Department of Mechanical and Industrial Engineering

CHANGING WASTE-RELATED BEHAVIOUR THROUGH WASTE SORTING BIN SYSTEM DESIGN IN LILLEORU TRAINING CENTER, ESTONIA

PRÜGIGA SEONDUVA KÄITUMISE MUUTMINE PRÜGIKASTISÜSTEEMI DISAINI ABIL LILLEORU KOOLITUSKESKUSES, EESTIS

MASTER THESIS

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Tallinn, 2019

AUTHOR´S DECLARATION

Hereby I declare, that I have written this thesis independently.
No academic degree has been applied for based on this material. All works, major viewpoints and data of the other authors used in this thesis have been referenced.

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Thesis is in accordance with terms and requirements.

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Accepted for defence

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THESIS TASK

Student: Katrin Rekor 106895MADM

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Thesis topic:

(in English) Changing waste-related behaviour through waste sorting bin system design in Lilleoru training center, Estonia

(in Estonian) Prügiga seonduva käitumise muutmine prügikastisüsteemi disaini abil Lilleoru koolituskeskuses, Eestis

Thesis main objectives:

1. To change waste-related user behaviour through waste sorting bin system design process in Lilleoru training center.
2. To create waste-related behaviour steps, based on Cultural-Historical Activity Theory principles.
3. To offer a working design solutions for Lilleoru training center.

Thesis task and time schedule:

No	Task description	Deadline
1	Discover: Gathering research information about Lilleoru, its users and about initial waste management.	01.12.2018
2	Define: Waste mapping, primary requirements and constraints.	01.01.2019
3	Develop: Waste bin experiments, developing design offerings for the training center	01.03.2019
4	Deliver: Model development, mockups of design solutions, and label graphic design.	01.05.2019

Language: English **Deadline for submission of thesis:** "....." .....201.....

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ABSTRACT

The thesis carries out a thorough study and analyses of waste-related behaviour to manage a waste-related behaviour change in Lilleoru training center. Waste-related behaviour of the users is researched through waste mapping, waste bin setup, waste bin making and design proposal experiments throughout the entire process of change management. Through the study of waste throwing habits of target audience, I identify the possible waste sorting bin system and design for Lilleoru training center, and five steps of waste sorting change management for organisations.

RESÜMEE

Magistritöö analüüsib põhjalikult prügiga seotud käitumist Lilleoru õppekeskuses eesmärgiga viia läbi prügi sorteerimist puudutava käitumise muutus keskuse kasutajagruppide hulgas. Hoone kasutajagruppide käitumist uuritakse kaardistades prügikastide sisu, eksperimenteerides prügikastide paigutuse, sildistamise ja disainiga kogu muutuste juhtimise protsessi vältel. Vaatluste ja eksperimentide tulemusena pakun välja nii prügikastisüsteemi disaini lahenduse Lilleoru keskuse jaoks, mis aitaks tõsta prügi sorteerimise tulemuslikkust, kui ka prügi sorteerimist puudutava käitumise muutuse juhtimise viis sammu organisatsioonidele.

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1. PREFACE

The topic of my thesis emerged in response to a practical necessity in Lilleoru training center in Harju County, Estonia where I work as a volunteer. I am grateful to Ave Oit, the chairwoman of Lilleoru NGO, who pointed out the topic. I also want to thank Reet Aus, the Green Key environmental manager in Lilleoru NGO, and Harri Moora, the Programme Director and Senior Expert in SEI Tallinn, for consulting me on sustainability topics.

I am grateful to the supervisors - Kaie Kotov and Martin Pärn, for helping to take my work to new levels. Special gratitude to Kadi Pärn for supporting me and helping to structurize my work and to Riste Keskpaik for language editing. Thanks to all Lilleoru NGO members for your help and support, especially to Tea Tammelaan, Pille Lenk and Toivo Aalja. I am grateful to my family for every kind of inspiration and support and to Ingvar Villido, the founder of Lilleoru training center, for personal guidance and helpful techniques that have had a profound impact on my life.

Keywords: change management; Cultural-Historical Activity Theory; generative research; master thesis

2. INTRODUCTION

Waste has many names - rubbish, junk, litter, scrap, rubbish, trash or refuse. These concepts refer that waste is something unwanted by its owner (Tang, Yeoh, 2008). There is no waste in nature, it is a man-made concept (Kenkre, 2017).

In 1998, on the 26th of May, the government of the Republic of Estonia confirmed to set a goal towards the improvement of waste management, the reducing of waste generation, and the promotion of recycling (Gornaja, 1999). By now, in Estonia, in waste management, we have come to a critical point, where the State cannot likely fulfil the agreements made with the European Union, which means paying a strapping penalty.[1]

Lilleoru is an awareness training center, founded in 1993 in Aruvalla village, Harju County, Estonia upon the initiative of Ingvar Villido. Applying awareness as a tool provides endless opportunities to improve all aspects of everyday life, for example, practice sustainability. That means to understand the workings of nature more fully, and to live in a wise relationship with it.

> *We, as humans, need nature, not vice versa. Nature is perfectly capable of taking care of itself (Ingvar Villido).*

I am a member of Lilleoru learning community which is officially managed and represented by Lilleoru NGO. In Lilleoru, I am responsible for cleaning and waste management. After completing the building of the new training center in 2018, the community encountered the problem of not having sustainable solutions for waste management. In the beginning my task was to create a sustainable waste management system and to design waste bins for the new training center. In the course of the work, I started to realize that the biggest change I can make under the circumstances does not regard objects but people's behaviour. As a result of a series of experiments, feedback and the study process I came up with the practical design for the sorting waste bins and found out the optimal locations in the building.

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1. https://www.aripaev.ee/uudised/2018/09/25/pakendiorganisatsioonid-muudatusi-ei-saa-te-ha-uleoo; 23.05.2019

Designing the project I relied on the framework of practice-led research (Mäkela, 2006). Using the main principles of Cultural-Historical Activity Theory[2] (CHAT) that puts the understanding of people's everyday behavior center stage I applied iteration processes[3] and generative design methods (Sanders, Stappers, 2014) to design a research process for collecting reliable data about target users initial behavior. The results of the conducted research experiments are presented in the appendices (Appendices Nr II-Nr VII). CHAT is the principle of the change management theory in my project.

As a result of the analysis five steps to facilitate change in waste-related behaviour for organisations are suggested.

2. http://faculty.washington.edu/kfoot/Publications/Foot-CHAT-explored-dist-tf.pdf; 23.05.2019

3. https://www.interaction-design.org/literature/article/design-iteration-brings-powerful-results-so-do-it-again-designer; 23.05.2019

3. THE THEORY OF CIRCULAR ECONOMY AND THE WASTE HIERARCHY

> *The strong sustainability view is that - physical or human capital cannot substitute for all the environmental resources that comprise natural capital, because there is uncertainty over many environmental values, such as the value that future generations may place on increasingly scarce natural resources and ecosystem services (Brears, 2018, pg 11).*

What is circular economy (CE)? The home page of the Ellen MacArthur Foundation (that was inaugurated in 2010 to accelerate the transition to a circular economy) describes it as follows: Looking beyond the current take-make-waste extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- Design out waste and pollution;
- Keep products and materials in use;
- Regenerate natural systems.[4]

In a circular economy, economic activity builds and rebuilds overall system health. The concept recognises the importance of the economy needing to work effectively at all scales – for large and small businesses, for organisations and individuals, globally and locally. [4]

Transitioning to a circular economy does not only amount to adjustments aimed at reducing the negative impacts of the linear economy. Rather, it represents a systemic shift that builds long-term resilience, generates business and economic opportunities, and provides environmental and societal benefits.[4]

The model distinguishes between technical and biological cycles. Consumption happens only in biological cycles, where food and biologically-based materials (such as cotton or wood) are designed to feed back into the system through processes like composting and anaerobic digestion. These cycles regenerate living systems, such as soil, which provide renewable resources for the economy. Technical cycles recover and restore products, components, and materials through strategies like reuse, repair, remanufacture or (in the last resort) recycling. [4]

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4. https://www.ellenmacarthurfoundation.org/circular-economy/concept; 23.05.2019

The notion of circularity has deep historical and philosophical origins. The idea of feedback, of cycles in real-world systems, is ancient and has echoes in various schools of philosophy. It enjoyed a revival in industrialised countries after World War II when the advent of computer-based studies of non-linear systems unambiguously revealed the complex, interrelated, and therefore unpredictable nature of the world we live in – more akin to a metabolism than a machine. With current advances, digital technology has the power to support the transition to a circular economy by radically increasing virtualisation, de-materialisation, transparency, and feedback-driven intelligence. [4]

The circular economy model synthesises several major schools of thought. They include the functional service economy (performance economy) of Walter Stahel; the Cradle to Cradle design philosophy of William McDonough and Michael Braungart; biomimicry as articulated by Janine Benyus; the industrial ecology of Reid Lifset and Thomas Graedel; natural capitalism by Amory and Hunter Lovins and Paul Hawken; and the blue economy systems approach described by Gunter Pauli. [4]

> *Circular Economy aims to reduce resource consumption, recover materials, and recycle waste into new products and materials (Brears, 2018, pg 1).*

> *Circular Economy aims to keep resources in use for as long as possible, extract value from them while in use, and recover and regenerate products and materials at the end of each service life. As such, the Circular Economy focuses on recycling, limiting, and reusing the physical inputs of the economy and using waste as a resource, leading to reduced primary resource consumption. This is commonly referred to as the 3R (reduce, reuse, recycle) approach. (Brears, 2018, pg 13)*

Circular Economy is actually supported by another theory - the WASTEnomics, where the four core principles are: waste to zero; waste to own; waste as societal liability; and waste as asset (Kenny Tang and Jacob Yeoh, 2008). WASTEnomics sees the waste as something which could be a raw material of another product, as Circular Economy does. It tries to prevent with its principles, that the environment we use becomes a ‘waste sink’ - using either landfills or incinerators (Figure 3.1.). This scheme below describes the interrelations between the WASTEnomics and the Circular Economy principles.

The Circular Economy goes further, by its concrete suggestions and guidance for applying in the reality. The four key principles are:
1. preserve natural capital;
2. take a life cycle perspective (a. detoxification; b. dematerialisation; c. design for value recovery);

3. use policy instruments to achieve sustainable economic and environmental outcomes;
4. engage stakeholders to achieve sustainable outcomes (Brears, 2018, pg 20).

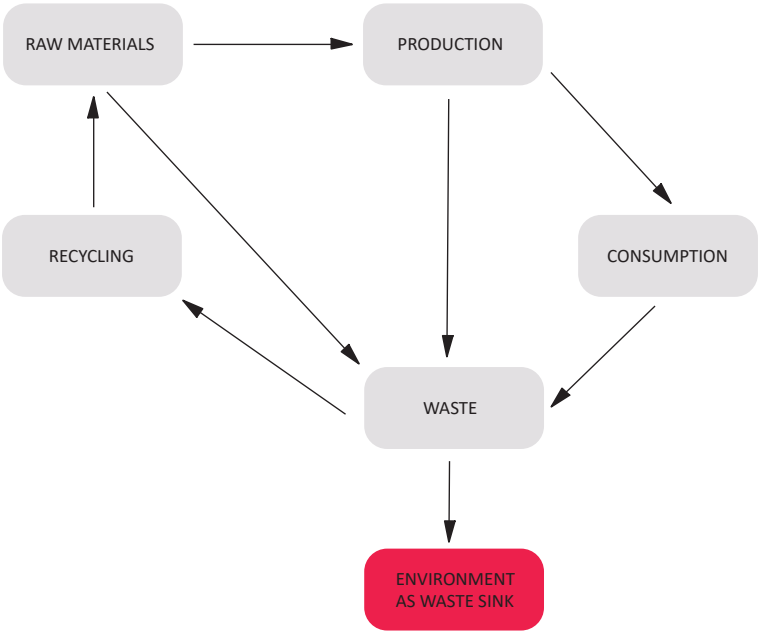

Figure 3.1. The Circular Economy (Dictionary of Environmental Economics, 2001, pg 28).

> *In Circular Economy waste is 'designed out' of a products' life cycle throughout innovation, rather than relying on solutions at the end of a product's life (Brears, 2018, pg 15).*

Product life cycle stages include (Brears, 2018, pg 21):

- Product design;
- Raw material extraction and processing;
- Manufacturing of the product;
- Packaging and distribution to the consumer;
- Product use and maintenance;
- End-of-life management (reuse, recycling, and disposal).

Table 3.1. Innovative Circular Economy approaches (Brears, 2018, pg 15).

Circular Economy approaches	**Description**
Light-weighting	Reduce the quantity of materials required to deliver a service
Durability	Lengthening the products" useful life
Efficiency	Reducing the use of energy and materials in production and use phases
Substitution	Reducing the use of materials that are hazardous or difficult to recycle in products and production processes

Table 3.1. continuing.

Recyclates	Creating markets for secondary raw materials
Eco-design	Designing products that are easier to maintain, repair, upgrade, remanufacture, or recycle
Maintenance/ repair services	Developing the necessary services for consumers to have products maintained or repaired
Waste reduction	Incentivising separation and collecting systems that minimize the costs of recycling and reuse
Industrial symbi-osis	Facilitating the clustering of activities to prevent by-products from becoming wastes
Consumer options	Encouraging wider and better consumer choice through renting, lending, or sharing services as alternatives to owning products, while safeguarding consumer interests (in terms of costs, protection, information, contract terms, insurance aspects, etc.)

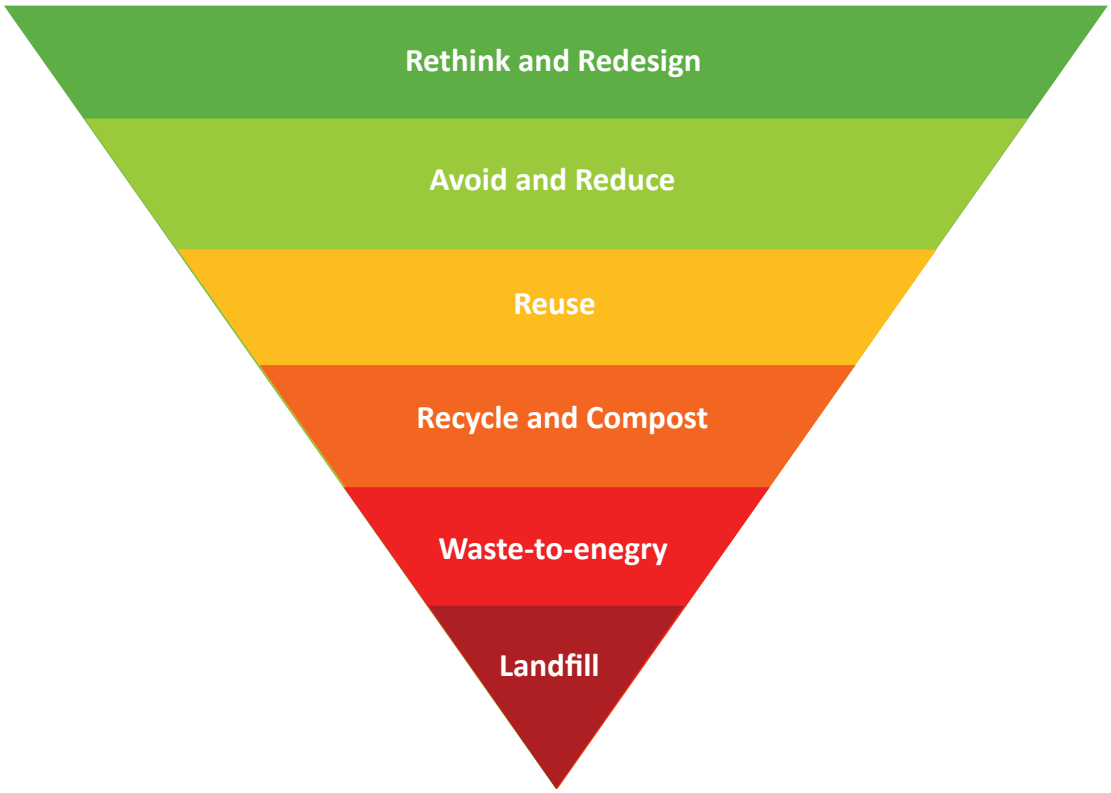

Figure 3.2. Zero waste hierarchy[5].

5. https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/warr-strategy/

the-waste-hierarchy); 17.05.2019

The waste hierarchy describes how sustainable different currently existing waste management practices are. In 1975, the European Union's Waste Framework Directive introduced the waste hierarchy into European waste policy for the first time.[6] It suggests that rethinking and redesigning is the best waste practice, after which comes reducing and avoiding waste. Adopting the strategy of voiding waste helps to reduce the extraction and use of virgin raw materials. The goal is to maximize efficiency and avoid unnecessary consumption through behaviours such as:

- Selecting items with the least packaging or that require the fewest resources to produce;
- Avoiding disposable goods or single-use materials;
- Buying products that are recycled, recyclable, repairable, refillable, re-usable or biodegradable;
- Using leftover food rather than throwing it away.[7]

The strategies of Rethink and Redesign:

- Design and purchase products from reused, recycled or sustainably-harvested renewable, non-toxic materials to be durable, repairable, reusable, fully recyclable or compostable, and easily disassembled;
- Shift funds and financial incentives to support a *Circular Economy* over the harvesting and use of virgin natural resources;
- Enact new incentives for cyclical use of materials, and disincentives for wasting*;*
- Facilitate change in how end users' needs are met from "ownership" of goods to "shared" goods and provision of services;
- Support and expand systems where product manufacturing considers the full life-cycle of their product in a way that follows the Zero Waste Hierarchy and moves towards more sustainable products and processes;
- Identify and phase out materials that cause problems for *Closed Loop Systems;*
- Facilitate and implement policies and systems to encourage and support *Local Economies;*
- Re-consider purchasing needs and look for alternatives to product ownership;
- Provide information to allow for informed decision-making;
- Be aware of and discourage systems that drive needless consumption.[8]

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6. https://eprints.soton.ac.uk/413600/1/CIWM_February_Williams.pdf; 23.05.2019
7. http://www.energyjustice.net/zerowaste; 20.05.2019

8. http://zwia.org/zwh/#1533001382197-873a7519-c4ae; 20.05.2019
Those two practices: avoid and reuse, are the ones where there is yet not any ‘waste’ as such. There are plenty of aftermarkets (f.e. second-hand shops), where things are sold, and the market is still growing. Waste as a notion occurs with recycling - waste is sorted, collected, and then recycled. Also the act of composting is dealing with waste, and in custom cases (where any micro-organisms, or special worms are not used) the compost separates emissions. The least preferred versions to deal with waste are waste-to-energy (incinerator) and landfill.

To sum up - the chapter gives a brief overview of circular economy and waste hierarchy theories (including WASTEnomics theory). Those theories form my view on how I understand the behaviour of users in Lilleoru training center.

4. METHODOLOGY

Design process is normally a fuzzy process, with wicked design problems[9] to solve at the beginning. The wicked problems can be very different, but are generally very hard to grasp. The wicked problems in design thinking hint that design is a flexible activity of using diversity of ideas and methods.[9] Although the process is organic nature there is also a pathway which leads to greater certainty, from ill-defined to defined problems using specific design methodologies.

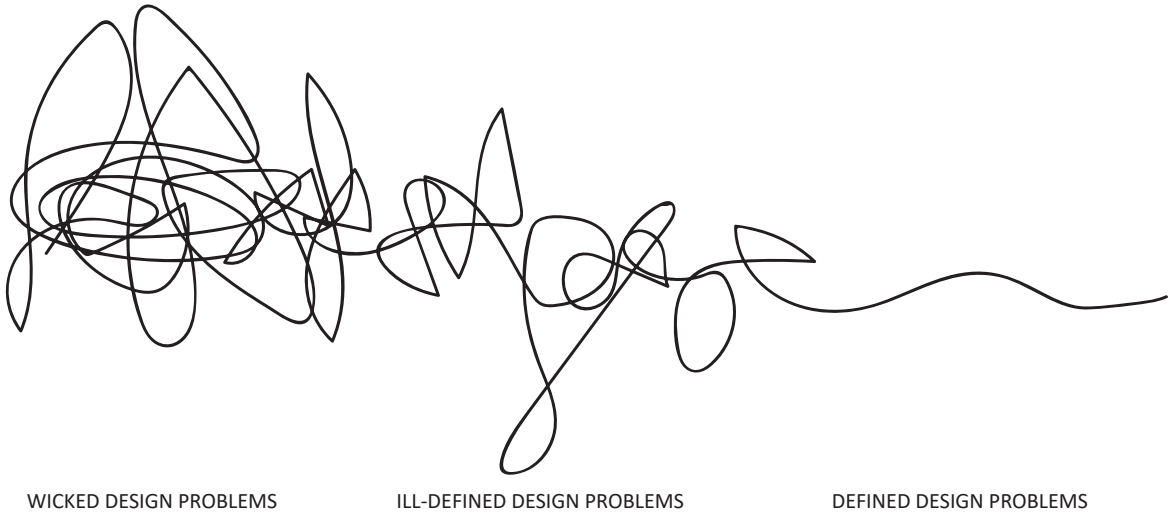

Figure 4.1. Dealing with complexity and wicked problems using design thinking[10].

The thesis proceeds from the framework of practice-led research. It focuses on research that 1) evolves through the making of art and design, where 2) the questions and challenges are identified and formed within these practices or out of the needs of the practitioners, where 3) the process of answering these questions or needs is advanced by means of practice and through making, while 4) drawing on methods and methodologies familiar in the field of art and design and finally, 5) where the researcher is also involved as a practitioner (Mäkela, 2006, pg 13). My project evolved from the initial problem setting (the need for a sustainable waste management strategy) through practical observations, experimentation and analysis to proposing of an operative solution of designing and locating the optimal bin system for the training center. The methods applied in this process are drawing from Cultural-Historical Activity Theory (CHAT), iterative design and from some generative research principles.

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9. http://web.mit.edu/jrankin/www/engin_as_lib_art/Design_thinking.pdf; 23.05.2019
10. https://www.slideshare.net/ServiceDesignLinz/keynote-oliver-kempkens-jam-2016-design-thinking; pg 33; 20.05.2019

CHAT centers on three core ideas:
1) Humans act collectively, learn by doing, and communicate in and via their actions;
2) Humans make, employ, and adapt tools of all kinds to learn and communicate;
3) Community is central to the process of making and interpreting meaning — and thus to all forms of learning, communicating, and acting.[2]

It considers that one never reacts directly to the environment, but rather intermediates the environment by culture, tools and signs.[11] CHAT suggests that new tools are used simultaneously with old tools and they are introduced to established organizational and social contexts to transform established practices.[11] In the context of my thesis, the established practices are patterns of waste-related behaviour in the community. In my research project I experimented with new design solutions together with the old to facilitate change in the established practices.

I am also using iterative process scheme to describe the structure of the process.

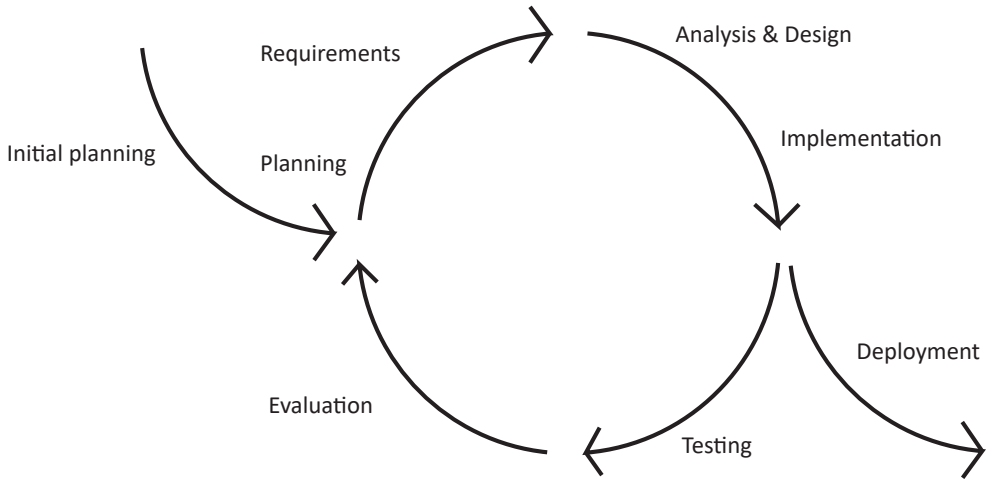

Figure 4.2. The iterative design scheme.[3]

For my thesis project I have used five iterations. In the first iteration (in Step 1, Figure 4.3. and Figure 10.1.), where I carried out two waste mappings, I used initial planning, planning and analysis phases. For the rest of the iterations (in Step 2 until Step 6, Figure 4.3. and Figure 10.1.), I used all of the iteration design phases. Below there is a figure of the process of my thesis project.

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2. http://faculty.washington.edu/kfoot/Publications/Foot-CHAT-explored-dist-tf.pdf; 20.05.2019
11. https://www.researchgate.net/publication/267332415_Cultural-Historical_Activity_theory_for_introducing_transformations_in_architecture_and_construction_A_case_study; 20.05.2019
3. https://www.interaction-design.org/literature/article/design-iteration-brings-powerful-results-so-do-it-again-designer; 20.05.2019

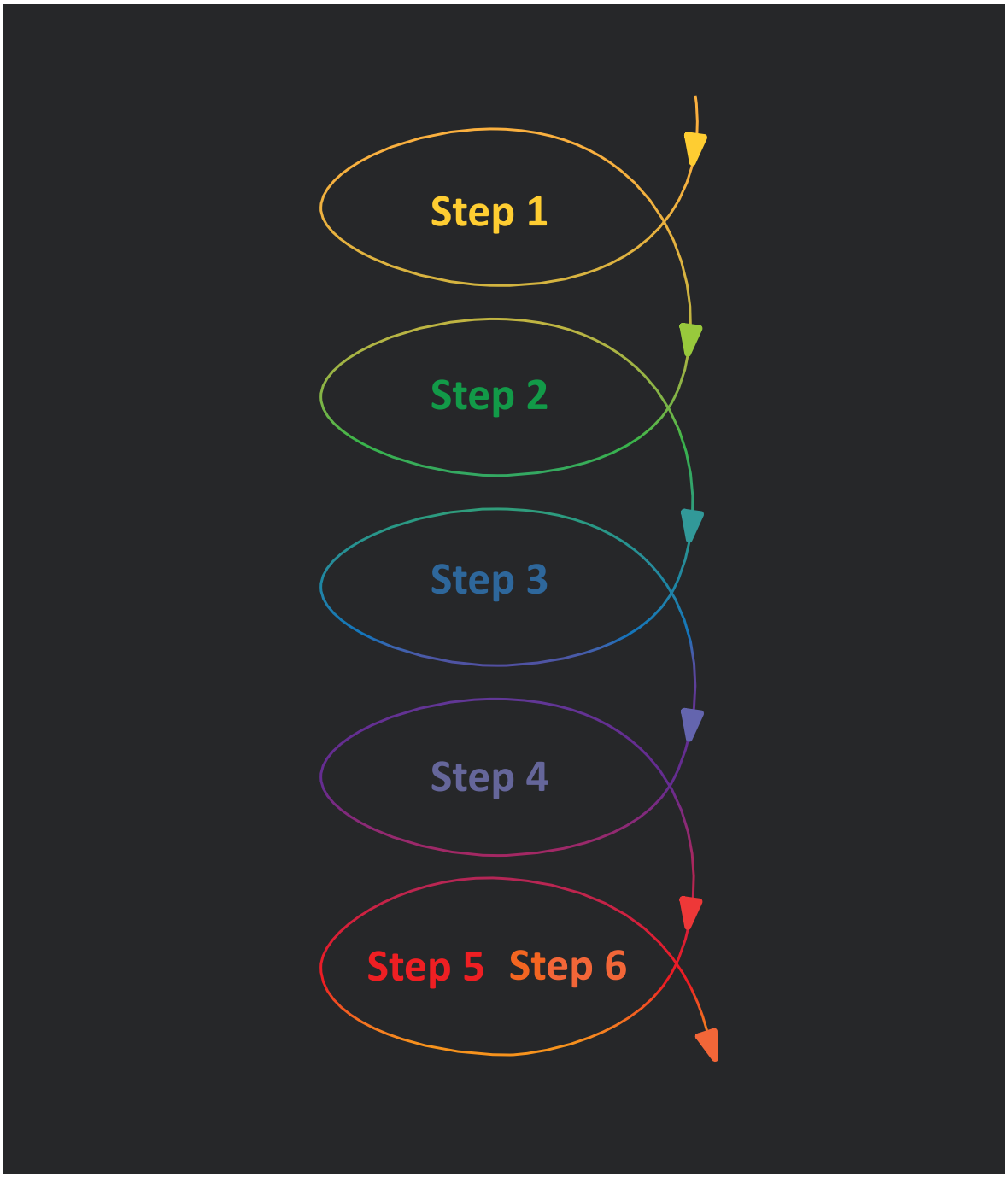

Figure 4.3. The iterative design scheme of my thesis project.

For handling the complexity in the first end of design (in defining the design brief)[12], I used generative research methodologies. The generative research methodology includes studying what people say, do, make (Sanders, Stappers, 2014).

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12. https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond; 23.05.2019

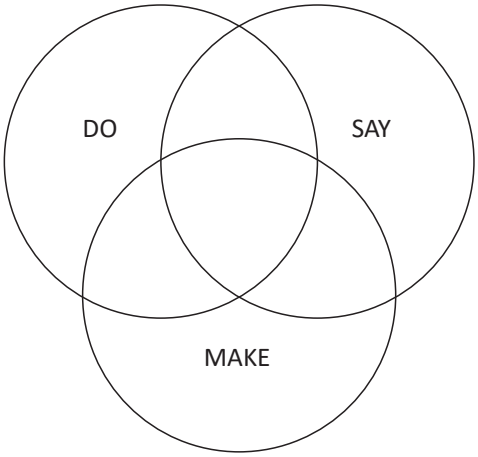


Figure 4.4. The interaction scheme between SAY, DO, and MAKE methods in generative research (Sanders, Stappers, 2014, pg 66).

In the generative phase I mostly relied on DO processes, because it was the most appropriate for collecting data about the user's waste-related behaviour. The DO processes I enforced were waste mapping, waste bin setup, bin making and design proposal experiments and participation observation. I also used SAY methods interviewing some key-persons in the training center management about their experience and concerns (Appendix IX). The MAKE process aims to find out what people think about the past and their desires to the future. The main target users of the bin systems, however, are visitors of the courses and events organized in the center and it would have been too demanding for them to go through this design process. Studying visitors' behavior was included in DO process which in itself gave enough informational input for the next stages of design.

In conclusion, my thesis is based on practice-led research. The design process of my project relies on the principles of CHAT, iteration processes and some of generative design methods to come up with a practical steps for waste-related behaviour change.

5. WHAT IS LILLEORU

Lilleoru is a learning center, which was founded in 1993, by Ingvar Villido. Today, the name covers an open learning and competence center (the School of Practical Awareness), a retreat center and the Flower of Life park.

Figure 5.1. Lilleoru training center: the School of Practical Awareness. Photographed in summer 2018 by Piret Pakler.

Lilleoru is located in Aruvalla village, Rae parish, Harjumaa, Estonia. It is about 25 kilometres away from Tallinn, the capital of Estonia. Lilleoru learning center is managed by Lilleoru NGO. At present about 150 people who regularly go to trainings there and manage the place form the active core of members. They develop and manage the learning center as well as take care of the territory and the buildings.

Different activities are carried out in Lilleoru. There is a big eco-label permaculture garden consisting of an orchard, herb and flower garden, forest area with a temple forest, study and adventure trails, primary school, a workshop for making curative herbal teas etc. Permaculture is practiced in the garden and forest area but Lilleoru also tries to apply this knowledge indoors.

Next to the Lilleoru training centre a private residential area — Taevasmaa village was founded by some long-time members of the learning community. Today about 50 people live in the village. There is also a retreat area in Lilleoru, with about 15 inhabitants.

5.1. The School of Practical Awareness

The School of Practical Awareness opened its doors in 2018. In addition to the unique educational content, the building is also special because of what it is made of and how — the house was built by volunteers and with the help of co-financing. More than 1000 people and donors contributed to this project over the course of five years, over 40 000 hours of voluntary work was done on the project. It is the biggest reed-bale building in Europe and the only public building of its kind in the world.

In 2019 the NGO has started to develop the next stage of the project — accomodation facilities to the adjoining wing.

5.2. Events in the School of Practical Awareness

An international training and competence center operating under the roof of the new building is based on the Art of Conscious Change Programme (ACC). The versatile training programme of the learning center includes both, workshops and courses conducted by different practitioners of Lilleoru's base teaching. Courses of the ACC, continuing education masterclasses and members' trainings regularly take place there. The purpose of the trainings is to introduce possibilities to manage one's life using awareness and one's inner resources with excellence. In addition there are many classes by guest teachers from all over the world supporting the lifestyle based on the conscious application of awareness in everyday life.

The building also houses Lilleoru Primary School and the Foundation for Future Education.

The building was first put to public use in the summer of 2018 when Lilleoru hosted the annual European conference and gathering of the Global Ecovillage Network (GEN) that brought here more than 500 visitors from more than 46 different countries from all over the world.

Here is an example of the schedule of events in the training center in one week (Table 5.2.1.).

Table 5.2.1. Schedule of events in the training center in one week. April 2019.

Date/ time	**Event**	**Room**
1st to 4th of April, Monday-Thursday/ 10-16	Primary school	Primary school room, other rooms
1st of April, Monday/ 18:30-20	Hatha Yoga	Seminar room
2nd of April, Tuesday/ 19-20	Course webinar	Therapy room
3rd of April, Wednesday/ 18:30-20	Hatha Yoga	Seminar room
4th of April, Thursday/ 19-21	Workshop lecture	Main hall
6th of April, Saturday/ 18:30-20:15	Continuing education	Main hall
7th of April, Sunday/ 11-19	Workshop	Kitchen, cafe area

5.3. Why are we dealing with more sustainable waste management

- Lilleoru has been promoting sustainable way of life for years;
- Lilleoru is the founding member of the Coalition for Sustainable Development in Estonia (2018)[13] and the Estonian Association of Eco-communities (est. 2008)[14];
- Lilleoru is practicing permaculture principles (Holmgren, 2002);
- To become more aware of our consumption habits, and to reduce undesirable consequences.

13. http://www.terveilm.ee/kestliku-arengu-koalitsioon/; 23.05.2019

14. https://www.kogukonnad.ee/; 23.05.2019

6. THE USER

Lilleoru is a public training centre that has nearly 200 unique visits monthly. There is a primary school working in the building which opened its doors in September 2018.

The users of the building are divided into: visitors (1. regular visitors of the house who are the members of Lilleoru NGO, its learning community; 2. visitors of courses and events; and 3. volunteers who come to Lilleoru for a certain period), the staff (1. office staff; 2. cleaning staff, 3. kitchen staff, 4. maintenance staff, 5. IT and sound equipment staff, 6. shop staff, and 7. therapists), and the primary school's children and its staff.

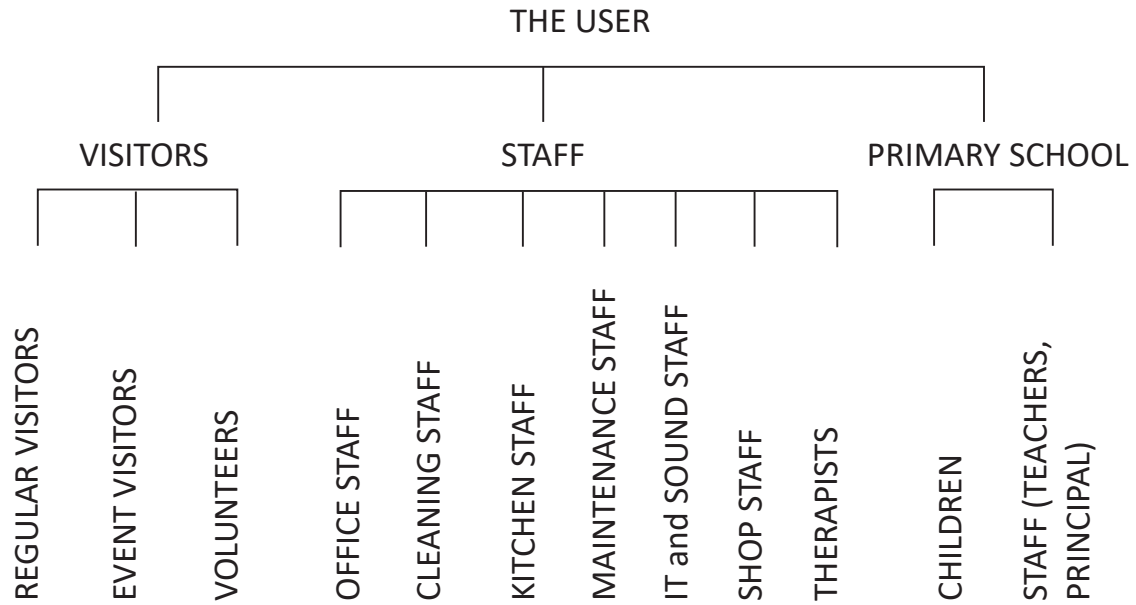


Figure 6.1. Main user groups of the building.

In the context of the thesis the regular visitor and the event visitor appear to be quite similar. Most of the NGO members (the regular visitors), come to the building once a month, for the continuing education training for one day. Some event visitors participate in events more than once a month.

The regular visitors use and move all around the rooms similar to the staff. Also the event visitors move around the whole house —for example they visit shower and dressing rooms after yoga lessons , café area for coffee and lunch/dinner, the shop, and some event room in the second floor

(main hall, seminar room, therapy room). See room plans in Annex I. The primary school children and staff also move around the whole house (children's wardrobe is in the office area for example) for different classes, and also outside territory. The list of activities of the user groups in each room of the training center is presented below (Table 6.1.).

Table 6.1. Activities of the user groups in the rooms of the training center. (The lower group in the "User groups' and "Activities" sections refer to background activities).

Area	**Operating area**	**User groups**	**Activities**
Second floor	Main hall	Regular visitor Event visitor Primary school Office staff IT and sound staff Maintenance staff Cleaning staff	Attending workshops Attending meetings Attending concerts Attending yoga classes Resting during breaks Sleeping at night Setting sound, screen, etc Maintenance Cleaning
Second floor	Seminar room	Regular visitor Event visitor Primary school Office staff IT and sound staff Maintenance staff Cleaning staff	Attending workshops Attending meetings Attending yoga classes Resting during breaks Sleeping at night Playing Growing plants Setting sound, screen, etc Maintenance Cleaning
Second floor	Therapy room	Therapists Regular visitor Event visitor Office staff Maintenance staff Cleaning staff	Attending meetings Attending therapies Conducting webinars Sleeping at night Growing plants Maintenance Cleaning
Second floor	Private room	Regular visitor Event visitor Maintenance staff Cleaning staff	Attending appointments/ interviews Meditation Maintenance Cleaning

Table 6.1. continuing.

Area	Operating area	User group	Activities
Second floor	Second floor hall	Regular visitor Event visitor Primary school Shop staff IT and sound staff Maintenance staff Cleaning staff	Attending meetings Having breaks from workshops Buying books/ tickets Cleaning Maintenance
First floor	Cafe area	Regular visitor Event visitor Primary school Kitchen Staff Maintenance staff Cleaning staff Shop staff	Eating Attending coffee/ tea breaks Attending meetings Serving food Working individually with a laptop Maintenance Cleaning Preparing labels/ products for the store
First floor	Kitchen, storage rooms, etc	Kitchen staff Maintenance staff	Preparing food Cleaning Maintenance
First floor	Cleaner"s room	Maintenance staff Cleaning staff Kitchen staff Regular visitor School staff Shop staff	Maintenance (Preparing) Cleaning
First floor	Household room	Cleaning staff Kitchen staff Shop staff Maintenance staff	Washing clothes Drying clothes Shop storage Maintenance Cleaning
First floor	Technological room	Maintenance staff Cleaning staff	Maintenance Cleaning
First floor	Storage room	Maintenance staff Cleaning staff	Place for tools Place for cleaning storage Cleaning Maintenance
First floor	School room	Primary school Regular visitor Event visitor Maintenance staff	Attending school/ giving lessons Attending workshops Attending seminars Attending other events Maintenance Cleaning

Table 6.1. continuing.

Area	Operating area	User groups	Activities
First floor, second floor	Toilets	All users	Using the toilet Cleaning Maintenance
First floor	Wardrobe	All users	Putting overcoats/ changing shoes Doing make-up, combing hair in front of the mirror Maintenance Cleaning
First floor	Office	All users	Attending meetings Working with computers/ laptops Printing Operating IT sector Maintenance Cleaning
First floor	Dressing rooms	Regular visitor Event visitor Primary school Kitchen Staff Maintenance staff Cleaning staff	Changing clothes Drying clothes Putting their extra things there Maintenance Cleaning
First floor	Shower rooms	Regular visitor Event visitor Primary school Kitchen Staff Maintenance staff Cleaning staff	Having a shower Maintenance Cleaning

From where does the waste come then? From observations and waste mapping I could see that users bring their own convenience items to the building and they consume the products and goods sold in the house. Visitors bring their own food, all users bring hygiene products for personal use, office staff gets letters, deplete felt pens, break pencil sharpeners, etc… This means that they bring products which become waste during the stay and they consume some local products that produce leftovers.

The users are different by name but they act similarly in the training center frequenting most of the rooms. There are some exceptions, like the storages, the kitchen and the maintenance rooms are only used by the staff, regular visitors, and volunteers but altogether in these rooms there are only three waste bins (plus kitchen bins). In my thesis project I mostly address waste management in the public areas, where more waste is created and/or discarded and the interaction between users and the waste disposal system.

7. INITIAL WASTE MANAGEMENT SYSTEM ANALYSIS

I started with my thesis project at the end of November, 2018. By then we had gotten the official permit for the public use of the building (in 30th of August 2018), and had hosted the Global Eco-village Network conference (GEN2018) in July 2018. Also we had started with organizing regular classes and events as well as primary school had moved into the building.

7.1. GEN2018 as an initial waste management task

The GEN conference was the first public event occurring in the house (some indoor decoration works were not even finished yet by then). I was assigned the responsibility for cleaning at the event which also included waste management. 500+ visitors was quite a lot to host, and I had only few weeks to organise everything. For the conference we created a waste sorting system into five categories with labels and instructions and placed the stations everywhere where needed all over the territory a outside and inside the house. This was the starting point of organized waste management in the training center.

Figure 7.1.1. GEN2018: “Meet the ecovillages” day. Photographed by Jüri Joost.

During the conference (and after it, as well), I discovered that most of the waste is still mixed waste, despite of the labelling and sorting system I had made. People threw their waste to the wrong bins. Especially at the busiest spots (for example, next to the cafeteria) the results were not good. We had better results indoors, but not sufficient yet. The results were surprising because the guests were "eco-people", so to say. From that time I realized the need for a real change wanting to make people sort their waste as much as possible, to reduce the amount of collected mixed waste in this way — to try to change people's waste behaviour. After the big public conference we left the system to be organised in the future and from there arose the subject for my Master's thesis.

7.2. Waste management system in Lilleoru training center by November 2018

The waste management task in the training center is divided between the kitchen and cleaning areas of responsibility, which are managed separately. Waste is collected together to larger bins, except compost, and is transported to AS Sekto (packages and paper & cardboard) and to Iru incinerator by AS Keskkonnateenused (mixed waste). We have one waste house co-owned with Taevasmaa village, but separate waste canisters. The training center has three canisters/ bins in the waste house — one paper & cardboard, one mixed waste, and one package bin.

Simple and partly reused bin solutions were adopted during GEN2018 and after. After the event, only mixed waste was collected, except in the kitchen. Most of the waste bins were paper tubes (ca 35L), except the smaller waste bins inside toilet rooms (from plastic, with a top, about 14L) and a designed sink cabinet in the toilet upstairs.

The waste bins had signs (mixed waste, package, compost and paper & cardboard) in July. Since then some signs were still on the tubes, but the bins were not arranged in a systematic way.

Figure 7.2.1. (Left). Plastic bins in toilets.
Figure 7.2.2. Recycled paper tubes.

Figure 7.2.3. Sink cabin waste bins.

By November 2018 waste management in Lilleoru training center public areas (except the kitchen) applied only waste-to-energy waste practices. (See also Figure 3.2 — full hierarchy of waste practices.)

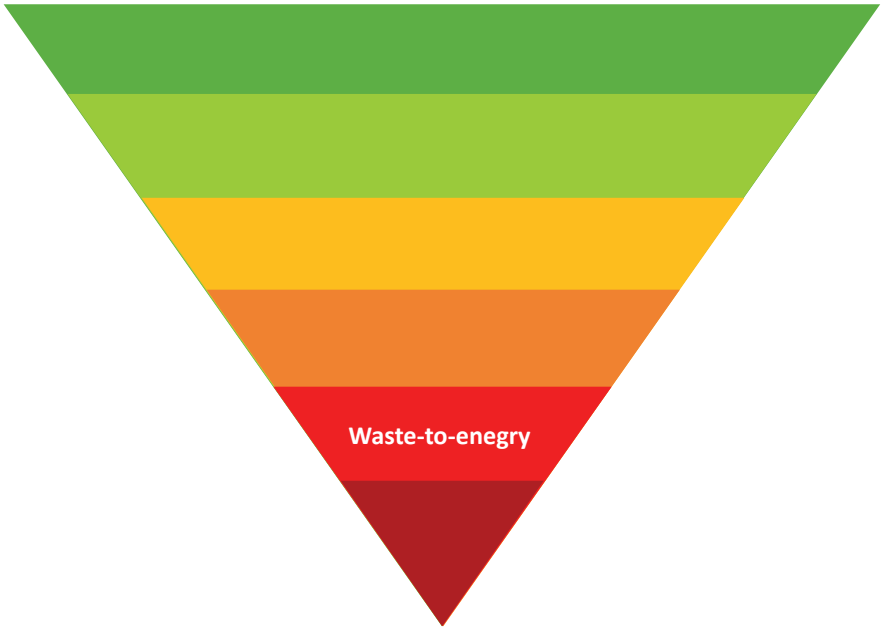


Figure 7.2.4. Initial, waste-to-energy concept in waste hierarchy system, in Lilleoru training center public areas.

7.3. Waste management in the kitchen of Lilleoru training center

The kitchen received its operating permit in March 2019. Yet it was already put to some use since June 2018.

Currently the old kitchen's disposal system from the retreat center house (which was the main communal kitchen in the previous period) has been adopted in the kitchen. No plastic or paper dishes are used in the kitchen. Pille, the head of the kitchen, orders yogurt from the nearby Pahkla Camphill Village (to also support people with special needs producing the yoghurt) and the packages (three-liter yars) are reused. The local permaculture garden sells some seasonal groceries, herbal teas and honey to the kitchen — also a great example of reducing package waste, and of growing local clean food. The head of the kitchen orders most of the groceries from nearby farmers, also in wintertime, but the rest of the necessary items (from cereals to candles) she buys from the wholesale store, packaged. Composting by the training center started from June 2018 following the example of the "old kitchen" which has had its compost grounds as long as anyone can remember.

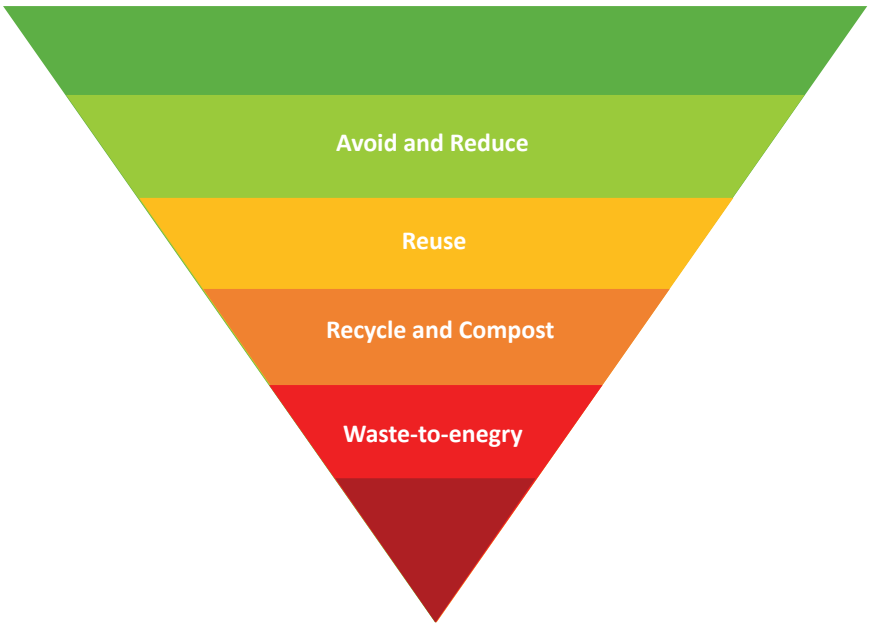


Figure 7.3.1. Waste practices applied in the kitchen of the training center.

From participation observations I have learned that most of the waste in the kitchen is comprised of packages (if they rinse them first) and compost, but also cardboard (from transporting food materials).

During the period of the thesis project, I was not able to manage all of the waste problems in the kitchen, so I concentrated on the public areas. Yet by January 2019, I had labelled all bins, and had given instructions how to sort waste in the kitchen (Tallinn's waste sorting instructions 2019).

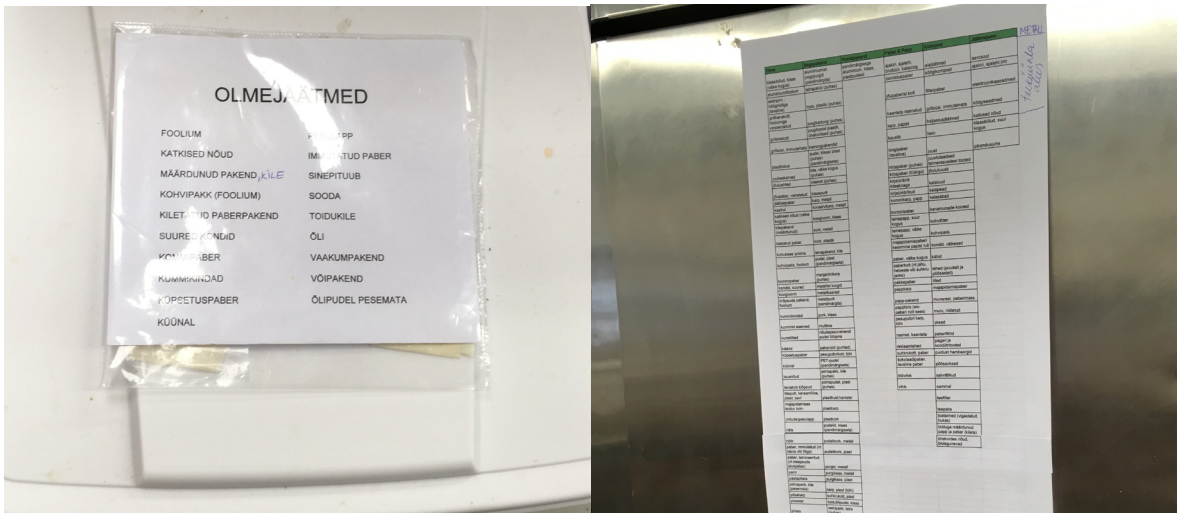


Figure 7.3.2. (Left). Waste bins in the kitchen now.
Figure 7.3.3. Waste sorting instruction on the kitchen fridge door.

7.4. The Circular Economy in Lilleoru

What else is being done in Lilleoru which supports the Circular Economy approach in addition to all that what has been mentioned above? We have a local giftshop, that offers sustainable products from cleaning products to toothbrushes, some of which are produced by the members of the NGO (Reet Aus wear, herbal teas) and are promoting sustainable lifestyle. The product development team (consisting of a number of members of the NGO), have formulated their operating principles following sustainability principles in the creation of a product. They have recently put out shampoos, soaps and cosmetics made from natural and ecological ingredients. Bicycle rent to support domestic tourism and moving lifestyle has been set up. We use some recycled cleaning cloths in the cleaning and maintenance teams, and use sustainable and ecological cleaning products only.

The Lilleoru training center itself is partly built from reused materials — revived materials from the theatrical project of NO99 entertaining a temporary reed-bale-theater hall in the summer of 2011. The building was designed with the consideration that visitors and users would not not wear shoes indoors — we decided that we avoid the extra work of regular thorough cleaning of the floors, so we did rethink the usage of a public building (which is not normally shoe-free). The present furnishing is all reused, and the new tables are simple and monocomponent that can be arranged in various manners.

7.5 Conclusion

To conclude the information about the current waste management system, I noticed that the present solutions are of various types. In Lilleoru all waste hierarchy practices are used simultaneously (except landfill) just like in circular economy recycling, reusing, avoiding and redesigning are used at the same time to offer solutions to most problems. In Lilleoru waste still occurs in waste-to-energy, recycle & compost, and reuse levels. Most waste practices were initially still relying on the waste-to-energy concept. What is clear about a public building however, is that the NGO provides services to the users of the training center, and we can control the waste generation among ourselves (in the kitchen, the product development, and cleaning teams and administration), but we can not control how much waste material the event visitor's bring along. In my research I focus more on waste management in public rooms and facilitating the change from waste-to-energy practices to recycling practices.

8. GREEN KEY STANDARD CERTIFICATE FOR THE LILLEORU TRAINING CENTER

Lilleoru is applying for the Green Key Standard certificate[15] for the training center. The Green Key is a voluntary eco-label awarded to more than 3,000 hotels and other establishments in 57 countries.[15] The eco-label is a worldwide known standard which attracts clients who appreciate sustainable thinking. So it is a community of people and buildings. In Estonia it is possible to apply the certificate for training centers, attractions, or accommodation buildings. In Estonia, the certificate is authorized by Stockholm Environmental Institute (SEI) for one year (after that it can be extended).

The Green Key system management is divided into two stages — the present conditions and the future developments. The first stage is the application and the evaluation of criteria to be met. Those consider many areas, for example, how the building is ecologically managed (water, electricity consumption; the cleaning products and waste issues; product development and staff/community trainings; and others). The application also requires a sustainability plan for the future (a plan for each year) which is the second stage, to update and remember the important issues to be met.

Here are some criteria that are more important in the context of this thesis:

- In the company, there are established environment policies;
- The management organises environmental issue trainings and meetings for the staff and community;
- The company encourages guests to participate in environment issues;
- Information about water and electricity savings, and waste sorting is available;
- The waste is sorted at least in three categories;
- There are waste sorting instructions for the staff which are easily accessible;
- Plastic disposable dishes are used only during some specific event, and only for take-away;
- There are waste bins in every toilet;
- Indicative: the food waste are composted;
- Indicative: the company signs a contract with the suppliers to recycle or reuse the packages;
- Issuing responsible environmental policy (the health promotion, providing career opportunities, the involvement and training of the staff);
- The materials/ accessories which is not necessary any more, are donated to reuse;
- The printouts need to be printed on recycled paper, ecolabel paper of printed in a company where environmental policies are followed;
- The company shows up initiative to reduce paper consumption in the office and rooms.[16]

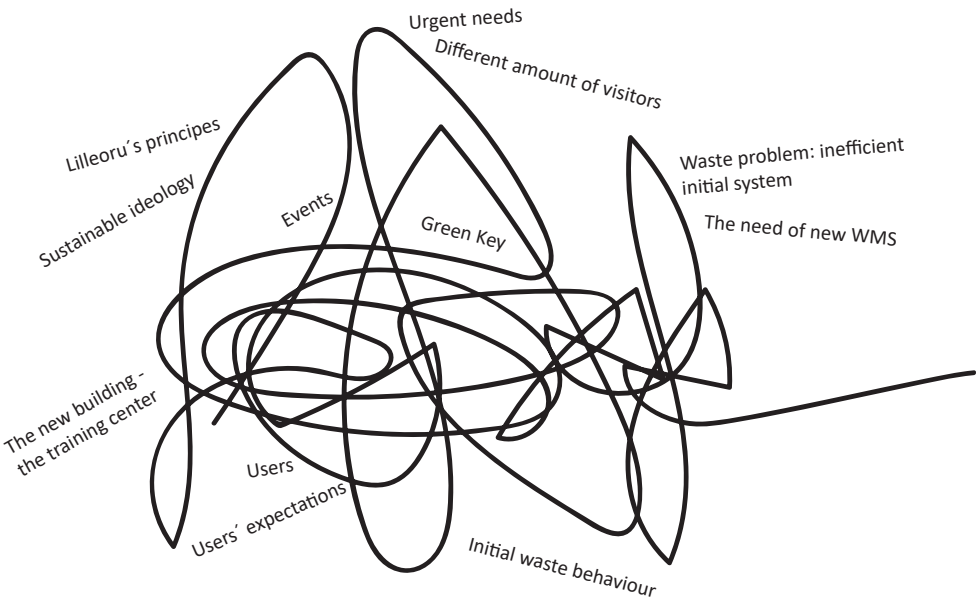
In Lilleoru, when we started the application we found out that most of the criteria were already met by that time (January 2019), including the Waste Management System (WMS). In WMS the only criteria were to sort at least three types of waste and not to use plastic disposable dishes (see the bullets above). By that time I had already started with the thesis project, and had created a mockup to test t people's reactions to sorting waste but I take the criteria of the Green Key into account in the design phase.

15. https://www.greenkey.global/; 23.05.2019

16. https://www.puhkaeestis.ee/et/turismiprofessionaalile/kvaliteet-turismis/roheline-voti; 23.05.2019

9. DEFINING THE PROBLEM

In the methodology chapter, I described the character of the design process (Figure 4.1.), with its wicked, organic-like research task. In the context of my thesis, I identified some keywords to map out the entanglement of different problems (Figure 9.1.).



WICKED DESIGN PROBLEMS

Figure 9.1. Wicked design problems in Lilleoru, at the starting point of my thesis.

From the period before the thesis proposal the need to reduce the amount of mixed waste through creating a viable sorting system which would change the waste-related behaviour “upwards” (see Figure 3.2), from waste-to-energy towards "greener" solutions had already become clear. So we needed to take the first step. When I discovered and defined the problems, I came across other questions: Why do people not sort waste even when it is possible; How much waste is produced during certain time periods; What kind of waste emerges and where does it emerge from? From these questions I moved towards waste mapping experiments, to get answers to the previous questions.

10. THE SCHEME OF MY PROJECT

To oriente better in my thesis project, I made a visual scheme of the steps to follow.

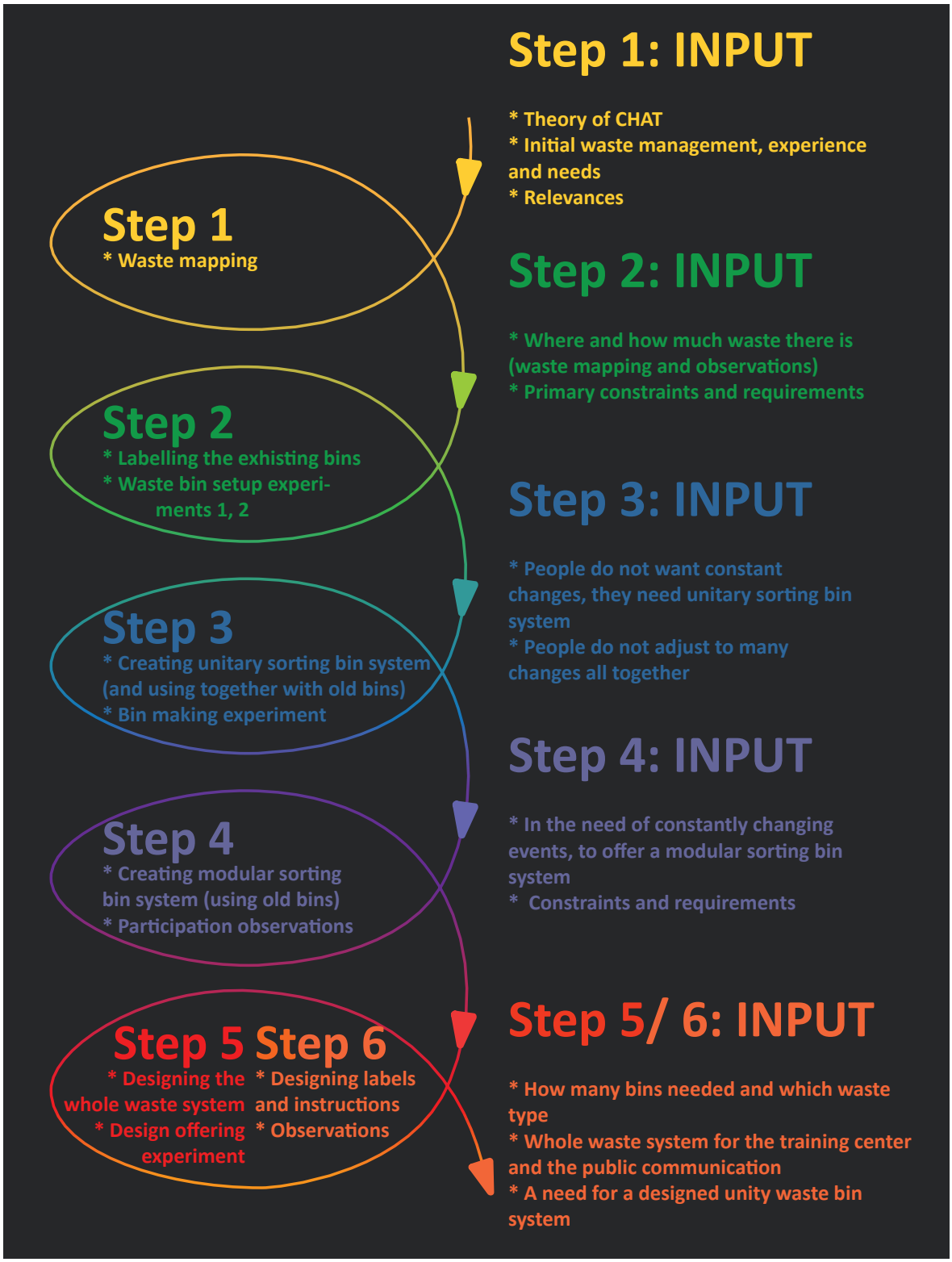


Figure 10.1. The scheme and the steps of my thesis project.

11. WASTE MAPPING

I conducted waste mapping two times, during two different events. In one occasion the event lasted lasted for three hours in the first evening. The next day I did waste mapping over 24 hours (people stayed overnight) (Table 11.1.).

I conducted the waste mapping as follows:

1. Marking and numbering bins on a plan (Figures 11.1.1, 11.1.2.);
2. Emptying the bins before the events;
3. Taking pictures of the bins' content after the events.

The waste bins were numbered when they were already located in the rooms.

Table 11.1. Data collecting from the waste mapping.

Event	**Date**	**The time range of waste mapping**	**The amount of visitors**	**Visitors who stayed overnight**
Helena Lass Workshop Silva Culture Workshop, day 1	22.11.18	3 hours	30 17	
Silva Culture Workshop, day 2	23.11.18	24 hours	17	6

11.1. The results

The results of waste mapping in 22nd of November (see Appendix II). In many bins there was no waste (in bins nr 23, 29, 7, 6, 5, 4, 20, 18, 21, 22). In bin nr 25 there was only paper inside, wet tissue paper was inside bins nr 3, 26, 27, 17, inside the other bins there was mixed waste. As people got in the events and did not have any coffee pause before or after, there was not so much waste in bins.

The results of waste mapping in 23rd of November (see Appendix III). I left the bins untouched (to collect more info about what waste is in the house), and only mixed waste was in the bins. In many bins there was no waste (in bins nr 22, 16, 21, 26, 24, 29, 8, 4). Inside bin nr 3 (under the tissue paper holder), there was also packages inside (the tissue paper wrapper), which means that probably the cleaning staff did not also sort waste. Waste came from the course breaks (coffee and tea breaks) at lunch and at supper. The people also brought their own food with them (the banana peels upstairs), and hygiene products.

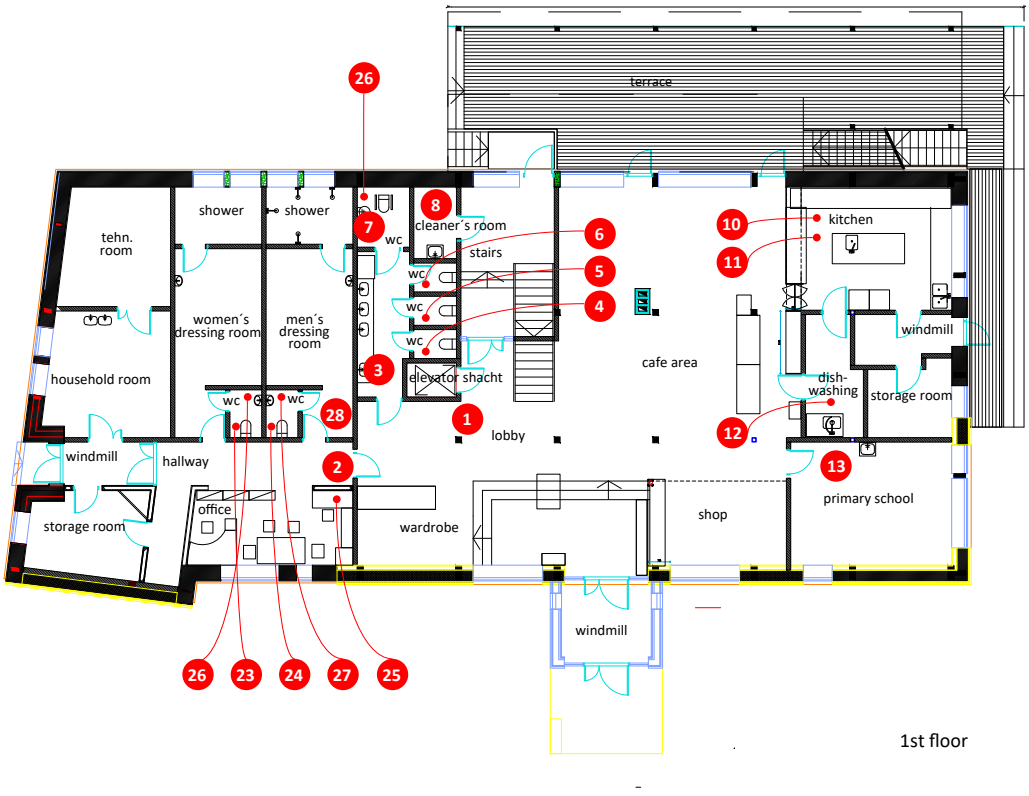


Figure 11.1.1. Waste bin setup on the first floor of the training center, in waste mapping.

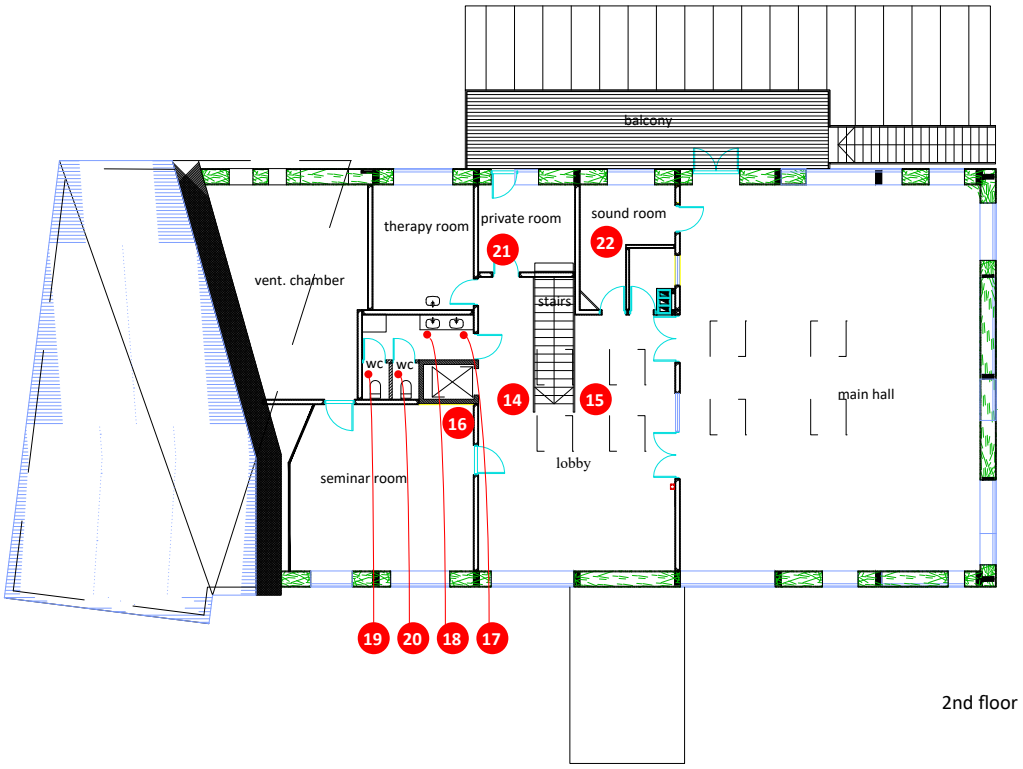


Figure 11.1.2. Waste bin setup on the second floor of the training center, in waste mapping.

11.2. Analysis

From the waste mapping, I saw that there appeared only mixed waste, even if some bins had labels - I witnessed that people do not either see the existing signs on the side of the bins, or they avoid it. I found out that there occurs four different types of waste (packages, paper & cardboard, compost, mixed waste), both down- and upstairs. So there is a need for a waste sorting system and solutions. The sizes of the existing bins are sufficient and not too big either (35L). Here are some other problems I witnessed. The compost in the mixed waste smells. The placement of the bins is chaotic, because there were other bins near the same area and some of them were not used much (f.e. in Appendix II, bins nr 14 and 15). In some areas there could be more bins (in cafe area; see the results in Appendix II). During the event, I saw that people want to throw away their waste when it emerges - they start looking for the nearest bin. In conclusion, the present solution does not offer the user any encouragement to be more environmentally sustainable.

11.3. The primary constraints for waste bin experiments

From the Lilleoru's main principles, waste mapping and from Green Key criterias, there occurred a few constraints and requirements for the future waste system experiments and design for the next bin experiments. This will supplement during waste bin experiment processes.

Primary constraints and requirements:

1. All four types of waste needs a waste sorting bin system.
2. There is a need for re-organisable bins.
3. Bins need labels.
4. Bin size up to 5kg or 35L (got to be suitable for draft waste bags) (otherwise too heavy for the cleaner to carry).
5. Suitable cover material to natural building like Lilleoru training center.
6. Compost should not smell.
7. Encourages guests to participate in environment issues.
8. People want to throw their waste away in the place where it occurs.

From these primary constraints, I try to find the efficient places for the existing bins, and put signs.

12. WASTE BIN SETUP EXPERIMENTS

The waste bin setup experiments consists of two researches to get more information about how the future bin solution should be and to lead people to the step of sorting waste.

12.1. Waste bin setup experiment 1

Waste mapping done and primary design constraints set I started to make experiments changing waste sorting system (using the constraints), with a purpose to see how the user react. In experiment nr 1, I put labels for waste sorting on top of the existing bins, and changed some locations.

I conducted the waste bin experiments 1 (and waste bin experiment 2, on pages 44-47) as follows:

1. Changing the bin locations in the rooms.
2. Marking and numbering bins on a plan (Figures 12.1.1, 12.1.6);
3. Emptying the bins before the events (in the previous evening);
4. Taking pictures of the bins' content after the events.

Table 12.1.1. Data collecting from the waste bin setup experiment 1.

Event	**Date**	**The time range of waste mapping**	**The amount of visitors**	**Visitors who stayed overnight**
Silva Culture Workshop, day 3 Babaji Kriya Yoga initiation, day 1	24.11.18	21,5 hours	17 50	6 30

During the day there was ca 70 people in the house, from whom 50 people were on event visitors training in retreat center house and about 20 people in training in the house. There was a lunch break and supper of all the 70 people together of which some were regular visitors, and two coffee and tea breaks for the Silva Culture workshop.

The bin setup: 1, 4, 6, 11, 12, 13, 14, 18, 20, 21, 22, 26, 28, 29, 30 - mixed waste; 2, 3, 7, 9, 10, 23, 24, 25 - paper & cardboard; 8 - batteries (see Figure 12.1.10.); 15, 17, 27 - packages.

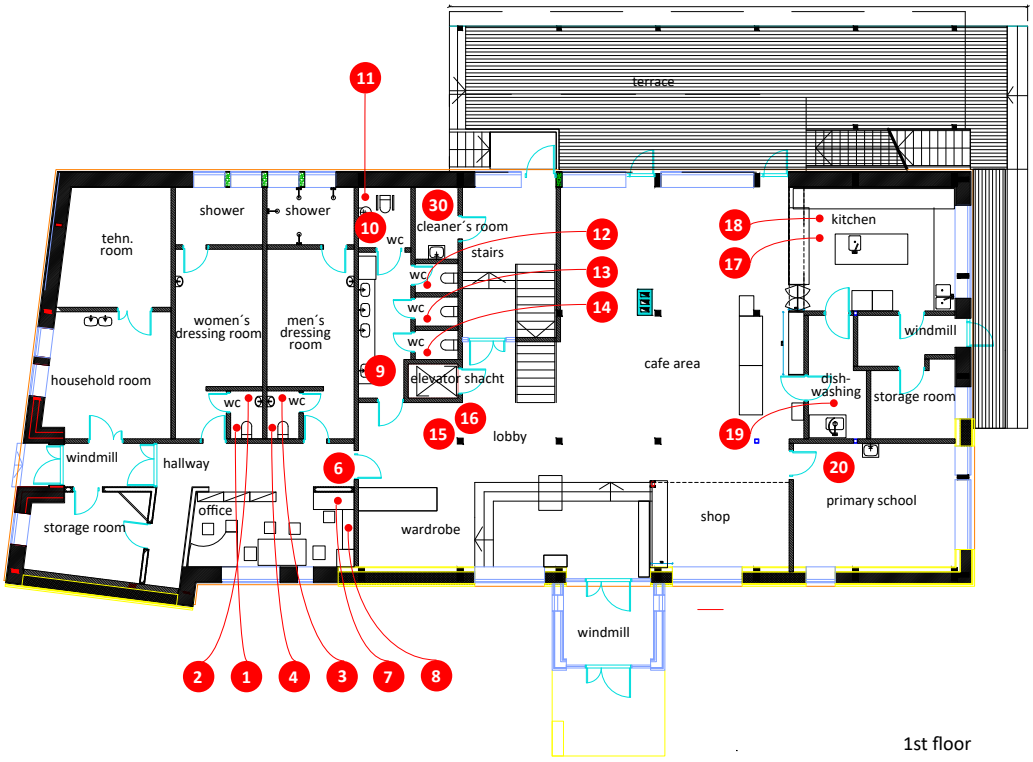


Figure 12.1.1. Waste bin setup on the first floor of the training center, in waste bin setup experiment 1.

The results. In bin nr 15 (package) (Figure 12.1.2), there is also compost and paper inside. Inside the paper bins there was no other waste this time. Inside bin nr 6 (mixed waste) (see Appendix IV), there was package and paper inside. Inside bin nr 27 (packages) (Figure 12.1.4.), there was compost, paper and packages inside. Inside bin nr 28 (mixed waste) (Figure 12.1.5.), there was a candle tag and paper inside. Inside bin nr 25 (paper & cardboard) (Appendix IV), there was only paper. Inside bin nr 30 (mixed waste) (Appendix IV), there was a cotton cloth. Inside bin nr 22 (mixed waste) (Figure 12.1.3.), there was paper, packages.

Figure 12.1.2. (Left). Waste is not sorted - compost and paper in "package" bin (nr 15).
Figure 12.1.3. Waste is not sorted - packages in "mixed waste" bin (nr 22).

Figure 12.1.4. (Left). Waste is not sorted - compost and paper in "package" bin (nr 27).
Figure 12.1.5. Waste is not sorted - paper and metal in "mixed waste" bin (nr 28).

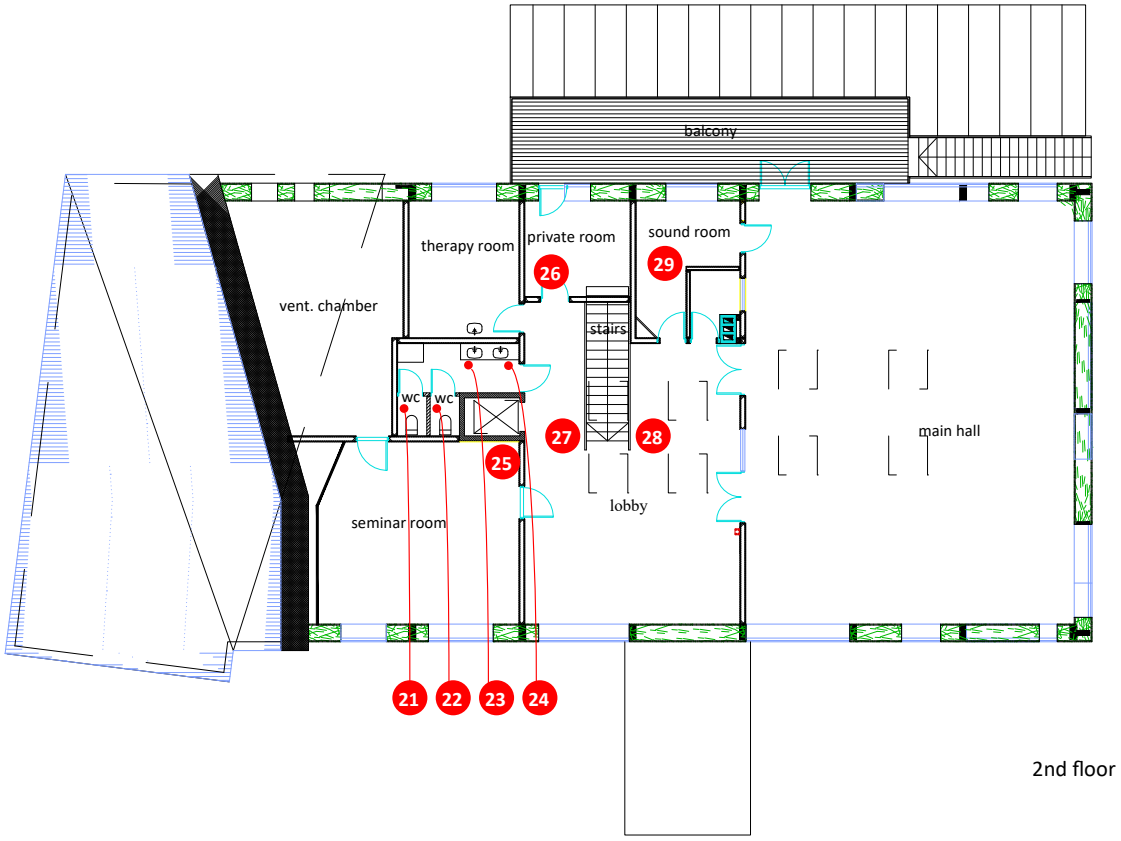


Figure 12.1.6. Waste bin setup on the second floor of the training center, in waste bin setup experiment 1.

Analyse. The people are throwing their waste wrongly. What is the reason then? Is it a lack of knowledge or just convenience? The fact is - when the waste is already thrown wrongly, then it does not matter where you throw the waste afterwise. People act randomly. And that is why the designed bins cannot be opened from upwards. And it seems from observations that some users can not notice the sign from the side.

Figure 12.1.7., 12.1.8., 12.1.9. Labelling the bins in the training center.
Figure 12.1.10. (down, right). A box for batteries - a printout from the website of Ragn Sells[17].

12.2. Waste bin setup experiment 2

I conducted a second waste bin experiment with labels on the existing bins and changed the bin setup again to clarify my assumptions from previous experiment, and to get more information of needed waste bin setup.

Table 12.2.1. Data collecting from the waste bin setup experiment 2.

Event	Date	The time range of waste mapping	The amount of visitors	Visitors who stayed overnight
Silva Culture Workshop, day 4 Babaji Kriya Yoga initiation, day 2	25.11.18	21,5 hours	17 50	

17. https://www.ragnsells.ee/wp-content/uploads/2015/05/sorteerimine_patareikarp.pdf; 17.05.2019

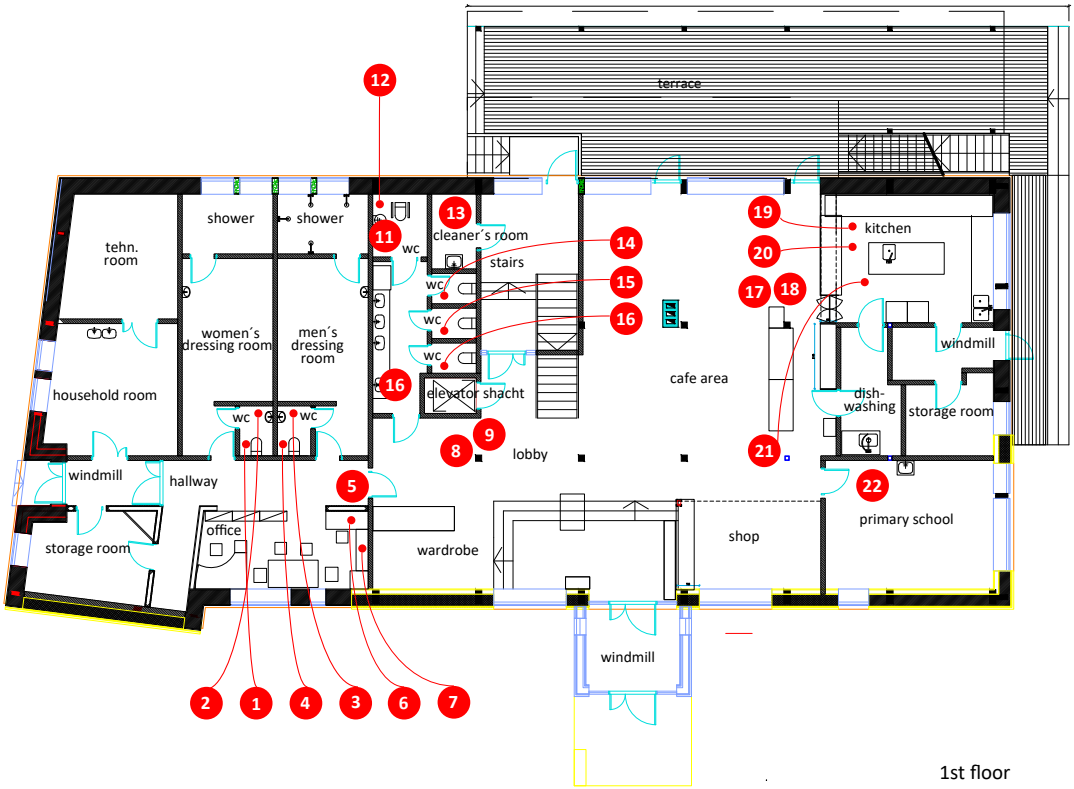


Figure 12.2.1. Waste bin setup on the first floor of the training center, in waste bin setup experiment 2.

The bin setup: 1, 3, 5, 9, 12, 13, 14, 15, 16, 19, 22, 25, 26, 32 - mixed waste; 2, 4, 6, 8, 10, 11, 24, 27, 28 - paper & cardboard; 7 - batteries; 17, 20, 31 - packages; 23, 29, 33 - without label.

This time there is 33 bins inside the house. I added four bins - two in the dining area, one to the second floor next to the stairs, and one I found in the backroom of the kitchen area.
I changed some labels on the hall of the first floor. Now there is the whole set of four different waste in the hall and dining area, on first floor.

The results. In bin nr 32 (mixed waste) (Figure 12.2.6.) there was package and paper. In bin nr 30 (compost), there is only compost. In bin nr 31 (package) (Appendix V) there is only package. In bin nr 24, 27, 28, 10, 6 (paper & cardboard) (Appendix V), there was only paper. In bin nr 5 (mixed waste) (Figure 12.2.3.), there are rubber gloves, plastic, paper. Inside bins nr 14, 1, 3, 15, 16, 12, 25, 26, there are mixed waste (hygiene products, paper rolls, toilet paper) (Appendix V). Inside bin nr 8 (paper & cardboard) (Figure 12.2.4.), there is a little paper, but also compost, package, mixed waste. Inside bin nr 9 (mixed waste) (Figure 12.2.5.), there is paper, package, compost. Inside bin nr 17 (package) (Appendix V), there is mostly package, but also a little of paper. Inside bin nr 18 (Appendix V), there is compost and a little of mixed waste.

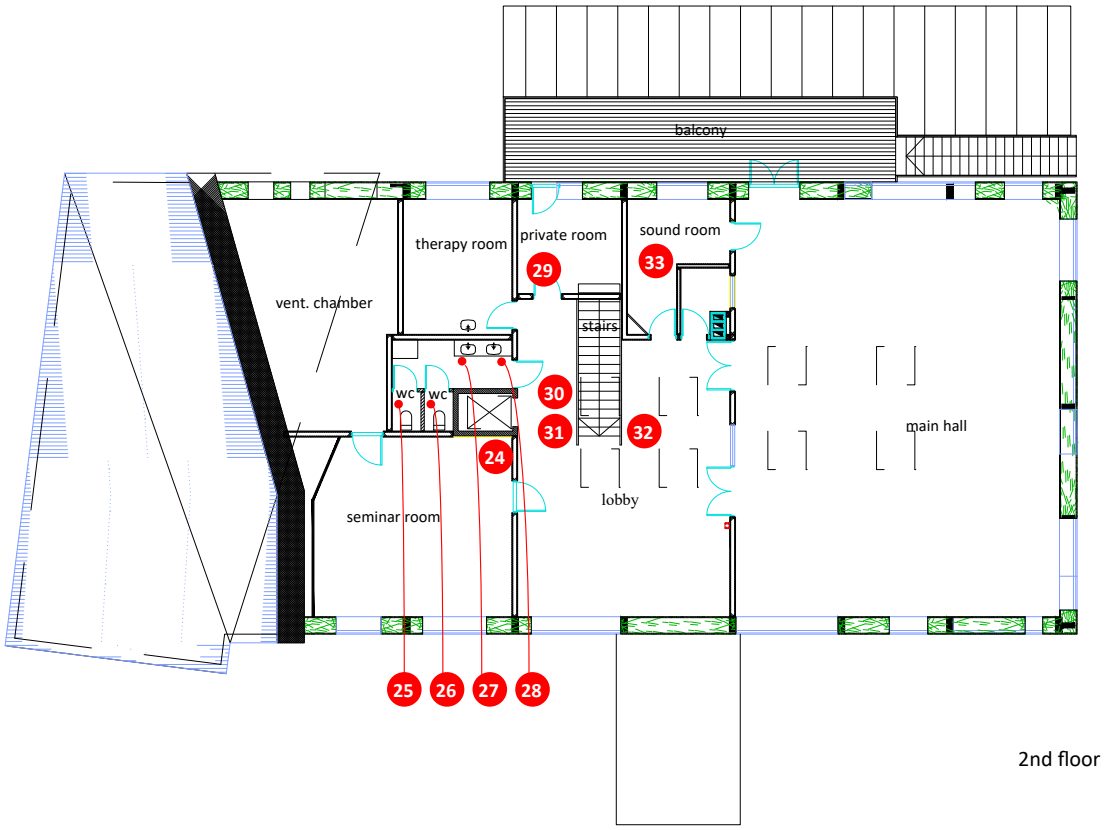


Figure 12.2.2. Waste bin setup on the second floor of the training center, in waste bin setup experiment 2.

Figure 12.2.3., 12.2.4., 12.2.5., 12.2.6. Waste is not sorted - paper and plastic in `mixed waste` bin (nr 5); compost and package and mixed waste in "paper & cardboard" bin (nr 8); paper and pack-

age and compost in "mixed waste" bin (nr 9); package and paper in "mixed waste" bin (nr 32).

Analyse. According to the results of the experiment, I claim that changing the labels of the bins (located in the same places), does not give a wished result, even contrary - when yesterday the label was different, then today I am throwing the (wrong) waste still in the same bin than yesterday. That is why, at least some of the waste bins need to be immovable and not change a place. At the same time there is a need to notice the needs of a certain event (bins nr 17, 18 in Appendix V), and place the bins in strategically correct place. During the last day I made some observations and small interviews in the kitchen about sorting (in Appendix IX).

12.3. Secondary constraints and requirements for the making of bins

I will add some constraints to the primary ones from the waste bin experiments.

Secondary constraints and requirements:

1. The bins need not to be opened from upwards (not to be able to see from outside);
2. The labels and instructions should be on the cover of bins;
3. There is a need for unitary sorting system bin (and should not move around the house);
4. There is a need for single bins, that could be arranged as in a modular system.

From these secondary constraints, I try to find the first solutions, which are formed from the old ones.

13. THE BIN MAKING - EXPERIMENT AND PARTICIPATION OBSERVATIONS

From the secondary constraints and requirements I can start making experiments with bin making, using the old bins at the same time, one change at a time - not to make a too big leap of change at a time.

13.1. The bin making experiment

I made a simple cardboard mockup for the first floor for trying out how a unitary sorting bin system could work.

I conducted the bin making experiments as follows:

1. Changing the bin locations a little, in the rooms.
2. Marking and numbering bins on a plan (Figures 13.1.1., 13.1.2.);
3. Emptying the bins before the events (in the previous evening);
4. Taking pictures of the bins' content after the events.

Table 13.1.1. Data collecting from the bin making experiment 1.

Event	**Date**	**Time**	**The time range of waste mapping**	**The amount of visitors**
The Art of Conscious Change course Learning community practice Primary school meeting Volunteering	8.12.18	10-17 19:30-22:30 11-13 9-18	28 hours	60 150 10 10

The day and events. In the SPA house there was a lunch break (12-13:00) for the trainees (ordered catering), and a coffee break (15-15:30). During the second break, I made observations (about where and how waste is thrown). From 17-18:45 there was people leaving from and some coming for the evening events. Supper for the volunteers and learning community was served in the retreat center (17:30-18:30).

During the course, there was a coffee break (for 30 minutes), I observed people's movement and behaviour with waste. Clementines, biscuits, apples, coffee and tea were served. There were plates and cups for the drink, in the close area there was only one waste bin, and the waste station near by. Some people wanted to throw waste away some people left the waste on the plate (which were brought on the table next to dishwashing room).

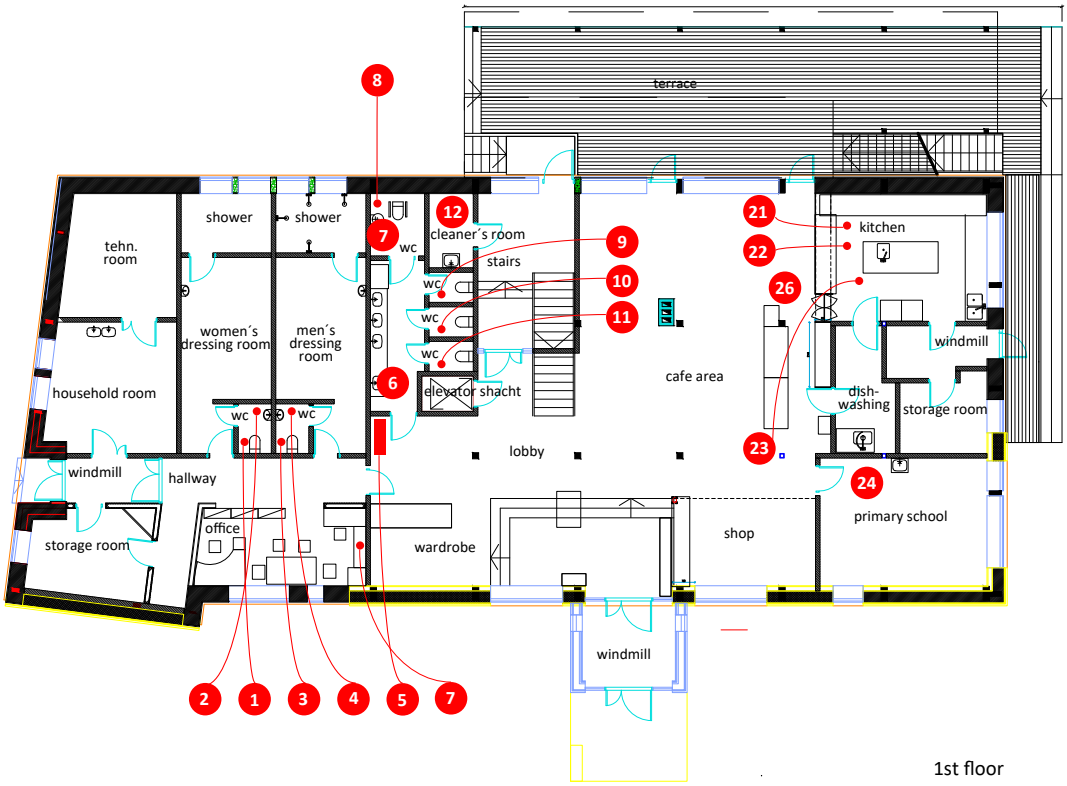


Figure 13.1.1. Waste bin setup on the first floor of the training center, in bin making experiment.

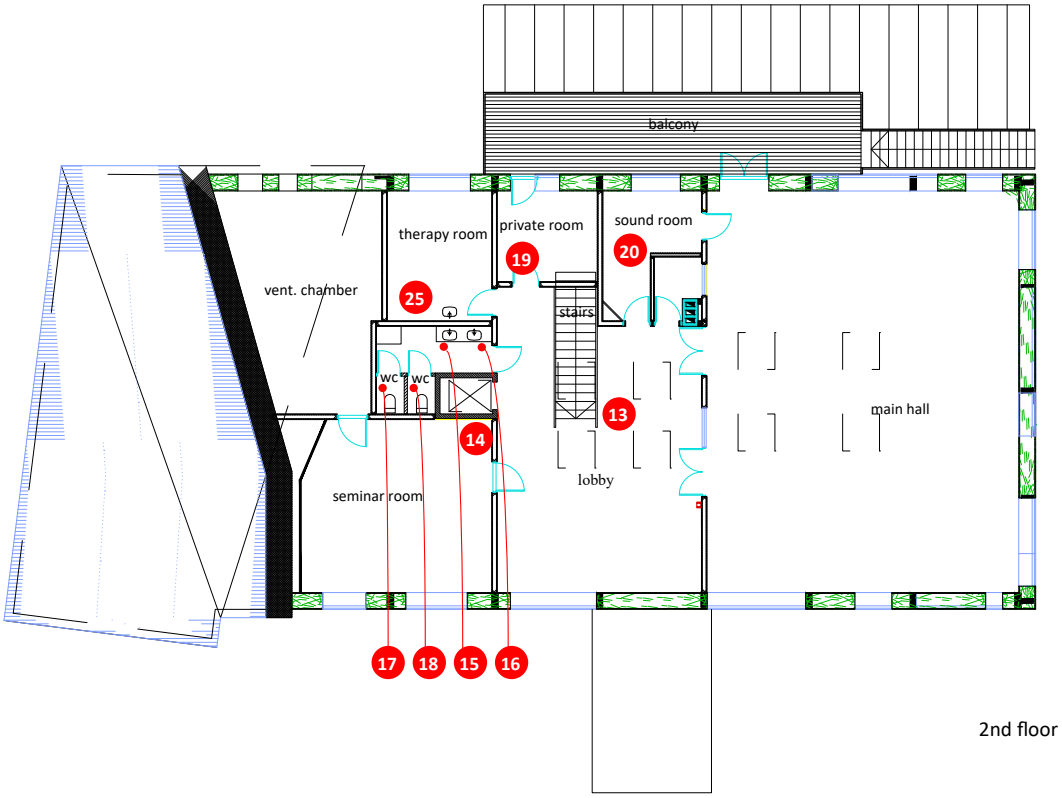


Figure 13.1.2. Waste bin setup on the second floor of the training center, in bin making experiment.

The set up. Most of the bins are still the paper tubes, which does not have any label with waste type on the side (except the bin nr 14, paper and cardboard). Bin nr 5 is a first version of design of a sorting station mock-up, where there are “holes” for four types of waste (compost, paper, package and mixed waste).

The results. In bin nr 14 (paper and cardboard) (Appendix VI) there was package. In bin nr 16, 2 (mixed waste), there is only tissue paper, and package. In bin nr 25, 19 (without label) there is only tea candle bottoms. In bin nr 17, 18, 15, 1, 10, 11 there was mixed waste. In bin nr 20, there is paper, package. Inside bin nr 13, there is tea candle bottoms, compost, package. In bin nr 3, 4 there is mixed waste and package inside. Inside bin nr 7, 9 there is only tissue paper inside. Inside bin nr 6 there is diapers, paper and tissue paper inside. There is paper, package and compost inside bin nr 26. Inside waste station nr 5 (Figures 13.1.6.-13.1.9.), there is only compost in compost, most of paper (besides 1 “paper” coffee cup) inside paper, only package inside package, and most of mixed waste (besides 1 plastic bag) inside mixed waste. There is only batteries inside box nr 7 (batteries).

Figure 13.1.3. (Left). Waste making experiment mockup with labels and instructions.
Figure 13.1.4. The second solution for the compost "hole" cover.
Figure 13.1.5. (Right). The first solution for the compost "hole" cover.

Analyse. The unity waste bin system works. Most of the waste is thrown inside the right "hole", with few misleadings. It seems still that these misleadings come from uncertainty what waste is what type. There is a need of sometimes having some extra waste stations, so the movable bins should be labelled, if needed (not in the case of mixed waste). In the dining area there should be different waste type (especially compost) bins in the area.

Figure 13.1.6. (Up left). Paper and mixed waste in "paper" waste bin in the unity sorting bin system.
Figure 13.1.7. (Up right). Compost waste in "compost" waste bin in the unity sorting bin system.
Figure 13.1.8. (Down left). Package waste in "package"waste bin in the unity sorting bin system.
Figure 13.1.9. Mixed waste in "mixed waste` bin in the unity sorting bin system.

13.2. Waste bin making and participation observations

I made modular single bins to across the building to test whether the previous constraints offer right solutions.

I conducted the bin making and participation observations as follows:

1. Changing the bin locations a little, in the rooms;
2. Emptying the waste bins during cleaning.

I made participation observations during few weeks, and took a role of cleaning staff at that time to notice the pluses and minuses of the present solution criterias. I took some bins away from public use, because there was not so much waste inside. I used the old bins together with new ideas of covering the waste bag.

Figure 13.2.1. Modular single bin mockup.

The results and analyse. It is not clear why, but there are still some misleadings on waste throwing of the users. Could it be because there still is a little opening on the top (inside is seen a little)? The design offering should answer to that. There was no problem of losing some bins from public use, but should the user bring their food and drinks to upstairs, where we have carpet on the floor?

The experiments were a success and the criterias seem to be right. I will go on further in the direction of design offer, but before that I will make a quick research what is happening in reality in that field.

14. DESIGN RESEARCH

To better understand the present situation in the market I made a visit to the Tartu Nature House and a mapping of existing product solutions (keeping the requirements in mind).

14.1. Visiting Tartu Nature House, Estonia

In reference to the Green Key requirements, I visited Tartu Loodusmaja and its Green Office. I got several ideas from there:

- Sorting the waste (see Figures 14.1.1., 14.1.2.);
- Raising awareness of waste-related behaviour (see Figures 14.1.3.-14.1.4.).

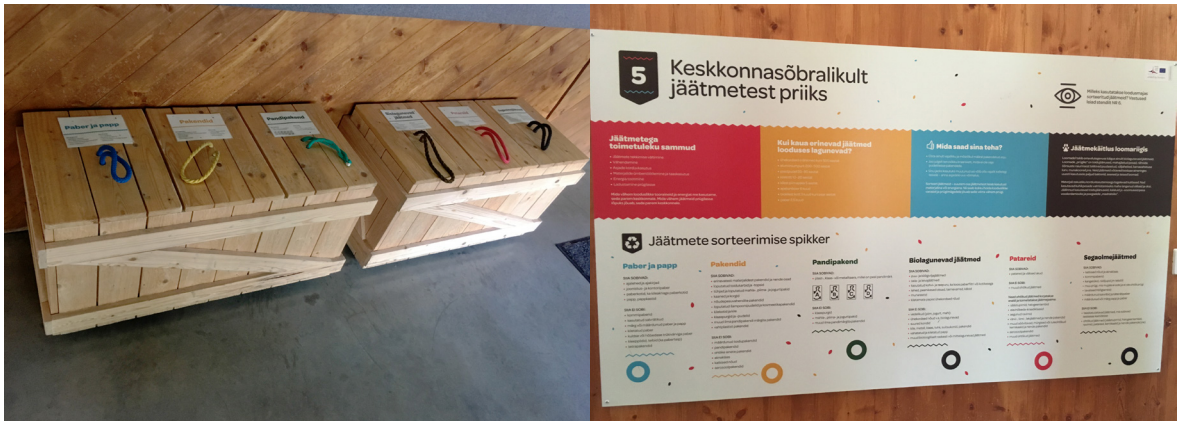


Figure 14.1.1. Waste sorting bin system.

Figure 14.1.2. A poster which instructs waste sorting.

Figure 14.1.3. (Left). Suggestion of moving by foot.

Figure 14.1.4. (Middle). A poster of the water consumption.

Figure 14.1.5. A poster of how plastic waste turns to a new product.

Table 14.1.1. Plusses and minuses of the visit"s examples for Lilleoru"s case.

Figure	Plusses	Minuses
Figure 14.1.1.	This bin system is a module, what is used in interior design in many ways - sometimes it is a box for slippers, sometimes a seat and sometimes a cupboard for medical equipment.	As a bin it is uncomfortable to use because its covers are very heavy. The appearance is suitable for Tartu Nature house, but not to Lilleoru training center. For cleaning staff it is not so comfortable to empty.
Figure 14.1.2.	A very educative poster.	Before waste disposal you need to read a lot.
Figure 14.1.3.	A great idea to practice in a building with an elevator. Could be used as a principle for having less bins in the house to move more (Green Office idea).	None. Could be used as a principe.
Figure 14.1.4.	For an educative building, it is a good solution to educate its customers.	The customers of Lilleoru does come for inner education.
Figure 14.1.5.	Good solution for education again.	In Lilleoru"s primary school is a good solution.

There are some ideas which are adaptable to Lilleoru training center, but bin system solutions are not suitable, because we do not need such kind of a modular interior design element system.

14.2. Mapping of existing product solutions

To map out the existing product solution, I am making a comparative table.

Table 14.2.1. A comparative table of existing sorting bin solutions in the present market.

Sorting bin solution	Name	Cost	Appearance	Performance	Suitable?
	Indoor bin Berna	5 tk = 1345 eur	Material: colored metal.	Emptying system not visible from outside. But emptying is one at a time.	Too colorful and bothersome to emty.
	Indoor bin Bermuda Quad	925 eur	Material: sheet metal, plastic tops. No labels or instructions.	Emptying system not visible from outside. Is a unity system.	That is a problem, that there is no labels or room to put them ourselves.

Table 14.2.1. continuing.

Sorting bin solution	Name	Cost	Appearance	Performance	Suitable?
	Indoor bin Zell	5 piece = 990 eur.	Material: colored metal. Quite neutral appearance.	Do not know how the inner emptying system is, is not visible. Has enough sorting units in one bin.	If the waste unit is bigger than the whole, then what happens? There is no solution for that here.
	MOHEIM Swing bin	1 piece = 62 eur	Material ABS, natural wood veneered MDF. Materials in appearance are rather tolerant to any situation.	The design does not involve a system where to put a litter bag, so maybe it is designed only for paper waste in the office.	Although the appearance is suitable, the shape and performance is not well suited for our conditions.
	Unknown	Unknown	Veneer and plastic. Appearance quite neutral.	Only three types of waste could be sorted, not modular. Not seen how it is opened.	Only three types of waste could be sorted, not modulat. Not seen how it is opened.

From the table I got to know that the biggest problems are:

- The possibilities for labelling the waste sorting system are missing;
- The waste bins are not very easy to empty by the cleaning staff;
- The aesthetics is not very suitable to a natural style building like Lilleoru training center.

In conclusion. On the present market there are not so suitable product solutions to Lilleoru training center - there is a need to propose design solutions.

14.3. Design constraints for bin systems in Lilleoru training center

To sum up all of the knowledge I got from defining the problem until the mapping of the existing product solutions, here are the last of constraints and requirements to design a suitable solution to Lilleoru training center.

1. Encourages guests to participate in environmental issues.
2. People can throw their waste away in the place where it emerges.
3. Dirt resistant and/ or easily cleanable.
4. Suitable cover material to natural building like Lilleoru training center.
5. One unit with waste, size up to 5kg or 35L (otherwise too heavy for the cleaner to carry).
6. One unit got to be with suitable measures for a draft waste bags.
7. There should be labels and instructions on top of a bin, appropriate to location and emerging waste types.
8. The bins are used by adults, seniors and children.
9. The waste inside should not be seen from outside.
10. The cleaner should be able to empty the bins easily and ergonomically (as little moves needed than better).
11. The bin of the compost waste should be closeable, breathable, the bin should avoid flies and bad smell (outside the bin); and portable (with a handle).
12. Paper & cardboard inside bin is portable (with a handle).
13. If the waste unit is bigger than the “hole”, the user should understand and should be able to throw this unit also.
14. The waste bag should not be seen from outside.
15. A unitary non-moveable sorting system solution downstairs, single modular ones to the other areas.

15. DESIGN PROPOSAL

As the latest steps, I will firstly talk through some of the findings from the experiments with the members of the Lilleoru NGO board. Next i will make sketches and a design proposal. Then I will make a mockup out of the offer, and test it in design offering experiment. As the last thing i will offer a label and instruction solutions to the bins.

15.1. Meeting with the NGO board

I met with Ave Oit and Toivo Aalja, the board members, and introduced the findings from my activities. I explained to them, that as the head of the cleaning team, i have reorganised the bins several times. From my experiences, I made an offer about the bin setup in rooms (and until how many people it possibly serves), the waste bin needs (what is the minimum in the present moment), and the problems that possibly need public communication.

We decided on the setup and waste bin minimum needs, and decided to make a decent last mockup to test the design offering. The last issue that we discussed, was about the problem that people bring their food and drinks to upstairs. Ave and Toivo thought that it is a very logical step to ask people to eat and drink in the cafe area only. They will start with public communication about that - to inform people in the beginning of the events.

15.2. Design proposal

The idea that met all of the needs (constraints and requirements), is a simple clever solution, what offers a possibility to reorganise and regroup the waste bin modules (the cover is not attached to the body, so it is possible to change waste units, without moving the bins) (Figure 15.2.1.). I also sketched and thought of possible solutions how to fix a waste bag (Figure 15.2.2.) or how to empty the buckets from inside. Thought about possible material choice (Valchromat) and got inspiration about the possible technologies to apply with using this material.

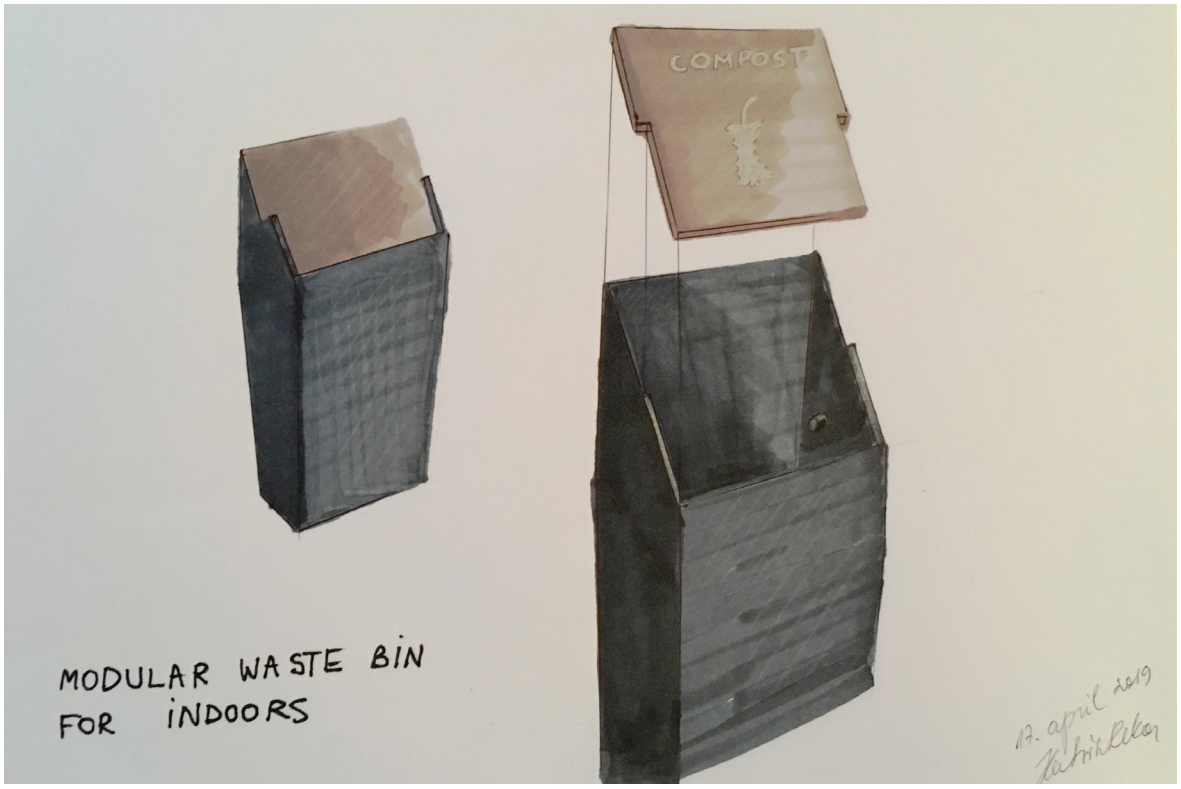


Figure 15.2.1. A sketch of design solution offering. A single modular bin.

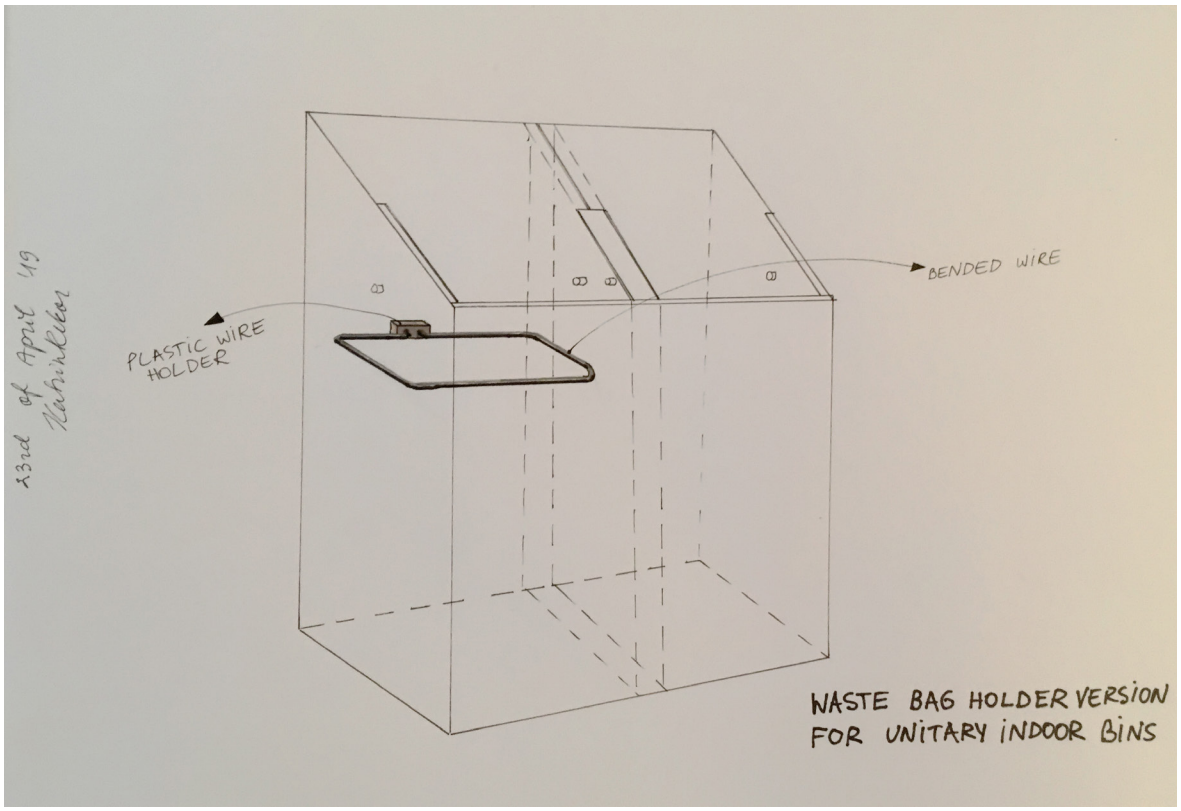


Figure 15.2.2. A sketch of a possible waste bag holding solution. A unity sorting bin system.

I made the final mockups to the training center (Figure 15.2.3.). This time i decided to make the mockup from RE-board and made 2D drawings for two unity sorting bins (Figure 15.2.4.) and for two single modular ones (Figure 15.2.5.).

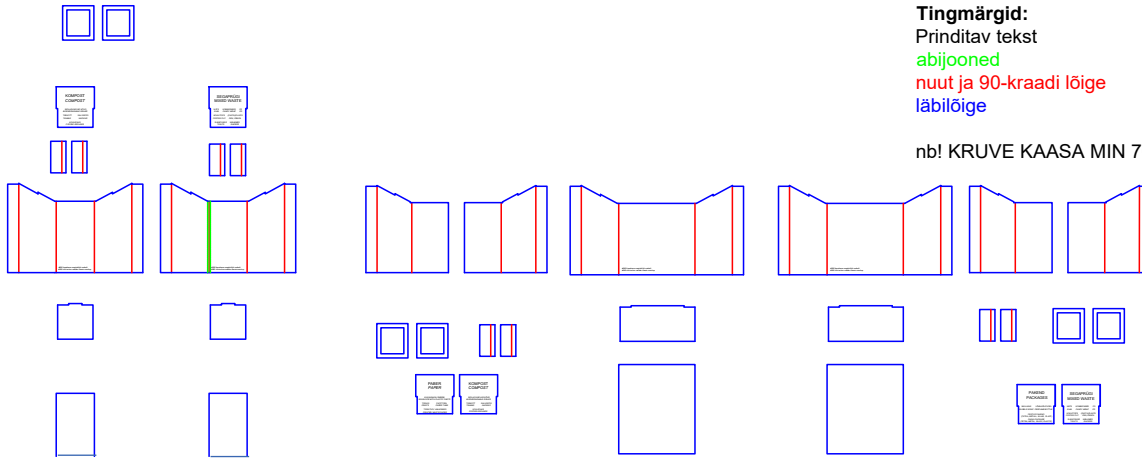


Figure 15.2.3. The mockup drawings for RE-board (blue lines are usual cutting lines, red ones are a mark for a V-cut).

Figure 15.2.4. Two unity sorting waste bins, with instructions and labels.

Figure 15.2.5. Two single modular bins, with instructions and labels.

Very soon, when some people started to try out the new mockup, it began clear, that people do not find a way where to put the waste? It was clear that i have to make some quick graphical solution on the cover, so people could use it, while I am redesigning the cover decals. Here is the quick solution during that evening (Figure 15.2.6., 15.2.7.).

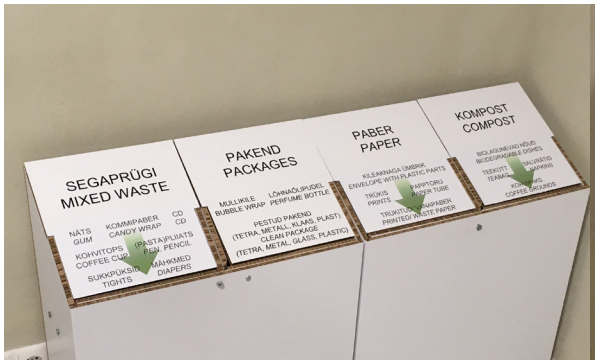


Figure 15.2.6. (left). Quick primary graphic solution on the covers of unity sorting bins.
Figure 15.2.7. Quick primary graphic solution on the covers of single modular bins.

15.3. Design proposal experiment

With the new mockup finished, I was anxious to see about how this changed the waste-related behaviour, so i made another experiment.

I conducted the design proposal experiment as follows:.

1. Marking and numbering bins on a plan (Figures 15.3.1., 15.3.2.);
2. Emptying the bins before the events (in the previous evening);
3. Taking pictures of the bins' content after the events.

Table 15.3.1. Data collecting from the design proposal experiment.

Event	**Date**	**Time**	**The time range of waste mapping**	**The amount of visitors**
The Art of Conscious Change course , day 1 "Teeme Ära" national waste cleaning day	4.05.19	9-17 9-17:30		25 60
The Art of Conscious Change course , day 2	5.05.19	9-16	45 hours	25

During these days lunch was offered from Lilleoru kitchen to both - the volunteers and to the course participants. The volunteers worked outside on Saturday, so there was not so much people in the training center. Sunday was also quite "calm" day, so I decided to make the photos earlier in the evening, at 6 p.m.

The setup. Bin nr 1 - compost, plastic, paper, mixed waste; nr 17 - mixed waste; nr 18 - compost; 25 - batteries; nr 16 - compost. The rest are mixed waste bins.

The results. In the unitary sorting bin (nr 1) (15.3.3.-15.3.6.) the results were more or less quite good, yet there was compost and paper in "mixed waste" bin, a little plastic in "paper" waste. The results of the single modular bin was the same, with a little mistakes - in "mixed waste" bin there was also plastic tare (in Appendix VII, bin nr 17). The rest of bins were not labelled, because there was no other waste type next to it.

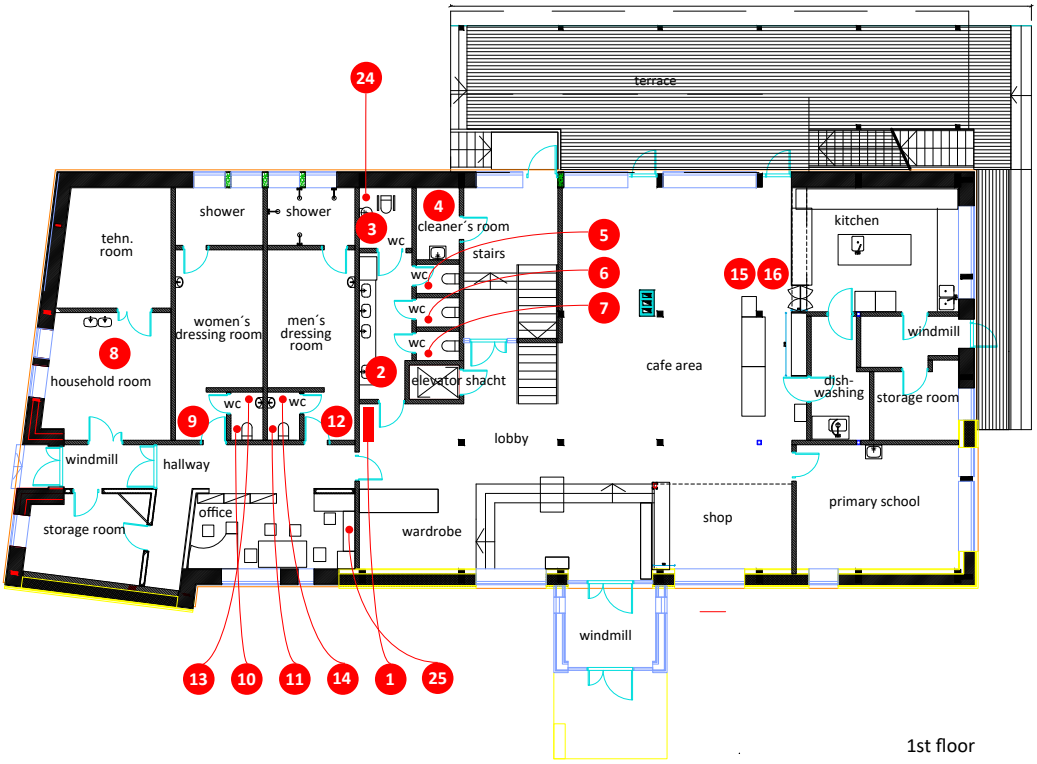


Figure 15.3.1. Waste bin setup on the first floor of the training center, in design proposal experiment.

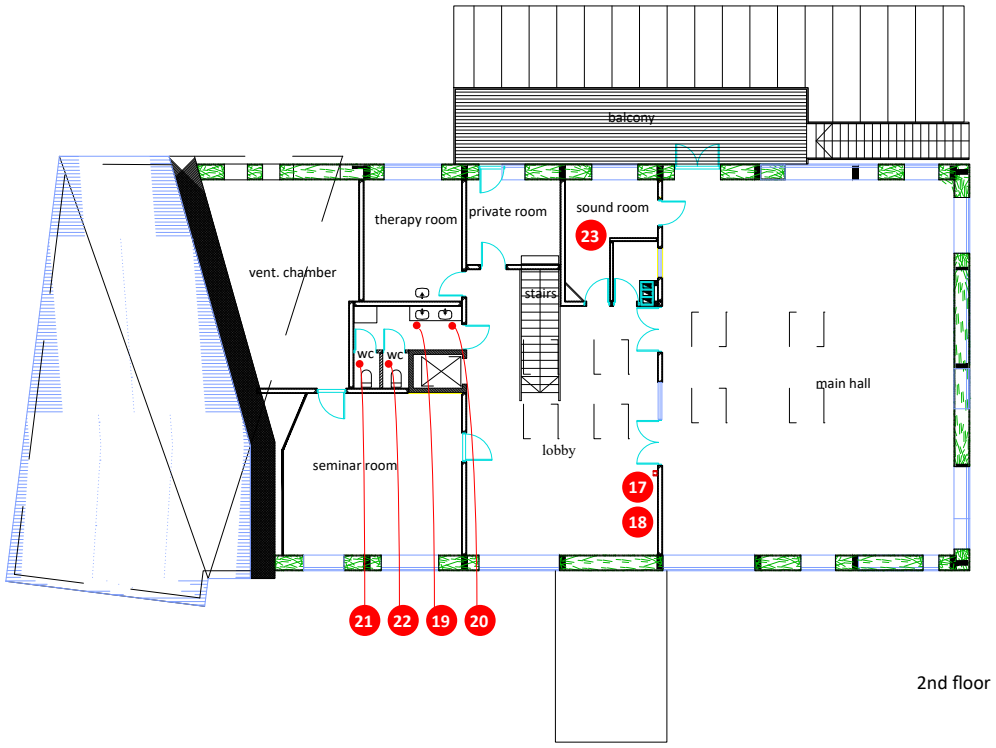


Figure 15.3.2. Waste bin setup on the second floor of the training center, in design proposal experiment.

Figure 15.3.3. (Up left). Compost waste in "compost" bin, in unitary sorting bin.
Figure 15.3.4. (Up right). Some plastic and most of paper in "paper" bin, in unitary sorting bin.
Figure 15.3.5. (Down left). Only plastic in "plastic" bin, in unitary sorting bin.
Figure 15.3.6. Some paper and compost in "mixed waste" bin, in unitary sorting bin.

Analysis. Cover needs better graphical solution, to be tested on people. Now people still are throwing waste a little wrongly, but maybe is not the issue how the bin looks like, or operates. It could be that a person´s awareness is somewhere else in the time they are with waste - people can make mistakes.

15.4 Design proposal in detail

I started to design the solution in 3D, taking the features of the material into consinderation. I will use film-veneer in the bottom and the rest of the waste bin is from Valchromat (8/16mm, dark grey). The bin opens from front for the cleaner. Both sides are with the possibility to put either a bucket or a bended metal wire inside (for the waste bag). The holder of the metal wire is milled inside the material (see Figure 15.4.2.). The measures of the bin (in Figure 15.4.3.) are designed now for Lilleoru's case.

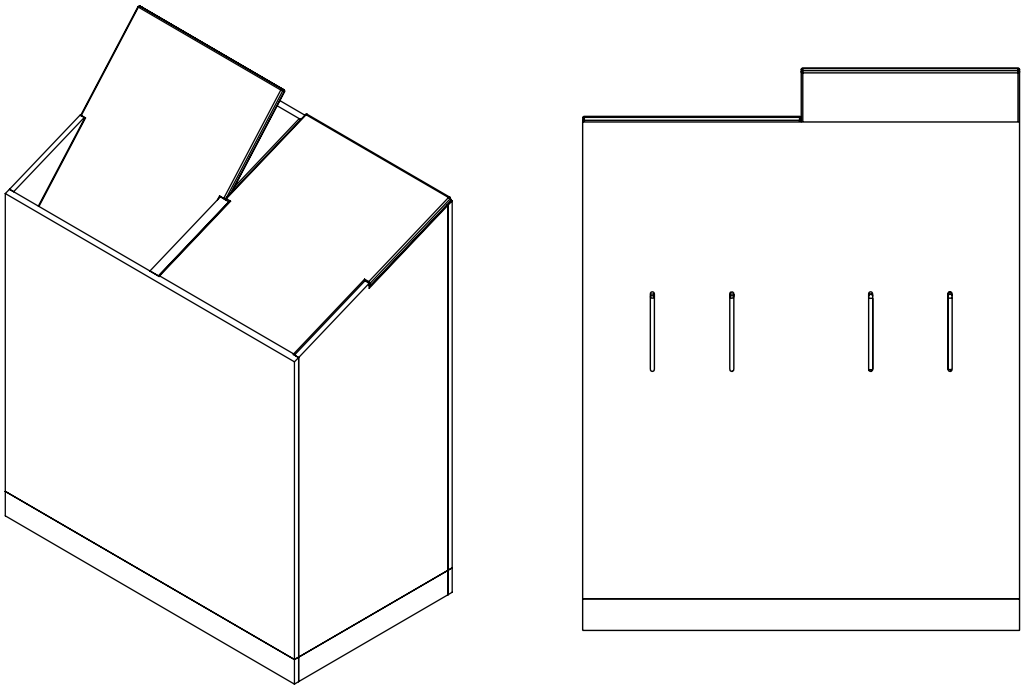


Figure 15.4.1. An axonometer from the front and from the back of the unitary sorting bin.
Figure 15.4.2. (Right). A view from back side of the bin.

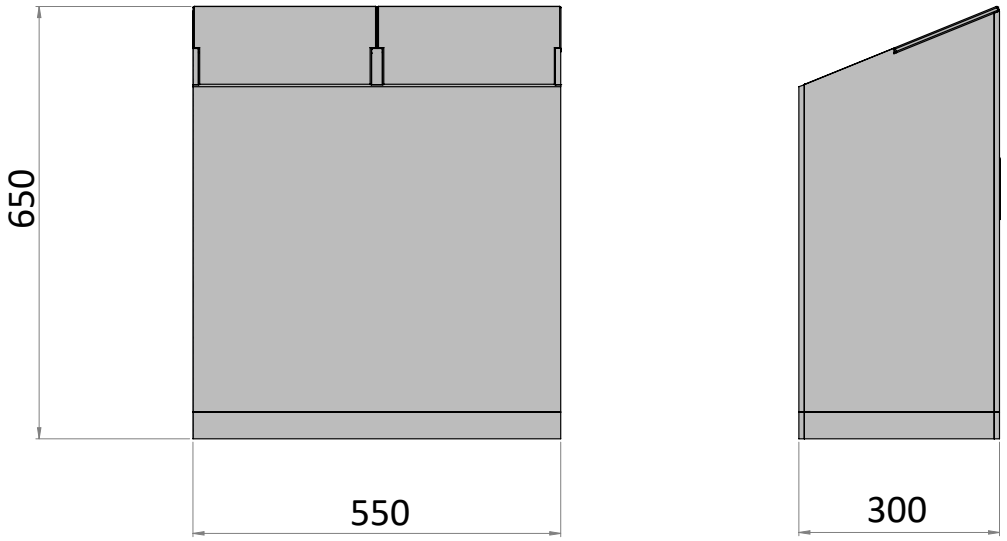


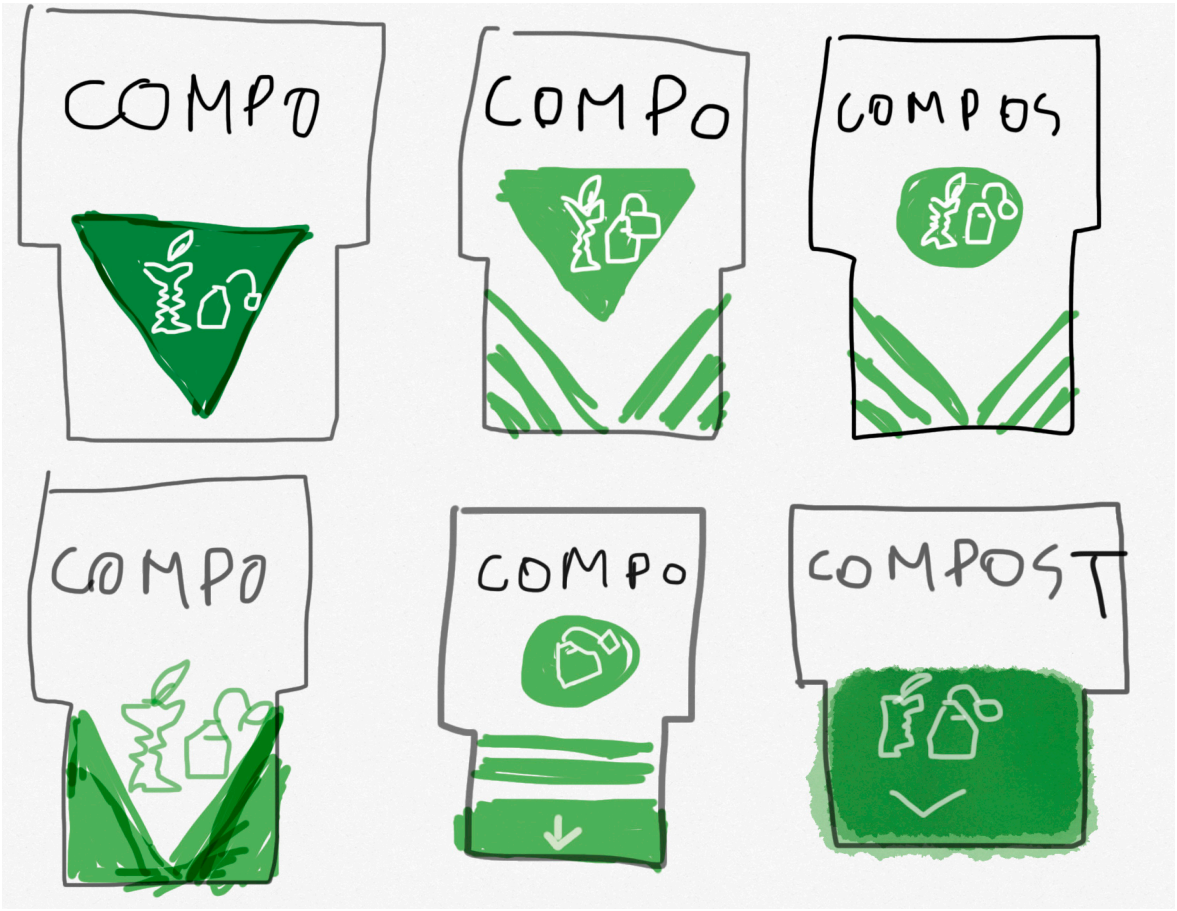
Figure 15.4.3. Basic measures for the unitary sorting bin.

Figure 15.4.4. A rendering of the unitary sorting bin with an open cover.

Figure 15.4.5. A partly transparent rendering of the two unitary sorting bins.

15.5. Cover decal design

Here are some sketches from where i chose two different styles to print out and test. I chose two middle ones, because of their simplicity in graphics and clear way of communication, but made still a little changes in them.



Figures 15.5.1. - 15.5.6. Quick sketches of the cover graphics.

Figures 15.5.7. and 15.5.8. Graphic versions of the cover solution.

Figure 15.5.9. Bin cover graphic solutions, the end solution.

Figure 15.5.10. Bin cover graphic solution on the covers of the mockup.

16. THE STEPS OF WASTE-RELATED BEHAVIOURAL CHANGE

Analysing the steps of the the analyse, I extrapolated five steps that lead to waste-related behavioural change.

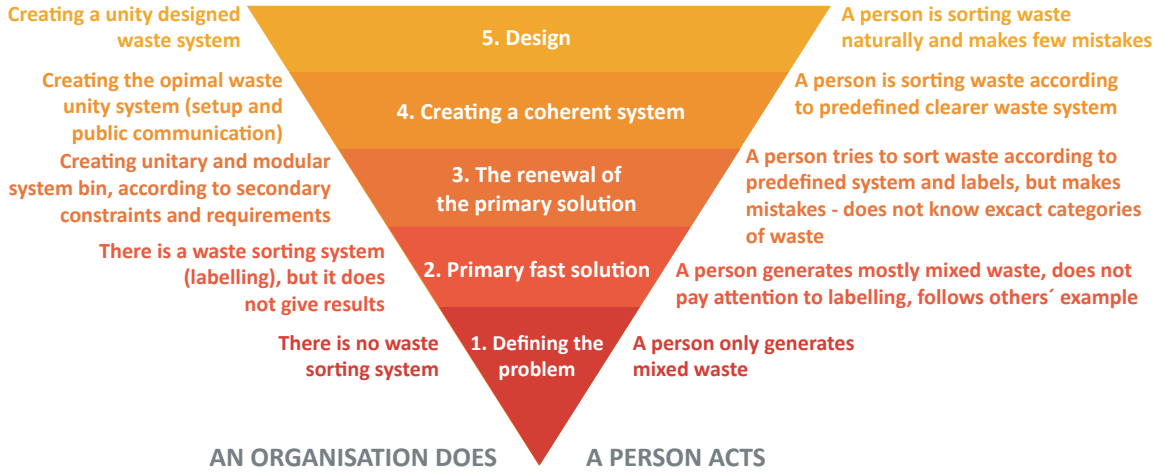


Figure 16.1. A five stepped model to organisational waste-related behavioural change from no waste sorting to waste sorting activities, using Cultural-Historical Activity Theories principles (model bigger in Appendix VIII).

This model provides a five-stepped model of activities to start sorting waste in some organisation. The model is supported by Cultural-Historical Activity Theory, where it is explained that a person acts together with one's cultural background, and need tools and signs in a new environment to succeed with the activity. To be able to do that in a natural way, the theory suggests that old tools are used simultaneously together with the new tools. This is what this model supports - not to make changes all at one time, but is a step-by-step action plan, using old bins and new ones together, and having a plan towards recycle system.

First step - defining the problem.
To start with make changes in some behaviour, it is needed to notice and define the problem of no sorting system in the public organisational level. The way that a person behaves is of course generating only mixed waste when there is no sorting system.

Second step - primary fast solution.
To be able to understand how many waste bins you need, and where, you need to start labelling the existing bins. Input from that is how much waste there is, and some constraints and require-

ments what you need for the next step. People in this stage generate mostly mixed waste, because they do not pay attention to labels, they also follow others' example - when somebody has thrown waste in the wrong bin, then the next person sees that and does the same.

Third step - the renewal of the primary solution.
In this stage secondary solutions are made, where the unity sorting system and single modular bin is designed, using the secondary constraints and requirements. People is this stage try to sort waste according to predefined system and labels, but makes mistakes - does not know exact categories of waste. The inputs for the next stage from this one, are the design constraints and requirements.

Fourth step - creating a coherent system.
Creating the optimal waste unity system (setup and public communication). It means that in this stage it is needed to understand and put together the optimal needs of the organisation's waste bins - in how many people how many bins and in what setup system you need. For example, in Lilleoru the optimal need for maximum 150 people is 25 bins, with four different waste categories. When there are more people in the public area, then more bins are needed, but the changes have to keep about two meters of radius from the place where it was earlier, with less people. Some constant problems in this step needs to be thought through. In Lilleoru, for example, we decided to start communicating that people should eat and drink only in the cafe area. From that you get to know how many bins and which type it is needed, and what you need to design. A person in this phase is sorting waste according to predefined clearer waste system.

Fifth step - design.
Creating a unity designed waste system with clear and simple labels and instructions. In the solution you have to design for both users - the visitors and the staff. A person in this phase is sorting waste naturally and makes few mistakes.

16.1. Waste-related behavioural change steps and its perspective

There was a missing link between the old behaviour and a new one. These five steps is needed take in order to create a smooth transition for the users, between those two different paradigms of waste-to-energy and recycle.

Each step can be quite different in different organisations, but they are needed in order to under-

stand the situation better and because if a change is without any steps, you can probably see the result from the cleaning process. This process acts motivational to the users, because they see the improvements what are made and that somebody does care about not only the issue as a conceps, but also about the real results. Of course we can more change the behaviour of the users who come in regularily, but the step of designing should also be a solution to that issue. As I was designing, while the experiments, in went in a place where people started to behave differently.

There are still some steps that could be done after the five steps are done. We can move towards avoid and reduce, and rethink and redesign. So what are the preconditions of doing that? Here are three steps for that:

1. Firstly you have to keep in mind to make one change at a time (in this way the impact of the change is also measurable) - to use old tools together with new ones.
2. Secondly you have to keep in mind the factors you can change, and the ones you can not control in the beginning. That impact of changing the things you really can show the user an example of starting to behave differently.
3. To make another change, you have to keep in mind that you can not change any behaviour without understanding how they act in the present, so some kind of a research or study is needed (as precise and concrete as possible). This gives also a better understanding towards your user.

In Lilleoru, the next steps towards zero waste, are service based - that the house offers as much solutions to people ' s needs as possible.

For that Lilleoru can:

- Avoid using paper towels in the toilets;
- Offer visitors soap and shampoo in the showers (in order to avoid them using and disposing some waste);
- Use bigger packages of food and cleaning products and refill dispensers;
- Keep using clever material choices in building, to use the smaller parts of leftovers somewhere else.

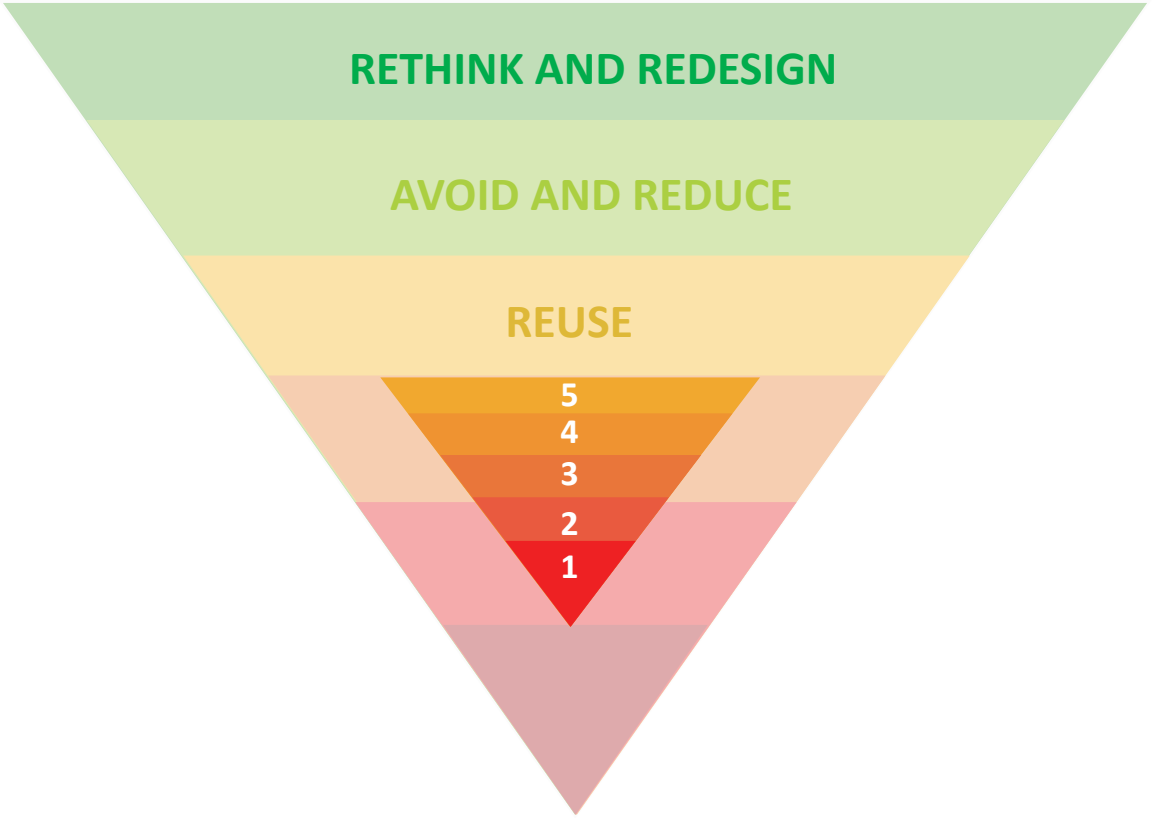


Figure 16.1.1. The relations between waste-related behavioural change steps and waste hierarhcy.

In conclusion. Waste-related behaviour change steps is designed to start sorting the waste in an organisation, it is to step from waste-to-energy level towards a greener notion, to recycling. These five steps form a smooth transition in the change management process, which is motivational for users and gives very practical and specific information about the users´ behaviour during that period. To move even further, there are some things to consider - to make few changes at a time, to control the measurability of the process (which way is it going), to understand what kind of change is in your hands to make, and to research the topic thoroughly (not just buy or make a new bin). These concepts are considered in Lilleoru also - a change begins of understanding the needs and its possible scope.

17. CONCLUSION

17.1. Summary

Throughout the entire process of my work I found out that designing new bins for the training center is only a part of a change there needed to be. There was a gap between the old way of the users´ behaviour and the new desired behaviour. It is not only about the new objects we build, it is about the habits we have with the old ones. With this process, I achieved the understanding of using old habits and their actual setting, and created a step-by-step pathway to establishing new behavioural habits like sorting the waste, which is a precondition to any recycling process.

17.2. Further development

We have now a new mockup in the training center, and I need to get some feedback from the users to it - what are the good sides and needed developments for the bins. I know already the users are sorting the waste at about 80% more, than before the steps I took to solve it, but I still have to ask feedback verbally to understand the solution's context better. When I get to a point when everything works well, I need to make final drawings for the bins and to build them. In order to find out how the waste-related behaviour change steps works exactly, I need to test it on another organisation who wants to make this change.

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19. LIST OF FIGURES AND TABLES

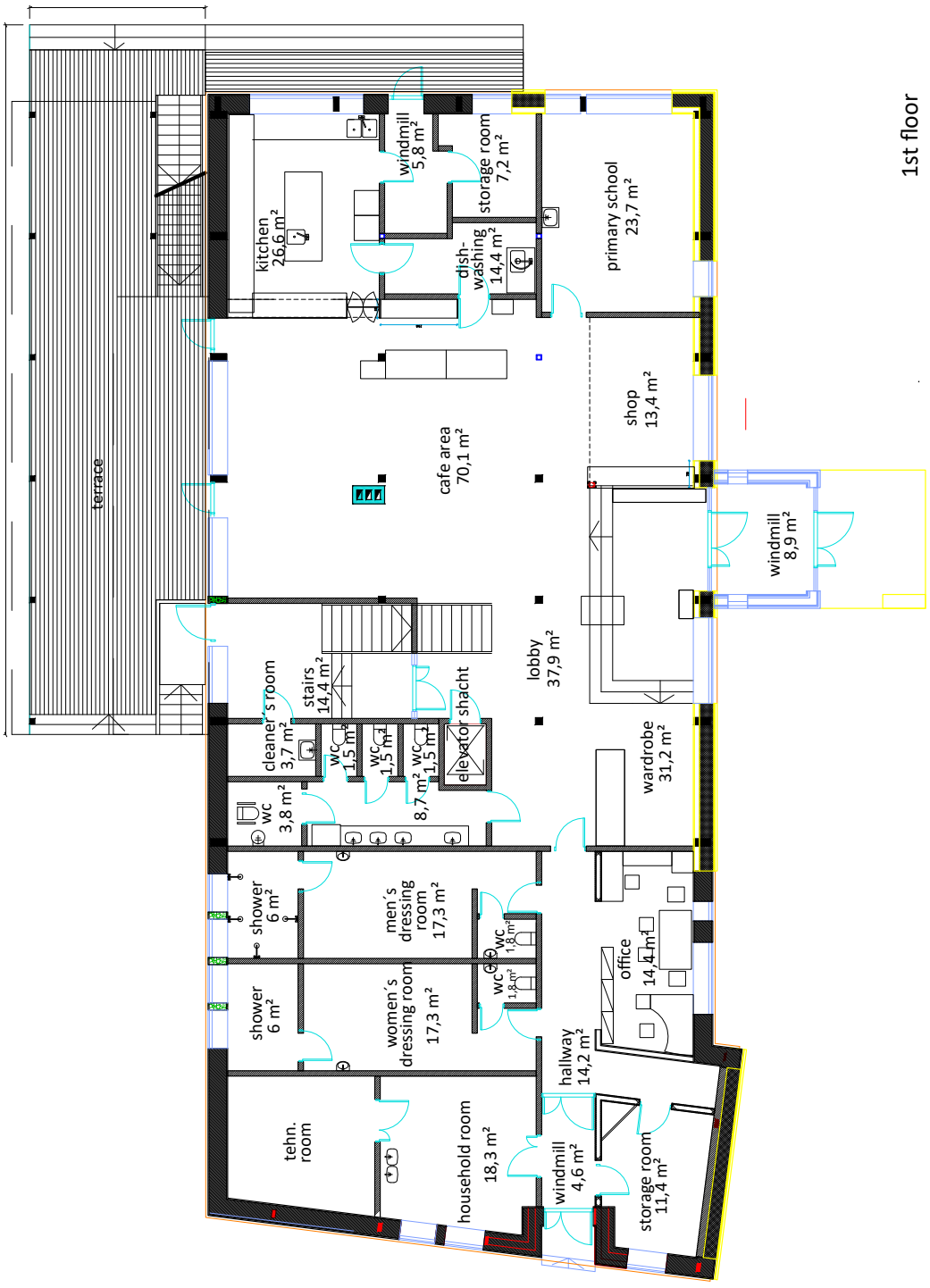
19.1. List of Figures

19.2. List of tables

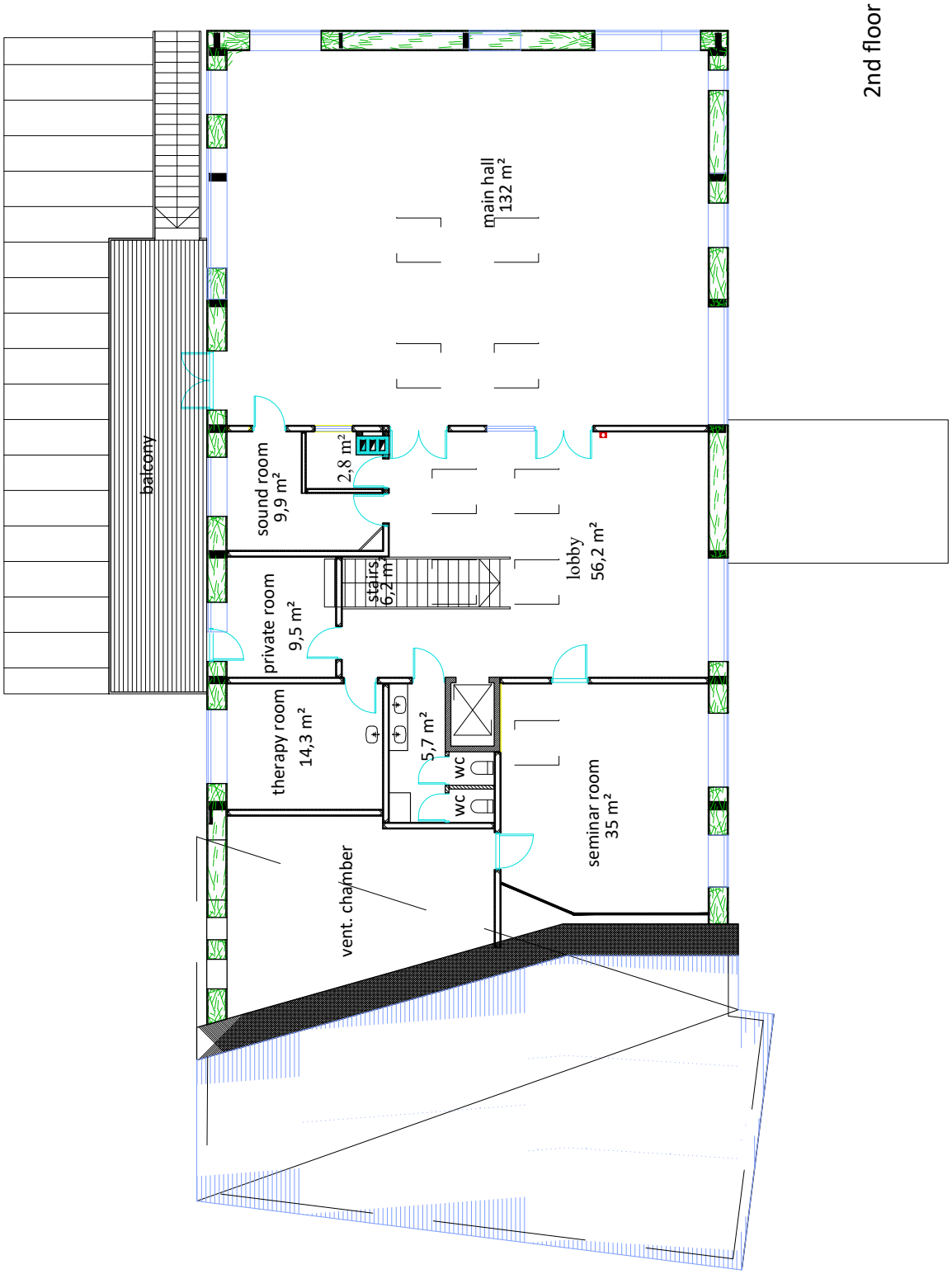
20. APPENDICES

Appendix I

The first floor plan of the training center with the room names and room sizes.

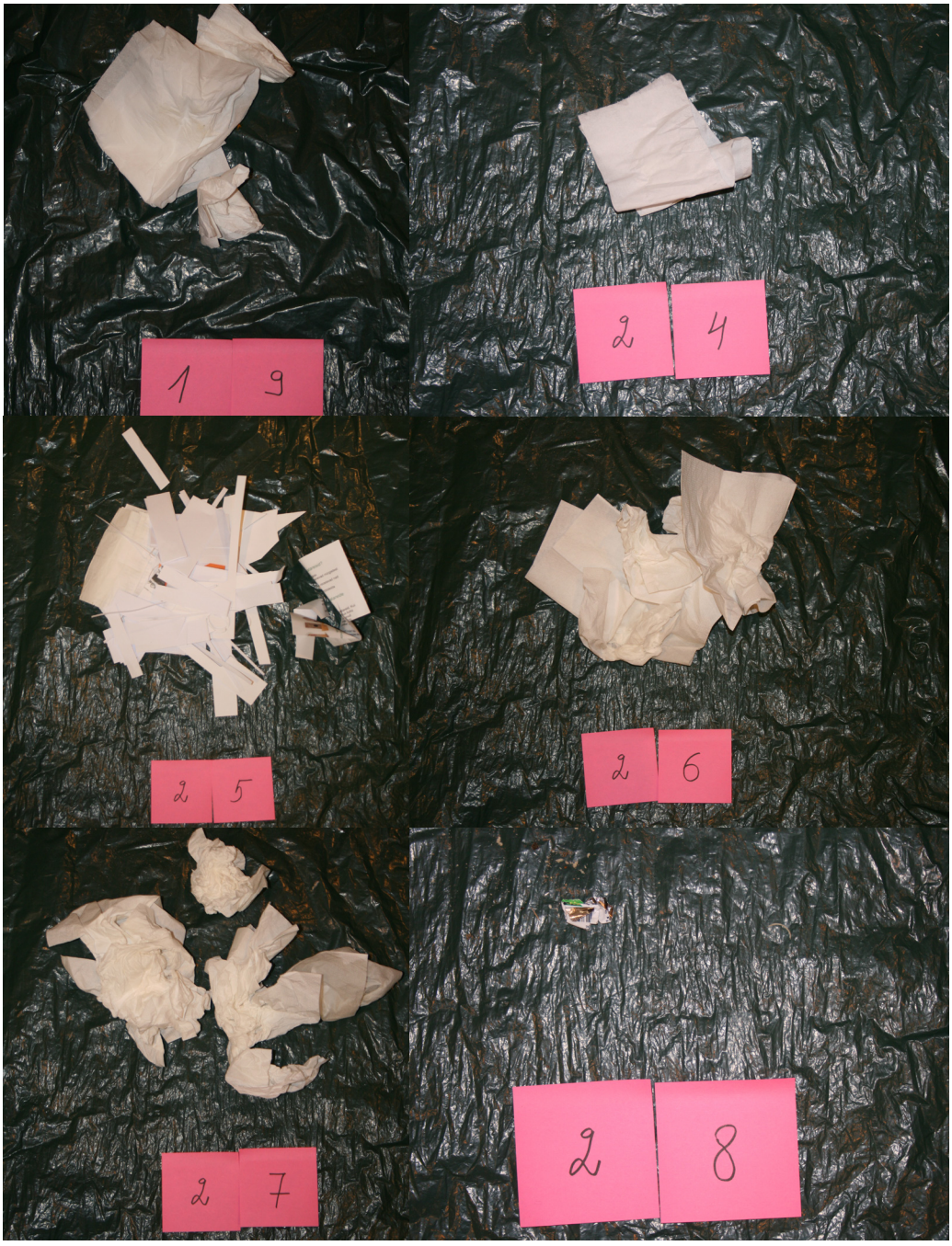


The second floor plan of the training center with the room names and room sizes.



Appendix II

22. November 2018, waste mapping results.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Appendix III

23. November 2018, extra waste mapping results.


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Appendix IV

24. November 2018, waste bin setup experiment results.


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1 4
Rum-Kokos
1 5
1 6
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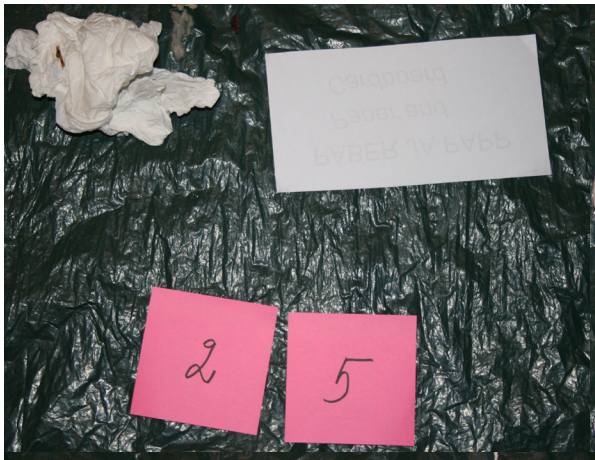
2 2
2 3
2 4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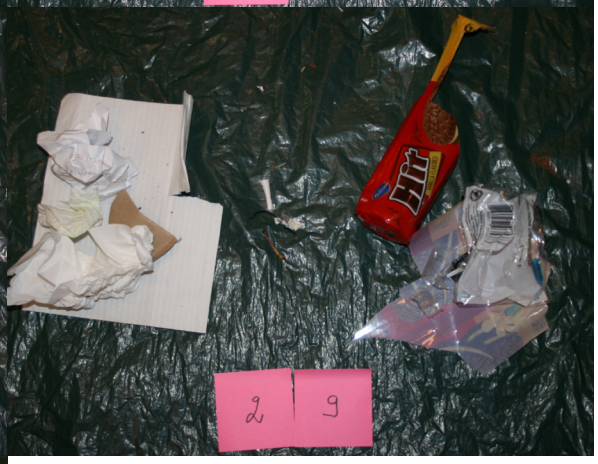
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Appendix V

25. November 2018, bin making experiment 1 results.


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1 7
1 8
2 4


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MESI-KAPP
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Appendix VI

8. December 2018, bin making experiment 2 results.


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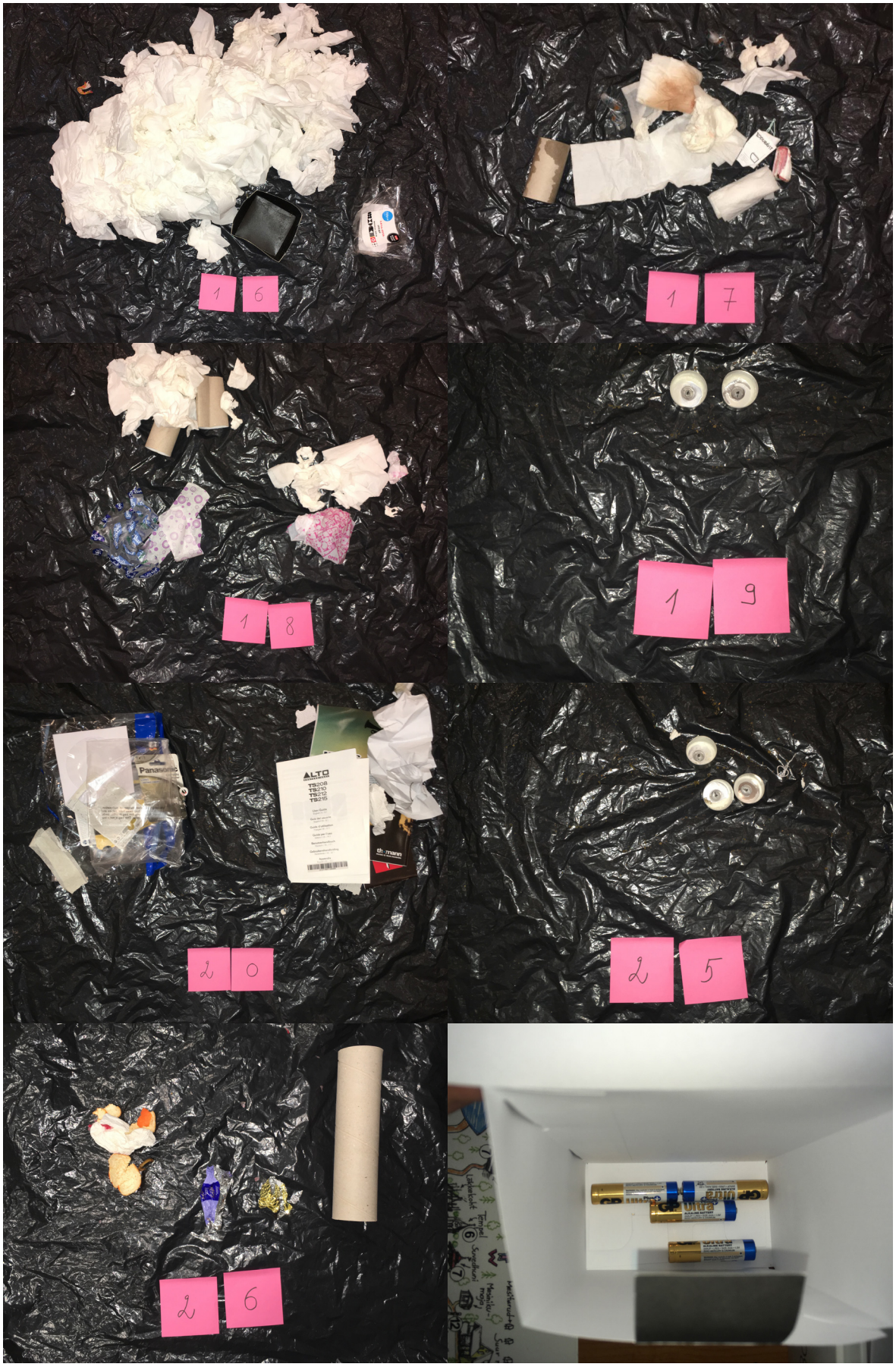
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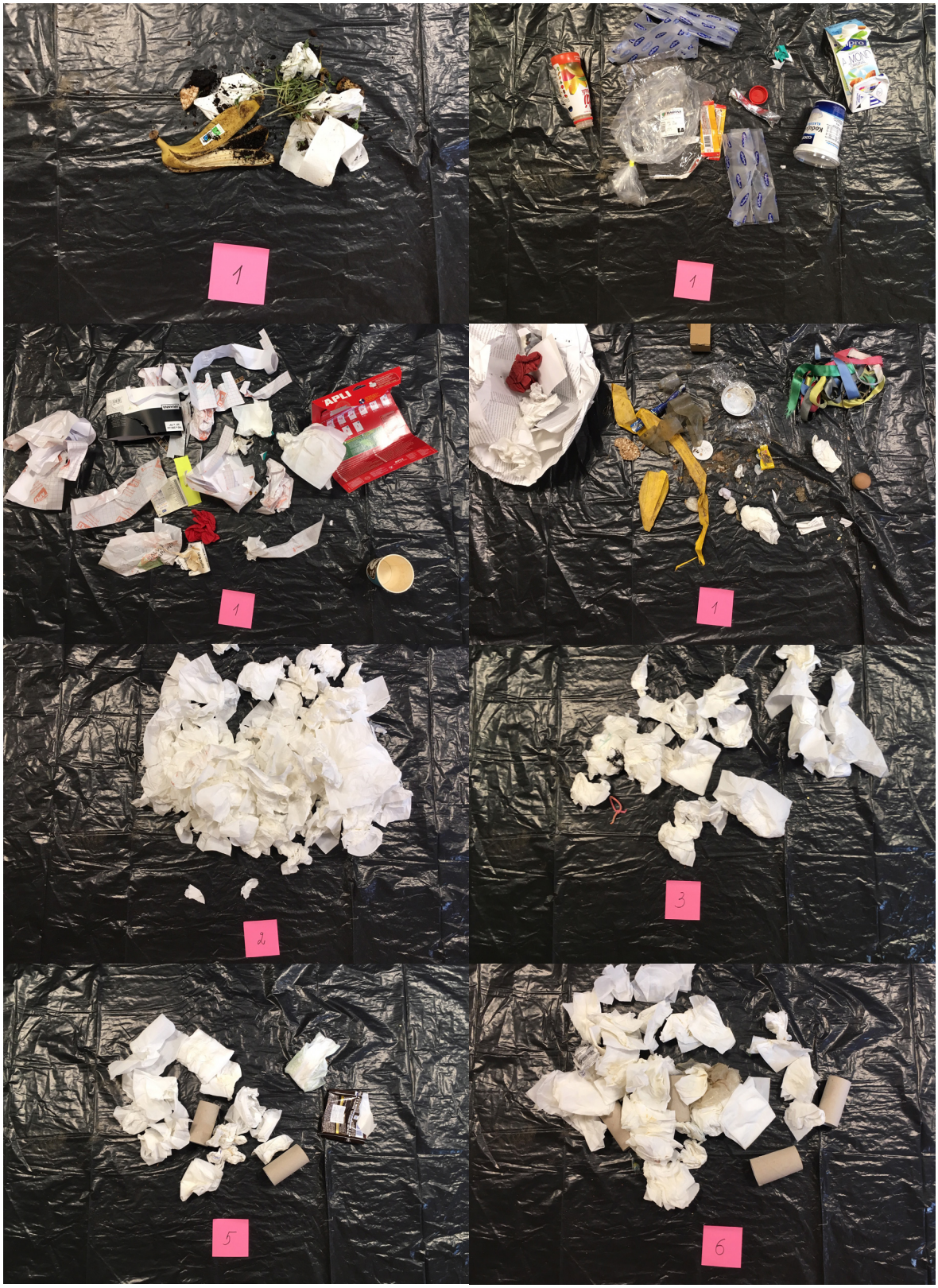
Appendix VII

5. May 2018, design proposal experiment results.

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Appendix VIII

Bigger scheme of the five steps of the waste-related hehaviour change.

Appendix IX

Specificative questions and answers throughout the thesis.

Interview with...	When?	What did i found out..	Analysis/ next steps
Tea (cleaning staff)	8th of December 2018	Can you not empty the bin together with the bag, if it is not full? I do not want to do that, because the bags in the toilets begin to smell; and also because it is troublesome.	Emptying the waste bags when they are not full is unpleasant to the cleaner and to the visitor.
Reet Aus (Green Key environmental manager in Lilleoru NGO)	12nd of February 2019	What about metal and glass? Should we sort them out as well, for example in the kitchen, where the need is most frequent? The waste which is collected from Lilleoru, should be recycled. If it is, there is no viable reason why we should collect them separately - we do not have so much of it.	I should ask about recycling of glass and metal from Sekto AS.
Magnus Vaht (Sekto AS)	14th of February 2019	In Sekto and in Iru the glass and metal is sorted out, and is recycled, in some other firm.	There is no viable reason why we should collect metal and glass separately from packages.
Pille (kitchen head)	23rd of March 2019	Why do you not want to wash the packages, like it is required from the Tallinn's waste sorting instruction? To clean it, needs water. I do not like the concept. Also sometimes the metal tin edges are sharp and could hurt.	Water consumption in Estonia is not a big problem, bigger problem is the amount of plastic (information from Reet Aus). If some metal tins are dangerous to wash, then it could be thrown to mixed waste uncleaned.