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Article

Offset policy in the process of technology transfer: an analysis in the context of Brazilian public health

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Abstract: This research aimed, within the scope of the anthropotechnological approach, analyze the technology transfer, performed via the offset policy in the field of public health, called the Radiotherapy Expansion Plan, from the Health Ministry. The objective of this policy is to create and improve accredited organizations, concerning the oncological treatment, specifically in the insertion of radiotherapeutic equipment. This process is divided into two stages: the insertion of the radiotherapy equipment, and the compensations provided for in the commercial agreement. To meet this purpose, the research started from understanding the theoretical and methodological approaches of the fields of study of anthropotechnology, technology transfer and offset policy. In this sense, there was used the methodological strategy of the case study, supported by applied research, with a qualitative and exploratory approach. External and internal environments of a specific situation were analyzed, located in the State of Paraná, which received the radiotherapy equipment. It was verified that the initiatives of insertion of radiotherapeutic equipment in the context of the Expansion Plan have undergone numerous confrontations, inserted in the contextual and organizational particularities that affect its development and effectiveness. There are challenges that require responses from a set of organizations involved, in order to implement the trade agreement established by the offset policy, highlighting the first stage as a process of technology transfer. Thus, the situation located in the State of Paraná consistently consolidated the insertion of the radiotherapy equipment. It allowed its disclosure as a reference situation, and based on the dimensions and indicators analysis provided by anthropotechnology, made possible the comprehensionof the technology transfer involved in the process.

Keywords: technology transfer; anthropotechnology; offset policy.

1. Introduction

The Many countries are facing a double challenge, from two transformation groups, due to the modernization process: first, a social restructuring, and second, the economic conditions. It is imperative for the countries to participate in an increasingly globalized international economy in terms of technology [1, 2].

Emerging from public policies, government programs represent initiatives of the State apparatus in specific segments such as security, health, education, economics and agriculture, with the purpose of assuring citizenship rights through access to public services.

Public procurement laws represent a mechanism to stimulate governmental action. First, these laws place specific rules to make the practice effective. Initially in an informal context, the emergence

of trade, industrial or technological offset in the Brazilian context first occurred within the armed forces, where technologically advanced military equipment was sought abroad. On the other hand, it supplied developed countries with commodities, among other means of payment.

With the modernization of the practice, not only the military segment, but several other segments of the state began to use the offset practice, in order to increase the efficiency of their services. Consequently, around this practice emerges another phenomenon: technology transfer [3].

The processes of technology transfer in offset practices represent a complex theme, due to the divergences between different populations and the methods that are used. That is, the cultural aspects and characteristics of the industry are elements that may determine the success or failure of the process [2]. In this perspective, the concern about the adaptability of the technology in different environments from the original one, promotes the discussion about necessary reflections in critical aspects, in order to obtain satisfactory results [4].

In this context, there is the rise of anthropotechnology as a field of study, where the matter has the objective to promote the understanding of influencing factors within the technology transfer process, from the perspective of ergonomic problems at macroorganizational levels, aiming at the success of the transference through an adaptation process [5, 6, 7, 4, 8].

Based on the assumption that the offset policy represents mechanisms that promote the process of international technology transfer between different population contexts, and recognizing that, in this scenario, there is a need to analyze the process in the face of organizational and institutional changes, the research question is formulated: Is anthropotechnology, as a field of study, able to understand the resource-based improvements promoted by offset policies in hospital institutions inserted in the radiotherapy expansion plan?

2. Theoretical Background

2.1. International Technology Transfer (ITT)

Considered as a way to access international markets, and to stimulate local economic growth, ITT has represented an important field of research, constituted of opportunities for production expansion, and as a means of infusing advanced technology in divergent contexts, especially for developing countries, dependents of the ITT from developed countries.

Concerning the way technology is transferred between nations, there is a general consensus that the most important mechanisms for technology transfer are international trade and the direct foreign investment [9]. For [10], the definition of ITT is described as the process by which the technology holder transmits the technology through several channels to the recipient, across national boundaries. Still, this process is not represented as a singular event, and the sequence of the process consists in identifying the needs and demands of technology, the event of the transfer process itself, and the implementation of the technology. Finally, there is the assurance that the technology was acquired by the recipient according to the plans.

The basic ITT model was developed in the 1970s to the 1980s. Four factors were identified, that determine the effectiveness of the technology transfer: (i) the objectives of the entity administering the technology; (ii) proficiency in mastering technology transfer; (iii) objectives of the technology recipient and their capacity to incorporate new knowledge and (iv) their organizational learning capacity [11]. Dynamic factors, such as technology itself and not the competitive advantages of holder

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organizations, are becoming significant in determining the most efficient management model in dealing with cross-border organizations [12].

In [13], the author presents his work around the impact of technology transfer efficiency, by presenting a contingent model, and the significant point of the model is the impact of ITT and its representations on factors such as political market, personnel involved, available resources and scientific technical objectives. In the case of the learning environment inserted in the ITT process, it is strongly linked to the communication process between the holder and the receiver. In this perspective, the cultural aspects and the distance between the owner of the technology and the receiver is a relevant concern to be considered in the international technology transfer management process [14].

The institutional perspective is a useful approach to processes of technology internationalization. In this perspective, the distance between organizations is reduced and the approach is exalted above differences [15]. Thus, when a foreign organization has an interest in moving technology to developing countries and in absorbing spaces in internal markets, the processes of formulating alternative strategies are strengthened, in order to achieve the effectiveness of the process [16].

Local, efficient absorptive capacity represents the central challenge of the international technology transfer process [17], including the absorptive capacity, as a prerequisite from the organizational learning perspective. It allows the recipient organization to recognize, assimilate and apply the new technologies and technology sources, for the end-activity bounded to the technology transfer process [18].

The failure of ITT processes demonstrate the significant existence of social and cultural organizations coupled with economic characteristics that may hinder or make it impossible to replicate the technology developed and used in developed countries in developing ones. Then it is necessary to adapt the holistic approach in ITT studies [19]. A comprehensive study on ITT analysis, coming from the open system perspective, allows to include not only technical aspects but environmental factors associated with the phenomenon in question [19].

According to the proposed context, the environmental variables allow to carry out an extended analysis of the ITT process. However, it must be recognized that, in the case of machines and equipments, the ITT irruptive process occurs in a disorderly manner, requiring adaptations concerning its usability and preservation of the professionals involved.

2.2. Anthropotechnology

To obtain the prospect of satisfactory results in the perspectives of productivity and worker health, it is fundamental to understand the behavior of the socio-technical dimensions involved in the process of technology transfer between countries. With the variation of determinants, such as geographical, industrial, social fabric, financial, economic and environmental factors, and from the need to understand these elements, emerged the science of Anthropotechnology [4].

A concept formulated by Alain Wisner, this new field of study, anthropotechnology, is described by [4], as the adaptation of the technology to be transferred to a certain population, taking into account the influence of geographic, economic, sociological and anthropological factors.

Its definition makes an analogy with ergonomics, i.e., the concerns of anthropotechnology lies in the analysis of difficulties of geographic, economic and anthropological origin [4, 7]. The adaptation of work to man and its multidisciplinary nature are structural elements of

anthropotechnology. In other words, the adaptation of technology to the reality of the local population [7, 4, 20, 6].

With a body of knowledge that supports the study of active man, anthropotechnology has its theoretical bases in disciplines capable of approaching ergonomic problems in the macroorganizational dimension. [5] presents in a schematic form, the disciplines and their relations, history of the techniques, ergonomics, cognitive psychology, human geography, economics, sociology and anthropology, thus forming the theoretical basis of anthropotechnology.

The confrontation between man and technology are precepts of the anthropotechnological approach. Then, it is natural that it presents emerging difficulties coming from this confrontation, which are related to social, geographical, historical and anthropological aspects of the population context where technology is inserted. In this perspective, it is important to take into account the activities performed by workers [20, 21].

2.3. Offset: The Policy of Commercial, Industrial and Technological Compensation – an alternative to investments in hospital infrastructure

Considered a global phenomenon, characterized by reciprocity involving interactions between organizations from different countries, the counterpart practice has been presented as a tool for commercial, industrial and technological import operations. Such phenomenon demands an international business behavior from the organizations involved [22]. From the point of view of operations, if a country decides to carry out an upgrade on its technical capacity, or to acquire equipment with embedded technology, and promoted through technology transfer used by the developed country, the operation represents one of the main conditions for the compensated trade [23, 22].

Latent benefits are embedded in countertrade practices, in addition to the motivating factors that can enhance social and economic growth [24]. About the motivating factors, the main reason for the emergence of the practice is the representativeness of a response to the borrowing capacity of developing countries [23].

Inserted in the context of offset trade, which is defined by an industrial or technological compensation practice, where the reward mechanism is not only monetary values, the offset modality creates means and conditions for the purchase of goods or services through possible counterparts.

In the understanding of [25], the offset policy negotiates an agreement, in which the buyer includes within the contract the condition that the seller has to perform certain activities that benefit the buyer, and its modalities are adopted according to the appropriate criteria.

A relevant feature of the offsetting practice is present in specific sectors of the industry, where unit sales prices are significant. It also appears for buyers, when the regulatory role of the State in the international business processes is intense, particularly in bureaucratic aspects and in the valorization of the national industry [26, 27].

The aerospace industry is a pioneer in offsetting, but in 1944 Bretton Woods began its activities: with the emergence of the World Bank and the International Monetary Fund, allied countries looked for alternatives in seeking sources of financial resources and mechanisms for re-establishing order in the post-war period [22, 27]. Compensation mechanisms, in particular offset, presented advantages in the theoretical perspective: reduction of compliance costs, extension of the price signal outside the maximum payment capacity, and triggering the process of technology transfer [28].

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The practice was initially conceived in developed countries, and the offset represented, for some nations, the ideal mechanism to emerge from economic traps provoked by them, where the accentuated economic and industrial development began to create problems of scarcity of raw materials. As a consequence, the allied countries began to participate in the compensatory practice, like the Marshall Plan, which transferred 13 billion dollars in US aid to Western Europe, and in the years 1951 to 1973, agricultural surpluses were exchanged with allied countries [29].

In the research done by [26], outside the aeronautics and defense industry, little is known about other sectors that use offset policies. Industrial machinery and equipment represent basic capital goods that all nations must exploit in their development process. These practices are not closely monitored by the government. However, the risk to national industry, the discovery of new competitiveness factors, as well as the defense readiness, can be significantly affected.

On the other hand, many technology transfer possibilities may be more substantial than the current estimates suggest, when related to the negotiation process and the displacement of goods and services [26, 28].

As part of the international trade, the offset trade usually involves forms of production sharing which are often represented by the subcontracting process [26]. With typologies identified as direct compensation, that represents the process of production sharing, the technology transfer, worker training, and indirect compensation that includes other forms of compensatory trade, such as the practice of bartering [26].

The challenge of the offset practice is not in the process of defining typologies or categorizations of actions, but in the internalization of the new goods, services, knowledge and techniques that the selected population will receive. In this way, observing this phenomenon from an anthropotechnology perspective, it becomes fundamental to understand the impacts of ITT (International Technology Transfer) and its activities in the recipient population context.

3. Methodology

This essay was based on previously published materials, composed of articles from the Science Direct, Web of Science and Scopus databases, with no time limit. The combinations of keywords in the search process within the databases were: “technology” + “transfer” + anthropotechnolog* + offset*. However, the combination did not find any results. As an alternative strategy, we chose three groups composed of two key words each: “technology transfer” + anthropotechnolog*, “technology transfer” + offset* and anthropotechnolog* + offset*. The results found with the present combinations showed 144 published articles. However, the attention was focused on verifying if the publications answer the context of the research question, as well as the phenomenon of study.

Without a time limit, 85 articles were ranked, according to Methodi Ordinatio, developed by [30]. This ranking occurs according to the Scientific relevance of the articles, through a process of equalization of the following variables: impact factor, year of publication and citation numbers. Furthermore, there were also used books, theses and dissertations available on the internet, and focused on the subject.

Concerning the articles, a systematic literature review was carried out, presenting who are the most cited authors within the articles found by the keyword combinations, that is, “technology transfer” + offset* and isolated anthropotechnolog*, as well as the countries which are developing the investigative process in the theme. (Graph 1) shows the nations where the research institutes are

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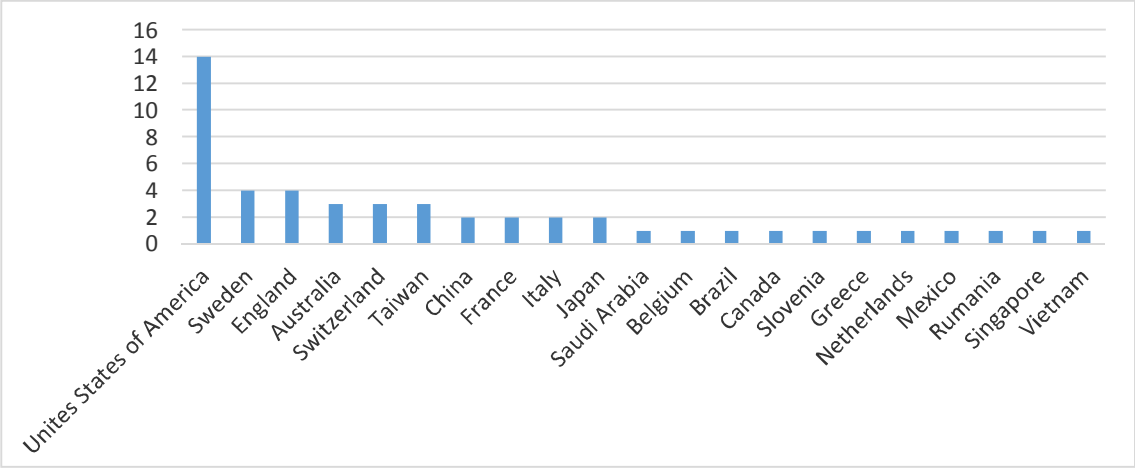
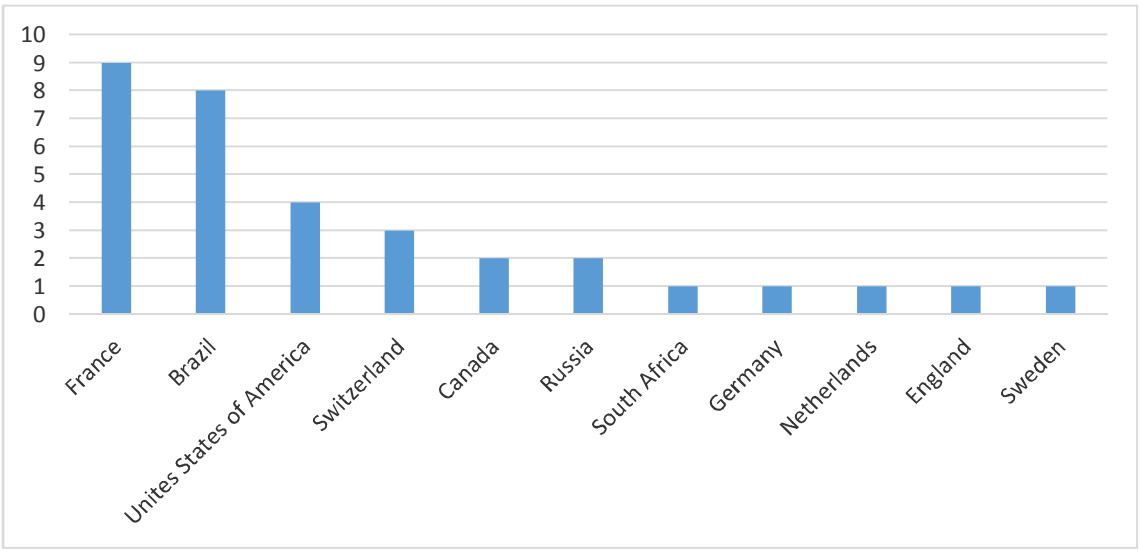
located, and the universities that carry out research on technology transfer within the offset policy, with emphasis on the United States and Sweden, followed by England, Australia, Switzerland, Taiwan and other nationalities.



Source: Elaborated by the authors.

(Graph 2) shows that the search for bibliography was based on a systematic methodology, and that the keyword anthropotechnolog* was used in an isolated way, in order to facilitate the process of research selection and filtering of works. It also presents the nationalities that develop researches that are presented in this study chain:



Source: Elaborated by the authors.

Concerning the most cited authors, with the proposed systematic literature review developed by [30], it was possible to identify, with the combinations of key words, the most cited authors, its intention is to demonstrate the period of the publications and the numbers of citations based on the systematic review of the literature used, since it is a contemporary practice, making the TT as the offsets policies present themselves slowly in relation to developed studies. who are presented on tables 1 and 2:

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Table 1. Most cited authors in Technology Transfer and offset*

Authors	Number of citations
1. Autken and Harrison (1997).	4628
2. Mencinger (2003).	380
3. Thurow (1997).	347
4. Maskus and Reidman (2004).	290
5. Bidaut and Cummings (1994).	214
6. Anderson (2005).	182
7. Vishwasrao (1994).	156
8. Muller (2007).	101
9. Branstetter and Saggi (2011).	92
10. Macpherson and Pritchard (2003).	53

Source: Elaborated by the authors.

Table 2. Most cited authors in Anthropotechnolog*

Authors	Number of citations
1. Carayon; Smith (2000).	365
2. Eason (1982).	121
3. Kworinka (1997).	108
4. Wisner (1995).	73
5. Garrigou et al., (1998).	30
6. Soares (2006).	11
7. Daniellou (2006).	7
8. Hendrick (1997).	7
9. Schrack (1980).	5
10. Sznekwar; Silva; Mascia (2008).	5

Source: Elaborated by the authors.

With a smaller scope, due to the delimitation and combination of keywords, and the most cited authors by the combination TT + offset *, and anthropotechnolog*, the latter separately, the emphasis was placed on the ten most cited of each combination, aiming to highlight the relevance of these works. After a systematic review of the literature, it was possible to establish a framework of

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dimensions and indicators inserted in the context of anthropotechnology, allowing its application in a given situation contemplated by the governmental initiative, our intention is to understand how the interference of dimensions and indicators occurs in the enterprise, replicating in other contemplated contexts and allowing in-depth analysis.

3.2. Dimensions and indicators of analysis

3.2.1. External Environment Variables

The set of dimensions and indicators represents the variables for analysis of the external environment. They are presented in Table 3, which report the environmental, technological, social and anthropological contexts. all variables derived from the systematic review of the literature, where he considered the contextual elements that could be investigated, revealing a scenario of analysis.

Table 3. External Environment Variables

GEOGRAPHICAL AND DEMOGRAPHIC DIMENSION Set of information regarding the physical environment, available infrastructure and population	
Indicators	
Location Geographical	Location
Infrastructure available	Access ways Energy supply Water supply Basic sanitation
Climate	General characteristics: temperature; variations in the year
Demography	Demographic information of the chosen situation
TECHNOLOGICAL DIMENSION Set of aspects that contribute to the work process	
Indicators	
Production and supply of raw material	Production and supply of raw materials for operation of the linear accelerator
Type of radiotherapy	Radiotherapy ratings
Equipment supply	Location of suppliers, equipment available, training and maintenance
Technical support / advisory bodies	Official technical support and advisory bodies to the activities, actions developed
LEGAL DIMENSION Set of segment legislation information	
Indicators	
Legal marks	About public purchases
Representative bodies	Entities and methods of operation
SOCIOECONOMIC DIMENSION Set of socioeconomic information	
Indicators	

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Political-economic data	Average income level, per capita, minimum wage value; Level of formal employment; Jobs by industry sector; Data on the use of radiotherapy in cancer treatments
SOCIOCULTURAL AND ANTHROPOLOGICAL DIMENSION Set of information that characterizes the population and training possibilities	
Indicators	
Traditional Culture	Use, customs and local traditions
Level of schooling of the population	Level of formal education of the population

Source: Elaborated by the authors.

3.2.2. Internal Environment Variables

The variables related to the context of the internal environment report the general and organizational characterizations of the chosen work situation. The dimensions are presented in Table 4, described below:

Table 4. Internal Environment Variables

DIMENSION OF GENERAL CHARACTERISTICS Identification of the work process and determinants of the work process	
Indicators	
General features	Work process Materials needed for the process Recommendations adopted
Organizational characteristics	Functional framework Hierarchical structure Ways of hiring staff Main activities
DIMENSION OF ORGANIZATIONAL CONDITIONS Characteristics of the organization related to the work situation and factors of the work activity	
Indicators	
Organizational Aspects of the Work Process	Time and division of labor Organization and structuring of work Control over the performance of tasks Capacity of daily attendance.
Technical Factors	Facilities available Maintenance procedures.

Source: Elaborated by the authors.

In order to identify and understand the dimensions and indicators proposed, we used documentary research on the situation contemplated and participant non-observational observation. The participant non-observational observation occurred in the organization contemplated by the

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radiotherapy expansion plan located in the State of Paraná, from June 2016 to October 2017. The researcher participated in the process of insertion and first operation of the linear accelerator equipment and, the process of selection of external radiotherapy for oncological treatment.

Participating in the flow of daily care, whether consultations or in radiotherapy applications, the researcher realized the adequacy of the organization in question in the management of installed capacity, before the official inauguration of the linear accelerator, and the organization in question already used it to compose a scope to the patients coming from the Unified Health System (SUS).

Approaches have occurred within the key sectors for the equipment management process, such as the engineering sector, radiotherapy sector, people management sector and general coordination. The intention was to understand how the organization was inserted in the expansion plan of radiotherapy, the established gains, what were the difficulties and how anthropotechnological factors contribute to the enterprise

4. Radiotherapy expansion plan

Established by the Ordinance No. 931, of May 10th, 2012 of the Ministry of Health, The radiotherapy expansion plan of the Brazilian Unified Health System (*SUS - Sistema Único de Saúde*), represents the largest worldwide investment in the acquisition of linear accelerators, with the aim of expanding the treatment network in the therapeutic modality of radiotherapy. This plan was executed with the use of the mechanisms of the offset policy, to the commercial purchase contract.

Composed of 80 (eighty) solutions in radiotherapy, it can be comprehended as the creation and expansion of radiotherapy centers. For the process of operationalization of the plan, the Ministry of Health divided the process into two stages, as explained in, **1st stage,** acquisition of the basic architectural and executive projects; services to support the fiscalization and supervision of the stage execution; equipments and the effective technological compensation, **2nd stage,** contracting of services to the building of the planned structure, according to a basic project and execution of the previous stage, to receive the acquired equipment.

It deals with the acquisition of linear accelerators, an equipment used in the external radiotherapy modality, that allows the professionals to control the intensity and directionality of the ionizing rays. The linear accelerators are a consistent evolution of modern radiotherapy, which seeks to develop reliable and controllable means for the radiation process, being considered the greatest reference in radiotherapy treatments. However, the determinant factor for the use of this equipment lies in the anatomical precise location of the malignant cells [31].

In addition to the acquisition of the equipment, the plan in the commercial agreement provides for a technology compensation agreement, which aims to build the industrial environment of linear accelerators, qualification of local suppliers for the production of components, accessories and software. In addition to the qualification of professionals, the Varian Medical Systems Co. must qualify suppliers selected by it; and establish agreements with scientific and technological institutions for the technology transfer focused on the software development. For the partnership with the scientific institutions selected in the previous stage, the selected company must keep a place to train engineers, physicists, technicians and related professionals focused on qualification about linear accelerators.

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There is a great concern about the final result, since the synchronization between stages is fundamental to the effectiveness of the plan. There are different institutions and people involved, such as the Ministry of Health, Varian Medical Systems Co., State Secretaries of Health, the hospitals covered by the plan and the contractors responsible by the planned work, as well as the scientific and technological institutions participating in the public call for technology transfer. Consequently, the institutional efforts are fundamental for the solution in radiotherapy to be made available. But currently, the evolution scenario of the plan is slow since 2012. According to data collected from June 2017, the current status of the plan was presented: only 3 solutions were delivered; 6 are in execution; 1 project is halted; 6 in bidding process; 1 in elaboration of the reference term; 8 with executive projects under analysis; 3 executive projects in the Varian company; 26 with basic architecture and engineering projects in reanalysis processes; 1 basic design of architecture and engineering in analysis; 21 projects were suspended by determination of the executive committee and 4 projects were excluded by the managing committee.

Concerning the three solutions delivered, the current situation is as follows: the first solution was delivered in November 2016 in the State of Paraíba; the second solution delivered in May 2017 in the State of Bahia; and the third solution in June 2017 in the State of Paraná. So, compared to the first schedule, it is clear that the inefficiency of the contextual analysis represent the main problem or obstacle in the insertion of the solutions in hospitals accredited for the oncological treatment.

5. Discussion of ITT in a situation contemplated by the Radiotherapy Expansion Plan

The inefficiencies of the *offset* policy included in the radiotherapy expansion plan make it evident that the problems of population contexts and organizational characteristics directly influence the efficiency of the enterprise in question.Several stages of the governmental initiative represent the ITT due to the interorganizational relations established by the *offset* policy , that is, the receiving organization, organization that holds the technology in the equipment and the mediating organizations that establish the relationship through the practice of commerce. This assertion is supported by [13, 21, 32].

In the scenario of the organizations involved in the flow of steps, these do not identify this phase as a ITT process, however, within the commercial agreement, the existence of the technological compensation provided for the scientific and technological institutions selected through specific call, the establishment of ITT is explicit, where the focus will be on making improvements on the software made available along with the linear accelerator. The development of the insertion process depends on the articulations established at each stage, highlighting the difficulties introduced in the first phase of the plan, especially in the achievement of the basic and executive projects by the organizations contemplated. Only the acquisition of the equipment and its auxiliaries is a simple process, however, to develop infrastructure for conditioning the equipment and establish symptoms among the organizations involved depends on several factors such as the competence and abilities of the construction organization, the spaces of the receiver structure of the enterprise, besides to consider contextual elements such as labor, suppliers, transportation and road structures that allow the mobility of resources necessary for the enterprise.

Taking the analysis from the first dimension of the situation chosen to be investigated, the city of Curitiba-Paraná represents an important pole of economic development in Brazil, with a

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privileged location in relation to the company *Varian Medical Systems* located in the capital of the State of São Paulo, in these terms, there is a favorable situation. In terms of radiotherapeutic treatment, the city of Curitiba offers a range of hospitals that allow the availability of various therapeutic modalities.

In the city of Curitiba, there are companies that specialize in hospital construction and infrastructure for radiological protection such as banker. In the case of the organization in question, the company that developed the banker was the company RAC Engenharia, also located in the city of Curitiba, facilitating the development of the enterprise. With respect to the available infrastructure, modalities of transport such as road and air transport facilitate the mobility of patients, professionals, suppliers, equipment and components, presenting a constant flow of mobility, it can be inferred that the aspect involved in the enterprise, in the organization, allowing to establish time of construction with precepts of economicity.

The use of energy by the organization in question is intense, however, the main concern is in the energy stability in case of a drop in supply, thus, substations and generators ensure the safe operation of the equipment inserted in the electric grid.

Regarding water supply, basic sanitation and solid waste collection, due to health, hygiene and environmental issues, the concern is continuous, several obstacles to overcome. To encourage urban development and productive activity with sustainability precepts, the population and organizations must establish improvements capable of becoming engaged for the common good.

Regarding the indicators related to the climatic aspect, it is necessary to stay equipment in an infrastructure where its temperature is controllable, the external climatic aspects do not impact on the operations, but, they influence other equipment, besides the energy consumption necessary for the thermal control. In addition to these concerns, there are heat islands in the location of the organization in question, zoning process, proximity to expressways that promote a high flow of vehicles.

Demographic aspects represent the concern about new cases of cancer in the population, with an increasing number of outpatient consultations, the average number of new cases discovered by the cited organization is about 470 new cases per month. These numbers demonstrate that cancer is a public health problem and needs specific policies that can promote diagnosis and treatment accurately.

Thus, all the variables inserted in the geographic-demographic dimension directly influence the operation of the creation and improvements of the sectors of radiotherapy inserted in the Radiation Therapy Expansion Plan.

In this sense, in addition to using criteria of selection of organizations, it is necessary to consider the environment in which it is inserted, projecting possible positive and negative risks that, when measured, can support the development of the project, as well as bring a greater effectiveness to the governmental initiative.

Analyzing the technological dimension inserted in the industrial context, the peculiarity of the linear accelerator delimits deeply the number of manufacturers. Therefore, the electronic session held

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by the Ministry of Health obtained only one participant, who has institutional and strategic interests aligned with the contractual requirements imposed by the public purchase.

While the production of the linear accelerator occurs in the United States, the functioning of the production chain is maintained constant by the relations already established, however, as the trade agreement establishes counterparts, such as the installation of the manufacturing process in Brazilian soil, with a percentage of productive components by national companies within a five-year timeframe, relations need to be developed in advance to ensure and preserve the industry and trade agreement.

On the necessary raw material, the development of Banker and the supply of electricity and water are the basic elements for running the linear accelerator. All of these details are embedded in the basic and executive designs, however, developing them in each contemplated organization needs to be uniquely established, as structural elements can directly affect the functioning and risk of damage to equipment and patients. It is evident that external radiotherapy is the most used by the organization in question, due to its participation in the radiotherapy applications that revolve around 70%, consequently, to possess in its technological park the necessary equipment as a linear accelerator allows to increase its capacity of treatment and decrease the waiting time for the radiotherapy sections.

In the world, there are five suppliers of linear accelerators that have the peculiarity of the segment. However, the counterparts provided in the trade agreement will allow the production of the linear accelerator in Brazilian soil, being the pioneer factory in Latin America. But, from the manufacturing process, it will be necessary to establish the production chain, as mentioned above.

Regarding the technical, support and advisory bodies, at operational levels, it is important that federal authorities authorize operations, either in the construction and insertion of the linear accelerator, or in the licensing for continuous operations with a renewal process, according to the norm. To prepare the institutions about the initiatives is to establish relationships that allow the governmental initiative to meet the regulatory requirements and allow the processing time to be optimized, in the sense of making the hospital organization available for the care of patients from the SUS. What can not be accomplished is to deprive the role of the regulatory agencies and federal autarchies, but to enhance their work.

In the legal dimension, it is evident that the use of the *offset* policy has a youthful normative support that many organizations that could be used do not know, but only in 2011, a specific regulation for the policy occurred. Previously, organizations such as the Brazilian Air Force and the Brazilian Navy used this practice to obtain military technology, and their regulations are specific to the process of TT acquisition in maintenance aspects.

Procurement processes and contracts in public administration need to be reformed, in line with new market dynamics, even with concern for local markets. It is necessary to expand the possibilities to get lower price, better product, better negotiation and possible counterparts. This process is not simple, the commercial, industrial and technological compensation measures known in the literature as offset policy depend exclusively on CI-CP's strategic political positioning that analyzes and decides if a certain purchase or contract can be executed with rudiments of the policy offset, which

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gives it a normative and institutional limitation to full use of this device in commercial trading relationships.

Regarding the representative bodies of the sector, specifically on cancer, the activities of the National Cancer Institute (INCA) and non-profit organizations highlight the concern with the disease that represents a public health problem. Observing the activities of the organizations in the context of the plan for the expansion of radiotherapy, INCA promotes several courses of improvement for professionals working in the oncological context, in order to optimize the labor and therapeutic practices in SUS. It also plays a role in social control, but remotely.

Patients who are depending on the Unified Health System (SUS) for treatment need the informational input, be it from hospitals, or from palliative care, forms of prevention, diagnosis and treatment. In society, there are numerous non-profit organizations that are concerned with this informational support, especially the Oncoguia Institute initiative with the Maria Curie operation that informs the development of the expansion plan in hospitals with social control precepts, that is, control carried out by the organized society on the governmental initiative. What the inference shows, is that the local management pact, foreseen in the first phase of the plan, is not acting in a consistent way to understand the difficulties of the process of insertion of the linear accelerator in the hospital environment. It is understood, therefore, that the pact existed only to articulate the process of selection, authorization and licensing, not the process of operationalization of the infrastructure and necessary adjustments of the hospital context, demonstrating the non-effectiveness of the plan and explaining the local problems of each city, not establishing the necessary adaptations.

The Anthropological Social Context analyzed the indicators presented in the macro context (Curitiba city), where it shows the socioeconomic and cultural conditions and the importance that it assumes in relation to the project proposed by the plan to leverage the modality of radiotherapy and to value knowledge and traditions.

With a recent past and marked evolution, the oncological context represented by hospitals authorized by the Ministry of Health in the city of Curitiba, configures the importance of this activity in the sectors of the economy, mainly in the service sector. Being a context that provides employment and income, with high recognition from its performance and contribution to the economic context, there are still socioeconomic and cultural disparities that directly impacted the enterprise.

The enterprise in the organization in question passed through three construction companies, according to information from the engineering sector, the factors that led the other construction companies to give up their execution were delays in the payment of measurements. Even with a targeted resource, the budget financial constraints carried out by the government have impacted the project's development time. Faced with these problems, the engineering sector acted with rationality and dynamism allowing the completion of the project according to the proposed schedule.

Other challenges are related to the training opportunities for action in the area, interacting knowledge from practice and with the explicit and systematized forms generally provided by the academy or technical schools. Developing continuing education and establishing partnerships with the academy and specialized technical schools, present themselves as important advances in the hospital context.

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In an expansive movement in the training of professionals in the segment of radiotherapy, it is necessary to deal with the diversity of aspects for the formational acceptance, to highlight the credibility of the training institution. For this, strategies are needed that, associated with the cultural characteristics of the city of Curitiba, can provide the diffusion, in this case, for the recognition of the properties of replicated, developed and absorbed knowledge, a condition that the organization in question can build.

5.1 Dimensions and indicators of the internal environment

The dimensions of the general characteristics and organizational conditions of the chosen work situation are discussed, where the linear accelerator insertion and its contribution to the context of the organization in question were investigated.

Developing the analysis on the proposed indicators, the organization contemplated by the radiotherapy expansion plan was inserted as an alternative to the selection and accreditation problems found in other hospital units, and also presents differentials inserted in the management process that, due to its characterization as a non-profit organization, ends up outsourcing in its institutional actions. With a clear mission and systematization about the origin of the patients, the organization provides, through its infrastructure, professionals and partnerships to attend to its mission, as well as its objectives as an organization.

Specifically in the radiotherapy sector, the existence of a technological park reveals the diversity of technological resources used to perform radiotherapy. Aligned with the objective of the plan, this organization presented all the necessary requirements for the expansion of existing services; however, the radiotherapy sector, through its clinical body, positions itself in a divided way: in participant asystematic observation, in dialogue with professionals, some of them are in favor of these acquisitions, as it increases the availability of equipment for the SUS; others, however, report that this type of technology for the treatment of cancer lags behind that in the technology park, and that the ideal is to increase the diversity of specialties and develop surgical capacity. For them, and that the government ended up tidying up, there were 80 (eighty) new problems for public health.

In the face of these discussions, it is evident that the growing demand for new cases of cancer suggests preventive measures to fight directly, however, most of the new cases appear, on average, at an early stage for the intermediary, requiring the hospital structure, means of treatments to mitigate the inevitable impacts that the disease causes. In a context with historical lag of investments in equipment, the plan comes as an attempt to jointly respond with other measures to strengthen SUS in the care of oncological cases.

Another aspect is in the process of insertion of the linear accelerator that, in this organization, by its competences and abilities, the insertion in the treatment process occurred in an efficient and simplified way in the presence of the clinical body, due to its already consolidated experience, to the over time, in working with this type of equipment and the need for professional training for its use.

It is a fact that the capacity of radiotherapy applications with the arrival of the linear accelerator has increased considerably in response to the demand of care that the organization in question accomplishes. Understand the organization's pretensions to acquire equipment that allows for an

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expansion of specializations, however, to have the technological infrastructure to increase the capacity of attendance, evidently, the service provided improves.

In the next point of analysis, the organizational conditions respecting the general characteristics and the working environment of the productive system of patient care, are presented in a systematized way, through steps that allow a dynamic management from the process variabilities. Stages considered critical are steps 2 and 5. Step 2 is responsible for the planning process and involves the medical radio-oncologist, medical physicist, and dosimetrist. The time required for articulation of the participants is about 15 days to effectively begin treatment, and step 5 involves the post-treatment reevaluation process.

Criticality in both steps is in the execution time and in the waiting time of the patient, it is advisable to increase the number of professionals to decrease the waiting time between the first consultation and the treatment process. The existing systematization, together with procedures adopted validated from the practice, can contribute to the ITT process, that is, to stimulate the professionals to provide subsidies that can be used in the future proposal to upgrade the embedded computer systems foreseen in the ITT.

Failure to consider the first phase of the radiotherapy expansion plan as a ITT process obfuscates the perception of existence and contribution. In this context, it is necessary to reflect on the wealth of information and subsidies arising from divergent contexts inserted in the plan, which allows to discover potentialities that can be inserted in the linear accelerators optimizing the process of radiotherapeutic treatment. Observing the infrastructure management practices and patients as of the organization in question, for other hospital units serves as reference, because in view of the absorbed demand and the geographic, demographic, cultural, anthropological context and the organizational characterization favorable to the effectiveness of institutional actions, are clear and objective.

Despite the divergent contexts where the solutions provided for in the plan are included, it is necessary to understand the external and internal environments of each situation, since the transhipments can occur from these variables and it is up to those involved to promote adequacies so that, increasingly, the breadth of SUS service is optimized.

6. Conclusions

This research aimed to discuss anthropotechnology as a field of study, to understand the improvements based on resources promoted by the offset policy in hospital institutions. For that, a survey was made, allowing to observe the phenomenon in international journals, in order to subsidize arguments necessary for the discussion. The reference terms used were offset*, anthropotechnolog* and "technology transfer".

The relevant findings found in the research demonstrate that the studies on offset policy are broad and complex. However, countries in the process of technological and industrial development show an emphasis in the use of this policy, to have access to technologies superior to the technologies they already possess. In such decision, some determinant factors in technology transfer are present. These factors need to be analyzed and understood, so that the articulated proposal developed by the offset policy be effective. However, these factors are not generalizable, due to the peculiarity of each agreement that is made.

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Not only observing the policies in certain segments, such as aerospace and defense, the offset policy has had its scope expanded in some nations, due to government strategic objectives, such as the case of Brazil. And that has happened despite the high initial investment, because the gains throughout the contractual relations transaction are significant in terms of economic, social and technological development. But caution is needed, when inserting technologies in society, because the impacts are generated from the point of view of workers' health and their productivity, together with the potential failure of the technology transfer process.

The irruptive technological process, inserted in the context of the offset policy, disrupts the work situations, in consequence of the speed and increment that the potential efficiency is developed, in a way incompatible with the real efficiency, that is, with the people. Anthropotechnology may represent the most appropriate field of study able to analyze the new technology embedded in machines and equipment in divergent population contexts. Under these conditions, and from the systematic literature review made, it was observed that there was no model capable of analyzing the efficacy and the impacts of the process. It can be highlighted the need of anthropotechnological studies in environments that received resource-based improvements through offset policy. The studies must be focused in understanding the ergonomic impact on professionals; the optimization of performance in procedures, as well as in the enhancement factors in the operational competence of hospital institutions, in order to absorb these new technologies.

From the social point of view, the gains can be seen as the balance of work situations, when compared to the scenario in which they belong to a single project. From the economic point of view, it is to ensure the productivity and effectiveness of the ITT in concluding the process. When analyzing management, it is the work optimization and its performance improvement, which comes from underlying elements identified in the contribution of the workers. Thus, the feasibility of using anthropotechnology in the proposed phenomenon is convincing, allowing and leading to future studies focused on the accurate analysis of the organization and the workers environment.

In the situation defined to establish the case study, it was explicitly stated that the success of the linear accelerator insertion process in the chosen situation occurred due to the somatization of the geographical, demographic, technological, legal, socioeconomic, socio-cultural and anthropological perspective of the city of Curitiba, along with the general characteristics and organizational characteristics.

With the specific objectives established, it is conclusive through a case study that the processes of technology transfer in the implementation of the commercial agreement between the Ministry of Health and the Varian Medical Systems Company "was attended, since a specific situation was analyzed due to its reference in cancer treatments to SUS patients, making it possible to expand this analysis to other scenarios established by the radiotherapy expansion plan.

Regarding the ITT processes inserted in the offset policy, they initially seem to be in the background, since the acquisition and the commercial relationship become the main focus, however, the effective and positive overflow of ITT can contribute to the technological development of the receiving organizations, economic growth and intensify international relations with a focus on marketing, ITT, product research and development and know-how formation, and the negative overflow is the non-implementation of ITT, the equipment upgrade does not happen and the optimization, agreement does not become effective. Thus, the ideal is to perform the ITT first, before

the arrival of the equipment. In this way, the improvement can occur in advance and not observe the ITT only as a counterpart to the trade agreement.

The behavior of the process is linear, where the technology inserted in the acquired equipment is transferred. The study on the public health offset policy revealed the complexity of the activities developed with dependence on interorganizational relationships, where structured activities and centralized decision making end up making procedures slow and unstable. The initiative is valid, however, to consider the process of insertion of equipment as ITT and to reflect on the environmental contexts with a view to adaptations can represent strategic and operational gains for the institutions involved.

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