



CDW Replication Package 4

Data and material passports

Capital Region of Denmark | ICLEI Europe



Data and material passports

A material passport is used to document the amount, quality, accessibility and reusability of construction and demolition waste for reuse or recycling. This Replication Package describes the CityLoops definition of a material passport, as well as different methods for gathering data of materials, products, or components in order to create a material passport.

Material passports share the same objective, namely quantifying and qualifying the materials on site. However, they differ in the level of detail and number of aspects taken into account. The top five requirements for a material passport in CityLoops are:

- A bill of materials with quantities, material composition, and location of the materials on site.
- Inspection and maintenance history of the materials.
- Technical lifetime expectancy of the materials.
- 'End of life options' of the materials.
- A uniform system for data storage for structured output.

The Replication Package describes and compares four methods used in different demonstrations to gather and store data on CDW materials for reuse or recycling. The data in all demonstrations was stored in local databanks or Excel-sheets and used to document the quality and reusability of the materials, thus functioning as material passports. Two cities also developed digital marketplaces, which can use this type of data for materials classification (for more information, visit the Replication Package '[Material banks and marketplaces](#)')

This replication package on Data and material passports is part of a series of nine replication packages, developed by CityLoops. The replication packages address specific actions within the circular construction value chain and how they relate to the work done in CityLoops. The replication packages aim to give cities an in-depth overview of the main elements to consider during each specific step of a circular construction/demolition project. A list of all replication packages can be [found here](#).

Recommendations from lessons learnt

Four cities in CityLoops tested different methods of gathering data on materials for reuse or recycling purposes. Based on their experience, we have prepared some generic and method-specific recommendations that can help cities select and efficiently use the right methods for their construction projects:

- It is valuable to have a standard procedure in place for mapping and documenting the reusability/recyclability of materials in demolition projects.
- The [pre-demolition audit](#) should be done well in advance of the demolition and in cooperation with various stakeholders, so that the reusable or recyclable materials and

elements are identified, included in the tendering of the selective demolition and connected to the design processes.

- For all data gathering methods a more advanced resource mapping system is needed, e.g., a pre-demolition audit reporting software program to be used to report and archive audit findings.
- In the demo actions local systems were adapted and used for data storage, but integration between the database storing information about the materials and a digital marketplace can be difficult. Thus, some cities have moved on to external systems that can handle this.
- It is useful to make a market-oriented material passport so that in the bidding and tender phase the external partners can include and work with the information about the secondary materials.
- It may not be possible to find or describe all the wanted information for a Material Passport. Especially the expected lifetime and the estimated value can be a challenge.
- **The 3D visualization tool (digital twin)** is useful for large urban development projects, but also suitable for 3D modelling of buildings. It can be used for gathering data on masses and materials, and to plan how new buildings can be made with on-site resources. It interpret complex data efficiently, while the visualisation can also help with making decisions based on real data. Data for the 3D visualization came from e.g., excel sheets, traffic API and Circulus. There were many different types of data, which were entered manually. This process can be optimised if it becomes possible to connect data between different systems.
- **The drone scan** can produce useful data for the pre-demolition audit and planning of the demolition work. Volumetric measurements based on 3D imaging can be a useful tool for contractors, building owners, consultants, and designers. The drone scan is useful and quick for mapping the materials in a building or construction site, but you need humans to inspect the results. The scan cannot recognize materials, but from photos you can calculate masses, number of windows, bitumen on roof, etc. If you have the proper equipment, you can do both outside and inside scanning.
- **The road scan with cameras and sensors on vans** can collect data on the amount and quality of materials available from the road. It can provide additional insights in the status of road materials, but developments are still needed to interpret the data and automate data storage. It is especially useful for asphalt roads, as it cannot assess the quality of concrete pavers yet – in this case a drone may be a better option. It was not possible to assess data on lifetime expectancy and re-use options of materials, products, and components from the road scan, but a visual inspection on-site can provide this knowledge.
- **The simple excel sheet** is an easy way to get started with screening buildings and gathering data on elements or materials for reuse and recycling. You visit the building/construction site and enter data on materials for reuse/recycling in an excel sheet with photos. Afterwards you identify which materials are relevant for reuse or recycling, and whether you need to gather more information about them or test them for hazardous substances. The more different stakeholders you involve in the tour of

the area, e.g., environmental advisors, architects, contractors and engineers, the more ideas you will get on the reusability of elements and materials.

CityLoops instruments

- **Material passport definition:** Five requirements for a material passport were developed in the CityLoops report “*Construction material passports and databanks*”, which also describes different approaches to material passports. Furthermore, the report dives into how a material passport can be applied to a circular road renovation project.
The report with the definition of a material passport is [available here](#).
- **Procedure for CDW to obtain a Material Passport:** Roskilde has developed a simple five-step procedure for demolition materials to obtain a material passport and be approved for use in future construction.
This procedure can be found in Roskilde’s demonstration report extract on data and material passports, [available here](#).
- **Replication report for 3D visualization solutions (Digital Twin):** The digital twin of the city of Bodø has proven to be a useful tool for urban planners, policymakers, and researchers alike. It holds mass quality data from demonstration sites, material data from buildings on demonstration sites and pilot buildings, visualisation of transport, infrastructure and emission data and identified loose sediments and potential sea level rise at the demonstration site. This report describes the software and equipment used, the technical and physical requirements as well as the gathering and visualization of data. In order to replicate Bodø’s activities, it is not necessary to be in possession of the tools mentioned here. However, it is necessary to use tools that can geographically place data. In extension of this, the replicator should be in possession of a software that can manage data e.g., Excel.
[Here](#) you will find a short introduction to the 3D visualization
- **Blueprint for drone scan and 3D modelling tool:** The use of a 3D modelling tool to monitor demolition waste flows can be a cost-effective alternative in evaluating the amounts of material flows on-site when compared to traditional methods, e.g., tachymeter. The data capturing process with drones on the demolition sites demonstrated in the project takes on average less than an hour.
This instrument is [available here](#).
- **Guide for replication of road scans and data storage:** Road scans can provide additional insights in the status of road materials, but developments are still needed to interpret the data and automate data storage. The LiDaR system with high resolution imaging seems to be able to provide data that is closer to the traditional process of a visual inspection on site. It was not possible to assess data on lifetime expectancy and re-use options of materials, products, and components from the street scan.
A guide for replication of the road scans and data storage can be found in the report “*Collecting and storing data in a circular road renovation process*”, [available here](#).

CityLoops demonstration experiences

- **Bodø - 3D visualization in a digital twin:** Bodø mapped the masses and structures of the old airport and entered the data on quantity, quality and reusability in a digital twin. The digital twin technology delivers 3D visualization solutions for designing a new part of the city using existing structures and resources. This is a great demonstration action to replicate for other cities that are facing large urban development projects. [Here you can read](#) about experiences from using the digital tools in relation to the demolition of the military airport, mapping and visualizing masses and structures.
- **Mikkeli - Drone scan of buildings and construction site:** Mikkeli scanned buildings and demolition sites with drones using a 3D modelling tool for tracking the flows of on-site CDW. The scans provided 3D models and digital imagery from each of the monitoring sessions done on site during the demolition process.
Read about Mikkeli's [experience here](#).
More information of Mikkeli's demonstration results in using the drone scan can be [found here](#).
- **Apeldoorn - Road scan with cameras on vans:** Apeldoorn collected data on the amount and quality of materials available from Grieffiersveld road through scans with cameras and sensors mounted on vans, using two different road scanning processes: One scan was done with an IDS RIS Hi-Pave ground penetrating radar system at the back and a gamma spectrometer at the front of the van and another scan collected Light Detection and Ranging (LiDaR) data and panoramic high resolution images. Apeldoorn's GBI databank was adapted to store the data.
Read about Apeldoorn's [experience here](#).
- **Roskilde - Simple data registration in excel-sheets:** Roskilde conducted a manual resource inspection of the buildings to be partly demolished, identifying materials for reuse or recycling. A simple digital databank and material passport was then created for selected materials from the demolished buildings, consisting of an Excel sheet for each material. The databank describing the material's lifespan, what kind of testing it has to go through, and where it could end up in future uses. This is a very simple, cheap and low-key solution that is easy to replicate. However, the data would need to be uploaded digitally if the materials were to be added to a marketplace. Roskilde has afterwards moved on to using the Upcycling Forum databank and marketplace.
Read about Roskilde's [experience here](#).

CITYLOOPS

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and bio-waste, where seven European cities are piloting solutions to be more circular.

Høje-Taastrup and Roskilde (Denmark), Mikkelí (Finland), Apeldoorn (the Netherlands), Bodø (Norway), Porto (Portugal) and Seville (Spain) are the seven cities implementing a series of demonstration actions on CDW and soil, and bio-waste, and developing and testing over 30 new tools and processes.

Alongside these, a sector-wide circularity assessment and an urban circularity assessment are to be carried out in each of the cities. The former, to optimise the demonstration activities, whereas the latter to enable cities to effectively integrate circularity into planning and decision making. Another two key aspects of CityLoops are stakeholder engagement and circular procurement.

CityLoops started in October 2019 and will run until September 2023.



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