



Data and material passports in Mikkeli

Extract from the Demonstration Report

Mikkeli, Finland



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This text describes Mikkeli's experience in gathering and digitalizing data in the demolition of the Tuukkala Hospital and Pankalampi Health Centre. The sections come from Mikkeli's CityLoops demonstration report available [here](#).

Introduction

The Mikkeli demo case consisted of two phases:

- 1) case studies of the demolition of two old public buildings: Health Care Centre and Hospital, and
- 2) action research of the decision-making processes and policy interventions related to systemic changes needed in the setting of circular economy policies, planning, market engagement, procurement, contracting, permitting and enforcement of public owned demolition projects and waste management and reuse of building parts and wastes.

The following new CityLoops instruments and approaches were applied in the demonstration cases:

- digital marketplace for buying or selling reusable building parts or materials.
- 3D modelling to track onsite CDW flows.
- Databank for Recovered Construction Materials.
- Monitoring environmental and health effects of demolition as well as hazardous materials and contamination of buildings.
- the CityLoops guide for pre-demolition audits was co-developed in parallel with the demo cases, using the Finnish pre-demolition audit guide as a model. The guide was tested by commissioning a pre-demolition audit of a part of the Pankalampi case.
- the CityLoops guide for selective demolition was co-developed in parallel with the demo cases.
- Lifecycle CO2 calculators for concrete, soil and mixed CDW developed by Roskilde Municipality were tested in Mikkeli demonstrations to compare waste management options

Screening of the buildings

Before and during the demolition of the demonstration buildings, screening procedures were carried out to find out the recycling and reuse possibilities of the demolition materials, to test 3D drone modelling to track material flows, and to monitor the health and environmental effects of the demolition.

Pre-demolition audits

A pre-demolition audit is an important part of planning a demolition project. The purpose is to assess the types and quantities of wastes, harmful substances, and the potential for the reuse of demolition materials and to suggest a material management plan accordingly. The pre-

demolition audit is typically divided in two parts: 1) an audit of asbestos and other hazardous materials and 2) inventory on reusable and recyclable materials.

In case of Mikkeli demonstrations, City of Mikkeli commissioned an audit of asbestos and other hazardous materials from a pre-selected external consultant (Ramboll Finland Ltd) for both demonstration premises as a standard practice. As a requirement for applying for a demolition permit, the City used its own staff to provide the building permit authority with a notification of demolition wastes, where the amount of each waste fraction was estimated.

In the CityLoops demonstration, the main focus was on the inventory part of reusable materials which is a voluntary practice in Finland. Xamk ordered a pre-demolition audit for the Pankalampi dental clinic building as part of the CityLoops project. The inventory was made by Ramboll Finland according to Finnish Ministry of Environment Guide (Wahlström et al. 2019). The audit report was included in tendering documents of the procurement of demolition contractors. In addition, Xamk students made a detailed inventory of the reusable furniture, HVAC equipment etc. of the dental clinic building, on the request of the Mikkeli Activity Centre.

CITYLOOPS GUIDE FOR PRE-DEMOLITION AUDIT

This procedure explains how a pre-demolition inventory and material audit can be conducted to identify building components and materials with reuse or recycling potential. CityLoops Mikkeli team participated in the co-development of the CityLoops pre-demolition audit guide in co-operation with the Capital Region of Denmark (see box below). The Finnish Ministry of Environment Guide on Pre-demolition Audits (Wahlström et al. 2019) was translated in English and used as basis for CityLoops guide. The experiences from Mikkeli demonstration were utilized in the CityLoops guide for pre-demolition audit. Furthermore, the pre-demolition audit report of the Pankalampi dental clinic building (Eskelinen 2020) was translated into English for the use of other demonstration and replication cities. Practical experiences from implementing pre-demolitions audits were gathered by interviewing Finnish consultants and other projects.

Lessons learned

The pre-demolition audit guide is an important tool that is suitable for replication in all demolition sites. Reuse of building parts cannot be promoted without a pre-demolition audit. Effective implementation still requires more experience. The pre-demolition audit should be done well in advance of the demolition and in cooperation with various stakeholders, so that the recycling of reusable materials can be connected to the design processes.

<Link to instrument>

[Microsoft Word - CityLoops Pre-Demolition Guide Final draft 15.3](#)

3D drone scan and flow-tracking

Drone monitoring was carried out by Xamk at the Tuukkala and Pankalampi demolition sites during 2021. The imaging was performed mainly 1-2 times a week during demolition phase, (in Tuukkala demolition site 10 times and in Pankalampi 24 times). In addition, monitoring continued in 2022 at the Pellosniemi replication site (10 times), where four apartment buildings owned by Mikalo Ltd rental housing company were demolished. The aim of the drone monitoring was to demonstrate mainly CDW volume calculations using 3D modelling tool (Figure 4). The methods and results are explained in more detail in a separate report (Vihavainen et al. 2023a)



Figure 4 Volume calculation from a material pile based on drone imaging and 3D modelling (figure Juha Vihavainen).

3D MODELLING TO TRACK ONSITE CDW FLOWS

The 3D modelling tool for tracking the flows of on-site CDW is an operations model in which a camera drone and a photogrammetry software are used for modelling and monitoring demolition sites in 3D. The tool uses commercially available software and equipment: Pix4DMapper software and DJI Phantom 4 drone. Volumetric measurements of material piles performed with 3D tool were compared to traditional tachymeter technique. The project also explored the suitability of a multispectral camera for material identification.

Lessons learned

The use of 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. Method can also produce useful data e.g., for the pre-demolition audit and planning of the demolition work. Volumetric measurements

based on 3D imaging could be a useful tool for contractors, building owners, consultants, and designers especially in the future, when the reuse of building parts and materials are expected to increase.

Multispectral camera used by Xamk (Micasense RedEdge-MX) was not able to recognize different CDW materials. However, camera techniques should be further investigated for automatic material recognition.

<Link to instrument>

[3D TOOL FOR FLOW-TRACKING CDW \(cityloops.eu\)](https://cityloops.eu)

Environmental health and safety check

In addition to increasing the circular economy, the demolition of buildings has many other environmental and health aspects that must be taken into account in sustainable and responsible demolition work. For example, stormwater from demolition sites can cause a significant load of solid matter and harmful substances into receiving water bodies but when the CityLoops project started, there was only little national research data on the topic in Finland. Recently, more attention has been paid to the management of stormwater in construction and demolition sites in Finland. Bigger cities have created guidelines for monitoring and managing construction site water, and there have been national discussions about the needs for e.g., legislative changes. Furthermore, workers and residents of the surrounding area can be exposed to dust and harmful substances during the demolition work. As part of the Mikkeli demonstration action, Xamk monitored environmental and health risks during the demolition phase of the Pankalampi Health Centre and Tuukkala Hospital.

The occupational hygiene measurements were made during the internal demolition phase. The amount of total respirable dust, the concentration of PAH compounds bound to particles, and the VOC concentrations were measured from sampling points located inside the buildings and with personal meters from two workers at the demolition site. Real-time dust monitoring with DustTrak Aerosol Monitor was used to measure the total mass of particles in five different particle size classes based on light scattering (Figure 5). The samples were analysed in the accredited laboratory of the Institute of Occupational Health.



Figure 5. Real-time dust monitoring with DustTrak Aerosol Monitor during the internal demolition phase in Pankalampi demolition site (left), dust deposition collectors (middle) and water sampling (right) in Pankalampi demolition site (photos Juha Vihavainen).

The dust deposition from the demolition work was monitored by collecting samples in the yard area of the demolition sites in Pankalampi and Tuukkala (Figure 5). Dry matter and ash content as well as elements (As, Cd, Cr, Cu, Hg, Ni, Pb and Zn) were analysed from the samples in an accredited laboratory (Eurofins Ltd). In addition, fine particle content in outdoor air was monitored with a DustTrak meter.

Water samples were taken from three stormwater wells around the Pankalampi demolition site (Figure 5). A blank sample was taken before the demolition work. Other samples were taken during the demolition work in May and July 2021 and after the demolition work in November 2021 and June 2022. The metal content, sulphate, total nitrogen, total phosphorus, DOC (dissolved organic carbon), TOC (total organic carbon), fluoride and chloride concentrations were analysed in an accredited laboratory (ALS Finland). In addition, field measurements were made with a YSI ProDSS water quality probe, which measured water temperature, electrical conductivity, pH, ORP (Oxidation Reduction Potential), dissolved oxygen and turbidity. Solid matter content was analysed at Xamk's environmental laboratory.

In Tuukkala, vanadium was found in bricks in the inventory of hazardous materials carried out by Ramboll Ltd. By the CityLoops project, more material samples were taken from the bricks. Samples were taken separately from masonry mortar, joint mortar for vertical and horizontal joints, and bricks. Heavy metal concentrations were analysed from the samples in an accredited laboratory (ALS Finland Oy). The elemental concentrations were also analyzed in Xamk's environmental laboratory using the X-ray fluorescence method (Niton XL3 950 GOLDD- analyzer).

Material samples were also taken in Pellosniemi replication site. Concrete and brick samples were analyzed in an accredited laboratory (ALS Finland Oy) for heavy metal concentrations, PAH and PCB compounds, as well as certain POP and VOC compounds. The elemental concentrations were analyzed with Niton XL3 950 GOLDD- analyzer in Xamk's environmental laboratory.

The methods and results of all environmental and health measurements are explained in more detail in the separate report (Vihavainen et al. 2023b).

Integration of the recovered materials data into the databank and digital marketplace

Databank

The data bank was designed by Xamk to store demolition site data gathered from drone monitoring. Developing the databank and testing it for Mikkeli demonstrations is described in more detail in a separate report (Hämäläinen 2023).

DATABANK

The data bank was designed by Xamk to store demolition site data gathered from drone monitoring. It was developed using the MERN stack. The data bank is designed to handle three layers of data: demolition sites, material lots, and materials. Site data was classified based on the Finnish Ministry of the Environment's guidelines (Wahlström et al. 2019) along with some minor changes. Material lots contain data such as the lot id, volume, and weight. Materials contain a category, reusability grade, a description, and file attachments.

Lessons learned

Balancing the amount of detail and ease of data entry suited our needs for the pilot sites but ended up creating some challenges when considering compatibility with other systems such as the marketplace. Originally there were plans to have the option to transfer material lots from the data bank to the marketplace automatically but having to enter the same amount of information for each material in the data bank as the marketplace wasn't feasible.

The CityLoops databank has been tested in Mikkeli, but it has not been used on a larger scale. During the implementation of the CityLoops project, it was noticed that there is a need for a more advanced system. In a spin-off project of CityLoops, Miksei Ltd. and Xamk have developed a pre-demolition audit reporting software program to be used to report and archive audit findings. Lessons learned from the development of the CityLoops database were used in the creation of the pre-demolition audit software.

<Link to instrument>

https://cityloops.eu/fileadmin/user_upload/Materials/Factsheet_tools/Factsheet_Databank_and_Digital_marketplace_Mikkeli.pdf

Digital marketplace for reusable items

INSTRUMENT NAME

The Digital marketplace (DMP) was developed by Miksei Mikkeli in close collaboration with the Mikkeli stakeholders and users of the DMP. The programming work was executed by an SME Metatavu Oy.

The DMP holds information about volume, price and general quality of several construction material categories. It is working as a web platform to facilitate the exchange of materials between the seller and buyer of the reused material. In the marketplace, currently available materials are listed as ads, with the opportunity for entities or households seeking such materials to search for them or solicit what they need.

In the demolition phase, the target users were the local waste management company Metsäsairila Ltd and the local non-governmental organisation Mikkeli Activity Center. Metsäsairila sells demolition materials, like crushed concrete, while Mikkeli Activity Center sells building parts, such as taps and sinks, and different equipment and furniture dismantled or taken from the demonstration object buildings on location and in digital marketplace.

Finally, the marketplace efforts were integrated with another similar national initiative in Finland (<https://materiaalitori.fi>), and efforts were made to increase awareness of the marketplace to encourage its use by other entities who demolish buildings or possess surplus building parts and materials.

Lessons learned

Miksei has found out that it has been challenging for the sellers and buyers to know about, and also for the circular economy operators to start using the marketplace, despite being involved in the development of it. The marketplace was used in the demonstration phase to enhance the reuse and recycling of the materials, but for now its effectiveness in doing that has been quite low. To develop more flexibility and bring new ideas to the demolition process and the value chains, Miksei uses social media and organises workshops and meetings with potential sellers that could be useful. We expect to get more material offers in the marketplace before the end of the CityLoops project from the planned demolitions, but also understand additional effort will be required to find many more users for the platform after the demonstration phase.

Since the start of the CityLoops project, many digital marketplaces for the construction and demolition materials have been established in Finland, and now there are marketplaces available for public organizations and households as well. For example the biggest marketplace, tori.fi, has continuously over 100 ads of dismantled bricks for sale, and dozens ads of dismantled windows, doors and timber. Besides Tori, there are

other marketplaces, based on auction principles, and Facebook groups, which sell recycled construction materials and building parts.

The conclusion is that commercial marketplaces are wide-spread and well-known for the public in Finland, and they manage nowadays a lot of reusable material and building parts. The success of the ads in the commercial DMPs is not known, though, and there still is a place for a dedicated solutions targeted to companies and public organisations, at least locally.

The publication of DMPs and other digital solutions require vast amount of marketing and communication to the stakeholders, which requires resources dedicated to the marketing and communication. The stakeholders must also be willing to implement the circular upcycling operation model, so that more items and building parts are to be reused.

www.kiertoon.fi

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), Mikkeli (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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