INTEGRATION, MONITORING, AND ASSESSMENT OF SUSTAINABILITY IN HIGHER EDUCATION INSTITUTIONS

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OUTLINE

- Overview
  - Gap, Research questions and objectives
- Literature Review
  - Commitments, models to integrate SDI; holistic approach; SATs
- Method
- Results
- Conclusions

OVERVIEW

OVERVIEW

- Since the emergence of the environmental crisis, global higher education systems have been called upon to **assist society in devising alternatives** better aligned with ecosystemic limits (Miller & Spoolman, 2017).
- HEIs have been impelled to assume the profound and unprecedented **duty of acting as leaders** to inspire and accelerate the societal transformation that will enable humanity to tackle the global sustainability crisis (Talloires Declaration, 1990).
- However, how can HEIs worldwide assume their leader role if they **struggle to integrate sustainable development** into the core areas and layers?
-

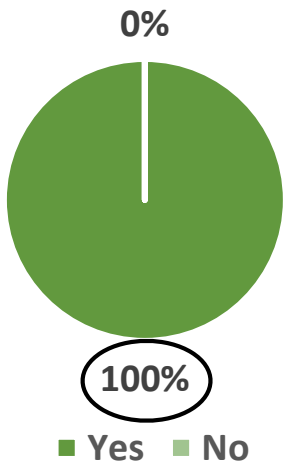
OVERVIEW - GAP

- The **Normative Instruction No. 10** created by MPOG institutes the **Sustainable Logistic Management Plan (SLMP)**, a new management model for public agencies.
- The **SLMP is a management tool** that includes objectives, responsibilities, actions, targets, deadlines, and monitoring mechanisms for sustainability and rationalisation of spending.
- Requirements: **Compliance with 24 requirements** and **Integration of over three dozen indicators of sustainable performance**.
- Main challenges include: SLMP **not explicitly designed for HEI**, requiring adaptation without altering the norm's rationale. **Laborious data collection** and reporting due to fragmented databases.

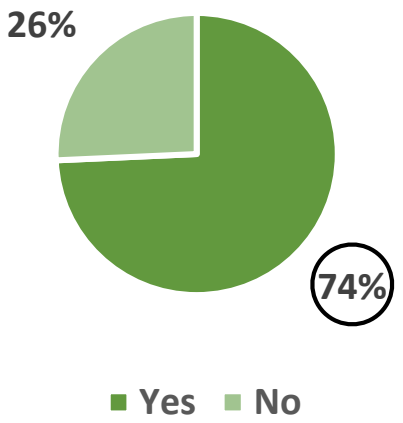
OVERVIEW - GAP

Plan for Integrating Sustainable Development into HEIs

(a) HEI has an IDP



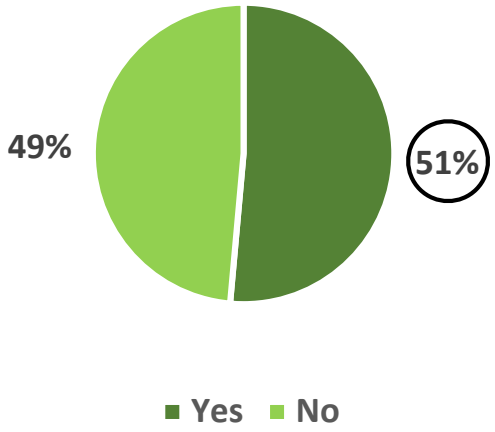
(b) The IDP considers SD in its mission or vision



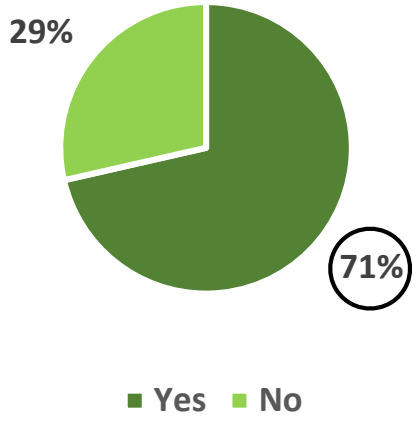
OVERVIEW - GAP

Plan for Integrating Sustainable Development into HEIs

(a) HEI has a SD policy



(b) HEI has a formal structure to cope with SD issues



OVERVIEW - GAP

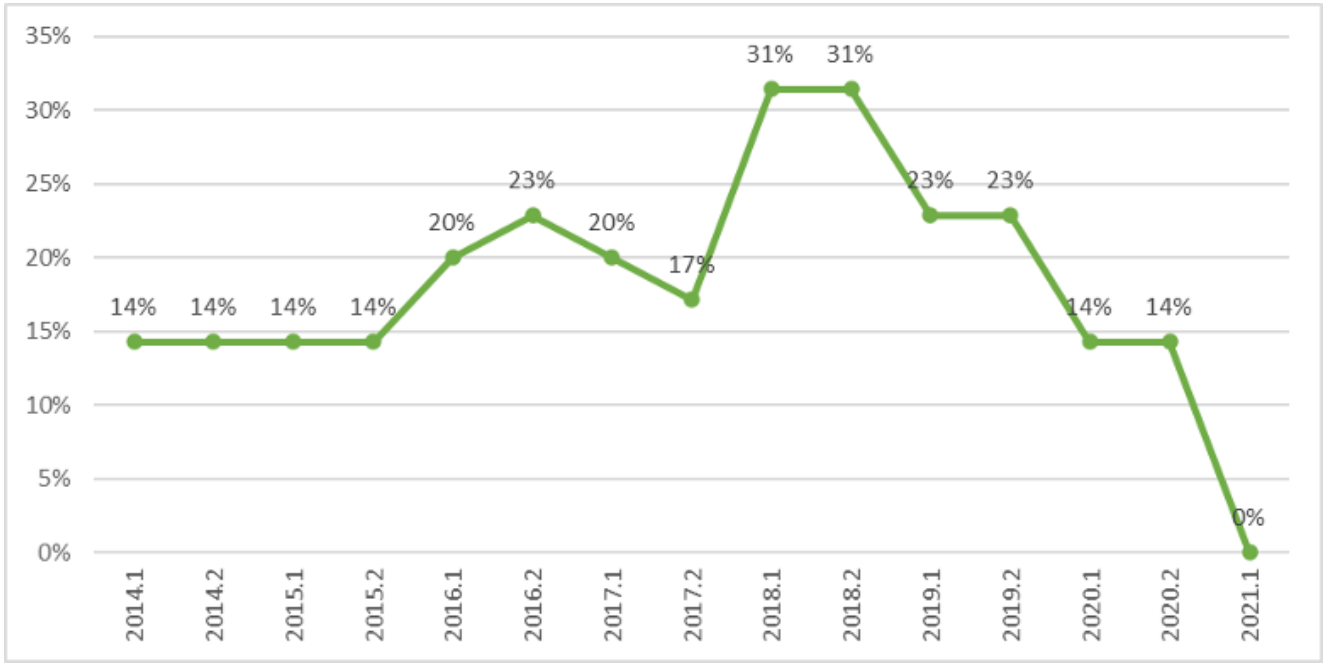
Plan for Integrating Sustainable Development into HEIs

Requirement	Degree of accomplishment	
	n	%
(R02 – R13) HEI has SLMP (SD planning)	25	71%
(R14) The Plan has objectives for the Action Plans	22	63%
(R15) The Plan has details on the implementation of the actions	23	66%
(R16) The Plan defines the units and areas involved in the implementation of each action and the respective responsible parties	24	69%
(R17) The Plan has goals to be reached for each action	22	63%
(R18) The Plan has a timeline for the implementation of the actions	23	66%
(R19) The Plan has a forecast of financial, human, and instrumental resources, among others, necessary for the implementation of the actions.	12	34%
(R20) Designation of the SLMP management committee	26	74%
Average accomplishment of the set of planning requirements	-	*63%*

OVERVIEW - GAP

Execution of planning for Integrating SD into HEIs

Percentage of accomplishment in SD reports published each semester



OVERVIEW - GAP

Execution of planning for Integrating SD into HEIs

Report on Electric Power Consumption

Requirement	Degree of accomplishment	
	n	%
(24;11) Electricity consumption (kWh)	9	26%
(24;12) Electricity consumption per capita (kWh)	4	11%
(24;9) Expenditure with electric energy	6	17%
(24;10) Electric energy expenditure per capita	3	9%
(24;13) Adequacy of the demand contract (off-peak)	1	3%
(24;14) Adequacy of the demand contract (peak)	1	3%
(24;15) Energy expenditure by area	2	6%
Average accomplishment of the set of Energy requirements	-	11%

OVERVIEW - GAP

Execution of planning for Integrating SD into HEIs

Reporting on purchasing and contracting processes

Requirement	Degree of accomplishment	
	n	%
(24;27) Expenses per telephonic line/extension (fixed)	2	6%
(24;28) Expenses per telephonic line (mobile)	1	3%
(24;29) Surveillance - Initial value of the Post	2	6%
(24;30) Surveillance - Current value of the Post	1	3%
(24;31) Cleaning service - Cleaning expenses by area	2	6%
(24;32) Cleaning service - Degree of renegotiation	0	0%
Average accomplishment of the set of purchasing and contracting processes requirements	-	4%

OVERVIEW - GAP

Isolated Approach in Literature

Formal commitments undertaken by HEIs	Efforts to identify key dimensions of SD into HEIs and include them on HEIs strategies.	Development of sustainability assessment tools (SATs)	Efforts to disclosure of HEIs performance related to sustainable development.
DECLARATIONS	PLAN	MONITORING	REPORTING
(Svanström et al., 2008)(Lozano et al., 2015) (Adlong, 2013) (Zutshi et al., 2018)	(Kościelniak, 2014) (Farinha et al., 2019) (Ikegami & Neuts, 2020) (Baker-Shelley et al., 2017) (Owens, 2017) (Shawe et al., 2019) (Bieler & McKenzie, 2017b) (Jorge et al., 2015) (Ramísio et al., 2019)	(N. Alghamdi et al., 2017) (Nejati & Nejati, 2013) (Alba-Hidalgo et al., 2018) (Amaral et al., 2015) (Zainordin & Ismail, 2018) (Masaru Yarime & Tanaka, 2012) (Adenle et al., 2020b)	(Ceulemans et al., 2015) (A. Adams, 2013) (Sepasi et al., 2019) (Bini & Bellucci, 2019)

EXAMPLES OF REFERENCES THAT STUDY EACH COMPONENT AS A ISOLETED OR NEWRLY ISOLATED ELEMENTS

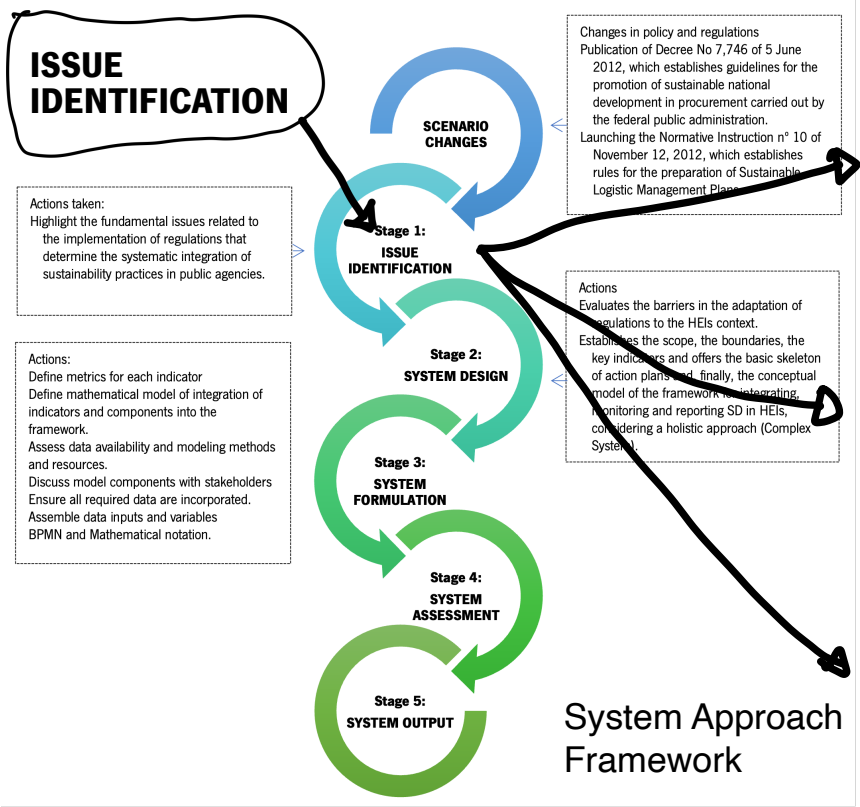
RESEARCH QUESTION

Research Question 1: How can a sustainable **assessment framework be conceptualised** given the relationship between HEI organisational strategies and the implementation of SLMPs in Brazilian federal public universities?

Research Question 2: How can NI10, 12/11/12 be **effectively operationalised in HEI** to promote sustainability, considering key dimensions, actions, indicators, and integration of multiple sectors, while addressing incongruences and conflicts and aligning with international literature?

Research Question 3: How a methodology for data collection and systematising **can be developed to integrating different dimensions mathematically**, and utilising a **benchmarking approach** to compare the progress of every Brazilian federal public HEI?

RESEARCH QUESTION AND ISSUES



RQ1	**How can a sustainable assessment framework be conceptualized given the relationship between HEI organisational strategies and the implementation of SLMPs in Brazilian federal public universities?**
Issues related	**(a)** To what extent do organisational strategic documents support the development of a SLMP in HEI? **(b)** What is the current status of SLMP implementation in Brazilian federal public universities?
RQ2	**How can NI10, 12/11/12 be effectively operationalised in HEI to promote sustainability, considering key dimensions, actions, indicators, and integration of multiple sectors, while addressing incongruences and conflicts and aligning with international literature?**
Issues related	**(c)** What are the key dimensions, actions, and indicators required to effectively operationalize the normative instruction and develop a coherent and feasible structure for planning, assessing, and reporting the sustainability of HEI in an integrated manner that aligns with international literature on planning and Sustainable Assessment Tools (SAT) for promoting SDI in HEI? **(d)** What are the incongruences and conflicts of the normative instruction, which was created with a general spectrum, when applied to HEI?
RQ3	**How a methodology for data collection and systematising can be developed to integrating different dimensions mathematically, and utilising a benchmarking approach to compare the progress of every Brazilian federal public HEI?**
Issues related	**(e)** What is the most effective and credible methodology for data collection? **(f)** How can multiple sectors within each university be integrated into the process of developing the plan, monitoring indicators, and preparing semi-annual and annual reports? **(g)** How can different dimensions be integrated to formulate a single system? **(h)** Can a benchmarking approach be utilised to develop a system for comparing the progress of every Brazilian federal public HEI?

RESEARCH OBJECTIVES

Objective 1: To **conduct a literature review** on SDI in HEI, analyse the changes related to the implementation of SDI in Brazilian federal public HEI, and **develop the conceptual model** of the proposed framework.

Objective 2: To develop the **detailed procedural structure** of the proposed framework and **formulate the integration model according to the Brazilian normative regulations**.

Objective 3: To **test the effectiveness of the framework** by evaluating the sustainability performance of a typical Brazilian federal public HEI.

LITERATURE REVIEW

HEIS COMMITMENT TO SUSTAINABLE DEVELOPMENT

- The main **keywords**, **journals** and **authors** working in the field of **sustainable development** applied to **HEIs**, as well as those responsible for developing **sustainability assessment tools**, were initially identified through a systematic literature review.
- The main **commitments** that have **conducted HEIs to the role of leaders** in the transition to a more sustainable society, followed by the main **management models** and **networks** adopted by HEIS **to integrate sustainable development** were studied and summarised.
- At the end of the survey it was possible to catalogue **72 SATs,** of which the most relevant were analysed in detail and their **indicators compiled**.

HEIS COMMITMENT TO SUSTAINABLE DEVELOPMENT

The ten most active journals publishing on the field of SD in HEI ranked by number of articles indexed.

Ranking	Source Title	doc[a]	Citations	TLS[d]	IF (JIF)[b]
1	Sustainability	437	1858	1622	2.576
2	International Journal of Sustainability in Higher Education	312	3596	2076	2.000
3	Journal of Cleaner Production	257	8439	2666	7.246
4	Environmental Education Research	66	1068	409	2.266
5	Engineering	36	631	118	6.495
6	Frontiers of Architectural Research	29	492	130	19[c]
7	Studies in Higher Education	26	84	0	3.000
8	Higher Education	23	175	0	2.856
9	Amfiteatru Economic	23	293	59	1.625
10	Assessment Evaluation in Higher Education	20	65	83	76[c]

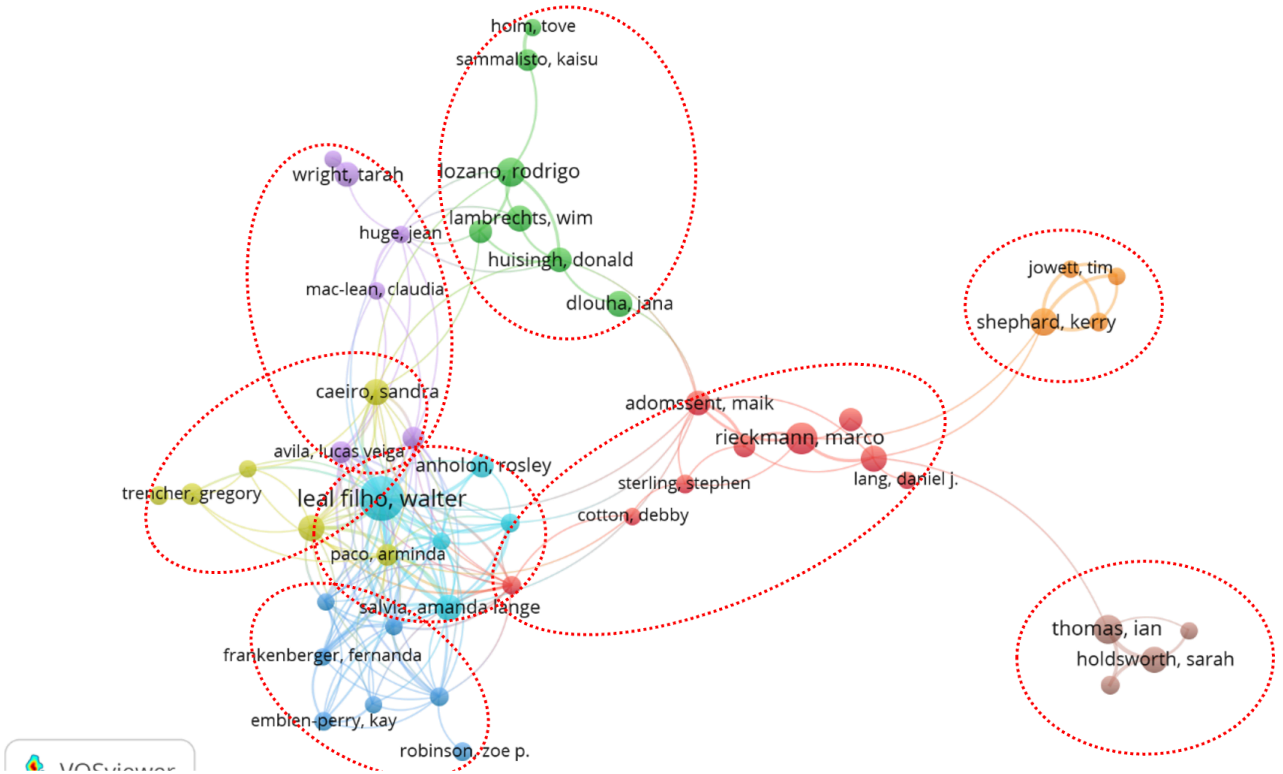
Note: a) Doc: Number of documents published; b) JIF: Journal Factor Impact, WoS; c) H Index Scopus; d) TLS: total link strength.

Data collected in January 2021

HEIS COMMITMENT TO SUSTAINABLE DEVELOPMENT

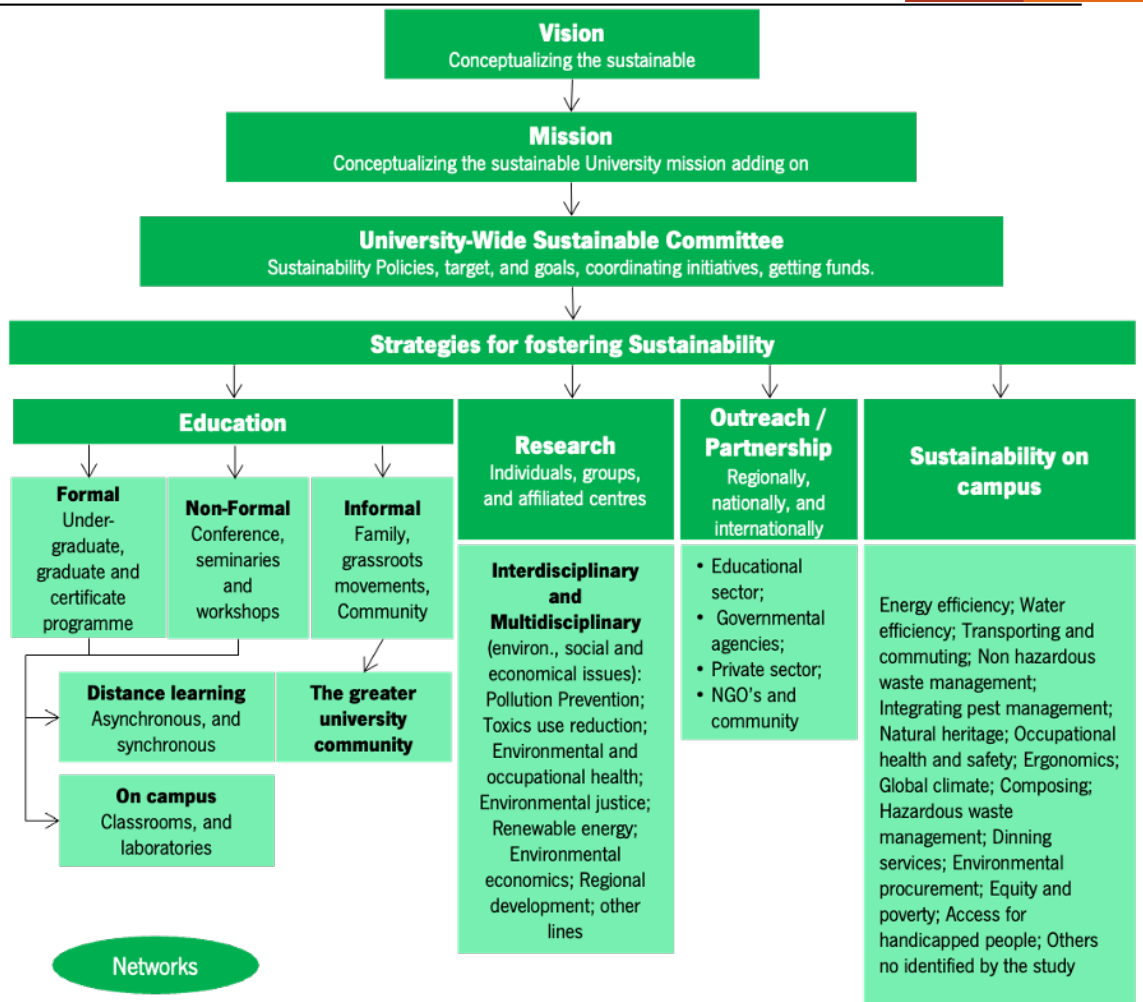
Author's cooperation network in SD in HEIs

String words: "
Sustainab*" AND "higher education" AND
LANGUAGE: (English), IC
Timespan = 2010 -2021



HEIS COMMITMENT TO SUSTAINABLE DEVELOPMENT

Sustainability university model adapted from Velazquez et al. (2006)



SUSTAINABILITY ASSESSMENT TOOL - SAT

Comparative analysis: (Shriberg, 2002a) (L. P. Amaral et al., 2015) (Lauder et al., 2015) (Fischer et al., 2015) (Asmuss & Kamal, 2013) (N. Alghamdi et al., 2017) (Findler, Schönherr, Lozano, & Stacherl, 2019a) (Saadatian et al., 2011) (Bullock & Wilder, 2016) (Casarejos, Frota, et al., 2017) (Alba-Hidalgo et al., 2018) (Du et al., 2020) (Adenle et al., 2020b) (Galleli et al., 2021)

Proposal of a SAT Framework: (Velazquez et al., 2006) (Lozano, 2006a) (Sonetti et al., 2016) (Saadatian et al., 2013) (H. Shi & Lai, 2013) (Alshuwaikhat et al., 2017) (Casarejos, Frota, et al., 2017) (Silva & Almeida, 2019) (Adenle et al., 2020b)

Analysis of sustainability reports related to SAT:(Kapitulčinová et al., 2018) (Sepasi et al., 2018) (Son-Turan & Lambrechts, 2019).

Mathematical model to integrate SAT: (Saadatian et al., 2011) (Casarejos, Frota, et al., 2017) (Lauder et al., 2015) (Adenle et al., 2020b) (Waheed, Khan, & Veitch, 2011)

METHOD

METHOD

Research Design and Approach:
Philosophy (pragmatism), approach (deductive), strategies (case study, action research)

Data Collection and Analysis:

- Desk research and document analysis to assess the evolution of sustainability initiatives in Brazilian federal public HEIs.
- Systematic literature review and science mapping to identify existing frameworks, dimensions, indicators, and metrics related to sustainability assessment in HEIs. E
- Expert interviews to validate the framework, data collection process, and indicators.

Ch. 1

Ch. 2

Ch. 3

Ch. 4

Ch. 5

Ch. 6

Ch. 7

Ch. 8

Ch. 9

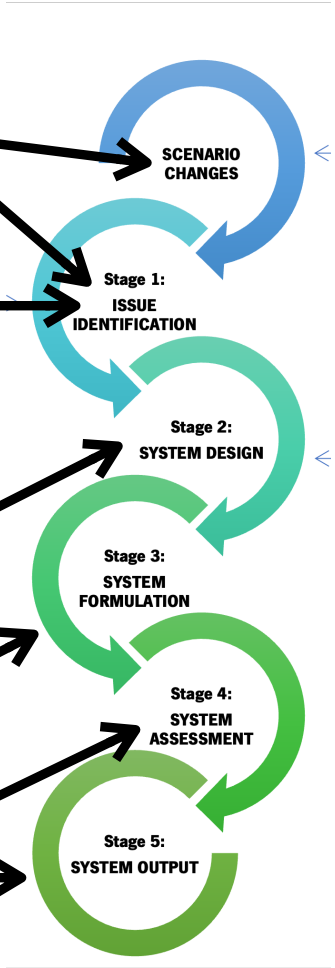
SLR to analyse the management models used to integrate and assess SDI; Analysed through **mapping** and **bibliometrics review** to analyse co-occurrences in keywords, the most prominent journals and authors. Chapter 2 - 2,853 and Chapter 3 - 2,586 documents

Desk Research on oficial documents regarding the sustainable plans and reporting produced by Brazilian Federal Public HEIs. Sample 35 HEIs (55%). Analysed through **descriptive statistics**

System Approach Framework to compile the main dimensions of sustainability in HEIs, their indicators and metrics; 10 interviews with staff devoted to manage sustainability issues in campus to identify the best data collecting strategy and to pre-validate the components, indicators an metrics previously compiled through SLR; Analysis: **modelling** the conceptual model of the FIRMARSHEI

System Approach Framework and **composite indicators** to transform the conceptual model into a mathematical model.

System Approach Framework to asses the performance of a typical case (**application test**). Analysis: **descriptive statistics**



METHOD

The **Federal University of Paraíba** was chosen as a **typical case study** for its volume of data available and ease of access to information. This institution **has implemented a SLMP**, with **several follow-up reports published**.

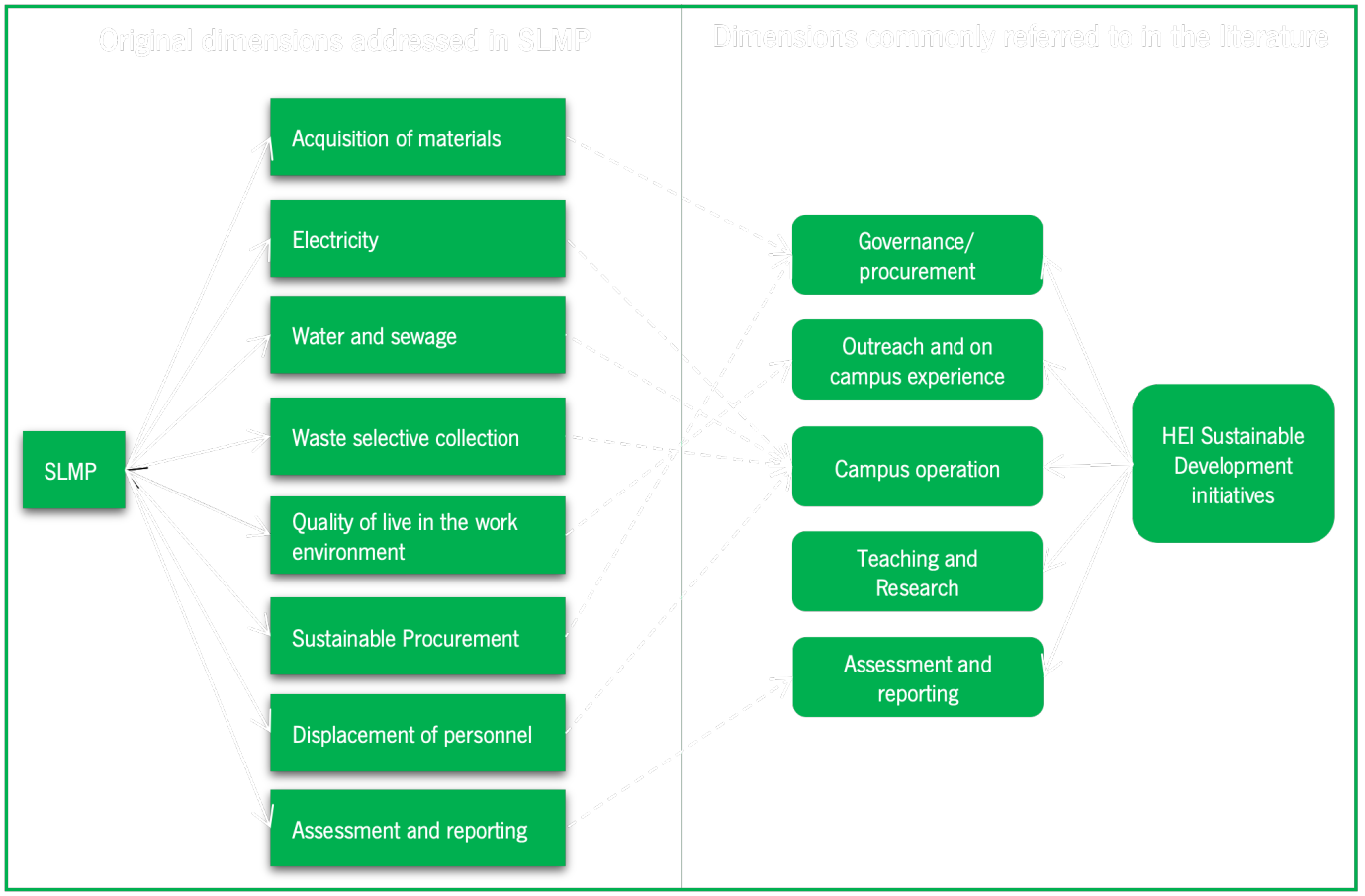
The UFPB is located in the Northeast of Brazil, is the largest HEI in its state, with **2,831 lecturers**, **4,368 technical-administrative** and outsourced professionals, and **37,752 students** allocated in four campuses. The University has been a national leader in the submission of patents in various areas of knowledge.

The UFPB is located in an area of **Atlantic forest** and has **several SD integration programmes underway**

RESULTS

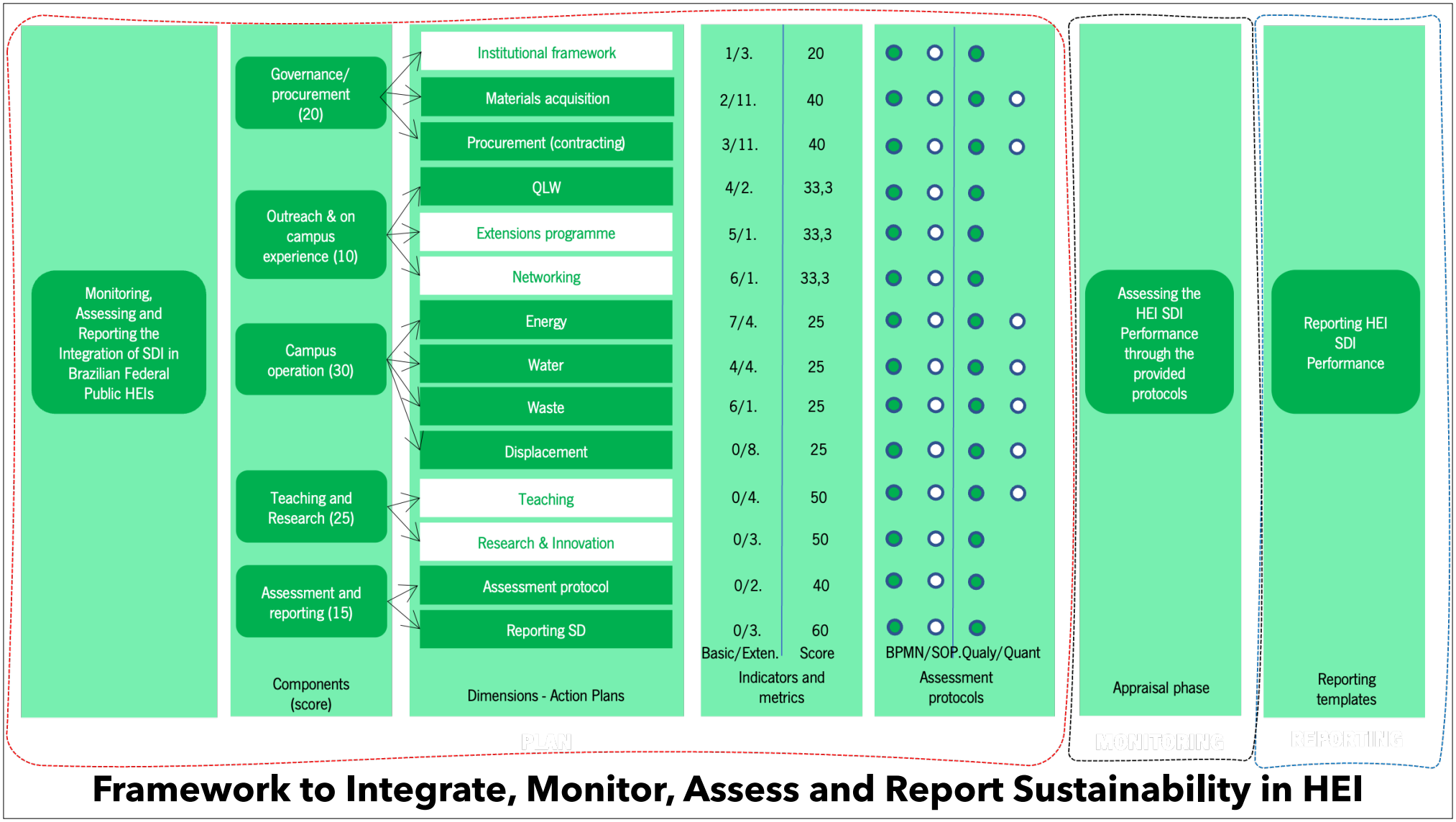
SYSTEM DESIGN

Adherence between normative and Brazilian HEI SDI model



SYSTEM DESIGN

89 Indicators of the model



Framework to Integrate, Monitor, Assess and Report Sustainability in HEI

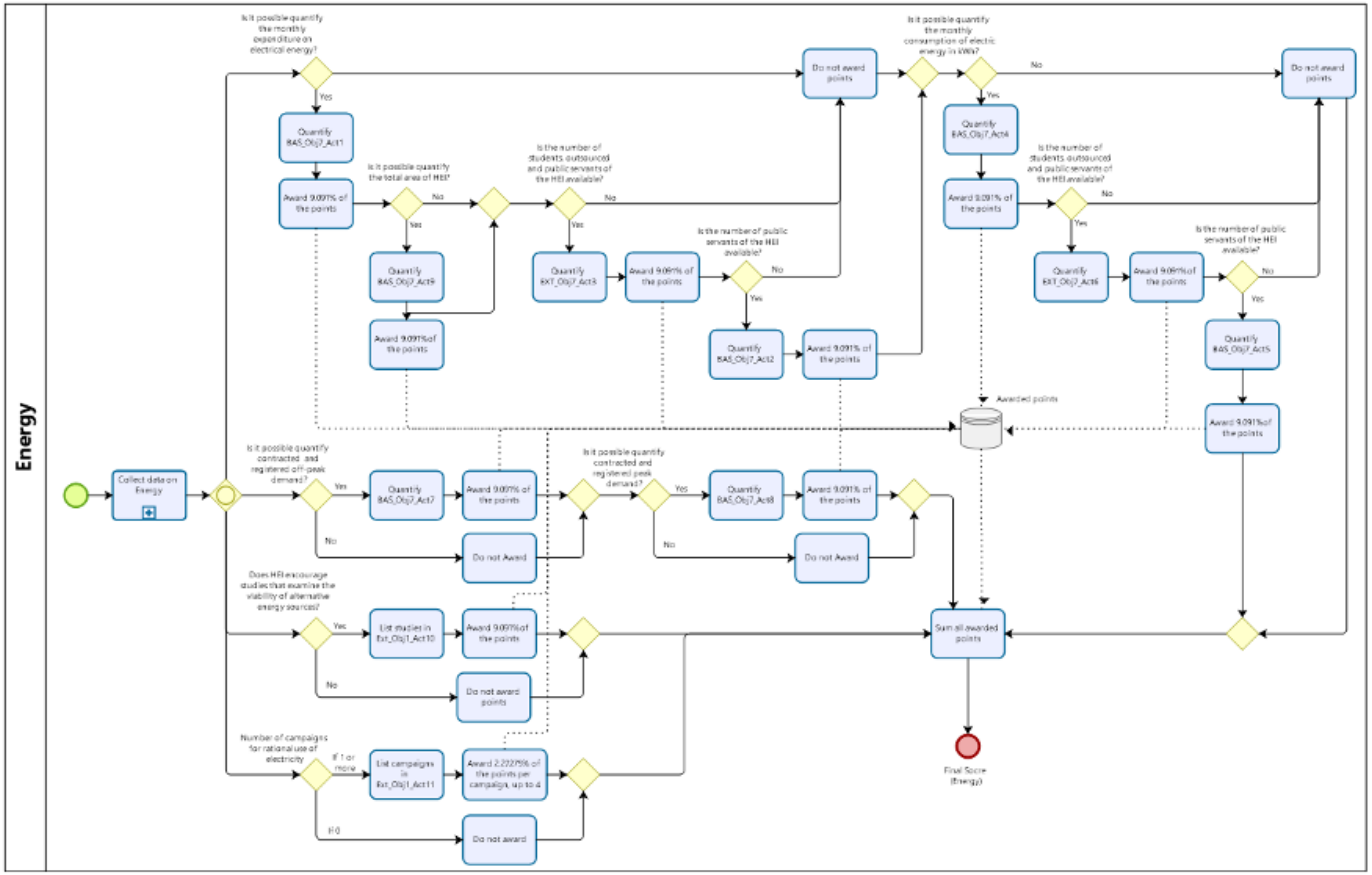
SYSTEM DESIGN - ACTION PLAN TEMPLATE.

ACTION PLAN – (NAME)													
Objective (NUMBER) – (NAME)													
Dimension 1: Quantify and monitor consumption							**TIMELINE**						
ID[a]	**Action**	**Name of indicator**	**Metric**	**Goal(Period)**	**Start**	**End**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**UC**[b]	**UI**[c]
Dimension 2: Promote the reduction of use													
Dimension 3 – SD Campaigns													

a: identification code of each action; b: Under control. Indicates the sector that is controlling the action; c: Under influence. Indicate those sectors that act as partners in the implementation of the action.

SYSTEM DESIGN - PROCESS DESIGN AND SOP

Process design using BPMN, supported by SOP



SYSTEM DESIGN - REPORTING TEMPLATE.

REPORTING ON THE ACTION PLAN ENERGY

Brief introduction explaining the elements that comprises the action plan and the institutional sectors involved in the implementations and most relevant achievements.

Table of indicators

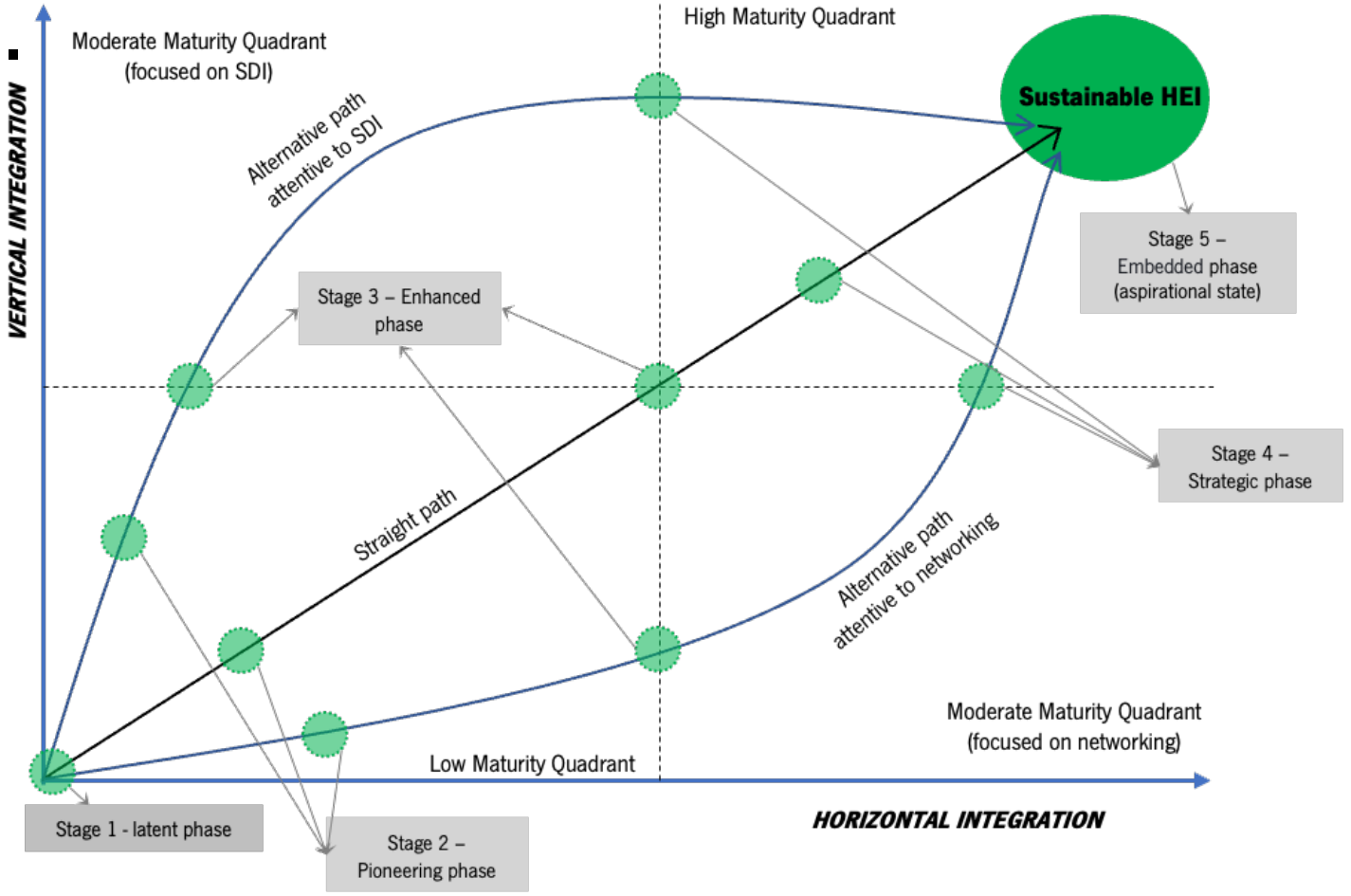
ID – Indicator / Baseline	**Months**												**Des. Stat.**		**Score**
	1	2	3	4	5	6	7	8	9	10	11	12	$\bar{x}$	σ	
BAS_Obj7_Act1 - Expenditure with energy															
BAS_Obj7_Act1 – Baseline (2017)															
BAS_Obj7_Act1 – Baseline (2018)															
BAS_Obj7_ Act2 - Electric energy consumption, in BRL R$, per capita of public servers															
BAS_Obj7_ Act2 – Baseline (2017)															
BAS_Obj7_ Act2 – Baseline (2018)															
Indicator n															
Baseline n															

- Graphic of the indicator BAS_Obj7_Act1 and baseline
- Graphic of the indicator BAS_Obj7_ Act4 and baseline

ID - Action	Status
BAS_Obj7_Act1 - To quantify the monthly expenditure, in BRL, on electrical energy	Complete/ incomplete...
Action n	

SYSTEM DESIGN - .

Holistic approach, through vertical and horizontal integration



SYSTEM FORMULATION

- The system formulation **focus on developing the mathematical model** that connects all **qualitative** and **quantitative** indicators of the framework designed to systematically integrate, implement, monitor, and report the SDI of Brazilian HEI.
- Calculates the **variation between the analysed year and a baseline**, the **normalising quantitative and qualitative indicators**, **aggregate dimensions considering their weight** and **calculate** the score of the **component** considering the sum of all the scores of the dimensions

SYSTEM FORMULATION

Relationship between value and impact		
Positive	Relationship Value vs. Impact	**Negative**
The increase in the percentage variation causes less impact (the lower, the worse)		The increase in the percentage variation causes greater impact (the lower, the better)
S_{oa}		S_{oa}
0.1	if $PV_{oa} \leq -40$	1
0.2	if $-30 \leq Pv_{oa} < -40$	0.9
0.3	if $-20 \leq Pv_{oa} < -30$	0.8
0.4	if $-10 \leq Pv_{oa} < -20$	0.7
0.5	if $0 \leq Pv_{oa} < -10$	0.6
0.6	if $0 > Pv_{oa} \geq 10$	0.5
0.7	if $10 > Pv_{oa} \geq 20$	0.4
0.8	if $20 > Pv_{oa} \geq 30$	0.3
0.9	if $20 > Pv_{oa} \geq 30$	0.2
1	if $Pv_{oa} \geq 40$	0.1

SYSTEM FORMULATION

Weights assigned to the 14 indicators and 5 model components

Distribution of dimension weights	
Component 1 - Governance/ Procurement (20)	
Dimensions	**Weight**
1.1 - Institutional Framework	20
1.2 - Material Acquisition	40
1.3 - Procurement	40
Component 2 - Outreach & on campus experience (10)	
Dimensions	**Weight**
2.1 - QLW	33.33
2.2 - Extensions programme	33.33
2.3 - Networking	33.33
Component 3 - Campus operation (30)	
Dimensions	**Weight**
3.1 - Energy	25
3.2 - Water	25
3.3 - Waste	25
3.4 - Displacement	25
Component 4 - Teaching and Research (25)	
Dimensions	**Weight**
4.1 - Teaching	50
4.2 - Research & innovation	50
Component 5 - Assessment and Reporting (15)	
Dimensions	**Weight**
5.1 - Assessment Protocol	40
5.2 - Reporting SD	60

SYSTEM ASSESSMENT AND OUTPUT

COMPONENT 1 - GOVERNANCE/ PROCUREMENT			
Dimensions	**W_d**	**$qtS_d + qlS_d$**	**Sd (Eq. 8)**
1.1 - Institutional Framework	20	1	20.000
1.2 - Material Acquisition	40	0.669	26.747
1.3 - Procurement	40	0.494	19.754
Total	**100**	**Cn (Eq. 9)**	**66.501**

COMPONENT 2 - OUTREACH & ON CAMPUS EXPERIENCE			
Dimensions	**Weight**	**Score obtained**	**Partial Score**
2.1 - QLW	33.33	0.86	28.6638
2.2 - Extensions programme	33.33	1	33.33
2.3 - Networking	33.33	1	33.33
Total	**100**	**95.324**	**90.658**

COMPONENT 3 - CAMPUS OPERATION			
Dimensions	**Weight**	**Score obtained**	**Partial Score**
3.1 - Energy	25	0.658	16.445
3.2 - Water	25	0.393	9.833
3.3 - Waste	25	0.467	11.675
3.4 - Displacement	25	0.776	19.400
Total	**100**	**2.294**	**57.353**

COMPONENT 4 - TEACHING AND RESEARCH			
Dimensions	**Weight**	**Score obtained**	**Partial Score**
Dimension 4.1 - Teaching	50	0.925	46.25
Dimension 4.2 - Research & innovation	50	1	50
Total	**100**	**1.925**	**96.25**

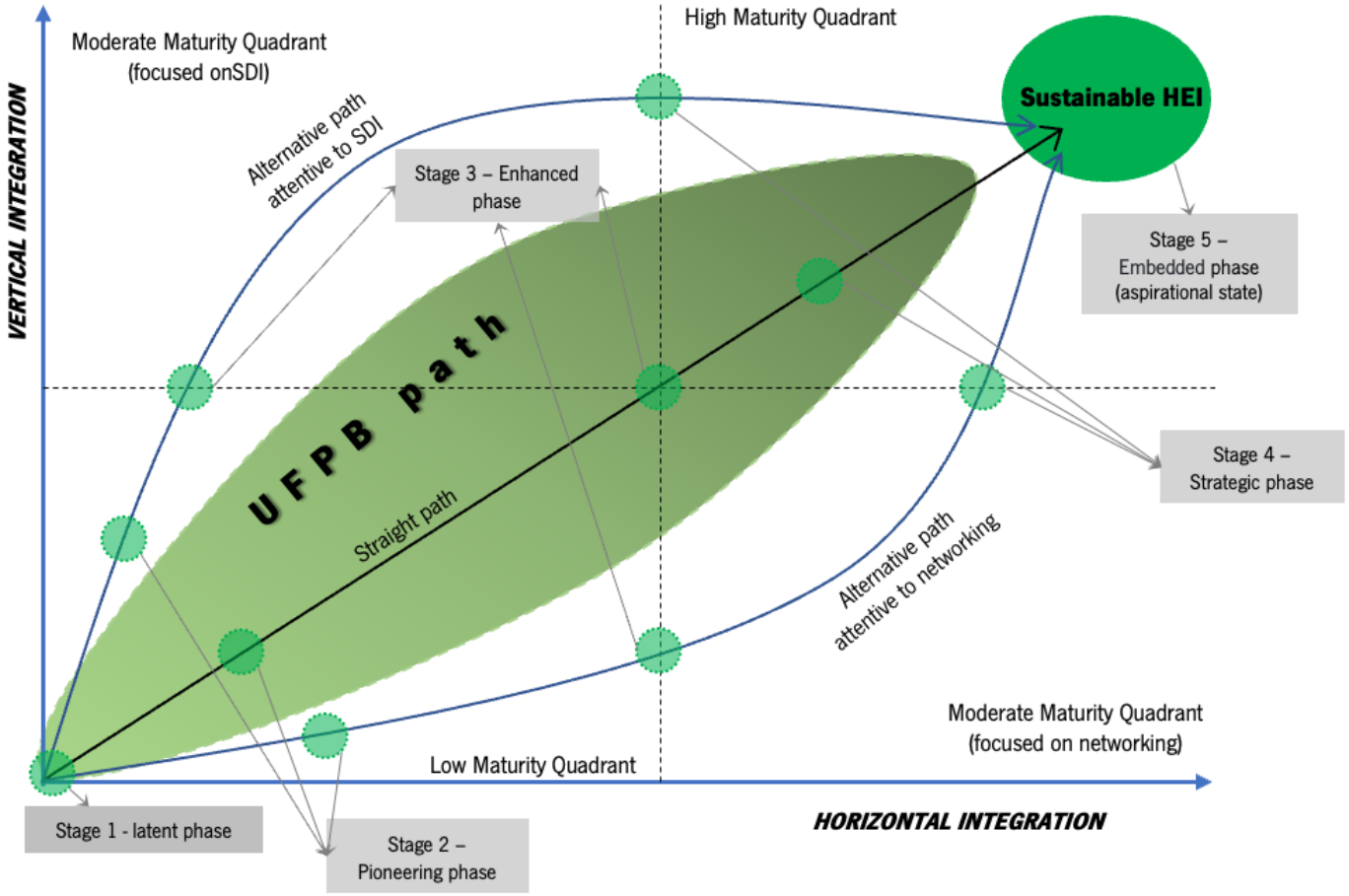
SYSTEM ASSESSMENT AND OUTPUT

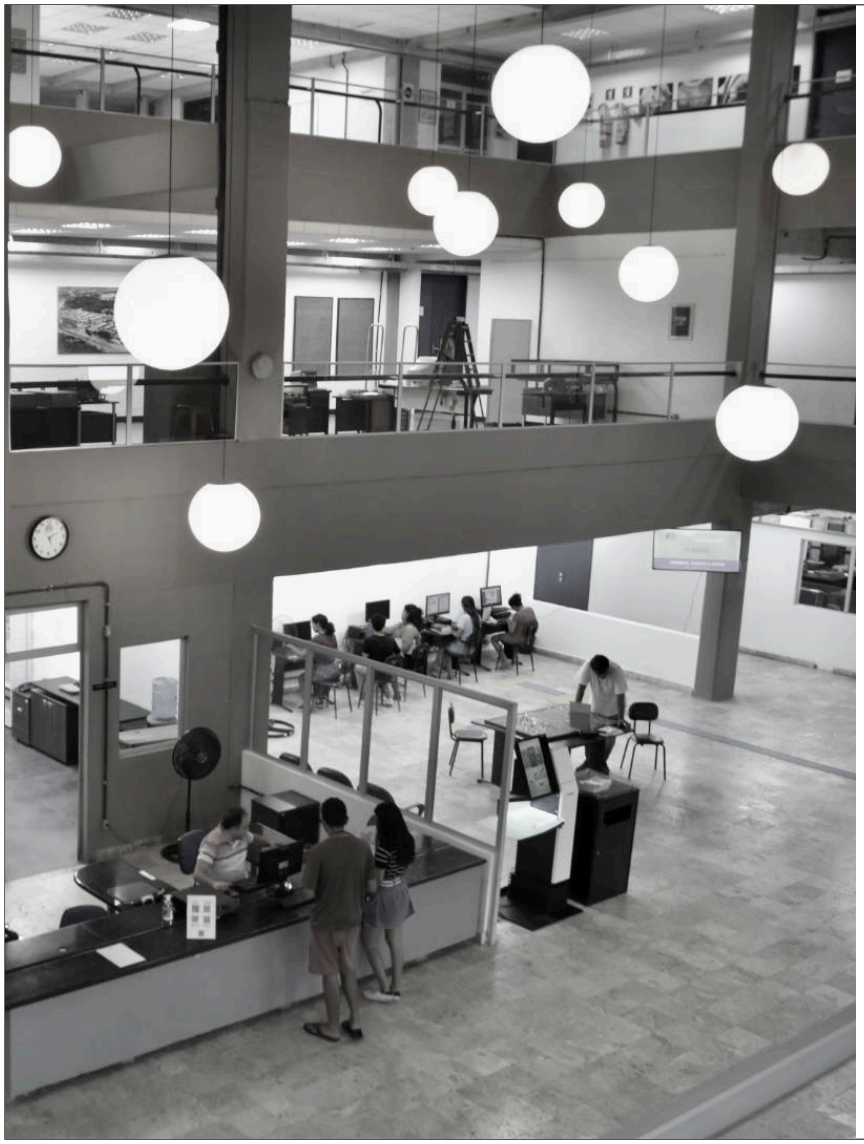
COMPONENT 5 - ASSESSMENT AND REPORTING			
Dimensions	**Weight**	**Score obtained**	**Partial Score**
5.1 - Assessment Protocol	40	1	40
5.2 - Reporting SD	60	1	60
Total	**100**	**2**	**100**

TOTAL SCORE			
Components	**Wc**	**Cn**	**Cn * Wc**
1 - Governance/ Procurement	0.20	66.501	13.300
2 - Outreach & on campus experience	0.10	95.324	9.532
3 - Campus operation	0.30	57.353	17.206
4 - Teaching and Research	0.25	96.250	24.063
5 - Assessment and Reporting	0.15	100	15.000
	TOTAL	**S (Eq. 10)**	**79.101**

FINAL RATING		
Rating	**Score**	**Overall Rating**
LATENT	Less than or equal to 24.9	**STRATEGIC (79.101)**
PIONEER	Between 25 and 39.9	
ENHANCED	Between 40 and 59.9	
STRATEGIC	Between 60 and 79.9	
EMBEDDED	Greater than or equal to 80	

SYSTEM ASSESSMENT AND OUTPUT





CONCLUSIONS

CONCLUSION

RQ1: How can a sustainable assessment framework be conceptualised given the relationship between HEI organisational strategies and the implementation of SLMPs in Brazilian federal public universities?

(a) To what extent do organisational strategic documents support the development of a SLMP in HEI?

- 74% of the analysed HEI addresses SD in their IDP; 51% have specific policies aimed at promoting SD; 71% have formal structure to address SD issues

(b) What is the current status of SLMP implementation in Brazilian federal public universities?

- The HEIs are on track regarding policies and plan, but struggling in implementing and reporting

CONCLUSION

RQ2: How can NI10, 12/11/12 be effectively operationalised in HEI to promote sustainability, considering key dimensions, actions, indicators, and integration of multiple sectors, while addressing incongruences and conflicts and aligning with international literature?

(c) What are the key dimensions, actions, and indicators required to effectively operationalise the NI10, 12/11/12 and develop a coherent and feasible structure for planning, assessing, and reporting the sustainability of HEI in an integrated manner that aligns with international literature on planning and Sustainable Assessment Tools (SAT) for promoting SDI in HEI?

- In chapters 2 and 3, a systematic literature review was conducted on commitments, and management models as well as SAT with their components, dimensions, indicators, and metrics. Finally, it was possible to realise the inability of the Cartesian approach to overcome the issues raised.

(d) What are the incongruences and conflicts of the NI10, 12/11/12, which was created with a general spectrum, when applied to HEI?

- The generalist approach of the regulation did not cover the scope of an HEI

CONCLUSION

RQ3: How a methodology for data collection and systematising can be developed to integrating different dimensions mathematically, and utilising a benchmarking approach to compare the progress of every Brazilian federal public HEI?

(e) What is the most effective and credible methodology for data collection?

- The use the government transparency portal when possible

(f) How can multiple sectors within each university be integrated into the process of developing the plan, monitoring indicators, and preparing semi-annual and annual reports?

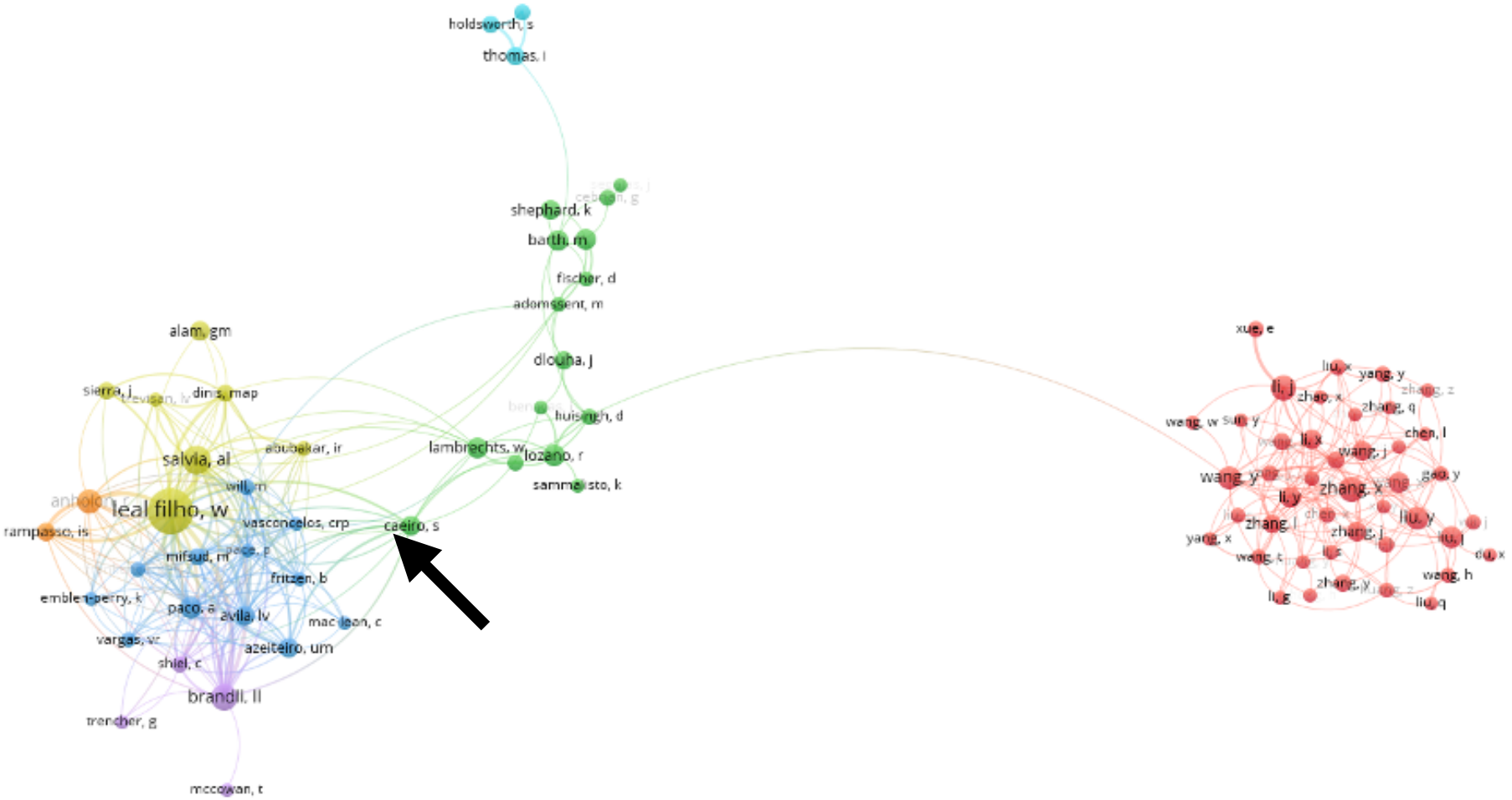
- The FIMARSHEI is a designed solution that can assist Brazilian HEIs in surpassing this issue

(g) How can different dimensions be mathematically integrated to formulate a single system?

- Through System Approach Framework and the Composite Indices Development

(h) Can a benchmarking approach be utilised to develop a system for comparing the progress of every Brazilian federal public HEI?

- The FIMARSHEI was designed and tested to be applied in a typical case of Brazilian federal HEI.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barth, m
fischer, d
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huisingh, d
lambrechts, w
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sammalisto, k
alam, gm
sierra, j
dinis, map
salvia, al
eboubekar, ir
leal filho, w
will, m
vasconcelos, crp
caeiro, s
rampasso, is
mifsud, m
fritzen, b
emblen-perry, k
paco, a
avila, lv
mac lean, c
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li, g
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