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CIRCULAR ECONOMY TAXONOMY
INITIAL WHITE PAPER FOR WORKING GROUP

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Planned activity (short-term):

Reflecting upcoming ISO standard, reflecting input from kick-off.

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Abstract:

The CircularPSP project aims to develop a circular economy taxonomy (i.e. set of terms, data sources and standards) in an open working group. The aim is to reduce friction, empower AI and drive regulation. The results will be free to use and of direct benefit for multiple AI-solutions to be financed and tested though the CircularPSP project.

Keywords:

standardisation, taxonomy, regulatory framework, white paper, circular economy, pcp

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ABBREVIATIONS

Abbreviation	Definition
CE	Circular Economy
DCAT	Data Catalog Vocabulary
NLP	Natural Language Processing

MISSION STATEMENT

CircularPSP aims to solve the common challenge of municipalities to transition towards a circular economy (CE). Through CircularPSP, eight leading CE-cities and regions are to launch a competitive tender for technical solutions aiming to overcome organisational, informational and operational barriers. However, multiple standards and taxonomy-related issues are universal and should not be solved in parallel. Instead, CircularPSP seeks to involve key stakeholders, leading companies, and academics to tackle the following issues together:

- **Define core terminology** (i.e. taxonomy) to ensure different AIs are not adding to the confusion over circular economy but lead to more clarity.
- **Identify a set of core data sources** for AIs to ensure that the learning does cover all relevant circularity areas in a city instead of being dominated by the most advanced value chain or region etc.
- Document a core set of data standards and protocols to ensure the intended scalable solutions are fit for purpose to operate in a field with diverse IT and legacy systems.

Having advanced on these aspects will directly help municipalities in coordinating their effort and improve the solutions to be developed by suppliers. Based on this initial result and experience gathered during CircularPSP, we will further seek to advance on easily applicable and transferable indicators and benchmarks.

Focus are the challenges of municipalities (or procuring organisation) - including their inexperienced staff - in contrast to efforts aiming to standardise business value chains. Though these viewpoints are not mutually exclusive, the needs of the ‘demand side’ are currently not sufficiently covered.

Format: The work will be conducted as an open working group. Any interested party is welcome to join and contribute at events and at any time in a living document which is to evolve over time with initial push coming from CircularPSP or voluntary contributors. Permanent members will be the CircularPSP consortium and all selected suppliers. The online "living" file will be maintained and versioned by the CircularPSP consortium which will take ongoing efforts on the European data strategy into account. Versions will trigger follow-up events (2-4 per year) to update on developments and resolve contradictions etc.

- The first meeting is to lay out the white paper and cooperatively set out the interesting terminology and data sources for municipalities and where contributions are required due to gaps in existing relevant taxonomy.
- The initial phase will focus on 'collection and definition' of terms and data sources to cover circular economy, enabling AI holistically in the context of municipalities. One source will be the offers of suppliers tendering for the CircularPSP solution.
- Over time, the taxonomy will be validated with (selected) classifications used the EU taxonomy in upcoming standards to support and enable further regulation by clearly identifying the remaining gaps.
- Where possible benchmarks - going beyond minimum requirements or boundaries - will be added as complementary information.

Starting point: This (initial) white paper lays the ground for the working group describing the overall challenge, status quo, principles that should be followed and issues which can and should be tackled within CircularPSP regarding taxonomy, standards and data sources. **Validation during CircularPSP project**: The results of the working group will be applied and tested by all suppliers of the CircularPSP solution, in particular through their AI. The CircularPSP tender will be released in November and is open to all parties. Insights from suppliers and testing procurers will feed back into future iterations of the CE Taxonomy.

Free use of results: Further, all parties are free to use working group results during ongoing and upcoming standardisation efforts and to contribute to the dialogue on circular economy. In such case, a reference and notification (or tagging) of the project is appreciated.

1. Background

1.1 Circular economy

The broader ambition of CE is to extend the life cycle of products as a way of reducing waste to a minimum. As a model for production, it emphasises sharing, reusing, repairing, recycling, and refurbishing existing materials to the degree possible, to keep them within the economy. Maximising the total value of the product breaks with the linear economy logic, and especially with planned obsolescence, designing products with a limited time span of effective use.

From an environmental perspective a CE logic has benefits. One of the clearest and easiest to measure is decreased greenhouse gas emissions. Other benefits of a more efficient use of existing products are a reduced use of scarce or harmful resources. Covid-19 became an important reminder of risks inherent to global value chain as well as price volatility. Inefficient use of materials is an increasing concern as European countries are dependent on imports. Dependence of raw materials from countries such as China and Russia create an additional layer of complexity and can and has become a security concern. Thinking circular from the start can have great and measurable impact, as roughly 80 percent of negative impact of products are determined during its design.

1.2 The EU and circularity

While increasing circularity is important, shifting to a circular economy built within and around a circular logic is challenging. One apparent constraint relates to procurement based on the lowest price, which benefits low-cost products rather those that benefit the buyer over the life cycle. To mitigate some of the challenges and to accelerate change, the European Commission launched the Circular Economy Action Plan. The plan initially focuses on resource intensive sectors, including ICT, plastics, textiles, and construction. In March 2022, the first packages of measures meant additional steps to accelerate a circular transition. The package spans several sectors, including construction, product regulation, textiles, as well as consumer-oriented measures.

1.3 Circular economic decision making and data

While circularity can seem straightforward, not all circular choices will be as easy to make. There are several reasons why it may be hard to make CE decisions as well as to prioritise between different potential choices. Some such factors are found in Table 1.

Table 1. Factors influencing circular economic decision making.

External	Internal
Legislation	Utilities
Culture and norms	Funding
National, local, and regional conditions	Perceptions
Stakeholders	Abilities
Available resources	Systems and routines
Sourcing and infrastructure	Strategy and objectives

From the perspective of a municipality, these factors can be divided into:

Framework conditions

On a societal level, formal institutional conditions such as legislation will partially define what can and what should be complied with and measured. Informal institutional conditions such as culture and norms will define what desirable objectives and outcomes are, reflected in the preferences of stakeholders in society. Of specific importance is the preferences of the constituents, towards which a municipality is accountable. This has the additional implications that policymakers have to balance the long-term ambitions of CE with often short-term preferences of voters. Available resources and sourcing, such as the availability of inputs in the region and/or within reasonable distance, and infrastructure, including roads as well as industrial production and recycling facilities will also shape circular decision making.

Challenges within the organisation

Within the municipal organisation, a core question is to understand which utility a municipality wants to achieve. How utility is understood and what will create utility will depend on the prior mentioned external factors as well as internal factors of the municipality. Of key importance becomes available resources. Policymakers must always balance value today, for example constituent preferences, with long-term resilience. Additionally, what can and should be prioritised is dependent on staff perceptions and abilities, as well as the routines and systems in place. Even in cases where, for example, re-shaping procurement has clear and measurable impact, long-term skills and routines may make a desirable reform impossible. Such a transformation is affected by legal constraints and internal systems. Most procurements are based on lowest cost rather than value for money. This can partially be understood from a legal perspective, where transparency is key. This need for transparency promotes the most transparent benchmark, i.e. numbers, but is also due to deeply rooted routines.

If and to what extent different economic, environmental, and social outcomes can be prioritized will depend on an interplay between framework and organisational conditions. The ability to forge a strategy, define priorities, set objectives, and implement will hinge on access and ability to use data.

While data and information are commonly emphasized as being crucial for informed decision making and organisational change, the terms are often used interchangeably. One way to define the boundaries is how the system theorist Russell Ackoff[1] classified the human mind into five categories:

1. Data: symbols
2. Information: Data that are processed to be useful
3. Knowledge: Application of data and information ("who", "what", "where", and "when")
4. Understanding: The "why"
5. Wisdom: evaluated understanding. Learning

One conclusion could be to prioritise measures that create “the right utility”, as data must be processed into information and transformed into knowledge (and ideally understanding and

[1] For basic information on these perspectives the following link can be helpful

wisdom). While data is increasingly available, and technology lowers thresholds for use, challenges remain. Challenges will furthermore be context specific, which creates additional complexity in promoting a general transformation towards circularity. Finally, data is available from a myriad of sources and is organized in vastly different ways. This affects the ability to use and combine data.

1.4 Data, principles, and taxonomies

The above categories are fairly intuitive, on a daily basis we process data into information to make more or less well-informed decisions. But what has happened in the last decades is that the access to data has exploded. In its wake, innovation and technical progress has followed. The wide public access and use of Large Language Modelshas potentially changed the conditions for analytics and may have far-reaching implications for how society becomes organized. From the perspective of a municipality, the increasing access to data does not answer the question on how to access data. If data is findable, the question is how data from one or often several sources can be structured to become information and crucially lead to knowledge and thus better-informed decision.

To bridge such gaps, several frameworks which define principles that allows organisations to make data operable have been introduced. **Principles** commonly relate to making data **findable** and **accessible** so they can be used, **interoperable** so that data from sources can be combined and **reusable** so that sufficient information exists to strategically use data for an analysis fit-for-purpose in the specific context. Of great importance is also that data can be analysed with minimum needs for humans to facilitate the process, that data is **machine actionable** and is defined by **data interoperability – i.e. standardised and documented so that** datasets can effectively be combined (by computers and/or humans) in analysis.

A cornerstone to effectively use data, and thus complying with the principles – are (standardised) **taxonomies**. Taxonomies are widely used in different scientific fields and can be understood as classification systems. A set of classes of concepts that are organised in a hierarchy, usually depicted as a tree turned upside down. The further one moves and more specific one becomes; the number of shared features decreases. As a consequence, upper classes possess all the features of the lower classes, unlike the other way around. From a data perspective, (or information that can be turned into usable data) information is made available with its relationship to other data in the taxonomy. Organising data in such a hierarchy makes it easier to use, reuse, analyse etc. The possibly most known, is the Linnaean taxonomy where one level is the class (for example mammals) which at the below level, has the order (for example primate) which is more specific.

Taxonomies are a cornerstone for how data is organised and processed. All data crucially has a hierarchy. The opportunity created by following common principles with an ever-increasing amount of data sources is that we can create tangible value. This is why principles are emphasised by the EU. But to take full advantage, interoperability is crucial which is why principles for how data can be combined is as important. A key process currently is Data Catalog Vocabulary (DCAT). DCAT provides classes and properties to allow datasets and data services to be described and included in a catalogue in a standardised way (for example combining statistical data with geographical data). This makes it easier to discover datasets and data services and to make a search that can lead to a combination of datasets from multiple sites. And as the it goes from a global root to a branch in

each country data from different countries can be combined (for example DCAP-AP-SE). With vocabularies the ability to use data beyond borders are also increasing.

A hypothetical circular economy case

Combining taxonomies, with principles of interoperability, creates ample opportunities. One example would be to use procurement data. European procurements are codified using the CPV taxonomy, through EU Ted it is possible to get access to current and historic calls for tender. A hypothetical case would be that a city wants to understand how European cities understand circularity. By collecting all historic procurements that are deemed circular (for example by using vocabularies to scan all procurement that apply the language of circularity) and comparing which tenders were chosen, it could be possible to find patterns among procurement professionals. The analysis could be used to develop a training on circularity to nudge behaviour. Based on interoperability (using DCAP as a short-cut), it would be possible to combine data (for example datasets) of cities' environmental performance. One possible analysis would then be to try to pinpoint if, and to what extent city recycling is affected by circular procurements. This analysis could be used to change how a city operates.

The EU – principles, data, taxonomies, and resources

The EU has become an important proponent of better and more effective use of data for analysis. By providing a common framework that encompasses how data 1) should be structured in taxonomies from the global to national levels in many fields, 2) should be made interoperable, to a higher degree findable, accessible, as a machine actionable and be able to combine interoperable datasets effectively in analysis.

Understanding principles and taxonomies

One way to understand taxonomies and why they are so important for data is to think of a language. To be able to communicate in for example Swedish, we can communicate by using words in accordance with the Swedish language taxonomy. The more precise we are (by referring to a cabriolet rather than a car) the better we can communicate. How we communicate will also depend on the syntax (how words are organised into a sentence) where a question follows another order than a statement. But we will not to be able to communicate with someone from Greece without knowing the language or with a tool that allows to interact. To overcome this barrier, for example, a dictionary increases our interoperability to a certain degree, tools such as Google Translate increase interoperability further. Word-by-word translation, however, has its downsides typically not able to recognise contextual meaning which follows along the words listed in a dictionary. Humans, however, are able to utilise the extended taxonomies of context and (meta-)data from classifications etc..

2. Practical challenges to be tackled

Common standards, taxonomies, and the ability to share, use and re-use data create great opportunities. Notwithstanding the ability to seize the opportunities will depend on several factors.

Even if the data is structured in accordance with the principles and taxonomies and principles, some remaining challenges include:

- The degree "the right data" is actually findable and accessible.
- The ability to understand what is "the right data".
- The ability to convert the "the right data" into information that allows the organisation to address the specific problem, given the external conditions within which the organisation operates and the internal constraints of the organisation.

From a CE perspective, if the "the right data" is **findable and accessible** is a question of point of departure. From one perspective, there is ample access to data that relates to aspects of circularity. Still accessible data will probably be insufficient to be deemed the right data for many cities, different countries have progressed at different paces in making data available. But even in a scenario where data would be available, the core challenge remains, the concept of CE is still unclear to many and perspectives diverge between individuals, organisations, within and between countries. While there are attempts to consolidate the concept of CE and to codify it in taxonomies, there is still not a commonly accepted benchmark.

Additionally, even if a common benchmark defines circular missions, planning activities, and measures progress, it is inherently dependent on combining circular data with other types of data. A case in point is to choose to refurbish or reuse rather than to buy new computers. To assess the relative value of reusing rather than recycling and buying new equipment, will depend on factors such as local infrastructure, the development of programmes and performance, portfolio of task, energy consumption etc. Reusing in the case that performance requirements change, or if new models have better energy consumption, may turn out to be less efficient and thus creates the risks of unforeseen externalities. Knowing which data is the right data to combine, is often less obvious than it seems. Depending on context, recycling (e.g. of certain fabrics in clothing) may be more harmful than buying new using other fabrics. The question of data is also related to time. Certain circular choices can only be made in the design phase. There are ample examples of time and data, not least the prior example of fabrics, where the circular impact is inherent to design phase.

Finally, circularity is an important priority, but it is competing with other potential sustainable choices. Additionally, there are competing interests related to efficiency and local economy development that may override the impetus for circularity. Conflicting sustainability priorities could arise when locally sourced goods guarantee employment opportunities, but provide a segment of the population with few other opportunities or where the right materials cannot be sourced. The question that follows then is whether the "right data" on circularity would be the right data in a specific context. A similar challenge relates to preferences in the organisation, capacities to use data or routines in key departments. One or several of these aspects may imply that the circular intent does not translate into a circular action.

3. CircularPSP Challenge in context of Taxonomy

Reminder: The issue of CE Taxonomy is an important and underlying problem of the CircularPSP Challenge but it does not constitute the entire challenge to be published in the Challenge Brief.

Below description, summarises aspects in which the use of one common CE Taxonomy will help to achieve a more efficient and higher-quality result.

Underlying imperatives of the CircularPSP project allow cities to take decisions and make priorities that can feasibly and long-term move strategy and operations towards a circular path. This requires finding a balance between the circular objectives and possibilities, challenges, and opportunities at city level with the common objective of moving Europe towards circularity. To allow cities to find the circular opportunity, the intention is to:

- **Contribute to the consolidation of a European framework for circularity**: Specifically, to collect data and reflections on current frameworks, and their relevance to the operational realities of European cities. This will provide a common inspirational mission that also provides a measurable and timebound framework can capture an ideal as well as a minimum requirement for city circularity.
- **Provide cities with tools to forge relevant and traceable indicators**: This will emphasise the operationalisation including through tracking progress, success and trigger motivation.
- **Provide cities with tools to access and convert the "the right data":** a core challenge is to know what the right data is. Based on the missions of cities, AI and Natural Language Processing (NLP), it is possible to connect data sources that are interoperable with the challenge defined so that cities can combine relevant data sources to the circular mission or process. The contribution of the project will be to provide the ability to measure circularity progress in balance with city specific priorities and constraints.
- **Provide cities with a scalable solution:** At the core of CircularPSP is to develop a platform solution that is firmly built on the principles for sharing and re-using data and datasets from different sources from strategy and operative decision making. While certain datasets will be common, others will be possibly to foresee and add to the solution at city level. Moving a city towards circularity will demand flexibility in accessing and combining the right data during analysis, so the right conclusions can be drawn as external and internal factors change and new opportunities emerge. A key contribution of CircularPSP is that the solution will be built based on an open structure, in accordance with the European data strategy. This will mean that as new datasets emerge or possibilities to combine data from different sources emerge, those can be accessed by the cities. Additionally, a priority will be to use AI, to suggest new and better ways to measure circularity and consequently develop actions that are fit for purpose. A final benefit of that as the state-of-the-art progresses, the framework used to measure circularity can be developed. This would provide analytics both for analysis, goal setting and measurement.

4. Working Group Contributions

4.1 Taxonomy (categories, terms and definitions)

The core is to scope the terminology including the term, their definition and any useful categories (or classifications with using EU taxonomy) which can be applied. Initially, the focus is on scoping and the entire structure is considered free to grow (i.e. the working group identifies areas in which terms are needed).

The following categories should be commonly and universally used:

- CE Principles
- User groups
- CE Strategies (e.g. R-Strategies and any strategies missing within this set)
- Further classifications and categories to be agreed in the working group, including CircularPSP suppliers and procurers

The work will be conducted cooperatively in this MS WORD working file with an initial table provided by CircularPSP. Suppliers will implement the newest version and validate progress.

4.2 Data sources

Provided the CE-solution is consistent with the common European standardisation and interoperability framework, it will be possible to can tap into existing and upcoming data sources with relevant information on the current state, practice and progress of CE transition. A core challenge will be the ability to make data informative for local users.

Data sources will be collected along the following categories:

- Relevant taxonomies
- Procurement indicators
- Further categories to be agreed in the working group, including CircularPSP suppliers and procurers

The work will be conducted cooperatively in this MS EXCEL working file with an initial table provided by CircularPSP. Suppliers will implement the newest version and validate progress.

4.3 Standards

The core are standards or protocols relevant for a solution to be able to support and interconnect municipalities in their transition towards a CE in the long-term. It is considered as a given that existing IT-related interoperability standards are followed.

The work will be conducted cooperatively in this MS WORD working file (same as terminology) with minimal content at the starting point. Suppliers are encouraged to consider relevant standards in context of municipalities.