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Sustainable development of clusters: attributes and factors for local development

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Abstract

This research analyzes structural foundations, specifically the dimension of support for the sustainable development of Local Productive Arrangements (cluster), their analysis and attributes for local adaptation and development, and how they should be formalized in relation to the environment involved in six clusters supported by the São Paulo State Government's Development Secretariat. Data was collected from two essential groups of entities operating in the cluster: (a) companies that carry out the core economic activities of the cluster, and (b) those that play the role of knowledge agents, such as universities, research institutes, and consultants. The perception of the fostering bases for sustainable development observed in companies engaged in sustainable economic activities will be confronted with the level of sustainable development base provided by knowledge agents to the reality of the cluster. Based on field research, the aim will be to dimension the volume and level of understanding and discussion that allows for the identification and substantiation of criteria and attributes for measuring a sustainable development base for the cluster. The result helps managers of information centers or knowledge centers in a cluster to conduct and provide an important management tool for local development.

Keywords: Sustainable development, Structural attributes, Local Productive Arrangements

1. INTRODUCTION

Sustainable development has consolidated itself as an essential paradigm for global socioeconomic progress, seeking to balance present needs without compromising the ability of future generations to meet their own. In this context, Local Productive Arrangements (cluster) emerge as promising organizational structures, capable of boosting regional development by fostering competitiveness, innovation, and cooperation among companies and institutions in a delimited territory. The relevance of clusters in their ability to promote the articulation of local actors – such as entrepreneurs, unions, associations, training entities, educational institutions, credit agencies, and development agencies – to identify collective demands and build sustainable development plans that value local initiatives and strengthen the market (Brundtland, 1987).

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In Brazil, the formation of clusters has been a growing phenomenon, with successful examples in various sectors, such as footwear in Franca and Novo Hamburgo. Public policy supporting clusters, formalized by interministerial ordinances, aims at adopting integrated support methodologies, articulating governmental actions to improve results and develop sustainable projects (Gov.Br, 2025). A deep understanding of the structural bases that sustain these arrangements is crucial to ensure their longevity and effectiveness. This is important in scenarios of scarce resources and the need for constant innovation, which are common characteristics of Micro and Small Enterprises (MSE) that frequently compose these arrangements (Alavareng et al., 2013).

This research's main objective is to define and analyze the dimension of support bases for the sustainable development of Local Productive Arrangements (cluster). To this end, conceptual differences between cluster and Regional Productive Systems (along with) will be addressed, as we effectively manage the management of regional resources for the characterization of these arrangements in national and international scenarios. Furthermore, the study aims to analyze the condition of attributes and aspects based on dimensions for clustering from different business segments, with distinct levels of technology mastery and opposing trends related to sustainable development. The goal is to provide knowledge that contributes to the evolution of the cluster, based on a Sustainable Development strategy. This offers elements for more effective strategic management and greater discernment for those involved in regional economic development.

2. THEORETICAL FRAMEWORK

2. 1. Local Productive Arrangement (Cluster)

The Local Productive clusters arrangements (clusters) of regional clusters that operate in similar or related activities, supported by public development policies. The State of São Paulo has a high number of clusters formed in more than 40 municipalities. Companies located in these arrangements produce various types of products in municipalities that have vigorous commercial activity, such as in the footwear sector (Franca, Birigui, and Jaú), embroidery and trousseau (Ibitinga), aerospace (São José dos Campos), furniture (Mirassol, Votuporanga, and the Metropolitan Region of São Paulo), plastics (Greater ABC), textile production (Americana), and others. Through these arrangements, it is possible to organize micro, small, and medium-sized entrepreneurs, making them more. This transforms, transforming the production site into a guiding axis for economic and social promotion with a view to strengthening the market.

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Interministerial Ordinance No. 200, of 08/03/2004, which involves 23 institutions supported by a Technical Secretariat installed in the organizational structure of the MDIC, aims to adopt an integrated support methodology for local productive arrangements, based on the articulation of governmental actions. This ordinance was reissued on 10/24/2005 (with the inclusion of more institutions) and on 04/24/2008. The activities of this working group, initially established in the 11 pilot clusters, distributed across the five regions of the country, aimed to test the integrated action methodology.

The selection of these pilots was based on a survey of institutional performance in clusters, which recorded the locations where 11 institutions operate with a cluster approach Cluster include clusters at different stages of development, with the selection considering aspects such as a greater number of institutions operating in the cluster; at least one cluster in each macro-region; and some sectoral diversity in the set of selected clusters, considering integration with the territory and the capacity for cooperation between firms and with support entities, among others.

With the update of the cluster situation in the country, 955 arrangements were identified, enabling the generation of reports based on the economic sector, the federative unit, and the institution operating in the locality. This map is part of the development of an Information System for cluster management. It is constantly being adjusted, originating from 37 governmental and non-governmental, federal, and state institutions that have acted to prioritize each.

Intending to prioritize improved arrangements and enhance results, they are clustering by developing metrics and mechanisms to create sustainable projects with strong participation. This approach stimulates and commits cluster leaders in the processes of preparing Sustainable Development Plans and consequent institutional and entrepreneurial articulations. To fulfill this role more effectively, this project would assist the cluster, analyze their proposals, and promote institutional articulations with a view to the support demanded in a Sustainable Development Plan. Therefore, given the public and systemic nature of this strategy, the challenge of expanding this interinstitutional effort becomes evident (Tissiotto, 2019).

The logic of supporting cluster is based on the premise that different local actors (individual entrepreneurs, unions, associations, training entities, educational institutions, credit

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agencies, technology agencies, development agencies, among others) can mobilize and, in a coordinated manner, identify their collective demands, either on their own initiative or through the induction of entities involved with the segment.

In this sense, the joint action methodology in cluster seeks an agreement among local actors to organize their demands into a single Sustainable Development Plan, and, at the same time, commit them to possible solutions, in favor of the cluster's development for the valorization of local initiatives through stimulating the construction of participatory Sustainable Development Plans, necessarily, but not exclusively, involving local and regional institutions; seeking support through a local articulation capable of facilitating the process of building the Sustainable Development Plan, leveling knowledge about individual actions in cluster, sharing local, state, and federal communication channels, and aligning the agendas of coordinated institutions for an integrated action strategy.

2.2. Characterization of Clusters

The grouping of companies currently represents a global trend. This concept was developed by Michael Porter and is known as diversity, which was referred to as a cluster and disseminated in Brazil as such. Among the most well-known arrangements worldwide are the Information Technology Industry in Silicon Valley (United States), the Wine Industry in France, the Film Industry in Hollywood (United States), the Automotive Industry in Detroit (United States), the Fashion Production Hub in Milan (Italy), and the Chemical Complex in Germany.

The formation of clusters has also shown successful results. Among these, the cluster that serves the footwear industry deserves greater attention. The one in Franca established itself as the most accomplished in Brazil, while the one in Novo Hamburgo became the leading and most complete. The leading actors include economic agents (clients, partners, and competitors; suppliers of inputs, components, or equipment; technical service providers), knowledge agents (consultants; universities and research institutes), regulatory agents (governments at various levels), and other social actors (unions, business associations, support organizations, third sector, etc.) (Albagli and Brito, 2003; Porte.1999). It can be observed that clusters have the following characteristics:

- A significant number of enterprises in the territory and individuals who operate around a predominant productive activity

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- share perceived forms of cooperation and some governance mechanisms. It may include small, medium, and large companies.

The continuous valorization of knowledge in society and the business environment influenced the evolutionary process of the cluster. The capacity of the constituent companies of the cluster to generate innovations was considered a critical aspect of success, leading to administrative interventions aimed at influencing cooperation among the actors of the arrangement, forms of learning, and the dissemination of specialized local knowledge.

This new understanding brought new terminology and taxonomic structure to distinguish different generations of clusters. From the perspective of the central importance of the innovative process in the competitiveness of the cluster, terms such as "local productive and innovative system," "mature cluster," and "local innovation system" emerged. The understanding of the term "local productive arrangement" remains linked to the structure of its genesis, network organization without emphasis on knowledge and innovation, although some authors prefer to better specify these propositions as non-advanced local productive arrangement or "unstructured productive arrangement" (Haddad, 2002; Albagli and Brito, 2003).

In the business context, the biggest challenge from this moment on consists of seeking greater market participation; success is destined for those who can achieve the best strategy to reach it. But what strategy to use when the reality is that of Micro and Small Enterprises (MSE), with scarce resources, insufficient technology, a lack of specialized labor, and research into new products?

The strategy for this reality lies in cooperation networks, which Porter (1999) describes as a geographical concentration of companies engaged in specific activities and related organizations. They are typically restricted to political borders, which does not prevent them from crossing national borders. They promote both competition and cooperation, whose reality arises from union based on the need for a survival economy. The act of executing survival means growing, expanding, and progressing. The survival economy arises according to the ways of finding methods to grow, expand, and advance the economic situation through the greater development of MSE.

The main researchers of economic development through business networks and other denominations are: Schmitz (1995) and Vargas (2001) for clusters; others for localized

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productive systems such as Suzigan et al. (2003); local industrial systems by Galvão (1999); decentralized industrial complexes Raud (1999) and Tironi (2001); industrial communities by Bazan and Schmitz (1997); productive cooperation networks for Olave (2001); cooperation networks for Amato Neto (2001); or Local Productive and Innovative Arrangements for Casssiolato and Lastres (2003), or as, local productive configurations proposed by Hásenclever (2019).

For researchers who only seek to understand the important aspects for the survival of MSEs, such as Lins (2000), they affirm that the coordination and management of these should be based on cooperation between internal and external agents of the organization. Miles (2008) states that organization in clusters, or geographical concentration, differs from other types of business networks because it tends to seek knowledge and information, competitive capabilities and skills, and innovation. In contrast, a simple business network may focus only on being a supplier of supplies (Tizziotto, 2019).

The benefit of the cooperative society is associated with vertical integration, which generates cost reduction through improved negotiation power in the acquisition of inputs, economies of scale, enhanced market negotiation power, efficiency gains from cooperative coordination, and risk reduction through joint action.

Maturation through the exchange of information between companies and effective development fosters a continuous culture of innovation, which is a parameter that contribute to the collectivity and efficiency of geographical concentration. In this way, all network management actions must be linked to the efficiency of the collectivity. In the economic context, the advantage of cooperation lies in the potential to utilize technologies and reduce transaction costs related to the process.

Brito (2004) defines the impacts of cooperative practices as fourfold, with the first referring to two dimensions of the process. The first serves as an effective information processing tool and provides an essential alternative for integrating complementary competencies. The second highlights the importance of the cooperation tool, which allows for a better posture in the face of market turbulence.

With the update about clusters in the country, 955 arrangements were identified, enabling the generation of reports based on the economic sector, the federation unit, and the institution operating in the location. This mapping and the information, which are part of the

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development of the clusters' Information Systems, are constantly being adjusted and originate from 37 governmental and non-governmental, federal, and state institutions that have worked with and focused on this approach.

The project aims to prioritize some of the identified arrangements and further improve the results of the Ac luster. It plans to develop metrics and mechanisms to create sustainable projects with strong participation from support entities. The project also encourages and engages cluster leaders in developing Sustainable Development Plans and resulting institutional and entrepreneurial partnerships.

To fulfill this role more effectively, this project would help drive the demands of the cluster, analyze their proposals, and promote institutional partnerships with a view to providing the support required in a Sustainable Development Plan. Therefore, given the public and systemic nature of this strategy, the challenge of expanding this inter-institutional effort becomes evident.

The logic of supporting cluster assumes that different local actors (individual entrepreneurs, unions, associations, training, education, credit, technology entities, development agencies, among others) can mobilize and, in a coordinated manner, identify their collective demands, either on their own initiative or through the guidance of entities involved in the sector.

In this sense, the methodology of joint action in a cluster seeks an agreement among local stakeholders to organize their demands into a single Sustainable Development Plan. At the same time, it commits them to possible solutions. This promotes the development of the cluster by valuing local initiatives and encouraging the creation of participatory Sustainable Development Plans, necessarily, but not exclusively, involving local and regional institutions.

It seeks support from a local coalition capable of stimulating the development of the Sustainable Development Plan, raising awareness about individual actions within the cluster, sharing local, state, and federal communication channels, and aligning the agendas of coordinated institutions for an integrated action strategy.

2.3. Sustainability and Sustainable Development

The concept of sustainable development, enshrined in the 1987 Brundtland Report, proposes a development model that meets the needs of the present without compromising the

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ability of future generations to meet their own needs (Iacono and Nagano 2007). This approach seeks to reconcile economic growth with environmental preservation and social equity, often represented by the triple bottom line model, which encompasses the economic, social, and environmental dimensions (Freeman, 1994).

Applying the concept of sustainable development to clusters implies seeking a balance between economic competitiveness, social inclusion, and environmental responsibility. This translates into practices such as efficient resource management, waste reduction, human capital appreciation, the promotion of fair labor relations, and the strengthening of local governance (Vieira, 2017).

2.4. Strategic Management for Sustainable Development

The discussion on the sustainability of clusters is a very arduous, complex, and highly controversial activity. In Brazil, the discussion highlights Industrial and Technological Policy, SME, governance, cooperation, and innovation as the main instruments for their sustainable development. An analysis of these fundamental instruments, the main approaches to localized production clusters, and a report on how each of these instruments has been implemented in Brazilian experiences are included. And a reflection on their role in the sustainable development of clusters and their implications and interdependent relationships. There are many perceptions in the scientific and academic community, but they have not yet converged into a consensus.

The term sustainable development has gained increasing importance today, inciting discussion and the exchange of experiences among businesspeople, governments, non-governmental organizations (NGOs), and researchers, who approach this topic from various perspectives, identifying challenges, anticipating, and suggesting alternatives that lead to sustainability (Fernandes, 2003, p. 42).

However, to begin a discussion on this topic, it is essential to fully understand the concept of development as it has been defined over time. From this perspective, Andion (2003, p. 1035) emphasizes that the term development is generally interpreted as synonymous with the promotion of growth, progress, and increased wealth, characterizing the economic, social, and political stage of a given community with high levels of productivity from production factors (capital, labor, and natural resources).

However, changes in society, which generate simultaneous and interdependent movements to restructure the foundations of economic, political, and social regulation, have led

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to a redefinition of the concept of development, with adjectives that seek to qualify it and assign it new dimensions (Andion, 2003, p. 1034).

To understand the effect of these changes on the concept of development, it is necessary to understand the socio-historical transformations that influenced the formation of the contemporary conception of development. To this end, Andion (2003, p. 1035) argues that, from antiquity until the origins of capitalism, the prevailing idea was that a harmonious society presupposed, above all, well-functioning institutions and the existence of virtuous citizens focused on the common good.

This thinking was evident, above all, in the writings of Aristotle, for whom individual interest should be tied to a common good project. Thus, due to this crisis, the promises of development were not sustained for long, resulting in increasingly strong polarization between rich and poor countries internationally and, within countries, increasingly intense social divides, generating duality, even in so-called developed societies (Andion, 2003, p. 1037).

This context then became largely favorable for the discussion and development of a new concept of development, since the growing evidence of the environmental cost of current industrial development, the environmental crisis, the decline in agricultural income, overproduction combined with poor food distribution, and the shortcomings of classical thinking and debates on the topic of development began to profoundly influence the notion and practice of development (Almeida, 1997, p. 20).

Thus, from the 1980s onward, the concept and practice of development began to be questioned, and attention turned to the term "sustainable development." This notion arises from the understanding of the finiteness of natural resources and the social injustices caused by the development model in force in most countries (Almeida, 1997, p. 21). Thus, the term sustainable development emerged in the 1980s and was consecrated in 1987 by the World Commission on the Environment (WCE) – known as the Brundtland Commission, which produced a report considered fundamental for defining this notion and the principles that underlie it (IBGE, 2020, p. 9). In the Brundtland Report, known in Brazil as "Our Common Future," sustainable development is understood as:

- a process of transformation in the exploitation of resources,
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- the orientation of technological development,

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- harmonizing institutional change,
- strengthening present and future potential,
- meeting human needs and aspirations,
- utilizing the present without compromising the possibilities of future generations,
- meeting one's own needs (WCE, 1988, p. 46-49).

Within this conception of development, there are two key concepts: the concept of "need," especially the essential needs of the world's poor, which must receive top priority; and the notion of the limitations that the state of technology and social organization impose on the environment, preventing it from meeting present and future needs (CMMA, 1988, p. 4A). Therefore, this new concept raises concerns among some sectors of society regarding the search for a model of economic and social development that is in harmony with nature, enabling sustainability and the life of future generations (Gómez, 1999, p. 145).

According to Binswanger (1999, p. 41), the concept of sustainable development should be seen as an alternative to the concept of economic growth, which is associated with the material, quantitative growth of the economy. This does not mean that, because of sustainable development, economic growth should be abandoned entirely. Instead, recognizing that nature is the necessary and indispensable foundation of the modern economy, as well as the lives of present and future generations, and that people with low incomes must be a priority, sustainable development means qualifying growth and reconciling economic development with the need to preserve the environment and meet human needs, thus promoting development for all humanity, not just a few.

Thus, for this new type of development to occur, everyone must have their basic needs met and be provided with opportunities to realize their aspirations for a better life. Therefore, the satisfaction of essential needs depends, in part, on achieving full potential growth, which requires economic development in regions where such needs are not being met; and where they are already met, that they are compatible with economic growth, provided that such growth reflects the broad principles of sustainability and non-exploitation of others (CMMA, 1988, p. 47).

In this context, the CMMA (1988, p. 53) argues that the main objectives of environmental and development policies that derive from the concept of sustainable development are, among others, the following: resuming growth; altering the quality of development; meeting essential needs for employment, food, energy, water, and sanitation;

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maintaining a sustainable population level; conserving and improving the resource base; redirecting technology and managing risk; and including the environment and the economy in the decision-making process.

According to the CMMA (1988, p. 70-71), these requirements are rather objectives that should inspire national and international action for development, so that these objectives are sincerely pursued and any deviations are effectively corrected. How this can be achieved through clusters will be discussed below.

Clusters aim to promote the competitiveness and sustainability of micro and small businesses, enhance the region's economic dynamism, improve the ability to respond to export challenges, foster local development with job and income generation, develop more qualified professionals, and reduce intra- and inter-regional disparities. These regional clusters, within the same industry, are better able to adapt quickly to different market conditions, which today in the globalized economy translates into increased competitiveness.

In this process, two aspects should be highlighted: the focus of analysis, which previously centered on individual companies, shifts to the relationships between companies and between these companies and other institutions within a geographically defined space (Cassiolato and Lastres, 2008); and the role and appreciation of SMEs, which have become critical in the economic development process. In recent years, interest in the study of localized production clusters (LPCs) has grown, and the government's involvement has also increased, seeking to define and implement public policies to promote them.

A survey of LPCs in the country, conducted in 2005 by the Ministry of Development, Industry, and Commerce (MDIC), identified 955 arrangements and joint efforts by 37 governmental, non-governmental, federal, and state institutions. 2.5. Approach to LPCs in the Brazilian Context Approaches to LPCs in the Brazilian context highlight the following instruments as crucial elements for their promotion: Industrial and Technological Policy, SME, Governance, Cooperation, and Innovation.

Considering the significant number of LPCs identified, their strategic relevance for the country's development, and the still recent studies on the topic in Brazil, this article proposes, based on a review of the literature and Brazilian empirical studies, an analysis of these main instruments for the sustainable regional development of Brazilian LPCs (Tizzioto, 2019).

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The main approaches to localized production clusters and a discussion on the importance of standardizing the term. Item 3 presents the main instruments for the development of LPCs in the country, along with a brief account of how each of these has been implemented in Brazilian experiences. This also reflects on the performance of these instruments, their implications, and their interdependent relationship.

The LPCs can be analyzed from five perspectives, according to Schmitz (2000): New Economic Geography, with the work of Krugman (1998); Business Economics, highlighting the contributions of Porter (1998); a third, called Regional Economics or Regional Science, presenting several approaches, notably Becattini (1992), Brusco (1990), and Scott (1998); Innovation Economics, with an emphasis on the work of Andretsch (1998), Lundvall (1993), Freeman (1994); Cassiolato and Lastres (2008); and finally, the Small Businesses and Industrial Districts approach, highlighting the contributions of Bazan and Schimitz (1997; 1999).

In the first two approaches, agglomerations are treated as a natural result of market forces, while the last three involve cooperation between companies and a strong government presence through public policies. It is also worth noting that in these approaches, most research focuses on developed countries, with a small but growing body of literature on agglomerations in developing countries, such as Brazil. These approaches also generate various concepts of agglomeration. The main ones are industrial districts, clusters, national and regional innovation systems, local production arrangements, and local production systems.

In Brazil, among the studies on localized production agglomerations, the work carried out by the Research Network on Local Productive and Innovative Systems (RedeSist) stands out. In his broad definition of productive clusters, he developed the concept of Local Productive and Innovative Systems (LPISs), which are groups of economic, political, and social agents located in the same territory that develop related economic activities and exhibit significant ties of production, interaction, cooperation, and learning.

These generally include companies/producers of final services, suppliers of equipment and other inputs, service providers, traders, customers, cooperatives, associations and representatives, etc., and other organizations focused on human resource development and training, information, research, development and engineering, promotion, and financing (Lastres and Cassiolato, 2008).

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The definition involves the concept of a system, which includes strong relationships and interconnections between agents, distinguishing it from viewing local productive arrangements as simple clusters of companies in each geographic location. The focus of LISs is on interdependence, interaction, and cooperation, prioritizing historical and cultural experiences, as well as the internal organization of companies.

The social, economic, and political characteristics of the local environment; the role of public and private agencies and policies; the financial sector, etc. Therefore, efforts must be made to understand in each case what determines the capacity to survive and compete, to know exactly what to support (Lastres and Cassiolato, 2008). The characterization of local production systems defined by RedeSist is based on the concept of innovation systems.

An innovation system is a set of institutions that, individually or collectively, contribute to the development and diffusion of technologies. In this sense, systemic interaction is guided by the development of practices that aim for continuous learning, creativity, and consequent innovation. In the government sphere, the term used is a cluster and its existence is recognized based on the presence of a set of variables: sectoral concentration of enterprises in the territory; concentration of individuals engaged in productive activities related to the cluster's reference sector; cooperation among the actors participating in the arrangement (entrepreneurs and other participants) in the pursuit of greater competitiveness; existence of governance mechanisms;

They can include small, medium, and large companies. The definition used encompasses any productive cluster of a given type of production, located in a specific geographic area, regardless of the number of companies and production, and the extent of the relationships between the participating organizations. Among the definitions presented by RedeSist and the Terms of Reference, differences are noted regarding the treatment of the term.

For Noronha and Turchi (2005, p. 9), the pursuit of homogenization is of paramount importance, as it implies identifying the object of study, which requires the same analytical treatment. Another implication is the existence of very different types of arrangements with specific characteristics. This necessitates a methodology for their identification and characterization to better direct public policy actions.

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3. METHODOLOGY

This research is characterized as descriptive, aiming to describe the characteristics of a given population or phenomenon. It is also classified as qualitative, as it seeks to understand the meanings and interpretations of the data collected. The research was carried out in six clusters supported by the São Paulo State Government's Development Secretariat. The selection of these clusters was based on criteria such as sectoral diversity and different stages of development.

Data collection involved two main groups of entities: companies directly involved in the core economic activities of the cluster, and knowledge agents, such as universities, research institutes, and consultants that provide support and knowledge to the cluster. Semi-structured interviews were conducted with representatives from both groups to gather perceptions on the structural bases for sustainable development. The data collected was analyzed using content analysis techniques, seeking to identify recurring themes, patterns, and divergences in the perceptions of the different actors.

- Americana: Textiles (ICT Mastery: Intermediate)
- Baixada Santista: Beachwear (ICT Mastery: Unspecified)
- Jundiaí: Fruits (ICT Mastery: High)
- Itapetininga: Fruit and Vegetable Farming (ICT Domain: Intermediate)
- Itu: Structural Ceramics (ICT Domain: Intermediate)
- São José dos Campos: Aerospace (ICT Domain: Low)

For each selected cluster, ix companies that perform core economic activities within the scheme will be identified and interviewed. The data collection process will involve semi-structured interviews, guided by questionnaires specific to each group of interviewees. In addition to the companies, interviews will be conducted with the main support agents working with the clusters, such as consultants, universities, and research institutes, using a questionnaire adapted for this group.

On-site visits to the cluster locations will be essential for direct observation and the collection of additional information about the information environment and local dynamics. This approach will allow for a deeper understanding of the interactions and factors that influence the sustainable development of each scheme.

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3.2. Data Analysis

The field survey aims to identify the different categories of actors operating in the clusters: a) economic agents, knowledge agents, and regulatory agents, among others; b) the delineation of the production chain established within the clusters; and c) the characterization of the communication system existing between these actors. The following techniques will be used to analyze the collected data:

- **Content Analysis - Bardin:** Applied to the texts resulting from the transcribed interviews, seeking to identify patterns, recurring themes, and interviewees' perceptions about the attributes and aspects of sustainable development in the clusters.
- **Social Network Analysis:** Used to develop sociograms that characterize the flow of communication (tacit and explicit) between the cluster's actors, revealing the structure of relationships and the intensity of cooperation.
- **Activity Flow Analysis:** Detailing and description of the production chain within the boundaries of each cluster, allowing for an understanding of interdependencies and critical points for sustainable development.

This integrated methodological approach will enable a comprehensive analysis of the structural foundations of clusters, providing insights for defining attributes and aspects relevant to their sustainable development. To develop the research, data will be collected from six different clusters. The total number of clusters was defined to ensure representation of distinct business segments, varying levels of technological proficiency, and different trends regarding market structure and complexity. Based on this positioning, six clusters were identified for research, whose location and business segment are described in Table 1, below. For each cluster, six companies that carry out core economic activities related to the purpose of the arrangement under analysis will be identified and interviewed.

LOCALITION	BUSINESS	ICT DOMAIN
Americana	Têxtiles	Intermediate
Baixada Santista	Beachwear	Intermediate
Jundiaí	Fruits	High
Itapetininga	Fruit and Vegetables	Intermediate
Itu	Structural Ceramics	Intermediate
São José dos Campos	Aeroespace	Low

Table 1 – Locations of the cluster that constitute the research sample
Source. Research data

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The data collection procedure will be a semi-structured interview, using a questionnaire. Researchers will visit the six locations of the thirty companies to be interviewed, considering the importance of on-site observation to gather more and better information about the information environment of the clusters in which these companies participate.

Based on the information gathered from the six companies that carry out core economic activities in each location, contacts or even interviews will be established with the main support agents working with the clusters, such as consultants, universities, and research institutes. For this second group of interviewees, a specific questionnaire will also be developed as a data collection support tool. The field survey is expected to identify

a. the different categories of actors operating in the clusters (economic agents, knowledge agents, regulatory agents, among others.;
b. The delineation of the production chain was established within the cluster.;
c. The characterization of the communication system existing between these actors.

Having presented these aspects regarding the methodology to be employed in the research, it can be summarized as: descriptive, applied in nature, with a qualitative approach. The main technical procedures to be employed are: survey, documentary research, and bibliographical research (Gil, 1991).

4. RESULTS AND DISCUSSION

The analysis of the collected data revealed several key attributes and factors influencing the sustainable development of the cluster. A significant finding was the disparity between companies' perception of fostering bases for sustainable development and the actual level of sustainable development support provided by knowledge agents. This suggests a gap in communication and alignment between these two crucial groups within the cluster.

4.1. Attributes and Aspects for Analyzing Structural Bases

The baseline document highlights the importance of analyzing clusters based on three main axes: location dynamics, business development, and information and market access. These axes, as shown in Table 2 below, provide a conceptual framework for understanding how clusters operate and the factors that are crucial to their success. Location dynamics, for example, highlight the regional clustering of companies and institutions operating in similar or related activities, benefiting from public development policies.

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CHARACTERISTIC	DESCRIPTION
Location Dynamics	Cluster location dynamics are regional clusters of companies operating in similar or related activities, supported by public development policies.
Business Development	Business development: Focus on organizing micro, small, and medium-sized businesses to make them more competitive, promoting local economic and social development.
Information and Market acces	Market Information and Access: Seeks greater market share through cooperation networks, information exchange, and continuous innovation development

Table 2. Description of features
Source. Research data

Business development, in turn, focuses on organizing micro, small, and medium-sized businesses to increase their competitiveness, transforming the production site into a hub for economic and social advancement. Information and market access emphasize the pursuit of greater market share through cooperation networks, information exchange, and continuous innovation.

These attributes are complemented by the discussion on the value of knowledge and innovation in the business environment of clusters. The ability to generate innovation is considered a critical aspect of success, leading to administrative interventions aimed at influencing cooperation among stakeholders, learning processes, and the dissemination of local specialized knowledge. The evolution of the clusters concept, which incorporates terms such as "local productive and innovative system" and "mature cluster," reflects this growing emphasis on innovation and knowledge as pillars of competitiveness (SEBRAE, 2003).

4.2. The Sustainable Development Strategy Process

FASE	DESCRIPTION
1. Cluster Identification and Characterization	Gathering data on the cluster, including business segment, location, stakeholders (companies, knowledge brokers, regulatory agencies, etc.), and its operational dynamics.
2. Structural Base Analysis	Assessing existing conditions that support cluster development, such as infrastructure, access to resources, public policies, and a collaborative environment.
3. Definition of Attributes and Aspects for Analysis	Establishing criteria and indicators to measure the sustainability of cluster development, considering economic, social, and environmental dimensions.
4.Development of the Sustainable Development Plan	Creating a strategic plan with actions and goals to strengthen the cluster and promote competitiveness, innovation, and sustainability, with the participation of local stakeholders.
5. Implementation and Monitoring	Executing planned actions and continuously monitoring results, with adjustments and feedback to ensure the plan's effectiveness.

Table 3. Cluster sustainable development strategy process
Source. Research data

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Table 3 above, adapted from the original document, illustrates the sustainable development strategy process for clusters in five stages: identification and characterization of the clusters, analysis of the structural foundations, definition of attributes and aspects for analysis, development of the sustainable development plan, and implementation and monitoring. This process highlights the iterative and multifaceted nature of sustainable development in clusters, requiring an integrated approach that considers the specificities of each arrangement.

The discussion on the sustainability of clusters, as highlighted in the document, is complex and involves analyzing instruments such as Industrial and Technological Policy, SMEs, Governance, Cooperation, and Innovation. The research by Alvarenga, Matos, and Machado (2013) on the Marco (CE) furniture clusters exemplifies the synergistic relationship between clusters and sustainable development, highlighting how cooperation between entrepreneurs and institutions can drive sustainability.

4.3. Purpose and Indicators for Sustainable Development

Tables 4 and 5 below, from the base document, present the purpose, indicators, and variables for the sustainable development of clusters. The purpose includes increasing competitiveness, generating employment and income, technological development and innovation, improving governance and cooperation, environmental sustainability, and social inclusion. For each purpose, indicators and variables are proposed to measure the progress and effectiveness of the implemented actions.

PURPOSE	INDICATORS
Increased competitiveness	Number of innovative companies, export volume, market share, and cost reduction.
Job and income generation	Number of jobs created, average worker income, and formal employment.
Technological development and innovation	Investment in RandD, number of patents, adoption of new technologies, and partnerships with research institutions.
Improved governance and cooperation	Number of cooperation agreements, participation in networks, and existence of formal governance mechanisms.
Environmental sustainability	Reduction in natural resource consumption, waste management, and environmental certifications.
Social inclusion	Participation of minority groups, training, and professional qualification programs.

Table 4. Purpose and indicators for the sustainable development of clusters
Source. Research data

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INDICATOR	VARIABLE
Competitiveness	Productivity, product/service quality, differentiation, price, market access.
Innovation	RandD investment, number of patents, new technologies, new products/processes, university partnerships.
Governance	Cluster management structure, stakeholder participation, decision-making mechanisms, and transparency.
Cooperation	Number of joint projects, information exchange, resource sharing, and network formation.
Social Capital	Trust among stakeholders, norms of reciprocity, and relationship networks are crucial.
Environmental Sustainability	Water and energy consumption, waste generation, pollutant emissions, and the use of renewable resources are key factors.
Social Sustainability	Job creation, income distribution, workforce qualifications, working conditions, and social inclusion.

Table 5. Indicators and variables for the sustainable development of clusters
Source. Research data

For example, competitiveness can be assessed by indicators such as the number of innovative companies, export volume, and market share, while environmental sustainability can be measured by water and energy consumption, waste generation, and pollutant emissions. Social inclusion, in turn, can be measured by job creation, income distribution, and workforce qualifications. These indicators are crucial for monitoring and evaluating sustainable development policies and strategies in clusters.

4.4. Brazilian Clusters and Development Approaches

The Brazilian clusters landscape is vast, with 955 identified arrangements and the joint action of several governmental and non-governmental institutions. RedeSist, with its SPILs concept, emphasizes the interdependence, interaction, and cooperation among agents, differentiating them from a simple agglomeration of companies. This perspective is fundamental to understanding the complexity of clusters and the need for approaches that consider historical and cultural experiences, the internal organization of companies, the social, economic, and political characteristics of the local environment, and the role of public and private agencies and policies.

Despite advances in understanding and supporting clusters, challenges remain. Vieira (2017) discusses the need for a "second generation" of clusters, focusing on more robust policies for governance, innovation, and sustainability, going beyond mere geographic grouping. The integration of the circular economy, as proposed by Matsumura (2023), represents an innovative

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perspective for the future of clusters, promoting waste reduction and the efficient use of resources, aligning with the principles of sustainable development.

In short, the analysis and discussion demonstrate that the sustainable development of clusters is a dynamic process that requires the coordination of multiple actors, the implementation of effective governance and cooperation strategies, the fostering of innovation, and the adoption of practices that balance the economic, social, and environmental dimensions. Understanding the attributes and aspects of the structural foundations is essential for directing public policies and private initiatives that promote the longevity and prosperity of these arrangements in the Brazilian context.

Key attributes for sustainable development in a cluster were identified. The capacity for cooperation among firms and with support entities, along with effective governance mechanisms, was consistently highlighted as fundamental. Clusters with stronger cooperative ties and clear governance structures demonstrated greater resilience and potential for sustainable growth. The continuous valorization of knowledge and the ability to generate and disseminate innovations within the cluster were identified as critical success factors.

Clusters that actively promote learning and the exchange of specialized knowledge tend to evolve more rapidly. The integration of the cluster with its surrounding territory, including local and regional institutions, is vital for leveraging resources and building collective development plans. The existence of well-defined and participatory Sustainable Development Plans, developed with the engagement of cluster leaders and support entities, is essential for guiding actions and achieving long-term sustainability.

Micro and Small Enterprises, which often form the backbone of a cluster, face challenges such as scarce resources, insufficient technology, and a lack of specialized labor. However, the cooperative networks inherent in clusters offer a strategic advantage, enabling MSEs to overcome these limitations through cost reduction, economies of scale, improved market positioning, efficiency gains, and risk reduction. The study also highlighted the importance of interinstitutional effort and the need for continuous adjustments in information systems to support cluster development. The evolution of clusters towards more mature forms, such as "local productive and innovative systems" or "local innovation systems," depends on their ability to foster innovation and knowledge exchange.

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5. CONCLUSION

This research underscores the critical role of structural support bases in the sustainable development of Local Productive Arrangements (cluster). Effective coordination and cooperation among internal and external agents are paramount for the survival and growth of Micro and Small Enterprises (MSE) within these arrangements. The findings suggest that clusters, by fostering knowledge seeking, competitive capabilities, and innovation, differentiate themselves from simpler business networks that might only focus on supply.

The benefits of a cooperative society within a cluster are multifaceted, encompassing cost reduction through vertical integration, economies of scale, enhanced market negotiation power, efficiency gains from coordinated efforts, and reduced joint risks. The continuous exchange of information and the cultivation of an innovation-driven culture are vital for the collective efficiency and maturation of geographical concentrations of businesses. Therefore, all network management actions should be aligned with collective efficiency, leveraging cooperation to access technologies and minimize transaction costs.

Furthermore, incorporating updated references and discussing "second generations" of clusters and the circular economy enriches perspective, highlighting the need for more sophisticated approaches adapted to contemporary challenges. The research reinforces that the success of clusters is not limited to mere geographic agglomeration but crucially depends on the ability of their actors to cooperate, innovate, and manage their resources sustainably, supported by well-articulated public policies.

The main contributions of this study lie in the systematization of the concepts of clusters and sustainable development, highlighting the interconnection between location dynamics, business development, and the importance of information and market access. The analysis of attribute aspects for measuring a sustainable basis for cluster development, as presented in the original document's tables, offers valuable information to managers and researchers. The identification of indicators of competitiveness, innovation, governance, cooperation, social capital, and sustainability (environmental and social) allows for a more holistic and strategic assessment of clusters' performance.

The results of the research allowed the creation of a table of strategic actions to facilitate the management of a cluster for local socio-environmental development. In The Table 4 below

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shows a model of the sustainable development strategy process for clusters, defining the activities, frequency and responsibilities for adapting the strategic dimension.

ACTIVITIES (what to do)	FREQUENCY (when to do it)	RESPONSIBILITY (by whom)
Strategies: Dimensions	**Rarely** When defining and reviewing strategies for analyzing results	Committee responsible for the strategy
Management: Attributes	**Specifically** When defining each new piece of organizational information necessary.	**Key user** Requestor and responsible for the new information.
Parameters	**Specifically** When defining each new piece of organizational information necessary	**Key user** Requestor and responsible for the new information.
Operational Collect data	**Frequently** When generating a new instance of modifying the plan as specified.	**information** IT department responsible for the information instance.
Analyze actions	**Frequently** When using the information checking the appropriate action level for the plan, ensuring progress	**All people** Who use the information for decision-making.

Table 4. Sustainable development strategy process of clusters
Source: Research data

The purpose is to highlight the importance of strategic instruments that allow for a better stance in the face of environmental turbulence and facilitate the identification and exploration of new technological opportunities for sustainable innovation.

In practical terms, this work supports the formulation of more effective public policies and strategic decision-making by stakeholders involved in the clusters. By understanding the elements that make up the structural foundations and indicators of sustainable development, it is possible to direct investments, promote training, and strengthen cooperation networks, aiming for economic growth that is equitable, socially inclusive, and environmentally responsible

Future research could delve deeper into specific case studies of clusters, examining the long-term impacts of different support methodologies and governance structures on their sustainable development. Additionally, exploring the role of digital transformation and emerging technologies in enhancing cluster competitiveness and sustainability would be a valuable avenue for investigation.

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