A short introduction

BONSAI

**Big Open Network
for Sustainability
Assessment Information**

A global challenge

▶ Including sustainability information in rational decisions requires accessible and unbiased information on alternative options. Currently, sustainability information on products – "product footprints" – is not easily available.

▶ When available, current "product footprints" are often incomparable, biased and misleading, resulting in irrational decisions.

This is caused by inappropriate procedures for obtaining and processing the underlying activity information. The underlying information is often:

- incomplete,
- based on out-dated information,
- generalised from a limited number of data sources reflecting only specific local conditions,
- calculated and presented without uncertainty information.

▶ Many different calculation procedures are currently in use to come from the activity data to the final "product footprints". Many of the resulting systems are unbalanced and unrealistic, providing biased and misleading results that are not comparable and do not reflect the impacts per additional unit of product consumed.

▶ Currently, the exchange, use and reuse of the sustainability information are hampered by proprietary or commercial data and data formats, requiring special permissions and tools.

A global vision

▶ The aim of BONSAI is to make reliable, unbiased sustainability information on products – "product footprints" – readily and freely available whenever and wherever it is needed to support product comparisons and decisions.

▶ Already in its starting point, BONSAI is a complete database, covering all human activities and interactions between these activities and the social, economic and biophysical environment.

BONSAI uses modern data harvesting and social networking techniques, continuously and automatically combining all relevant available data, from the web, from domain-specific databases, and from stand-alone contributions from enterprises, researchers and the general public, to maintain complete, updated, and generally applicable information.

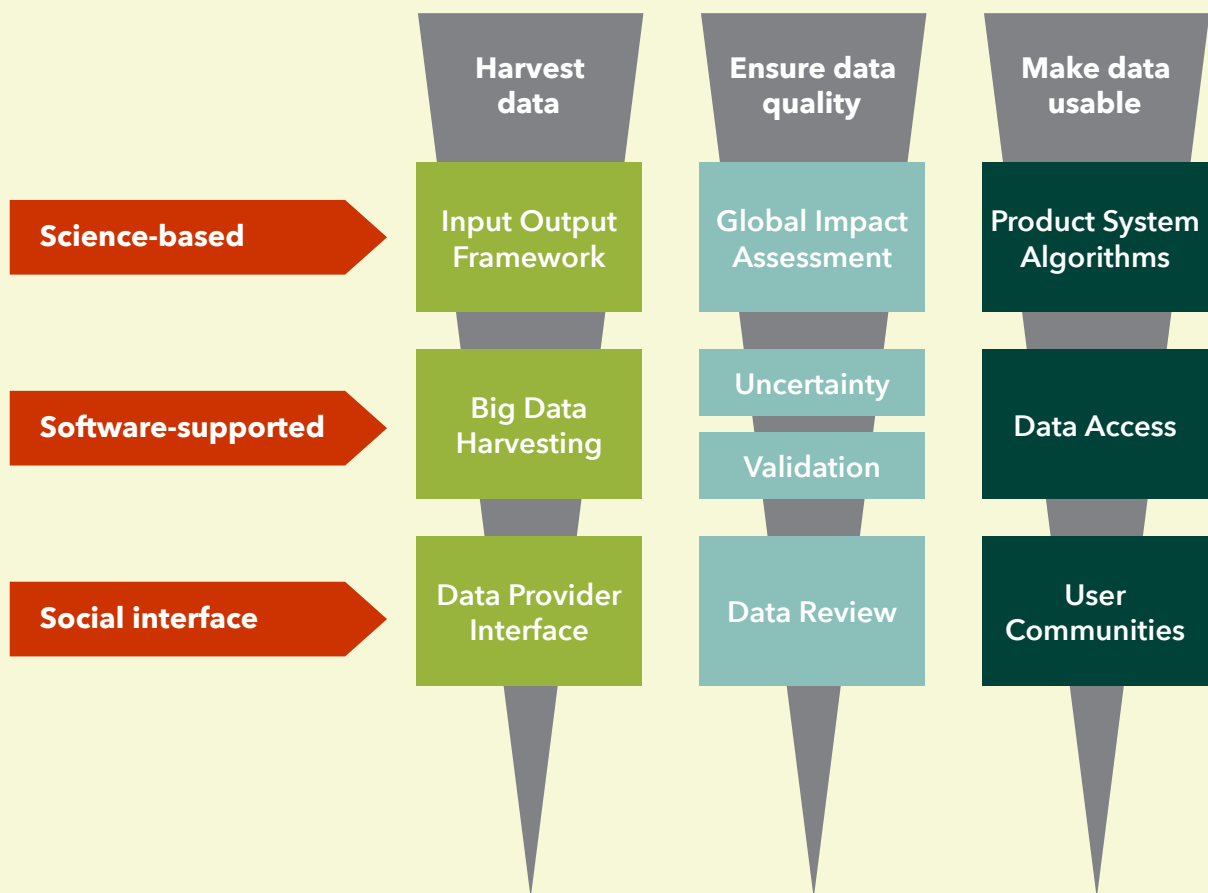BONSAI presents data with uncertainty, and with geographical and temporal validity bounds.

▶ BONSAI uses open source calculation methods based on current best scientific knowledge, resulting in mass-balanced systems, fully compliant with the ISO norms, providing comparable "footprints" showing the impacts per additional unit of product consumed.

▶ BONSAI uses open formats and technologies, and provide data that are free for others to use and reuse.

Our strategy

Our strategy is based on 3 principles:

▶ A *science-based approach*, relying on mass balancing, uncertainty assessment and review, and with focus on completeness, consistency and relevance for local decision support.

▶ A strong reliance on *software-supported* procedures using the latest advances in data science for data harvesting, uncertainty propagation, validation and review, and data presentation.

▶ A collaborative *social interface*, using open source and innovative social media technology for data input, review, and interaction with the user communities.

These principles are applied to the 3 action areas: Harvest data, ensure data quality, and make data usable. The different tasks are organised in 10 working groups as shown in the figure.

	Harvest data	Ensure data quality	Make data usable
Science-based	Input Output Framework	Global Impact Assessment	Product System Algorithms
Software-supported	Big Data Harvesting	Uncertainty / Validation	Data Access
Social interface	Data Provider Interface	Data Review	User Communities

Harvesting data

❯ SCIENCE-BASED

Completeness of the BONSAI database - in terms of human activities, interactions with the physical, social and economic environment, and geographical coverage - is ensured by extended tools and procedures from input-output economics. The **BONSAI Input-Output framework** develops open source procedures for integration of the Input-Output data with more activity-specific data sources (hybridisation).

This way, BONSAI achieves geographical, technological and social detail, reflecting the variation in data between countries, industries and social groups. The strength of the Input-Output framework is not only its potential multi-dimensional completeness, but also the consistency checks that are made possible by this completeness.

❯ SOFTWARE-SUPPORTED

Large amounts of footprint relevant data are available in the public domain but not in a ready-to-use and validated form. **BONSAI Big Data Harvesting** develops and implements algorithms for automatic data harvesting from the currently disparate and incompatible databases and raw data sources, placing each piece of harvested data in the relevant database context.

Out of the relevant data, less than 10% is currently inside the footprint databases

❯ SOCIAL INTERFACE

Existing tools for manually adding and editing LCA data are generally too difficult and time-consuming to ensure widespread participation in the data supply and editing. The **BONSAI Data Provider Interface** reduces the difficulty and time-effort for manual addition of LCA data by volunteers and editing by domain experts, applying experiences from the Wikidata project and from database-improved wiki-applications such as Wagn (wagn.org)

Ensuring data quality

▶ **SCIENCE-BASED**
The **BONSAI Global Impact Assessment** supports decision-making that involves trade-offs between different impact categories. This is done by providing geographically specific mathematical descriptions of the cause-effect chains (impact pathways) from the contributions to the final impacts (for example from CO_2-emissions to lost biodiversity from climate changes). Impact pathways are described for known causes for loss of natural and manmade resources, loss of ecosystem health, and loss of human wellbeing. Impact pathways include models for endpoint assessment, considering global and inter-generational equity and competing interests, values and worldviews.

Better be approximately right, than precisely wrong

▶ **SOFTWARE-SUPPORTED**
Data and model uncertainties are systematically captured, propagated and presented throughout BONSAI. The **Uncertainty Assessment** Working Group develops science-based tools for prioritisation of data collection, where the importance of additional data is assessed by their contribution to reducing the uncertainty of estimates of the total global impact.

To reduce the current reliance on physical persons for review and manual editing, the **BONSAI Data Validation** uses machine-assisted data exploration and learning to maintain open source tools and automatic software routines for validation of consistency and plausibility of sustainability data.

▶ **SOCIAL INTERFACE**
BONSAI Data Reviewing is an innovative social media based procedure for systematic peer review of new data, breaking down the traditional slow and resource-demanding review procedure into smaller instances of confirming the plausibility of single data triples, making it easy and rewarding to participate, both for domain experts and the interested public.

Making data usable

▶ SCIENCE-BASED

The **BONSAI Product System Algorithms** – the calculation rules for converting the original unlinked activity data into "product footprints" – are engineered as open source algorithms, based on the current best scientific knowledge, resulting in mass-balanced systems, fully compliant with the ISO norms, providing comparable "footprints", showing the impacts per additional unit of product consumed. BONSAI thus provides a science-based corrective to the disparate and inconsistent procedures found in current popular guidelines for product footprinting.

▶ SOFTWARE-SUPPORTED

BONSAI Data Access provides both the raw data and the calculated product footprints to the general public in an intuitive and easily accessible form. The presentation formats will be designed, tested, implemented, and maintained in close cooperation with the Wikimedia projects. BONSAI cooperates with the Open Source software community to develop graphical web-tools for presentation of entire product life cycles, ensuring that even complex product systems and scenarios, for example with many by-products, can be communicated to the uninitiated user.

▶ SOCIAL INTERFACE

BONSAI User Communities are invited to design web tools for interacting with the basic BONSAI data. The aim is to support users to specify additional data filters and system algorithms for specific needs (for example, using only data that have been additionally reviewed, or algorithms that support specific legal requirements).

We have not reached our aim before sustainability data are readily and freely available whenever and wherever it is needed to support product comparisons and decisions

Timeline

While having a central secretariat, much of the BONSAI development work is performed in independent Working Groups that contribute specific parts of the overall system. Some of the Working Groups are expected to be funded more easily, for example as collaborative industry projects, and will provide early deliverables:

- Hybrid add-ons to existing product lifecycle databases, like ecoinvent
- A complete description of all known causes for loss of natural and manmade resources, loss of ecosystem health, and loss of human well-being
- An assessment of the uncertainty of current product footprints and its causes
- A description of the relationships between raw data and the database activity descriptions, as basis for automatic data harvesting
- A low-cost review facility for footprint data
- A Wikimedia infobox format for presenting product footprints

The further deliverables and milestones will be determined in the detailed workplans for each Working Group. The BONSAI organisation will ensure continued maintenance and improvements.

Funding strategy and target

Specific deliverables may be funded by specific donations and/or as government research projects. The general organization budget will be funded by donations, supplemented by crowd-funding.

The initial target is 9 employees and an overall organizational budget of 2.4 million USD annually:

Expenditure item:	Annual budget (million USD)
Salaries	1.4
Internet hosting	0.2
External software development	0.3
Financial and operating expenditures	0.3
Travel and meetings	0.1
Facilities and equipment	0.1
Total	**2.4**

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