São Paulo - Brazil - May - 20th to 22nd - 2015

5th Academic

INTERNATIONAL WORKSHOP
ADVANCES IN CLEANER PRODUCTION

''CLEANER PRODUCTION TOWARDS A SUSTAINABLE TRANSITION''

CONCEPTUAL FRAMEWORK, PRINCIPLES AND GUIDELINES FOR SELECTION AND DEFINITION OF SUSTAINABILITY INDICATORS: AN STUDY APPLIED AT ECOINNOVATION IN SMARTPARKS PROJECT (SPAIN AND BRAZIL)

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CAPES

ECOINNOVATION IN SMARTPARKS PROJECT

ECOINOVAÇÃO EM SMARTPARKS:

Análises de Metodologias e Estratégias Sustentáveis para promover a Simbiose Industrial, Urbana e Agrícola no Brasil e na Espanha.

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GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

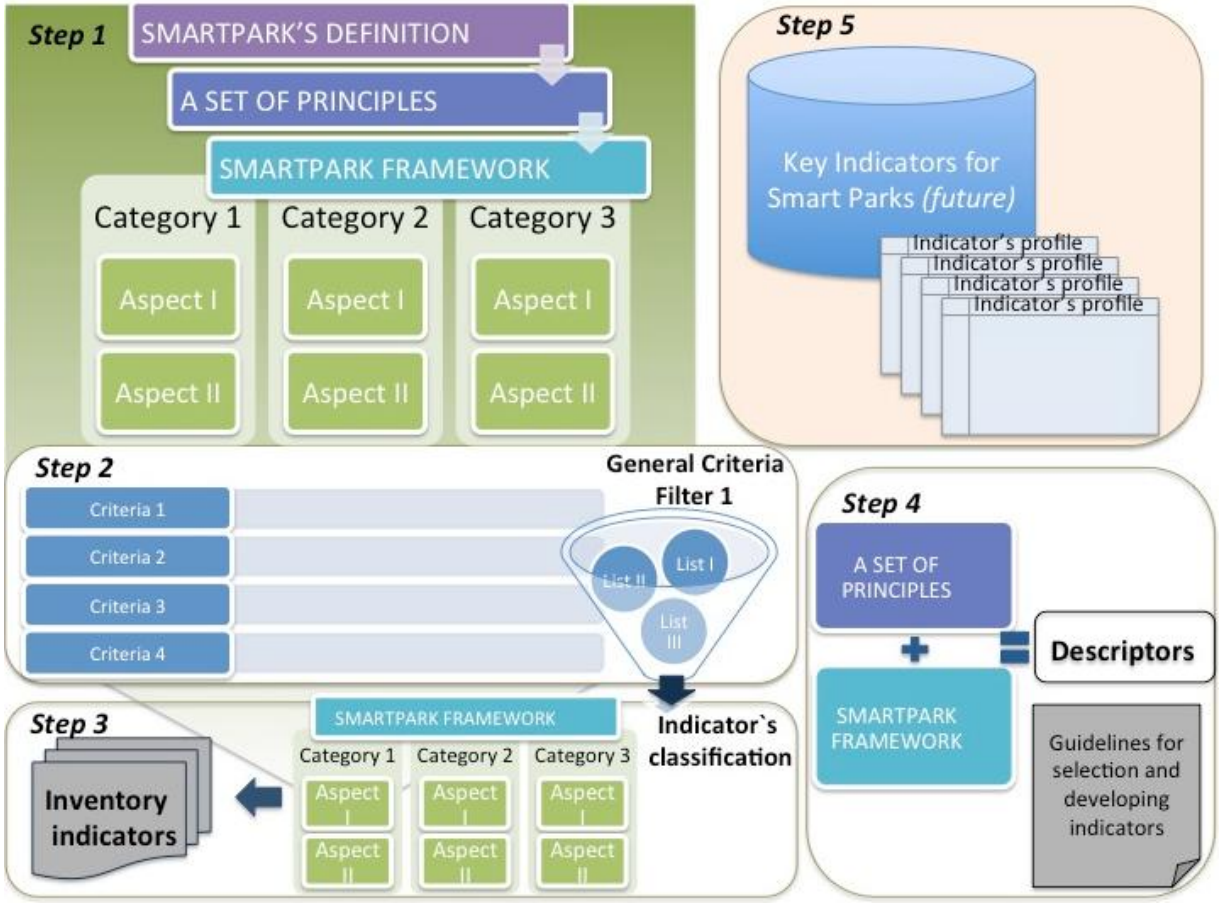
GOBIERNO DE ESPAÑA
MINISTERIO DE EDUCACIÓN, CULTURA Y DEPORTE

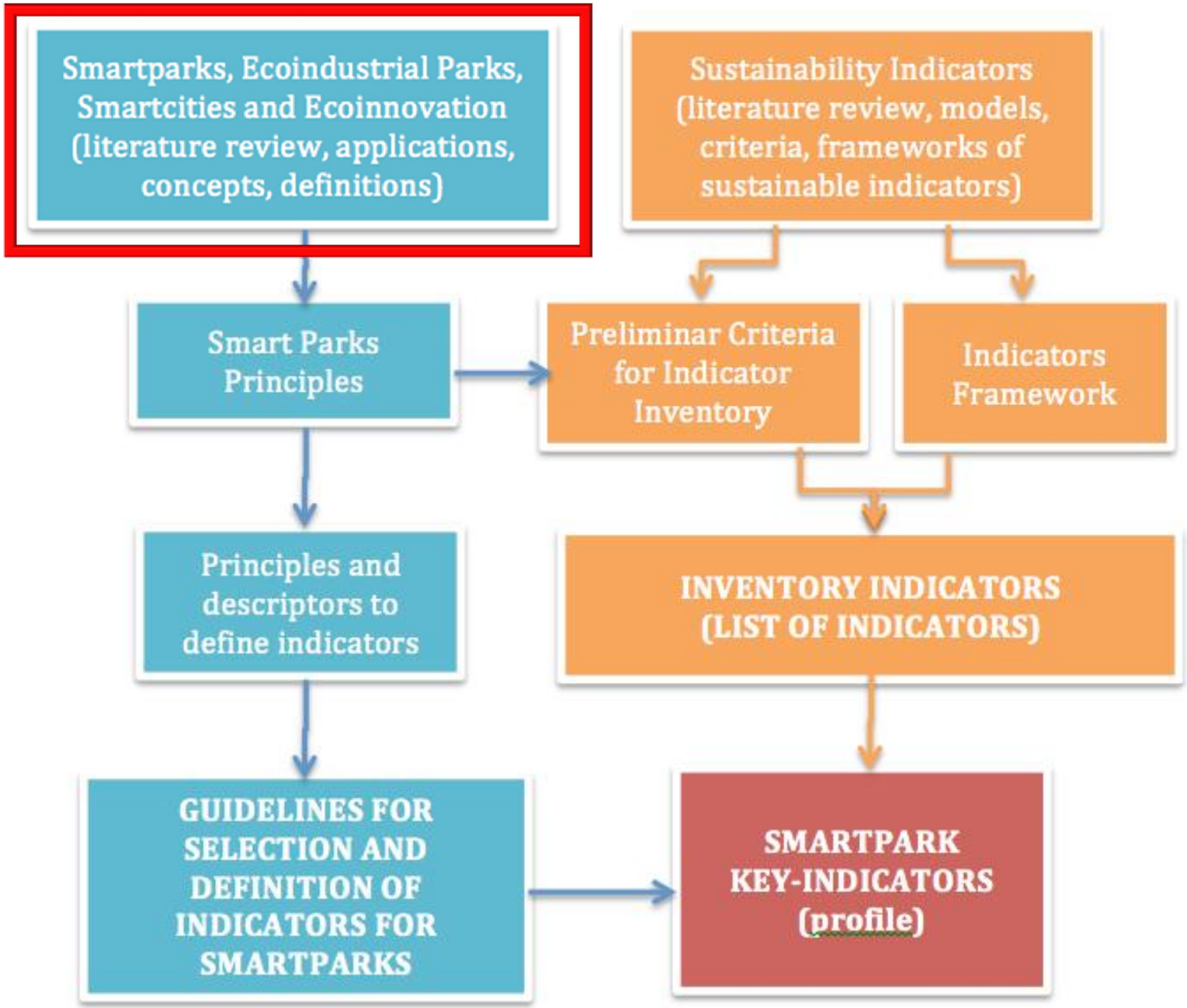
OBJECTIVE OF THE RESEARCH

To study **approaches and principles** for Smartparks conception, as well **models, criteria and frameworks of sustainable indicators**, in order to define and to stablish a **Indicators framework for Smartparks application**



STEPS - PROCEDURES

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Principles and descriptors to define indicators
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GUIDELINES FOR SELECTION AND DEFINITION OF INDICATORS FOR SMARTPARKS
SMARTPARK KEY-INDICATORS (profile)

SMARTPARK AND ECOINNOVATION (DEFINITIONS – Felicio et al., 2014)

Felicio et al., (2014)

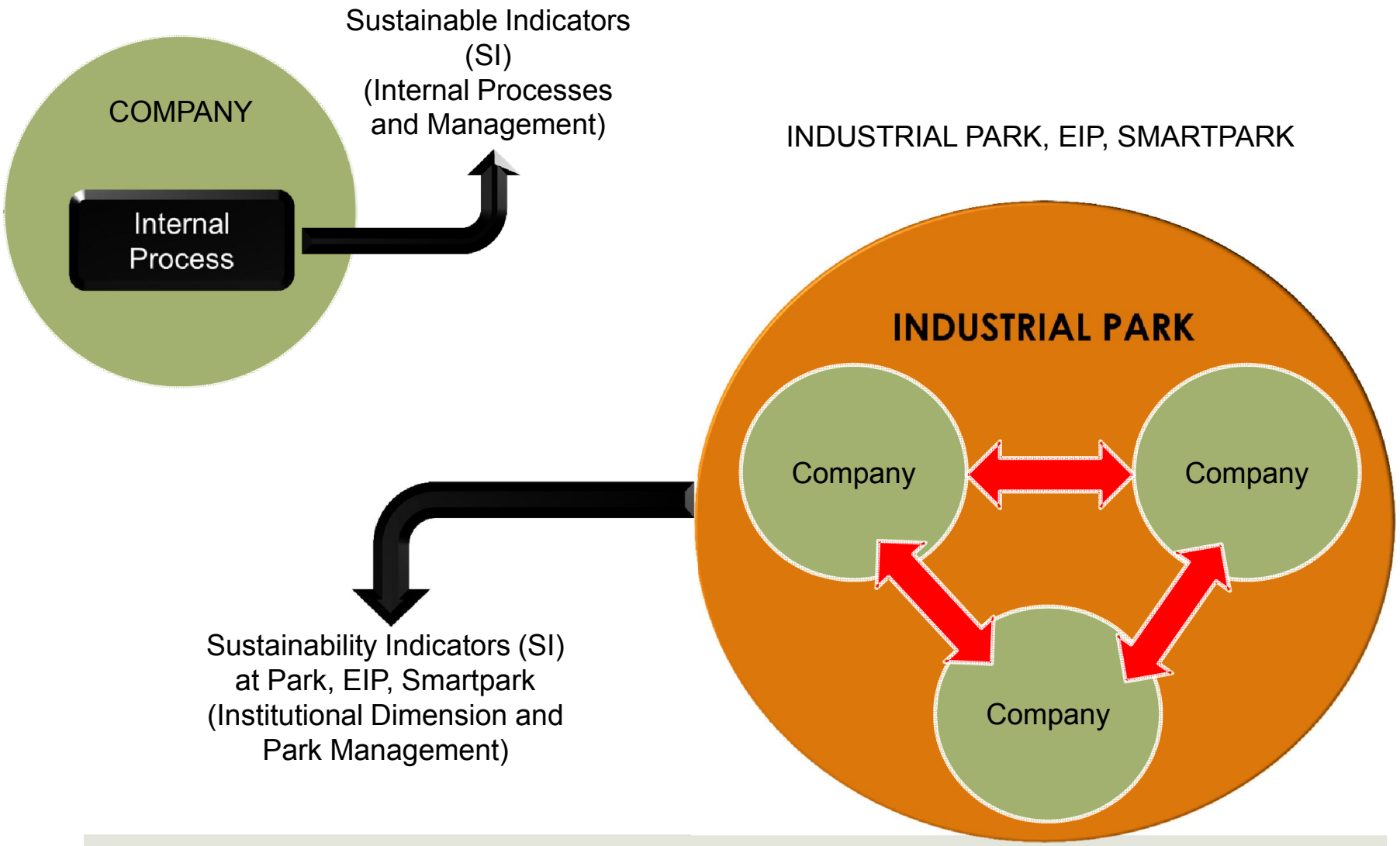
SMARTPARK AND ECOINNOVATION (DEFINITIONS)

Smart Park is a space, not necessarily with defined territory, formed by industries, organizations, businesses and services integrated by collaborative and sustainable manner, **sharing knowledge, services, energy, materials and water through monitoring and automatic control based on information and communication technology seeking social, economic and environmental performance** in order to achieve greater local and regional systemic efficiency in the urban, agricultural and industrial context (Felicio et al., 2014).

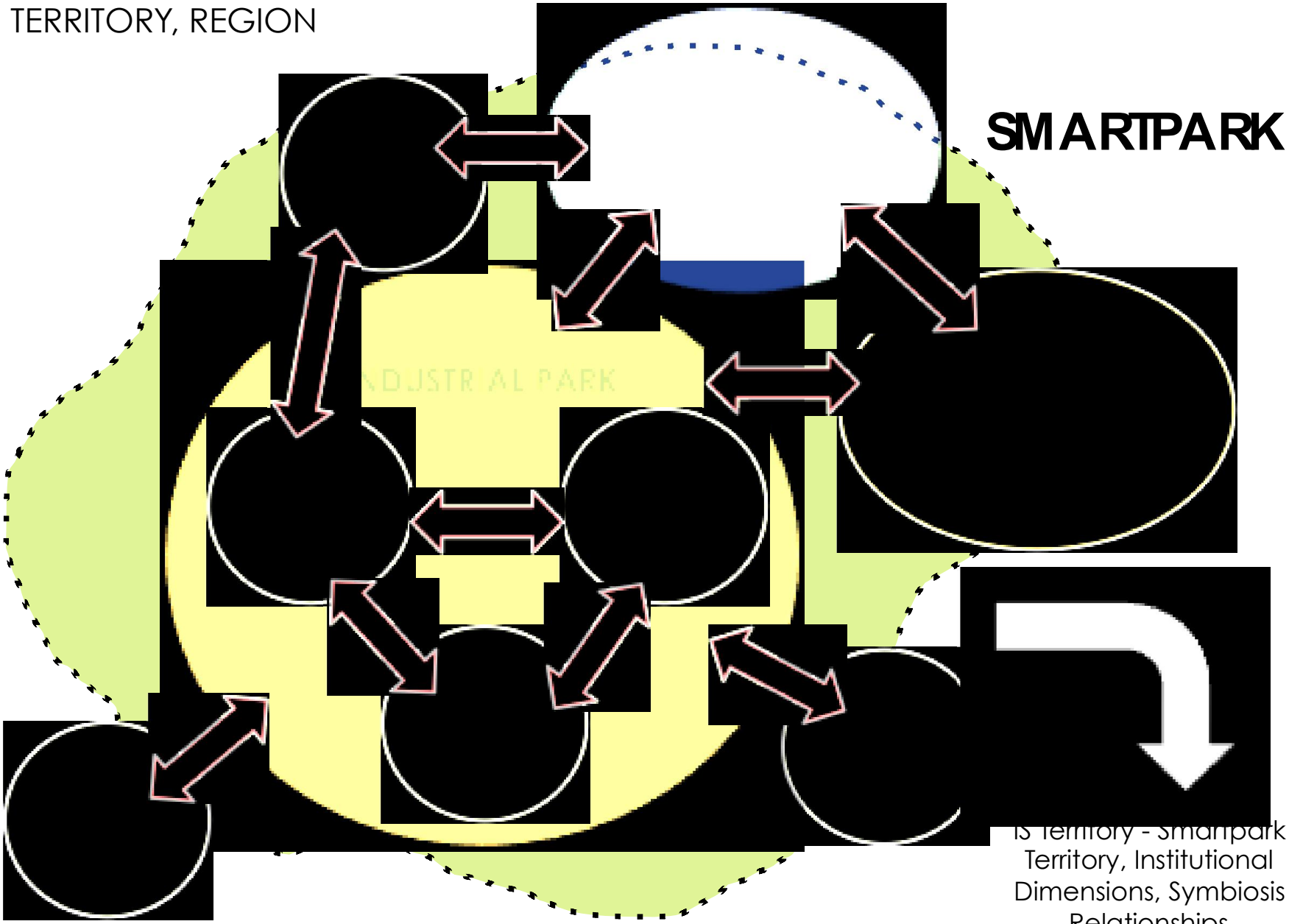
Eco-innovation can be understood as the **creation, development, assimilation, and dissemination of new or significantly improved business processes, products, technologies, business model and institutional structures** in a competitive way, which are developed by firms and industrial parks, governements or non-profit organizations **aiming to improve eco-eficiency (reduce costs and improve enviromental performance)** in order to satisfy human needs and provide a better quality of life for everyone (Felicio et al., 2014).

SPATIAL SCALES

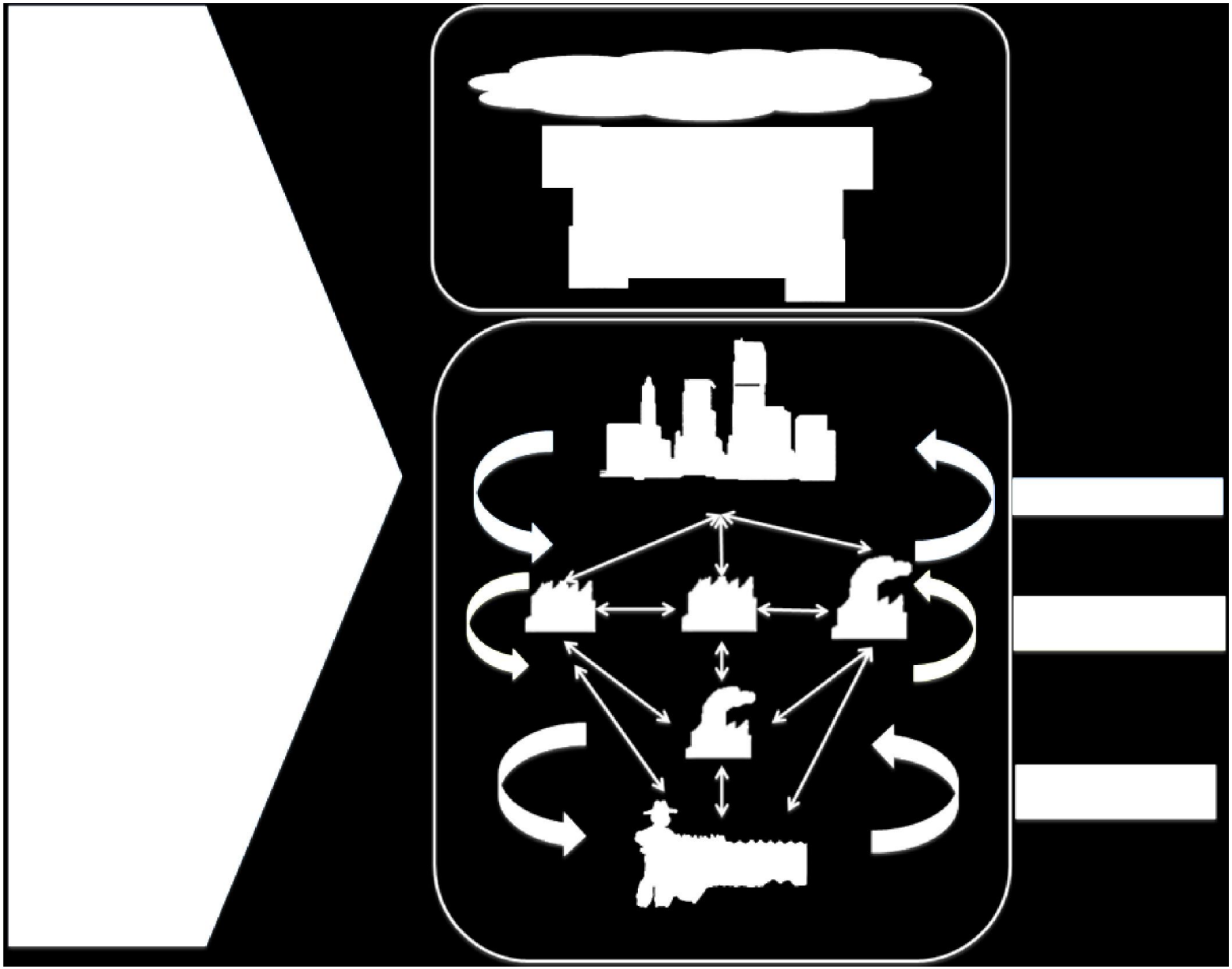
UNIT PRODUCTION, COMPANY, INDUSTRY



TERRITORY, REGION



IS Territory - Smartpark Territory, Institutional Dimensions, Symbiosis Relationships



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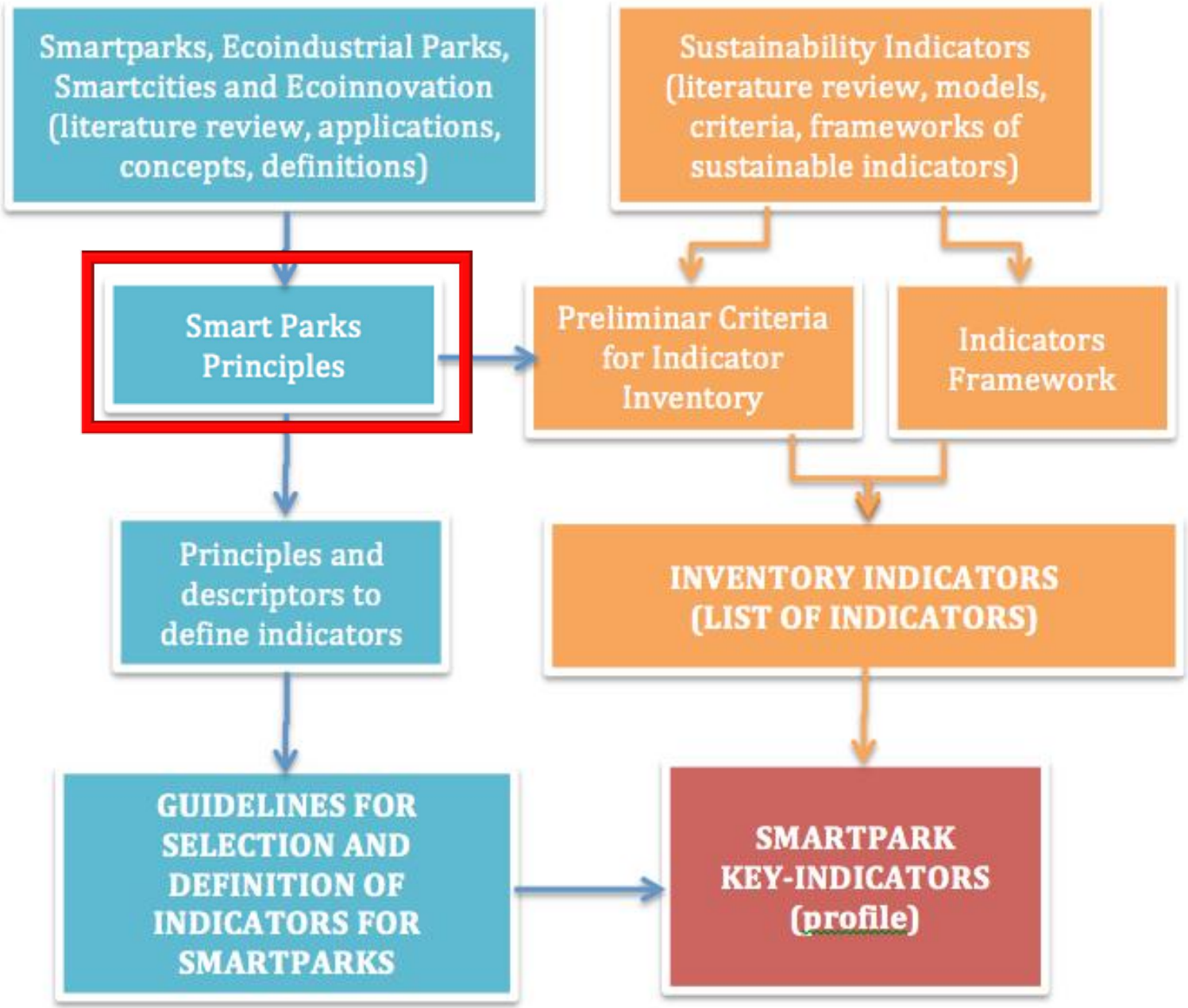
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PRINCIPLES FOR SMARTPARKS CONCEPTION

PRINCIPLE 1
COLLABORATION - COOPERATION

Collaboration and cooperation between companies and between Smartpark and sorrounding region on the exchange of energy, resources, common materials buying, water and usable by-products, recovered materials, wastes, energy . Link, network, mix or cluster of companies with generators, suppliers and customers at market-driven actions. Trust, commitment and proximity between companies, communities

PRINCIPLE 2
SHARING - COLLECTIVE USE

Sharing and collective use of infraestructures and equipments, support services and facilities (training center, office for purchasing common supplies, transportation logistics office). Sharing and collective use of resources and materials. Sharing and collective use of technologies and environmental data and informations. Joint use of firm functions and sharing network construction

PRINCIPLE 3
SINERGIES – SYMBIOSIS - INTERACTIONS

Strong sinergies, symbiosis, interactions and linkage to surrounding communities through economic development, social and environmental programs

PRINCIPLE 4
INNOVATION – TECHNOLOGY AUTOMATED SYSTEMS

Automated systems, infraestructures, equipments and sensors linked to computers to monitor and to control efficiency on water, waste disposal, energy generation, services, transports, access, security. Innovated product designs and new technologies on production

PRINCIPLE 5
EFFICIENCY – OPTIMIZATION – HIGH PERFORMANCE

High performance of efficiency in use and reuse of resources (materials, water, energy). Redesign processes to reduce energy, materials, resources and water usage. Generation and use of renewable energy and maximize high level of energy efficiency through facilities, equipments designs (co-generation, cascading, connections, inter-plant energy flows). Optimize the production process with resource exchanges, reuse and recycling networks (highly effective regional by-product exchange, market of materials, waste management, resource recovery systems, recycling and remanufacturing)

PRINCIPLE 6
CLEANER PRODUCTION – ENVIRONMENTAL PERFORMANCE

Emphasize cleaner production, improve the environmental performance and pollution prevention. Use of durable materials. Minimize waste generation, reduction of total waste stream (residential, commercial, public, and industrial). Define potential wastes products markets. Design collective gathering, integrated treatment plant and processing facilities of wastes. Avoid, substitution and reduce of toxic materials and hazardous substances (strict control of emissions, separation of by-product, residual materials) and reducing the quantity and toxicity of all emissions and wastes

PRINCIPLE 7
LOGÍSTICS - INTEGRATION

Integrated logistics engineering and management (products, materials and people transportation, designing routes, processes, infraestructures, equipments, public utilities with useful effects)

PRINCIPLE 8
QUALITY OF LIFE – HUMAN HEALTH – LOCAL DEVELOPMENT

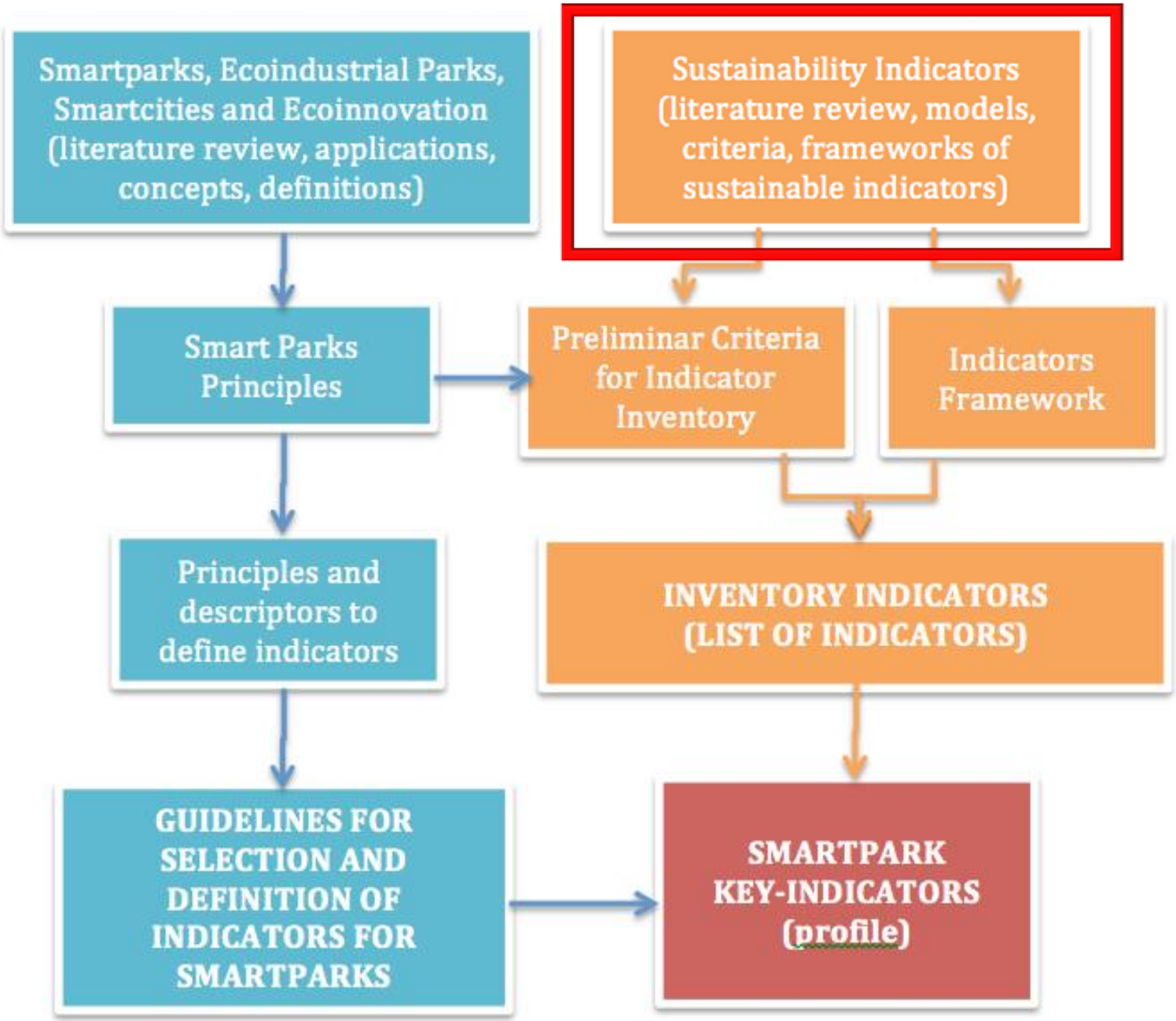
Enhancement of quality of life, human health and economic development in neighboring communities (projects and programs envolving industry, wellness programs, local government and community-based organizations). Increased occupant productivity/ satisfaction

PRINCIPLE 9
SUSTAINABLE DESIGN – INTEGRATED PLANNING

Sustainable Design and Integrated Planning for more adequate use of space (based on ecological carrying capacity, avaiable resources, communities interests, regional development plan, renewal and restoration of natural systems for biodiversity)

PRINCIPLE 10
PARTICIPATION –COMMUNITY INVOLVEMENT

Define the community interests and involve the community in the design and of development of the Smartpark. Create training and education programs, events (workshops, conferences, dissemination), community business development, building of employee housing, and collaborative urban planning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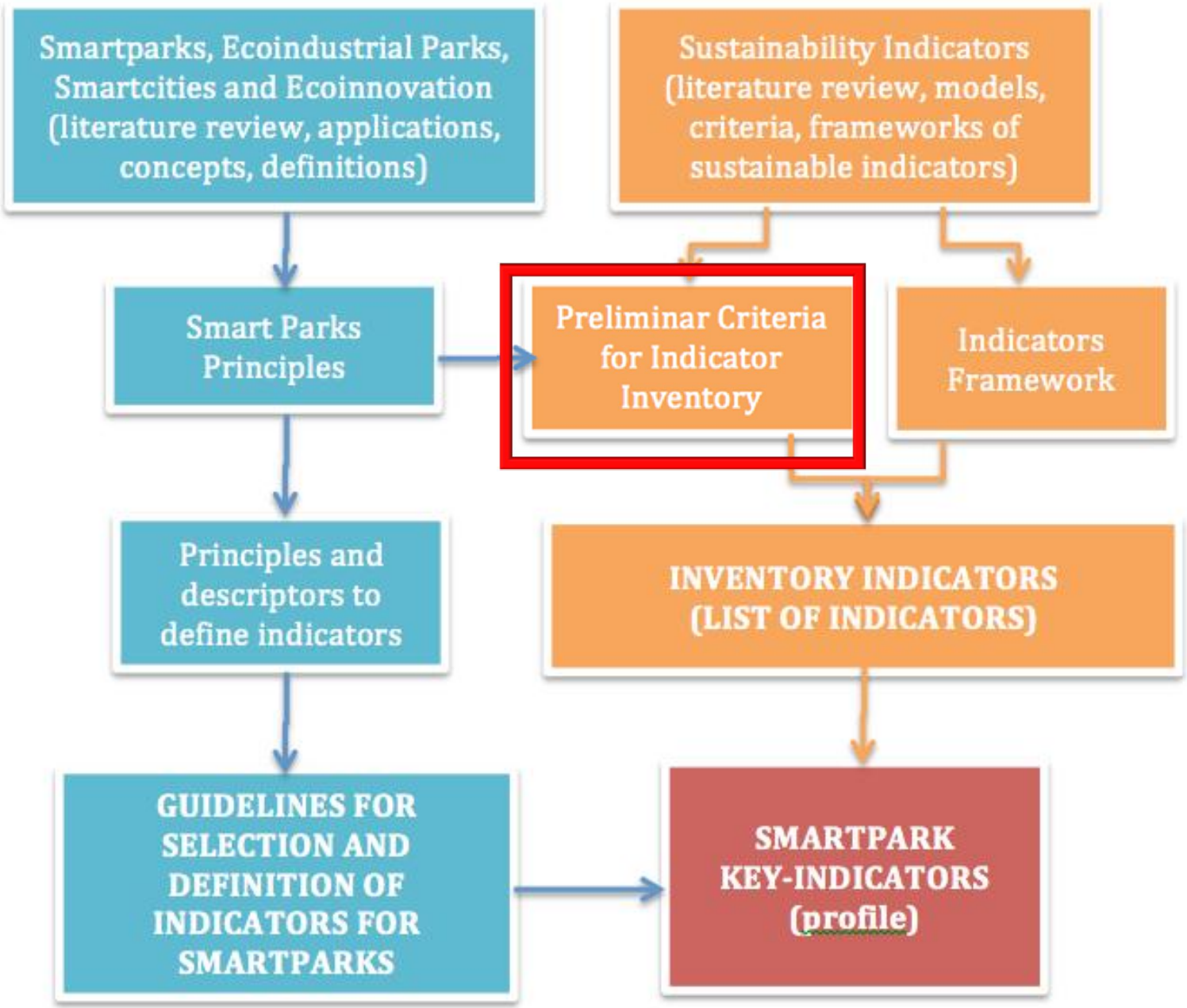
INDICATORS

Indicators identify the relevant characteristics of a system and clarify the complex relationships between different variables involved in a particular phenomenon, making it visible or noticeable in order to communicate its contained information, as well as to verify the desirable situations achievement and to identify the trends throughout time.

IMPORTANCE OF SUSTAINABILITY INDICATORS FOR SMARTPARKS

- SMARTPARKS require indicators that are **appropriate for addressing sustainability** from the perspective of Eco-innovation
- The insufficiency or even the absence of **indicators in comprehensive scales** that consider the planning and management of SMARTPARKS, and incorporate the **various relations of symbiosis and practical approaches and applied sustainability**
- There is a need **to bridge the gap between the indicators already developed for the scale of production processes and indicators of the relationship of symbiosis, eco-innovation and sustainability** in environmental planning and management in SMARTPARKS.

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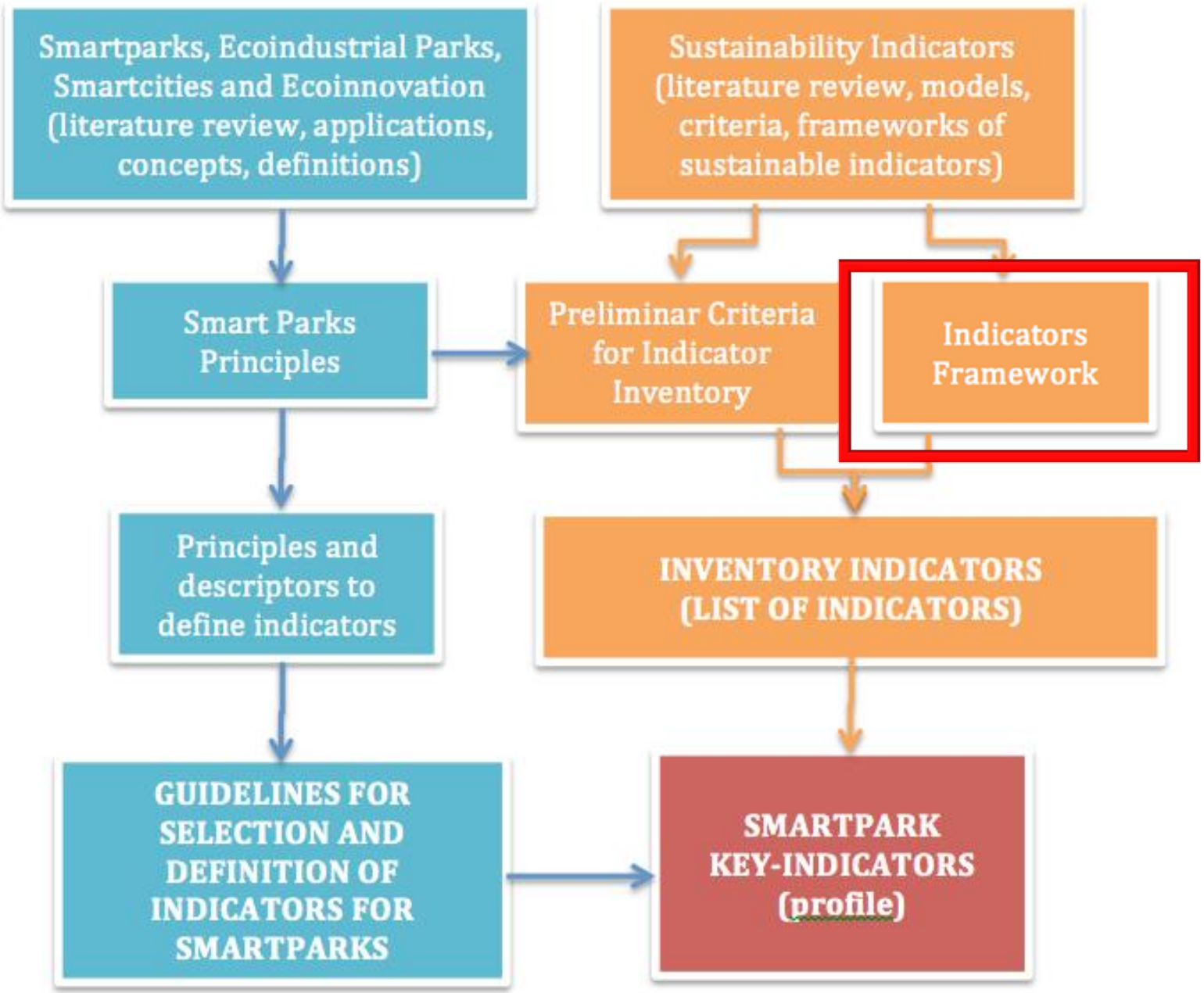
PRELIMINAR CRITERIA FOR INDICATOR INVENTORY

- Checking the indicator definition
- Possibility of application on SmartPark context
- Relevance for SmartPark planning, operation and management
- Possibility of control by SmartPark manager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INDICATORS FOR ECO-INNOVATION IN SMARTPARKS

- **Smartpark Infrastructure and Services** → **Planning Indicators**
- **Smartpark Activities and Operation** → **Monitoring Indicators**
- **Smartpark Interactions and Symbiosis** → **Management Indicators**

Smartpark Infrastructure and Services (Planning Indicators)

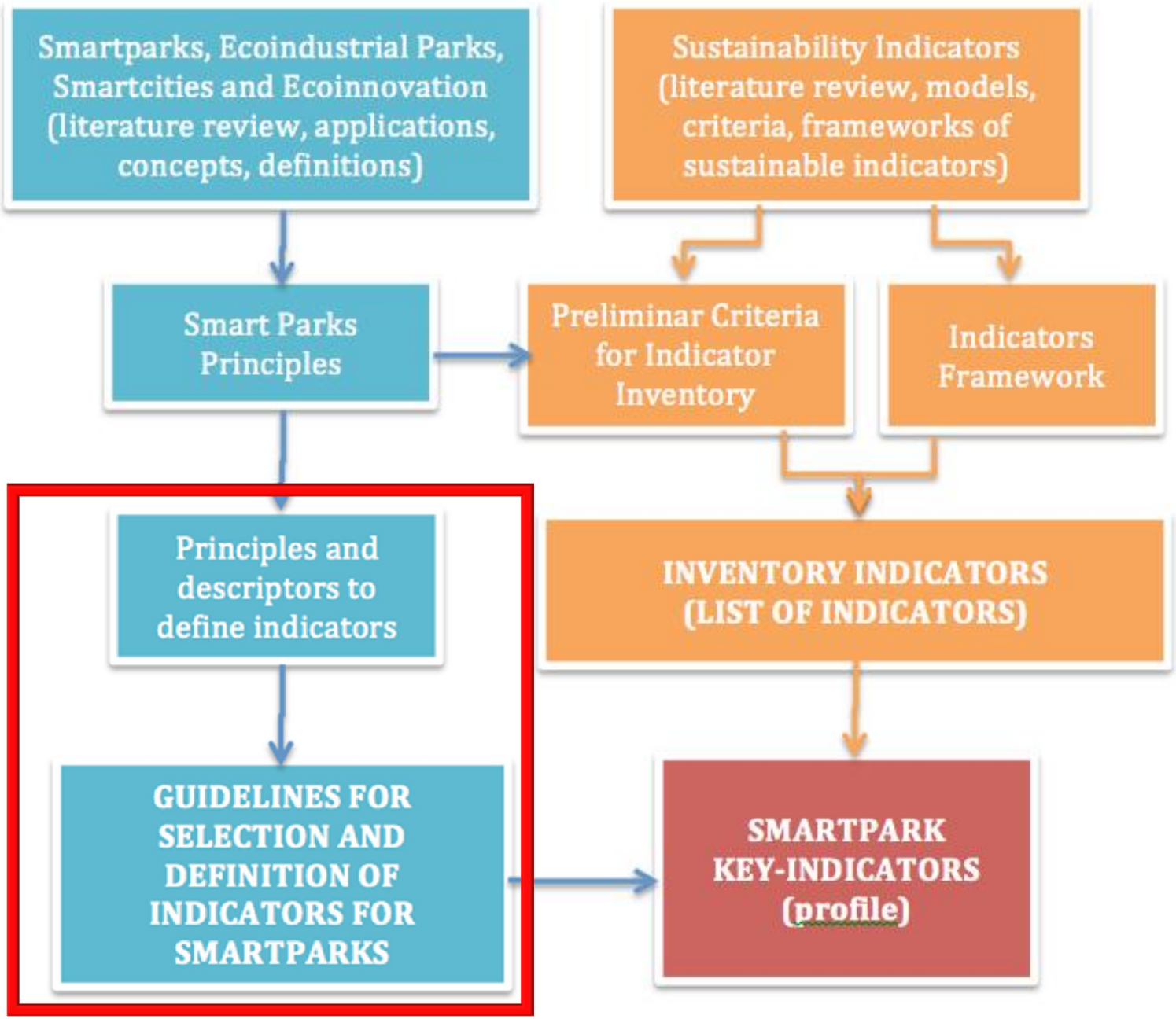
- I1 - infrastructure and transport services, mobility and accessibility (people, materials and products)
- I2 - infrastructure and communication services (telecommunications, networking, technology information)
- I3 - infrastructure and energy supply services (electric, fossil fuels, solar, wind)
- I4 - infrastructure and water supply services, wastewater and stormwater
- I5 - infrastructure and solid waste services
- I6 - facilities, public infrastructure, services and collective areas (green areas, reserves, community centers, events, catering, health, leisure, cultural, sports, security, library, bank, vehicle maintenance, shops, agencies)
- I7 - use, territory occupation and functional area (land, buildings, built-up area)
- I8 - infrastructure and housing and hosting services

Smartpark Activities and Operation (Monitoring Indicators)

- M1 - monitoring of water resources (use and water consumption)
- M2 - monitoring of energy resources (use and energy consumption)
- M3 - monitoring of material resources (use and consumption of inputs and raw materials)
- M4 – monitoring of industrial waste
- M5 – monitoring of urban waste
- M6 - monitoring of gases emissions
- M7 – monitoring of social aspects (quality of life, employment, working conditions, learning)
- M8 - monitoring of economic and financial aspects - business and incomes
- M9 - monitoring economic aspects of local development

Smartpark Interactions and Symbiosis (Management Indicators)

- G1 - synergies interactions (symbiosis)
- G2 - management and territorial integration (cultural, internal and surroundings) (participation, involvement and representation)
- G3 - management and administration (people, security, social programs, communication, information systems)
- G4 - interactions with physical environmental systems (landscapes, habitats, atmosphere, climate, geological structure)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DESCRIPTORS

To select and to define indicators for Smartparks

I1 – TRANSPORT INFRASTRUCTURES, SERVICES, MOBILITY AND ACCESSIBILITY

I1 **Transport infrastructures, services, mobility and accessibility**	Descriptors to select and to define indicators for Smartparks: • Cooperation, integration, combination and sharing of transport means of people, materials and products • Automatization and technological innovation in pathways and transport systems (innovation and alternative transport systems, electric vehicles, permeable pavements, cycle paths, alternative transportation services such as bicycle storage, alternative fuel refueling stations) • Integrated logistics, routes optimization and efficiency on transport systems of products, materials and people (accessibility) • Multimodal integration of local public transport • Environmental impacts (direct and indirect) reduction in transport systems and services (fuel consumption reduction, energy, gas emissions, wastes, contaminants, packaging reduction on materials and products transportation, packaging reuse for the transport of products)

I3 - ENERGY INFRASTRUCTURES AND SERVICES

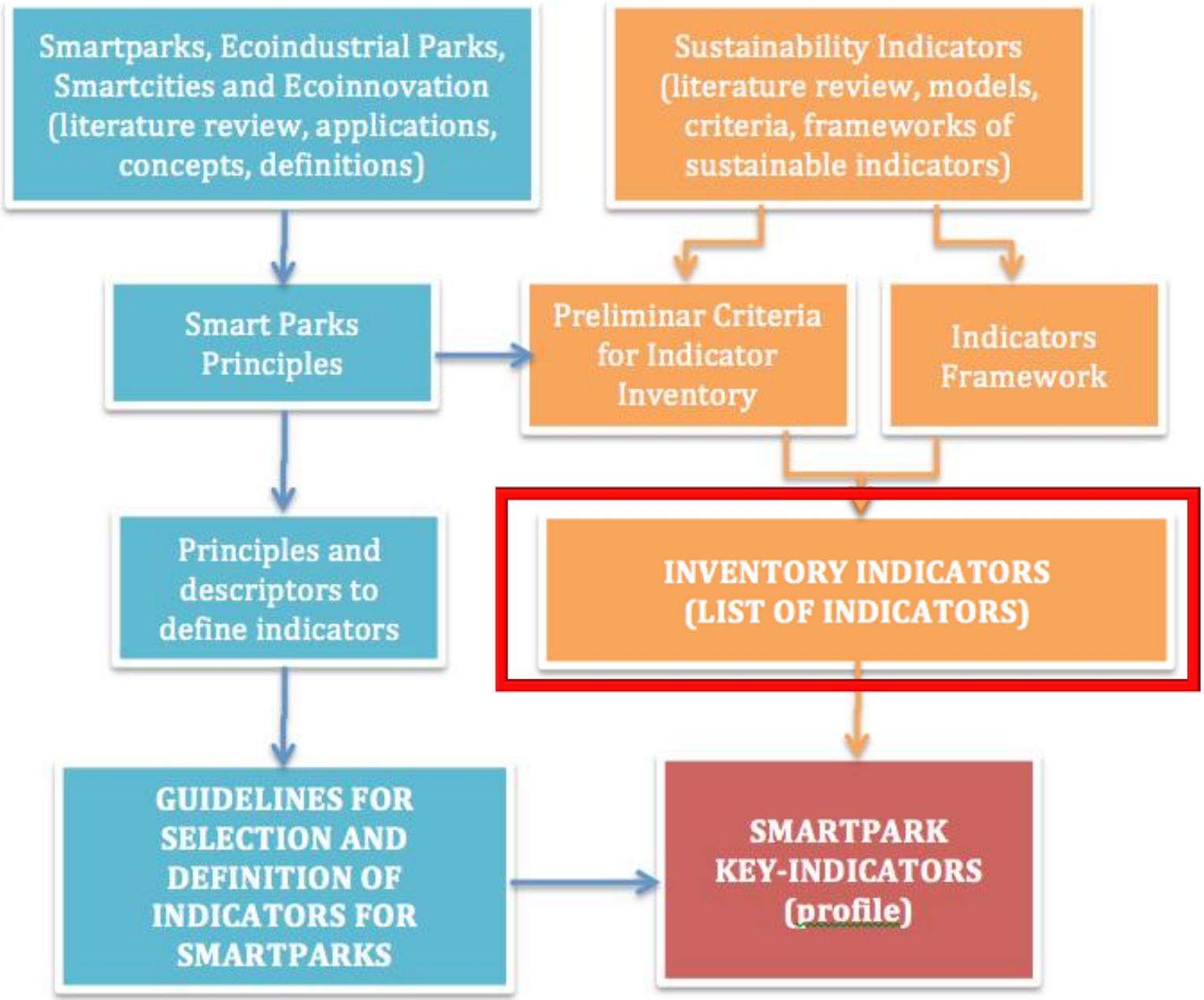
I3 **Energy infrastructures and services**	Descriptors to select and to define indicators for Smartparks: • Energy cooperation, integration and sharing (integrated networks, energy flows) • Self-sufficiency, energy cogeneration, cascading energy and energy rehabilitation (co-generation: capturing and using of otherwise "wasted" heat from the electrical generating process. Energy cascading: use of residual heat in liquids or steam from a primary process to provide heating or cooling to a later process). Effective use of insulating materials, glazing. On-site energy generation. • Automatization, control and technological innovation in energy production and consumption (alternative systems of energy production, energy efficiency controllers systems, automatically switch on and off occupancy sensors) • Optimization and efficiency of energy production and distribution systems (energy efficiency in buildings, passive solar and daylighting features, efficient equipments and lightings) • Integration with public energy systems and power supply network (inter-plant energy flows) • Minimizing (direct and indirect) impacts on energy generation and consumption. Generation and use of renewable energy (solar, wind, biomass and wastes energies). Maximize high level of energy efficiency through facilities, equipments designs. Maximize percent of daylight spaces. maximize ventilation performance.

M1 – WATER MONITORING

M1 **Water monitoring**	Descriptors to select and to define indicators for Smartparks: • Integrated systems for water monitoring • Automated systems, sensors linked to computers, infraestructures, equipments, support services and facilities to monitor and to control efficiency on water management • Monitoring the water consumption and water quality for improvement on environmental performance and pollution prevention. • Monitoring the exchanges, reuse and recycling of water. • Collaboration, sharing, cooperation on the exchange of data and informations about water. • Sinergies, interactions and linkage with regional programs of water monitoring • Monitoring the avaiability and natural systems of water at sorrounding territory

M4 – INDUSTRIAL WASTE MONITORING

M4 **Industrial waste monitoring**	Descriptors to select and to define indicators for Smartparks: • Integrated systems for industrial wastes monitoring • Automated systems, sensors linked to computers, infraestructures, equipments, support services and facilities to monitor and to control the industrial wastes • Monitoring the industrial wastes generation for pollution prevention and reduction of wastes • Monitoring the exchanges, recycling and treatment of industrial wastes • Collaboration, sharing and cooperation to provide industrial wastes data and informations • Sinergies, interactions, linkage and exchange of industrial wastes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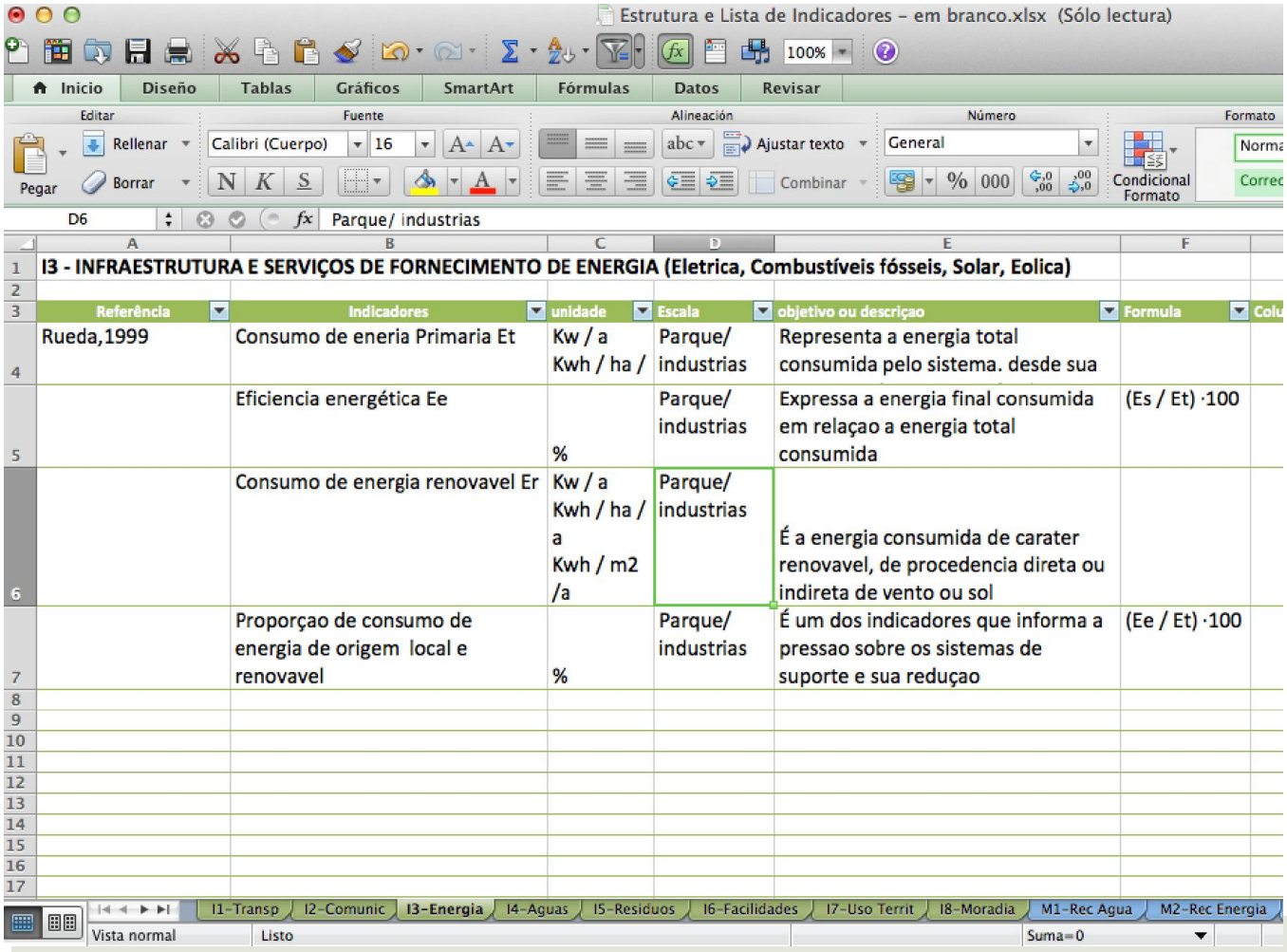
ID	Name	Number of indicators	Number of indicators after F1	Context of application	Scale	Methodology	Reference
1	Indicators of sustainability	555		Product Lifecycle Management (PLM)	Enterprise	Literature review	NAPPI, V (2014)
2	Indicators of sustainability	246	222	UAB – Universitat Autonoma de Barcelona	University	L'Institut de Ciència i Tecnologia Ambientals (**ICTA**)	André (UAB)
3	Performance Indicators system	133 indicators (9 systems)	108	Eco-Industrial Parks	Park	Systematic Literature Review	Developed by authors
4	List of factors and indicators in Smart City	74	21	Smart City	City	Literature review	Centre of Regional Science, Vienna UT(2007)
5	Modelos e Indicadores para ciudades más sostenibles	18	10	Cataluña cities	City	L'Institut de Ciència i Tecnologia Ambientals (**ICTA**)	Rueda,1999
6	Sustainable development indicators system - SIDS	132	68	Sustainable Performance of a country (Portugal)	Country	Literature review	Direção geral do meio ambiente(www.dga.min-amb.pt) (2000)
7	IBGE indicators	40		SDS	Country	Literature review	IBGE
8	Análisis global y comparativo del sistema de indicadores ambientales de las universidades españolas	98	23	University	Country/ University	L'Institut de Ciència i Tecnologia Ambientals (**ICTA**)	UAB,2000

EXCEL – INDICATORS INVENTORY



Estrutura e Lista de Indicadores – em branco.xlsx (Sólo lectura)

Inicio | Diseño | Tablas | Gráficos | SmartArt | Fórmulas | Datos | Revisar

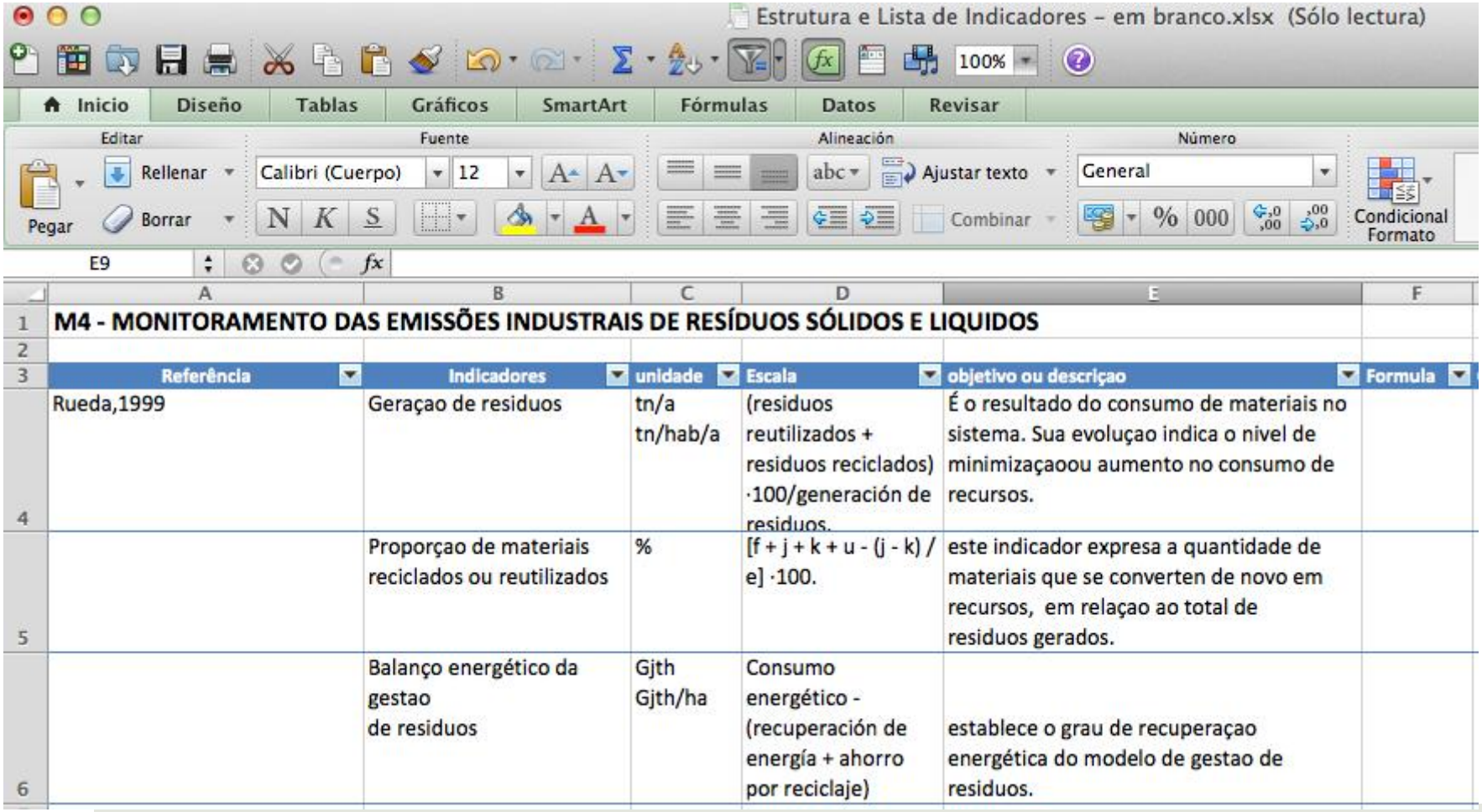
D6: Parque/ industrias

	A	B	C	D	E	F
1	**I3 - INFRAESTRUTURA E SERVIÇOS DE FORNECIMENTO DE ENERGIA (Eletrica, Combustíveis fósseis, Solar, Eolica)**					
2						
3	**Referência**	**Indicadores**	**unidade**	**Escala**	**objetivo ou descriçao**	**Formula**
4	Rueda,1999	Consumo de eneria Primaria Et	Kw / a Kwh / ha /	Parque/ industrias	Representa a energia total consumida pelo sistema. desde sua	
5		Eficiencia energética Ee	%	Parque/ industrias	Expressa a energia final consumida em relaçao a energia total consumida	(Es / Et) ·100
6		Consumo de energia renovavel Er	Kw / a Kwh / ha / a Kwh / m2 /a	Parque/ industrias	É a energia consumida de carater renovavel, de procedencia direta ou indireta de vento ou sol	
7		Proporçao de consumo de energia de origem local e renovavel	%	Parque/ industrias	É um dos indicadores que informa a pressao sobre os sistemas de suporte e sua reduçao	(Ee / Et) ·100

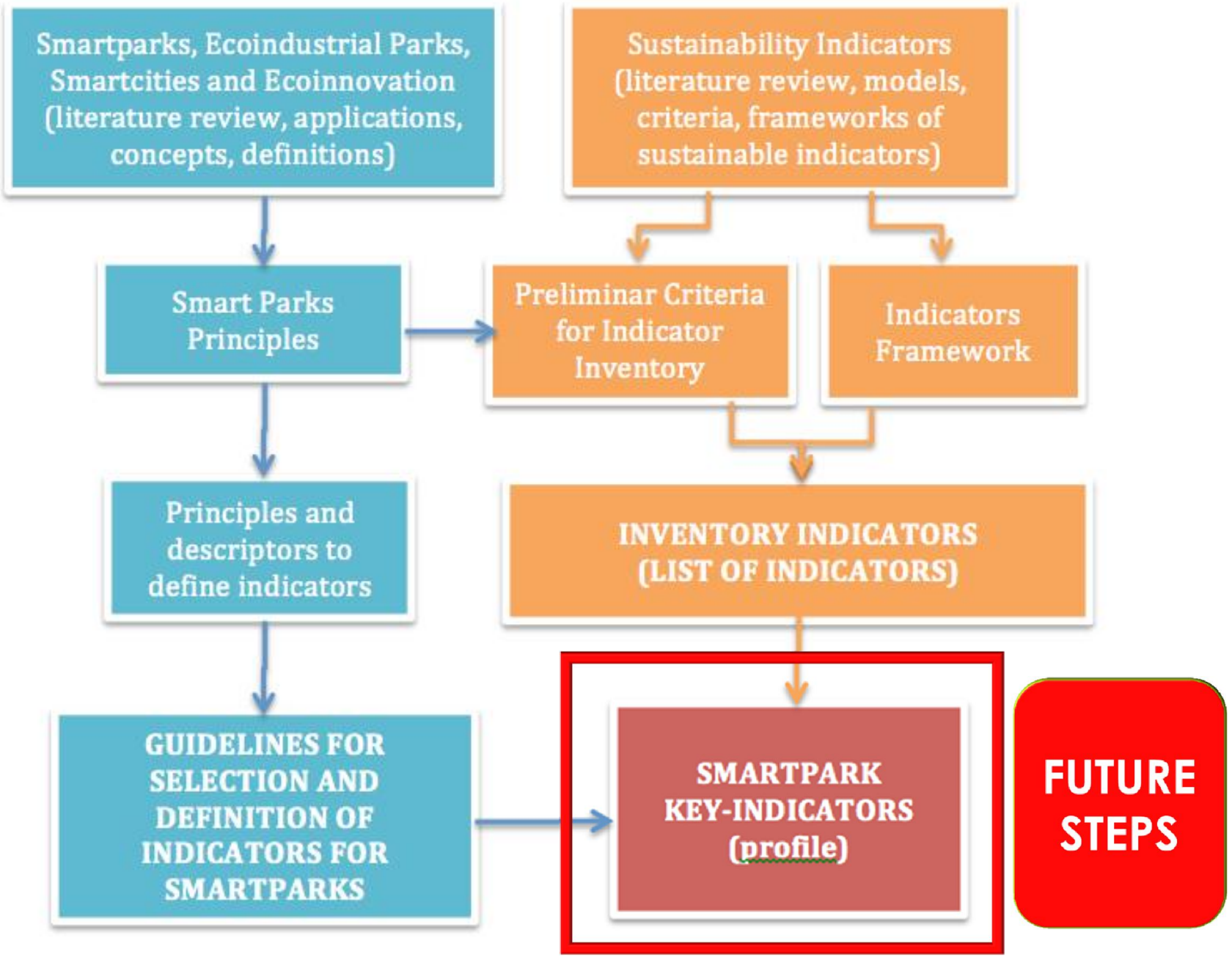
I1-Transp | I2-Comunic | I3-Energia | I4-Aguas | I5-Resíduos | I6-Facilidades | I7-Uso Territ | I8-Moradia | M1-Rec Agua | M2-Rec Energia

Vista normal | Listo | Suma=0

EXCEL – INDICATORS INVENTORY



	A	B	C	D	E	F
1	**M4 - MONITORAMENTO DAS EMISSÕES INDUSTRAIS DE RESÍDUOS SÓLIDOS E LIQUIDOS**					
2						
3	**Referência**	**Indicadores**	**unidade**	**Escala**	**objetivo ou descriçao**	**Formula**
4	Rueda,1999	Geraçao de residuos	tn/a tn/hab/a	(residuos reutilizados + residuos reciclados) ·100/generación de residuos.	É o resultado do consumo de materiais no sistema. Sua evoluçao indica o nivel de minimizaçaoou aumento no consumo de recursos.	
5		Proporçao de materiais reciclados ou reutilizados	%	[f + j + k + u - (j - k) / e] ·100.	este indicador expresa a quantidade de materiais que se converten de novo em recursos, em relaçao ao total de residuos gerados.	
6		Balanço energético da gestao de residuos	Gjth Gjth/ha	Consumo energético - (recuperación de energía + ahorro por reciclaje)	establece o grau de recuperaçao energética do modelo de gestao de residuos.	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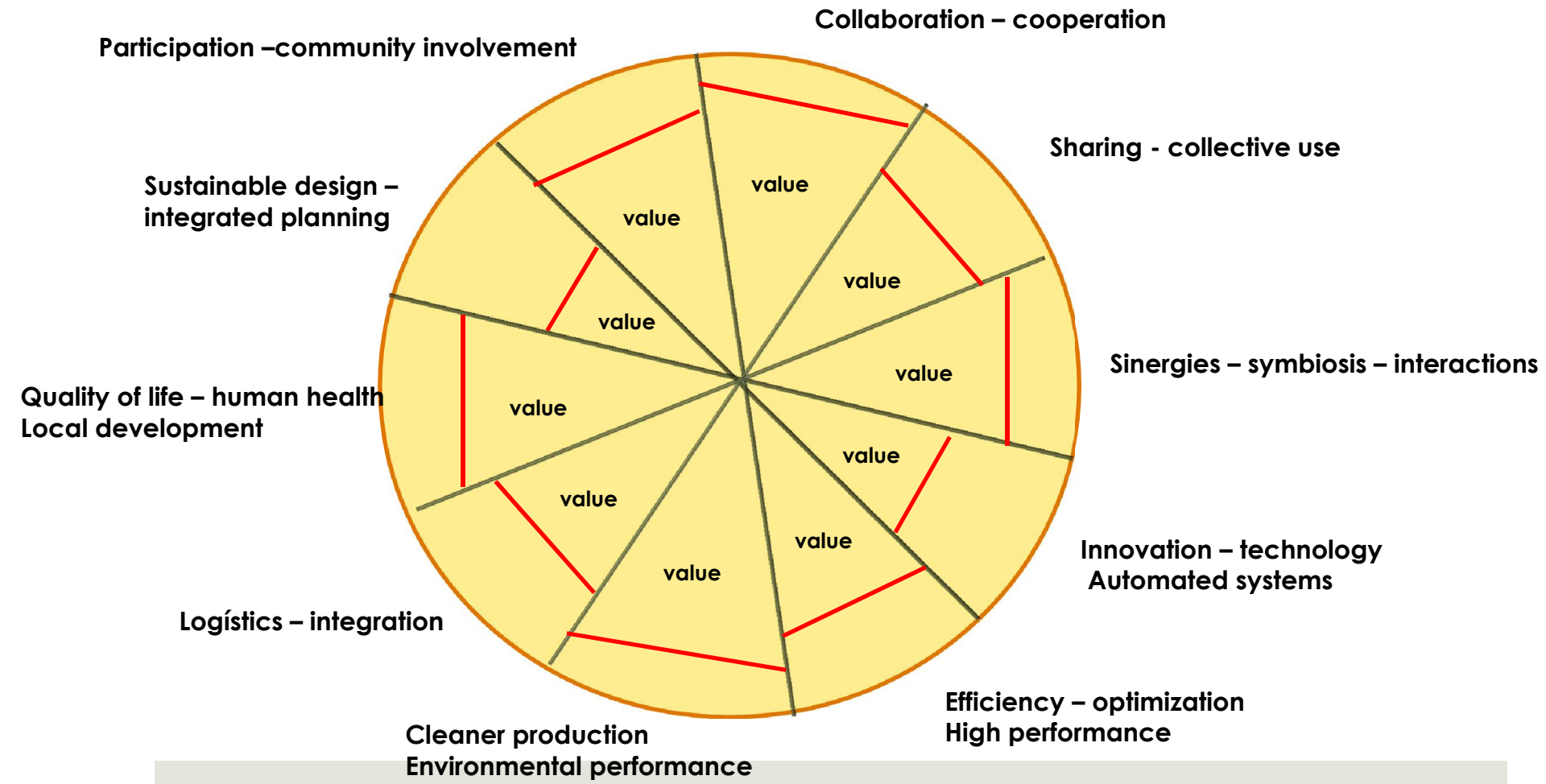
FUTURE STEPS

INDICATOR PROFILE

INDICATOR:		
DESCRIPTIVE CHARACTERISTICS OF INDICATOR		
NAME AND PURPOSE OF THE INDICATOR	DESCRIPTORS ANS RELATED ASPECTS	
INDICATOR MEASUREMENT		
PARAMETERS AND METRIC INVOLVED	ESTIMATE OR CALCULATION EXPRESSION	TYPE AND UNIT OF MEASURE
PROCEDURES FOR MEASUREMENT (form of data collection, instruments, frequency, location, responsible for the measurement)		DATA SOURCE
INDICATOR DATA		
HISTORIC EVOLUTION OF INDICATOR DATA (period)	EVOLUTION GRAPHIC	CURRENT RESULT
INTERPRETATION OF INDICATOR RESULTS		
TREND EXPECTED	DESIRED GOAL	
VISUAL COMMUNICATION	ANALYSIS AND INTERPRETATION	
PROPOSED ACTIONS (PLAN)	INTERFERING ASPECTS (INTERFERENCE FACTORS ON THE SYSTEM)	

INDICE SMARTPARKS (PRINCIPLES)



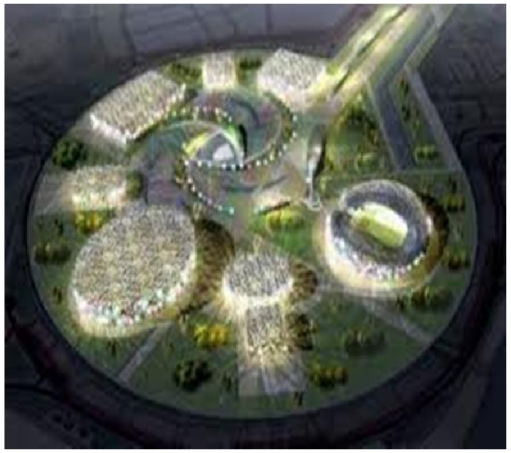
INDICATORS CRITERIA PROCEDURES (IDEAS)

Likert Scale	Criteria 1	Criteria 2	Criteria 3	Criteria 4
5 (completed attended)	Conceptually well founded, established, consistent, relevant, relevant, reliable	Reactive, sensitive to changes, comparable, able to show trends over the time	Easy measurement, application, data collection, data acquisition and access	Useful, meaningful, easy to understand and interpretation
4 (Mostly attended)	(specific conditions)	(specific conditions)	(specific conditions)	(specific conditions)
3 (Slightly attended)	(specific conditions)	(specific conditions)	(specific conditions)	(specific conditions)
2 (a litte attended)	(specific conditions)	(specific conditions)	(specific conditions)	(specific conditions)
1 (No attended)	(specific conditions)	(specific conditions)	(specific conditions)	(specific conditions)

INDICE SMARTPARKS (STRUCTURE)

	Smartpark Infrastructure and Services (Planning Indicators)	
I1	infrastructure and transport services, mobility and accessibility (people, materials and products)	value
I2	infrastructure and communication services (telecommunications, networking, technology information)	value
I3	infrastructure and energy supply services (electric, fossil fuels, solar, wind)	value
I4	infrastructure and water supply services, wastewater and stormwater	value
I5	infrastructure and solid waste services	value
I6	facilities, public infrastructure, services and collective areas (green areas, reserves, community centers, events, catering, health, leisure, cultural, sports, security, library, bank, vehicle maintenance, shops, agencies)	value
I7	use, territory occupation and functional area (land, buildings, built up area)	value
I8	infrastructure and housing and hosting services	value

THANK YOU FOR YOUR ATTENTION!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