SUSTAINABILITY INDICATORS WITHIN UNIVERSITY CAMPUSES:

THE EXPERIENCE OF UNIVERSIDADE DE SÃO PAULO, BRAZIL

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Abstract

This article aims at describing the performance of sustainability indicators for Universidade de São Paulo, developed in Agência USP de Inovação/USP Recicla Program. In this context, the university's resources consumption has been assessed and indicators have been established so as to support actions, goals and sustainability policies for the institution. Generally, indicators are attributes that facilitate the understanding of a situation, by indicating - as possible - the current situation and comparing it with the desired situation. A survey performed in 2009 considered two steps: i) introduction and analysis of certain consumption indicators in 7 USP campuses, such as disposable glasses, water, electric power, built-up areas and vegetal covering, transportation and generation of waste; ii) partial data conversion into "ecological footprint". The data presented and discussed herein were raised with each campus, including colleges, schools and teaching and research institutes; in specific purchase and material distribution, water and power consumption and engineering sectors and green areas inside USP. The results achieved indicated that each member of the university community demands approximately 160m²/year of forest to absorb the impacts caused by resources consumption and waste production. The main environmental impacts noticed are related to power consumption (66%), buildings (17%) and paper consumption (13%).

By considering the several challenges we faced the lack of an articulated data measurement and a control system at USP.

Keywords: *indicators, sustainability, university, management*

1. INTRODUCTION

Universidade de São Paulo (USP) was founded in January 25, 1934, by a State Decree, establishing the Faculdade de Filosofia, Ciências e Letras [School of Philosophy, Sciences and Arts] and joining the existing ones: Escola Politécnica [Polytechnic School], Faculdades de Medicina, de Direito e de Farmácia e Odontologia [Schools of Medicine, Law, Pharmacy and Dentistry], Instituto de Educação [Institute of Education], Escola de Medicina Veterinária [School of Veterinary Medicine] and Escola Superior Luiz de Queiroz [Luiz de Queiroz College of Agriculture], among others.

The main feature of its University constitution is the dynamics of the permanent incorporation of colleges, schools and institutes along the 20th century and beginning of the 21st, from which the most recent is the inclusion of the former Faenquil[1], in 2007, currently the Lorena School of Engineering.

Since it was founded in the 1930's, USP has successfully responded to the demands of São Paulo and Brazil's societies.   It is currently composed of forty teaching and research units, seven specialized institutes, four museums, two hospitals and extensions and seven related entities comprising all knowledge areas, in addition to the departments of central and administrative management. It occupies an area of about 77 million square meters distributed in seven campuses in the State of São Paulo.   There are about 5.400 teachers, 15.400 technical administrative servers and 57.000 students regularly enrolled in the 234 undergraduate programs and 22.000 students enrolled in the 228 Stricto Sensu Graduate Programs. It is also expressively inserted in the society through its hospitals, museums, culture, social and public policies programs. (OLIVA, 2009)

USP outstands in the domestic and international academic scenario and is responsible for significant scientific production and worldwide knowledge propagation, rated among the two hundred best universities in the world. (VILELA, 2009)

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[1] Faculdade de Engenharia Química de Lorena [School of Chemical Engineering] founded in 1969, in the city of Lorena, Vale do Paraíba, São Paulo.

Due to these aspects, several challenges appear to USP concerning its future, requiring an adequacy of planning, in which its mission, perspective, goals and actions for the maintenance of quality are clearly identified. Increasingly, this vision of the future must take into consideration exemplary practices focused on the sustainable management of the university.

Notably, aspects that are widely spread due to the aggravation of the socio-environmental crisis, after the industrial revolution, especially those which refer to the progress perspectives at any cost, have undoubtedly caused deep impacts to all continents, societies and ecosystems in the planet.

Thus, we are living a period in which consequences of modernity are expressed in the intense socio-environmental degradation, global warming, natural resources scarcity, destruction of the ozone layer, over-exploration of environments, excessive consumption of products and increase of waste production, among other aspects, characterizing a modern way of being, thinking and acting presented as restless and turbulent and considered synonyms of ease and happiness.

In the context of world impacts and articulations for the socio-environmental conservation, we understand that universities play an important role in the production and diffusion of knowledge and in the execution of exemplary practices concerning sustainability.

In addition, the University should provide a wide range of scientific knowledge, which cause changes, and orientation of political, economic and social movements that optimize investments and costs for the generation of instruments and technologies to save scarce resources and that also help the change of attitudes, habits and paradigms, pursuing sustainability.

So USP was ahead in this discussion when it created, in the 1990's, institutional programs[2] applied to its university community and focused on developing processes and technologies capable of reverting the scarce scenario pointed out by national and international reports.

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[2] Programa Permanente Para o Uso Eficiente de Energia na USP [Permanent Program for the Effective Use of Energy at USP], PURE, created in 1997, with the main objective to consolidate the already reached advances and open new lasting fronts for the rational and efficient use of energy. The energy rationing activities resulted in energy efficiency, ranging from 18% to 54% in different Units, totalizing an average of 29.8%. However, we highlight that the main actions of the rationing activity were the removal of lamps and lighting fixtures and turning off air conditioners. Extracted from http://www.usp.br/pure - acesso em 23/08/2010. And Programa de Uso Racional de Água na USP [Program for the Rational Use of Water at USP], PURA-USP, created in 1997, comprehending technical documentation, laboratories, new technologies, studies in residential buildings, programs of

Highlighted in this article, we find USP Recicla Program, from pedagogy to technology, created in 1993 as a Permanent Program of Environmental Education and Waste Management. Its actions concern the reduction of waste, training of people and diffusion and practice of the 3 Rs – reduction of consumption and waste, reuse and recycling of materials, acting along with the university community in the 7 campuses of the State of São Paulo.

Generally speaking, USP Recicla is different from other programs of environmental management in universities, especially because of its educational process that stimulates the enforcement of proper socio-environmental practices in institutions, the empowerment of people, networks and more conscious everyday actions that might transform the environmental reality of the university and its surroundings.

USP Recicla's network has the participation of over 600 members of the university community, actors and editors from the several segments of the institution. By means of a specific organization method made of a set of administration departments, the program tries to share and integrate the management of solid waste in the university.

The scope of USP Recicla's competences is connecting with USP's decision makers in order to take normative, operational, financial, planning, administrative, social, monitoring, supervision and evaluation actions, comprising in its actions themes such as education, health, environment, promotion of rights, incentive to employment generation, and income and social participation. Thereafter, results of this process privilege the autonomy, self-management and multiplication of social agents to contribute and achieve environmental benefits, economic optimization and social acceptance along with society (RIBEIRO, 2009).

The program works through commissions set up in main agencies and through the management at colleges, schools and research institutes, museums and advanced bases. It ensures the continuity of developed actions by spreading them outside the University, and becoming a reference to cities and other institutions.

The program was set by regulations of the University and is constituted by the following departments: i) Management Committee – department which sets and defines general and evaluation guidelines of the Program; ii) Campuses Commissions – it joins the commission coordinators of units/agencies, which comprise the USP Recicla of the Campus. It is

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quality and, finally, case studies in different types of buildings (offices, schools hospitals, kitchens, etc.). Extracted from: http://www.pura.poli.usp.br – access on 08/23/2010.

responsible for the articulation of commissions of units/agencies, developing the planning of local actions. iii) Commissions of Units/Agencies - for each of the units and agencies of the University, the generation of an USP Recicla Internal Commission is stimulated. These commissions are responsible for the implementation and operation of the Program at Units or agencies, considering specific characteristics and guidelines defined by other departments of USP Recicla. They are comprised by teachers, employees and students appointed by the manager or chosen by the unit/agency community.

At this point, several questions started to arise out of the Program at USP. Among them is the need to measure results and to create indicators in order to move forward and contribute to an environmental policy for the University.

USP Recicla accepted the challenge to build sustainability indicators and its developments collectively, involving its actors and other departments of USP to prepare this process.

It was observed that indicators are essential management tools and aim at improving processes and the continuous evaluation of results, allowing to "anticipate, prevent and correct" (MALHEIROS, 2007; MALHEIROS, 2008) and specially compare and verify the evolution of the situation over time. Indicators can offer basic subsidies to the decision-making processes.

In this perspective, herein we collect data from a project that has been established by USP Recicla Program, of Agência USP de Inovação, aiming at measuring the consumption of USP's resources more widely than its scope and at setting indicators in order to subside sustainability actions, goals and policies at the university.

2. **SUSTAINABILITY INDICATORS WITHIN UNIVERSITIES – CONCEPTUAL FOUNDATIONS FOR THE TOOL CREATION AT USP**

In general, indicators are attributes that facilitate the comprehension of certain situations. In other words, it indicates the current situation and compares it to the desired one. Good indicators are those applied to the practice, which generate information, are reliable and excite consideration, and can be used for analysis and formulation of strategies. An indicator says little when it is isolated or seen statically. Even a good set of indicators express only a clue of reality, part of its multiple aspects. The comprehensive reading of the set of indicators generates a picture of the situation. Thus, when developing them, it is necessary to be aware of the entire group of indicators, their meaning in the set and their relations. Indicators are used so that organizations can analyze their performance in an integrated way.

The objective of using this tool is to generate information that can be used to strategically evaluate goals and objectives and to enable the system's learning process and its continual improvement by means of constant feedback. We can see the use of indicators as in a PDCA cycle (Plan, Do, Check, Act), that foresees planning, execution, checking and action, where we can add evaluation and adjustment in all phases of the project.

For the good use of indicators, it is important to work with needful and available information, because you must think about the feasibility for using the indicator, basing the choice of indicators on criteria such as information importance, ease of monitoring, time, technology and cost.

There are some important characteristics to be considered so as to define indicators. The indicator must:

- be significant for the evaluation of the system;
- be valid, objective and consistent;
- be coherent and sensitive to changes in time and in the system;
- be focused on practical and clear aspects, easy to understand;
- allow an integrating focus, that is, provide condensed information about several aspects of the system;
- be easily measurable, based on low-cost and easily-available information
- allow a wide participation of the actors involved in its definition;
- allow the relationship with other indicators, facilitating their interaction.

Most indicators were developed for specific purposes, such as environmental, economic and health purposes and could not be considered indicators of sustainability themselves. Thus, due to their complexity, indicators of sustainability require interconnected systems of indicators including their multiple dimensions. Therefore, indicators of sustainability need to create patterns to be a reference for measuring the progress of society towards the so-called "sustainable future". Along this path, several aspects of sustainability must be considered, such as ecological, economical, social, cultural and institutional aspects among others (VAN BELLEN, 2005).

One of the most renowned methods that try to integrate the several dimensions of sustainability is DSR *(driving force, state, response)*, elected by the United Nations Commission on Sustainable Development in 1995. For this method, *driving force* represents human activities, processes and patterns that have caused impact on the sustainable

development; *state* provides a measurement of the sustainable development status and *response* corresponds to the responses to changes in this state.

Environmental indicators have special mention here, because they will be the foundation of the proposal of USP Recicla Program, analyzed herein.

Therefore, the regular publication of the OECD (Organization for Economic Cooperation and Development) is an important mechanism to monitor the environmental progress for countries that are part of this institution. The system uses the pressure, state and response model (PER), where environmental pressure (P) represents the pressure of human activities over the environment, the condition or state (E) represents environmental quality and response (R) represents the extension and intensity of society's reactions when responding to environmental changes.

Another approach of the ecological dimension is the one related to the flow of material and transportation, and resources and energy, which try to establish a link between the consumption of materials and its impacts on nature. (VAN BELLEN, 2005).

Lastly, concerning the *participation* in the development of sustainability indicators, Van Bellen (2005) remarks that there are at least two approaches lying in extremes. The *bottom-up*, in which there is a great participation of society in the process and the *top-down,* which is contrariwise determined only by specialists.

This article aims at describing the development process of sustainability indicators for USP, as of the data generated by its institutional programs, such as USP Recicla, PURE and PURA-SP, in addition to information generated by departments of general management, bringing some notes and challenges for its effective application at the university.

3. TRAJECTORY OF SUSTAINABILITY INDICATORS – EXPERIENCE OF USP

The construction of sustainability indicators for USP is mainly based on the methodological experience of University of Santiago de Compostela/Spain and some tasks initiated at certain campuses of USP itself.

The Program used parameters like the ecological footprint to didactically translate the consumption of the university community. Documents from the USP Recicla Program such as reports and memorandums of meetings with Commissions have been consulted, those documents focused on the construction of sustainability indicators.

The methodologies for the qualitative and quantitative diagnosis of residues used by USP Recicla Program in the campuses and the methods for measuring the energy and water

consumption of the purchasing and central storehouse sectors, in addition to the management agencies, and the green and planning[3] areas have also been consulted.

The indicators aimed at:

a) Inventory the consumption and waste disposal (inlet and outlet) within the campuses of Universidade de São Paulo;

b) Identify mechanisms for acquiring data from the USP Recicla Program, Uso Racional de Água Program (PURA-SP) and Uso Eficiente de Energia Program (PURE)

c) Measure impacts of the actions performed by the Institutional Programs in the campuses and the entire USP;

d) Contribute to the setting of short, medium and long term goals;

e) Enable long-term vision by subsiding the creation of socio-environmental sustainability policies for USP.

The indicators comprised the following items:

a) *The consumption of resources:* water, energy, white paper, recycled paper, disposable cups;

b) *paper reuse practices* use of front and back in thesis, essays and habilitation;

c) *waste disposal and selective waste collection;* generation of common garbage; sorting of plastic, glasses, metal and paper; sorting of batteries; generation of electro-electronic waste; collection of used oil; creation and forwarding of fluorescent lamps and a quality separation for recyclable materials.

d) *Transportation*;

e) *Built-up areas and vegetation coverage.*

The data have been acquired in departments of the University, according to table 1.

Table 1 – Synthesis table with the ones in charge of supplying information to the indicators

Type of Consumption and/or campuses characteristics data	Department that has the data	Amplitude / search level	The ones in charge of the survey
General data of campuses	Statistics yearbook COESF Campuses	campus	Technical team of the Program

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[3] Consultations to the Coordination of Campuses (the structure managing territorial spaces of the campuses), General Management Coordination – CODAGE and Physical Space Coordination – COESF.

	Coordination		
Paper	Storehouse and graduate departments	location - unit	Commissions of USP Recicla in units Technical team of Program
Disposable cups	Warehouse / purchase departments	location - unit	Commissions of USP Recicla in the units
Energy	PURE	location – unit / campus	Technical team of the Program
Water	Campuses Coordination PURA	location – unit / campus	Technical team of the Program
Collection of used vegetal oil	COSEAS – Food Division	location - unit	Commissions of USP Recicla in units Technical team of the Program
Batteries	Units USP Recicla Program	campus	USP Recicla Commissions at the Banco Real units
Fluorescent lamps	Storehouse / purchasing department	location – unit / campus	USP Recicla Program Infrastructure and Electrical Division of the Campuses Coordination
Green and built-up areas	COESF Campuses Coordination	location - unit campus	Technical team of the Program

The development of sustainability indicators at USP has been performed based on the following steps:

a) ***Preparation of a questionnaire***

Development of a registration system by means of spreadsheets to be filled out along with USP Recicla commissions at the Units and other departments of the campuses;

Preparation of a Guide for filling out the registration.

b) ***Qualification of the ones involved for applying the indicators***

The team involved has carried out technical meetings throughout all campuses in order to guide and qualify trainees for collecting and systemizing data. Promoting and carrying out meetings to clarify the procedures for collecting and

systemizing data, as well as the use and application of indicators at USP. Such process had the direct involvement of about 500 people, most of them members of commissions, in the data collection period

c) *Systematization and interpretation of the data*

The members USP Recicla commissions sent data to the respective technical teams of the campuses who then made a database of each unit and campus.

d) *Didactic translation of data to return to USP community*

The collected data were translated in a publication called USP SUSTAINABILITY: *Report of Environmental Impact of USP[4]*, whose purpose was to disclosure and sensitize the community regarding the "state of the art", that is, how the situation of consumption and the impacts of USP on the aspects presented herein are currently found.

The development process of the indicators involved a teacher–coordinator and a collaborative teacher who guided five environmental technicians, specialists and educators, eighteen trainees and scholarship students (most of them with development scholarships of the USP's Culture and Extension Department - PRCEU) and two administrative employees. The period of development, collection and systematization of data occurred between November 2008 and October 2009.

As of the systemized data we evidenced that Universidade de São Paulo, with a total area of 47.205.163.94 m^2, from which 1.722.119.17m^2 is built-up area, annually consumes 23.879.818 disposable cups, 1.970.487 reams of white paper and 52.309 reams of recycled paper, 124.075.421 KWh of energy and 1.956.920 m^3 of water. Moreover, it has an estimate waste collection of 4.558.70 tons/year of non-recyclable materials, 1.079.5 tons/year of recyclable materials and 5.638.2 tons/year of inorganic waste, in addition to sending 2.803.75 kg/year of batteries and 29.639 fluorescent lamps to recycling.

However, it is worth remarking that several challenges were faced in order to prepare this report, among them we can highlight the lack of feedback from several commissions in the period of data collection at the USP's units. We have identified, among other aspects, some resistance and slowness in the provision of information, in some departments, programs and agencies. In others, data were not available and systemized, producing extra work for the

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[4] Document released in an event organized by Agência USP e Inovação, on October 15, 2009, with several directors of units, coordinators and technicians of environmental programs. It can be accessed at http://www.inovacao.usp.br/sustentabilidade/impactos.php

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employee involved, who could not always understand the importance of the survey. There were those who thought they were not responsible for such activity and that other employees should be contacted. Moreover, certain units have changed the questionnaire and the information collection format hindering the data systematization and comparative analysis. The pointed aspects considerably reflected on the data reliability, which would determine the change in the collection process of future data. Most of the information sent hid important intelligence related to population, real consumption and others.

And among the suggestions for improvement the following were pointed out by the ones involved and considered important to be taken into account in next steps: the need to prepare different questionnaires for certain departments, which have diverse operation features (such as the ones not made for teaching); prepare the questionnaire in a participative/collaborative way with the units; use simple texts in order to facilitate the understanding of questions; develop a constitutive process previous to the application of questionnaires.

4. USE AND APPLICATION OF INDICATORS AT USP: CREATION OF SISTEMA TERRA [EARTH SYSTEM]

The complexity of carrying out a survey on the indicators and the contextual diversity of the university and its 7 units have clearly demonstrated the need for developing an integrated, organized and standardized system for collecting, following-up and systematizing data monitored by institutional sustainability measurement mechanisms for USP.

Therefore, by the middle of 2010, jointly with USP's Culture and Extension Department, the project *Sistema Terra: criação design e uso de indicadores de sustentabilidade na USP* [Earth System: creation, design and use of sustainability indicators at USP] was approved. The purpose of this project is developing an online corporate system to support the survey on consumption and residue generation at USP's units. This system aims at making the following procedures feasible: i) registration and planning of consumption and disposing variables; (ii) information accessibility and transparency; iii) generation of indicators for assisting the planning of programs, projects and USP campuses and units ; iv) subsidy for establishing management policies in order to set sustainability goals for USP; and v) preparation of reports and indicators.

However, the corporate systems have been built by USP Central Bodies since the 1970s, preserving their own computing systems, which support the administration and academic

procedures, and provide the necessary support required by the university in order to perform related activities. (CARVALHO & MARQUES, 2007)

Therefore, we see that the assets accumulated during this period are relevant within the Brazilian higher education institutions scenario, and set USP at a privileged position, since the institution easily follows the technological advances appearing in increasingly shorter time cycles5.

The highly diversified scenario of USP enabled the creation of corporate systems for different contexts: The large systems that automate processes in a single business area and the small ones developed to support the flow systems.

Currently, USP corporate systems are organized according to Table 2:

Table 2: USP Corporate Systems

SYSTEM	Description	Location	Responsible
Mercúrio	Financial, material, procurement, assets and supply management	CODAGE	DI
Marte	HR and payroll management	CODAGE	DI
Júpiter	Administration of under graduation activities	PRG	DI
Janus	Management of graduation activities	PRPG	DI
Proteos	Automated Protocol	CODAGE	DI
Apolo	Management of specialization, improvement and diffusion programs.	PRCEU	DI
Netuno	Management of registration and revalidation of certificates	General Secretary	DI
Atena	Support to the Research Department, such as the Management of Scholarships and further support.	Research Department	DI
Halley	Data Survey to prepare the Statistics Yearbook	Dean's Office	DI
Statistics Yearbook	Publication of statistic data and information about USP	Dean's Office	DI

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5 The Informatics Department of CODAGE is currently responsible for maintaining and developing this kind of application.

CERT	Management of the Special Commission of Work Regimen (CERT)	CERT	DI
DATAUSP	Representation Environment of the education, research, culture and extension activities performed at the institution.	Central Department	DI
USP Portal	Corporate portal, with information about the Institution	CCS	DI
Candinha	Control of corporate database replication environment	DI	DI
Pedro	Control of version and security level of corporate systems	DI	DI
Scheduling of Meetings	Systems for meeting scheduling and support services.	General Secretary	DI
USP fleet	Management of USP fleet.	DA	DI
Mail control	Control of mails posted	DA	DI
Knowledge Portal	Management of information on thesis and essays defended at USP.	CISC	CISC
Institutional Portals	Publish information about the Institution units and departments	Units and departments	Units and departments
Institutional Portals	Publish and exchange information about the Institution units and departments	Units and departments	Units and departments
COL	Support to distance education. Online programs	LARC/Poli	LAR

Source: MARQUES & CARVALHO, 2007

Within their main features and roles, these corporate systems are vital tools for the university's administrative and academic management, provided they:

- Perform standard procedures, norms and behaviors, establishing a common language for all users;
- store a history of operations in order to enable data recovery and track-down;
- Institutionalize the knowledge on processes, assuring their continuity and independence from personal knowledge;
- Aim at aligning with the institution's technological architecture;

- Eliminate redundant data by integrating databases, increasing the information credibility
- Meet the interests of the corporation/institution;

Once aligned with the mission of the institution, these systems can be created based on investments made by central bodies, such as interested specific segments and due to their amplitude the entire institution can be assisted or just part of it.

Within this context, the partnership between Agência USP de Inovação through USP Recicla Program and the Informatics Department of CODAGE aims at consolidating an integrated information system that supports the preparation and monitoring of sustainability indicators, which is purposely named Sistema Terra [Earth System].

The registration database and graphic interface of Sistema Terra are under construction. The scope of this project is implementing a database, at a final stage, in which it is possible to register indexes from all units regarding:

- The consumption of new and recycled paper – used in different activities performed by the university, especially for theses, essays, dissertations and professorship theses;
- Disposable cups consumption;
- Water consumption;
- Energy and alternative energy sources consumption;
- Liquefied Petroleum Gas consumption;
- Built area and vegetation coverage;
- USP population – students residing at the university's facilities, childcare, and other residents;
- Agricultural and cattle production;
- Grazing fields;
- Number of meals served at the university's restaurants;
- Fuel consumption for official transportation;
- Waste generation: Common, organic, electronic, recycling and civil construction residues.

It will enable a wide integration of the data generated by the systems mentioned in table 2. The main objective of the system is articulating the different departments and programs of the University as a form of appropriation and identification and with this tool in order to

support the plans, goals and measures of the different segments of the university, which will be performed by GRS (System Reference Group).

The GRSs created for the other systems aim at supporting the users, however, the main skill these groups bring is the operation of the system, its rules, methods of use and navigation, managing and mediating the final demands.

5. CONCLUSION

It is expected for the indicators to become educational tools for community awareness in relation to the reduction of consumption and environmental sustainability, provided that it is possible to check the reduction levels of waste, energy, water consumption, CO_2 emission and other resources by comparing data. It is also expected to stimulate the participation in all phases, as of the data collection, data analysis, formulation of joint strategies for local interventions, process assessment and adjustments.

The introduction of the sustainability indicators concept to USP Recicla Program aims at serving as the foundation for the decision-making processes at different levels in different fields. The Sistema Terra - under construction - is an important institutional database mechanism that will generate information on USP environment status. Surely, the reliability of the data will enable the generation of reports pointing out actual information on the University context in this regard.

Therefore, it is expected to establish an articulated network based on data from Sistema Terra in order to support the setting of goals, regulating the usage standard for resources and stimulating the systematization and comparability of information, whether in inter-unit, inter-commission or inter-campuses level. Therefore, it is expected to create synergies that stimulate the participation of the university community in the consolidation of a Sustainable USP.

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