition, the appropriate modeling for a consortium between collection carts, by means of human traction, and trucks, with a view to obtaining a greater volume within the lowest possible economic cost, is also considered an empirical experience that does not systematize or be added to the scientific framework. This shows, according to Oliveira Filho et al. (2020), that the records of assembly of systems for capturing recyclable materials that consider, at once, the variables of weight, volume, and irregularity of the waste in the territorial and income distribution are erratic. It also shows that the records of formulations of mathematical equations for logistical purposes through computerized systems that take into account the same variables are mistaken, managing to build mere models of consortium between warehouses, warehouses, human traction and trucks.

Such issues focus on 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. In this regard, the aforementioned issues give rise to the need to build structured knowledge on which models for the arrangement of selective collection logistics 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 selective collection, which are sustainable and viable in various situations such as differences in territory, time of year, materials, etc.

e) **Knowledge economy applied to techniques of verticalization of production and articulation of new energy and environmental opportunities:** the value added to recyclables through the verticalization of production requires, as we have already alluded to, volume and regularity. From this it can be deduced that there are more chances of success in aggregating in waste picker structures organized in marketing networks11. However, it is not inopportune to ask in which subchain the most value is added and up to what level of verticalization it is worth reaching.

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

New windows of opportunity have opened in Brazil with biofuels. As Oliveira Filho et al. (2020) recall, cooking oil has become an input for biodiesel plants. However, as it is a liquid waste, the adequate collection logistics structure is not properly matured on a large scale. The levels of value addition to cooking oil for commercialization with the Brazilian oil company (Petrobras) are also not mature, as the whole process is very recent.

Petrobras is currently the fourth largest company in the Americas, having recently started an aggressive strategy of purchasing oil for waste pickers' cooperatives. However, she still does not know the market and its nuances. Although the waste pickers have the potential to collect organic waste that could be worked on a scale with a view to building biodigesters for the production of compost and energy generation, these products could be sold or absorbed in the waste pickers' production plants. This is an expressive potential, on which there are already pilot projects for the implementation of biodigesters. The experience in cooperatives of biodigester collectors is limited to India and Brazil basically. In view of this, it is essential to monitor and articulate experience with scientific knowledge12.

This entire system of collecting recyclable materials, adding value and generating energy are perfectly quantifiable in terms of environmental resources saved, 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 benefited only large business organizations.

It adds additional value to recyclables through the verticalization of production, with more chances of success in cooperatives and associations of waste pickers organized in recyclable material marketing networks. In addition, it seeks to articulate this process with sustainability and energy generation issues.

Regarding education, it is important to consider the knowledge economy, in the context 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 lives of waste pickers and how this influences all their day-to-day decisions, including attempts to "improve their lives" or "raise" the levels of the steps of knowledge. An example of this would be the participation of waste pickers in the electoral process through voting.

What is observed is that those less organized workers with a lower level of knowledge end up voting for populist candidates with empty promises, representatives of

[12] The CATABAHIA Network has been setting up a biodigester to generate energy that will be directed to the network's own plastic industry. It is an innovative experience in the world, with full use of organic and recyclable waste.

parties that respond to the interests of the elite and big business, including those involved in recycling. On the other hand, the 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.

Finally, it should be stated, then, that knowledge, when acquired, provides an increase in the income of waste pickers, in addition to improvements in the quality of life and working conditions, with the acquisition of new equipment, adequate and hygienic environment, use of uniforms, training, education, etc. All this transforms recycling workers into protagonists of decision-making and administrative processes. further reducing their condition of invisible and marginal. However, still according to the words of Oliveira Filho *et al.* (2020), the knowledge acquired only has value when it is disseminated to those who do not have it, as would be the case of the diffusion of knowledge from the DC1 and DC2 cooperatives to those DC3 and DC4.

## FINAL CONSIDERATIONS

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

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

Also, 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, commercialization of equipment - observed mainly in those cooperatives that are already more advanced - can be fundamental for the improvement of the quality of life and work, in addition to better earnings. of cooperatives and waste picker workers.

In this sense, it is affirmed how this work was fundamental to reflect on what was questioned in the problem question: *How does the knowledge economy relate to and*

*positively influence work activities such as the collection of recyclable materials?;* when it was understood that knowledge, represented by technologies, new equipment and improvements in processes, is fundamental to improve the work of recyclable material collectors, such as the cooperatives belonging to DC1 and DC2, which have equipment for the processing of the 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 takes place in the condition of informality and social exclusion and rights. That is why the discussion addressed here is considered 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 socially and financially devalued. Finally, here it was also possible to systematize the activity of scavenging, on the steps of knowledge, in order to encourage the thought of new possibilities to improve and value these subjects, so that they can get rid of this condition of marginality.

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