



Expertise
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Jorma Anttila

Reuse and Recycling

Conditions for co-operation in Helsinki Region

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Bachelor of Engineering

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<p>The Helsinki Metropolitan Area Reuse Centre maintains reuse of goods and receives items from visiting customers. Helsinki Region Environmental Services HSY manages Sortti stations where residents and businesses are offered opportunity to dispose of large waste and to recycle materials. HSY is interested in developing co-operation with Reuse Centre, so that there are opportunities for recycling the materials of rejected items in reuse centres. Research questions are: What kind of non-reusable objects and how many non-reusable objects are offered to Reuse Centre? And, how do Reuse Centre customers experience the accessibility of Sortti stations and their waste reception services? Thesis has a connection to circular economy, where reuse is favored as first choice and material recycling as second.</p> <p>Reuse centres do not receive certain types of goods, such as, safety equipment, coat hangers, encyclopedias, and other products with a supply that exceeds the low demand. Reuse centres receive all waste electric and electronic waste, WEEE, in accordance with producer responsibility. Furniture that is of poor quality and defective is rejected directly. For garments and smaller items, decent and faulty items are sorted within the warehouse. About half of the received items end up in material recycling or energy recovery. Material downstream flows from the Reuse Centre are only about one percent of the flows of the Sortti stations.</p> <p>At the Nihtisila Reuse Centre in Espoo, donators were interviewed in summer 2018. The average distance to the reuse centre was 6 km. Nearby-residents were emphasized among the respondents. Of the respondents, 85% knew one at least one of the Sortti stations and 71% had used a Sortti station. Most of the respondents (87%) had all their items received. The rest had some rejected item, often furniture. A typical donation was 4 bags of clothing. The donators lived, on average, 11 km from their Sortti station. However, the donators were ready to travel 20 km of median to a station. Non-user were even more ready to longer distances than the users. The distance did not seem to be a problem.</p> <p>There could be a Sortti container for rejected mixed waste. The Reuse Centre has limited capacity for receiving items and material to be recycled.</p>	
Keywords	reuse, recycling, waste management

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<p>Pääkaupunkiseudun kierrätyskeskus pitää yllä tavaroiden uudelleenkäyttöä ja vastaanottaa vierailevilta asiakkaista tavaroita. Helsingin seudun ympäristöpalvelut HSY hoitaa Sortti-asemia, jossa asukkaille ja joillekin yrityksille tarjotaan mahdollisuus hankkiutua eroon suurista jätteistä ja tehdä materiaalikierrätystä. HSY on kiinnostunut kehittämään yhteistyötä kierrätyskeskusten kanssa, siten että niissä olisi mahdollisuuksia hylätyn tavaran materiaalikierrätykseen. Tutkimuksen kysymykset ovat: Millaisia ja kuinka paljon uudelleenkäyttöön kelpaamattomia esineitä kierrätyskeskuksiin tarjotaan? Ja miten asiakkaat kokevat jätteiden vastaanottopalveluiden saavutettavuuden?</p> <p>Työllä on yhteys kiertotalouteen, jossa uudelleenkäyttöä suositaan ensimmäisenä valintana ja materiaalikierrätystä toisena.</p> <p>Kierrätyskeskuksille ei kelpaa tietyt tavaralajit, kuten turvavälineet, henkarit, tietosanakirjat, ym. tuotteet, joiden tarjonta ylittää vähäisen kysynnän. Kierrätyskeskukset ottavat vastaan tuottajavastuun mukaisesti kaiken sähkö- ja elektroniikkaromun. Laadultaan ja ominaisuuksiltaan vajavaiset huonekalut hylätään suoraan. Vaatteiden ja pienempien esineiden kohdalla lajittelu myyntikelpoisiin tapahtuu varaston sisällä. Noin puolet vastaanotetuista tavaroista päättyy materiaalikierrätykseen tai hyödynnettäväksi energiaksi. Kierrätyskeskuksesta tulevat materiaalivirrat ovat vain noin prosentti Sortti-asemien materiaalikierrätykseen verrattuna.</p> <p>Espoon Nihtisillan kierrätyskeskukseen tavaroita lahjoittamassa olleita haastateltiin kesällä 2018. Keskimääräinen matka kierrätyskeskukseen oli 6 km. Lähellä asuvat korostuvat vastaajien joukossa. Vastaajista 85% tiesi jonkin Sortti-aseman ja 71% oli käyttänyt jotain Sortti-asemaa. Suurimmalla osalla vastaajista (87%) kaikki tavarat otettiin vastaan. Lopuilla oli jokin ei-vastaan otettu tavara, usein huonekalu. Tyypillinen lahjoitus oli 4 kassillista vaatteita. Lahjoittajat asuivat keskimäärin 11 km päässä jostain Sortti-asemasta. Lahjoittajat olivat kuitenkin valmiit viemään tavaraa 20 km mediaanilla, Sorttia käyttämättömät pikemminkin vielä kauemmas. Matkan pituus ei näyttänyt ongelmalta.</p> <p>Kierrätyskeskuksessa on tilan vuoksi rajattu kapasiteetti ottaa vastaan tavaroita.</p>	
Avainsanat	uudelleenkäyttö, kierrätys, jätehuolto

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Appendix 1. Fractions of waste electric and electronic equipment

1 Introduction

Promoting reusing is a very valuable way of sparing of natural resources and energy, and thus preserving environment and preventing harmful emissions. Helsinki Metropolitan Area Reuse Centre receives donations of all kind of items from ordinary citizens to be sold in their stores. There are cases, when an item to be received does not fulfill the demands of Reuse Center.

Helsinki Region Environmental Services Authority runs Sortti Stations, where all kinds of material is received for material recycling and recovery. Some items can also be given to Reuse Centre. There is a need to enhance co-operation between these two organizations so that customers of each delivery points need not to visit the other place, but can dispose all items in one place.

In this thesis donating customers of Reuse Center's store were surveyed with respect to their preparedness to use Sortti Stations. The questions made to customers were as follows:

1. What kind of non-reusable objects and how many non-reusable objects are offered to Reuse Center?
2. How do Reuse Center customers experience the accessibility of Sortti-Stations and their waste reception services?

2 Theoretical Background

2.1 Circular Economy

An EU directive gives guidelines to national legislations in waste circulation.

Directive 2008/98/EC on waste (Waste Framework Directive) sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling, recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and by-products. The Directive lays down some basic waste management principles: it requires that waste be managed without endangering human health and harming the environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and

without adversely affecting the countryside or places of special interest. Waste legislation and policy of the EU Member States shall apply as a priority order the following waste management hierarchy: (European Commission 2016.)



Figure 1. Waste management hierarchy according EU's Waste Framework Directive (European Commission 2016)

Directive “includes two new recycling and recovery targets to be achieved by 2020: 50% preparing for re-use and recycling of certain waste materials from households and other origins similar to households, and 70% preparing for re-use, recycling and other recovery of construction and demolition waste” (European Commission 2016.)

In Finland there have been long program to end landfills. Decree of landfilling (331/2013) (Government 2013) made it prohibited from 2016 to leave organic materials to landfills, when organic carbon concentration exceeds 10 percent. Landfills are also ceasing to exist and they are becoming waste transfer stations, where only incombustible fraction or reject from waste incineration are deposited.

Circular economy can be summed up as “3R” method: reduce, reuse and recycle”. Article 4 of Waste Framework Directive (2008/98/EC) gives formal waste hierarchy shown already in Figure 1. (1) Prevention is minimizing amount of waste produced. (2) Preparing for re-use is cleaning, repairing and refurbishing. (3) Recycling is making new products of old materials. (4) Other recovery means energy recovery, which is obtaining energy from waste. (5) Disposal is burial of waste in landfill. (European Environmental Bureau 2015.) In Finland, Waste Act from 2011 has already followed this principle.

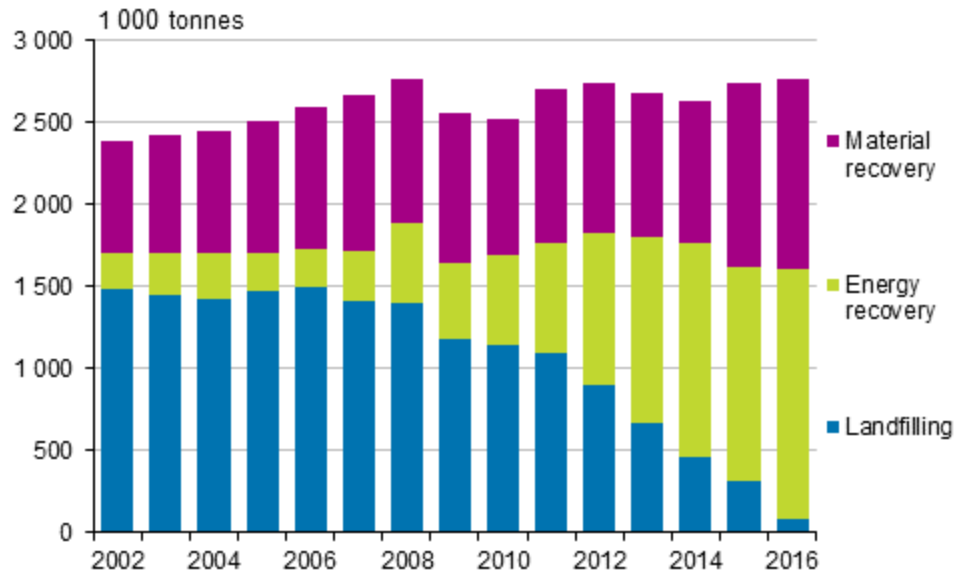


Figure 2. Waste treatment in Finland from 2002 to 2016 (Official Statistics Finland 2018)

Reusing and recycling of materials from municipal waste has advanced in Finland (Figure 2). “Disposal of municipal waste at landfill sites has decreased strongly according to the development that has continued in recent years. In 2016, only around three percent of municipal waste was disposed at landfill sites. It has been replaced by recovery of waste: both energy production and material recovery are competing for the recovery of former landfill waste, of which energy use of municipal waste has been the general treatment method in recent years.” (Official Statistics Finland 2018.) Statistics show also that all metal waste is recycled. In Sweden, also most household waste is recycled and the share being landfilled has decreased even to 0.5% (Avfall Sverige 2018).

In recovering waste “increasing entropy” should be avoided. It means decreasing the order of items. Reusing keeps the form of a product. Dismantling to pieces and demolition to materials break the internal order of items. Obtaining energy, i.e. incineration to heat and combustion gases, increases most entropy even in thermodynamic sense. Although it should be used only as last solution, it is often the only solution.

2.2 Metropolitan Area Reuse Center Ltd

The Metropolitan Area Reuse Center (MARC) runs several stores around the Helsinki metropolitan area, as well as a nationwide online store. It sells reusable household

items and furniture donated by the public. Items include all kind of household and office objects. The Reuse Center educates annually around 40 000 children, adolescents, adults, communities and businesses about sustainability. It is a social enterprise, which offers job experience, career opportunities and skills to long-term unemployed or to anyone with a need for some extra support. All possible profit is used to better services, instead of handing it out to shareholders. The shareholders of the non-profit company are for example the four capital area municipalities, Helsinki Region Environmental Services Authority HSY, many nature and environmental protection NGO:s as other NGO:s, and HYY Group, a company of University of Helsinki Student Union. (Kierrätyskeskus.)

The Reuse Center aims to provide an alternative to single-use culture, enabling sustainable lifestyle and preserving natural resources. By buying used items, the life-cycle ecological footprint of producing a corresponding new product is avoided. The Reuse Center has seven stores in Vantaa, Espoo and Helsinki. Everything, what is sold, are donated by the public or various companies. Customers are not paid of any items. The items given have to be fit enough for reuse. Donating is done either by leaving items to a store or by asking the Reuse to come collect them from home by a van. There are also collection containers in Sortti waste reception stations, from which the Reuse Centre hauls them by van. Seven stores sell items onwards or give them for free. The largest store is situated in Nihtisilta of Espoo, by the Turku motorway, east of Kauniainen. It has also large central warehouse of the whole organization.

Figure 3 shows positions of the reuse centres and Sortti stations.

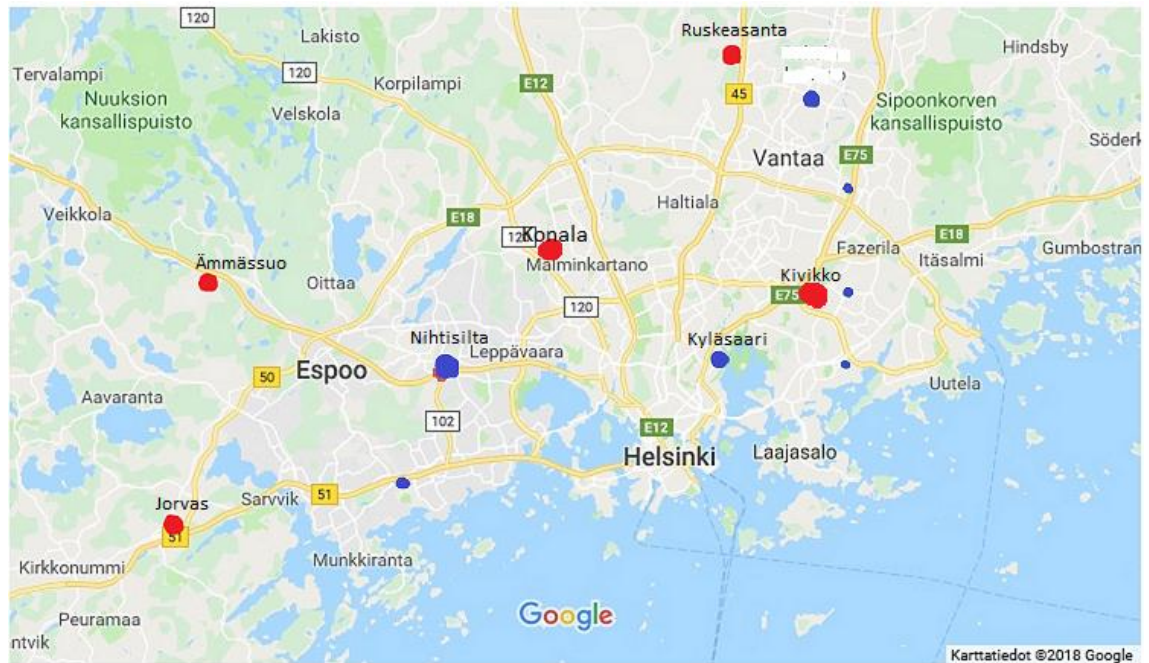


Figure 3. Reuse Centre stores (blue) and Sortti stations (red) in capital area

The Reuse Centre does not accept any kind of items. Safety equipment are systematically rejected because product liability cannot be warranted. There are outdated products like VHS cassettes and encyclopedia series. There would be oversupply of coat hangers and folders. But all electric and electronic waste is received regardless of their condition. Waste electric and electronic equipment (WEEE) includes equipment removed from use, which require electricity or an electromagnetic field in order to work. According to extended producer responsibility (European Commission 2014), broken equipment are submitted straight to so called producer community, which handles the dismantling of equipment to its raw materials. The producer community in relation to the Reuse Centre is SERTY. It uses various operators to handle the WEEE.

Reuse Center has Ekokompassi certificate, which is developed by the City of Helsinki. It has lighter bureaucracy and is cheaper more concrete than ISO 14001 environmental management standard. The principle of standards is the same. There is no need to ISO standard because there is no international trade, where somebody would demand it.” In the main office, there is Green Office of WWF.”

2.3 Sortti Sorting Stations of HSY

Waste sorting stations are operated by Helsinki Region Environmental Services Authority (HSY). HSY is a municipal body, which produces waste management and water services, as well as providing information on the Helsinki Metropolitan Area and environment. It declares to help inhabitants to act for a better environment. The member cities of the HSY are Espoo, Helsinki, Kauniainen and Vantaa. (HSY.)

Its principal tasks are water services, waste management and regional and environmental information. Water Services supplies drinking water for over one million inhabitants throughout the Helsinki Metropolitan Area. It treats wastewater generated by households and industry. Regional and Environmental Information monitors the air quality at 11 monitoring sites. It promotes the implementation of the Helsinki Metropolitan Area Climate Strategy 2030 and the Helsinki Metropolitan Area Climate Change Adaptation Strategy. (HSY.)

Waste management of HSY organizes waste management for residential properties and the public administration, both in the Helsinki Metropolitan Area and also in Kirkkonummi. The Waste Management employs 131 persons. Water services being clearly biggest by the revenue of HSY, the revenue of the Waste management was 29 % of the total, 364 million euros. Sorting stations or Sortti Stations are under Area Services Unit, and it employs ca. 40 persons.

There are five Sortti stations in the metropolitan area. The largest are Kivikko in the eastern Helsinki and Konala in the north-western Helsinki. The rest are in Vantaa, Espoo and Kirkkonummi. Sortti stations receives recyclable materials or material for combustion in energy production, and incombustible material for soil construction. In 2017 there were ca. 440 000 visits.

Sortti stations and reuse centres are situated quite evenly (Figure 3). Their locations complement each other. Sortti and Reuse are mostly not close each other; thus there is foundation for co-operation. Reuse centres could receive more items aimed to Sortti Stations.

The idea of Sortti Stations is to give inhabitants a relatively close place to bring their items, which cannot be discarded in waste bins of one's house or the housing co-

operative. Items can be too large to fit into the waste bins. Hazardous waste should not put into the bin. There are a considerable number of recyclable items which do not fit into areal nearby collecting points, for example, large metallic objects. Televisions and large domestic appliances are easiest to get disposed of in Sortti stations. For worn-out large furniture, there is no alternative deposit than Sortti stations. To dismantle a sofa to pieces would be very hard for anyone. Sortti stations are situated closer to residents than the former landfill Ämmässuo in the western Espoo.

And also a large amount of smaller material, which are usually put in to the waste bin need to be recycled to save non-renewable natural resources and energy. Unfortunately sorting stations cannot be situated to any place where people live. They demand large areas of industrial suburban land, and have environmental restrictions. That is why they are not situated in dense populated central areas, but in fringe of residential urban areas. Reuse centres can be situated in more central areas.

The operating system of HSY covers all areas of activity and meets the international standards and quality standards (ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007). ISO 9001 is a quality management standard, ISO 14001 is an environmental management standard, and OHSAS 18001 is an occupational health standard. Quality and environmental management systems of HSY were certified in 2017 (HSY 2017).

2.3.1 Functioning of Sortti Stations

Received materials are classified to carton, domestic hazardous waste, wood, sorted renovation and construction waste, paper, mixed combustible waste, metal, impregnated wood, gypsum, glass packages; such as glass bottles and glass jars, garden waste and brushwood, electric and electronic equipment from large electric domestic appliances to small electronic devices and wires. Wood includes un-padded furniture made for instance of chip board.

Cartons or cardboard is used in making new cartons; in Finland it means mainly for tissue cores. Wooden material is used in energy power plant as pure fuel to produce heat and electricity. Untreated pure wood, such as pallets, is used as a structure material in composting process. Small amounts of metal, like nails, screws, hinges and any fittings do not harm the process. They will be separated by operators during crushing to fuel or after incineration.

Mixed combustible waste includes padded furniture like sofas and items made of plastic, and anything combustible. It is incinerated in waste power plant of Vantaan Energia in Vantaa. Because the material would not burn well by itself, extra fuel, natural gas, is needed to enhance the combustion process. The waste gives still large amount of extra energy for production of power and heat. Metallic materials, mainly steel and iron, are used in making new metallic materials. Pure gypsum boards are used in making new gypsum boards. Impure boards are collected among all kinds of incombustible material like concrete, fiber wool, porcelain sinks, toilet-seats and all glass, which is not packing glass. Paper and glass packages received in stations are collected by other organization than Sortti, They are Rinki Oy and Paperinkeräys oy.

Waste electric and electronical equipment (WEEE) have many types like large domestic appliances including washing machines and refrigerators. Refrigerators are collected separately so that their CFC will be removed in a special plant. There are computers having valuable rare metals, then small electric equipment, like lamps, radios, CD players, vacuum cleaners and electric tools. Cathode ray-tubes, which have harmful metals, is a fraction, and flat displays and TV:s is another. All equipment is transported to their special plants and will be crushed and processed to get their basic materials for use. For instance copper is a valuable material. It is got more easily, when WEEE is sorted separately from general metals. Material separation of electronic devices, mostly computers, is demanding multiphase process including crushing, magnet and eddy current separators, manual separation, shredders, water separation etc.

Impregnated wood is polluting when incinerated. Special plants treat it. Hazardous waste includes paints, glues, fillers, mortar powder, waste motor oil, car and boat batteries, inflammable liquids like solvents, gifted chemicals, pesticides, acids, caustics and cleaning agents, mercury, aerosols, small batteries, energy saving bubs, fluorescence tubes and gas cylinders.

A certain category is garden waste and leaves. Ämmässuo waste processing plant composts or decomposes them to biogas. There is also a container for reusable items collected by the Reuse Center. Amounts coming daily are not large.

Customers do not have to pay for bringing hazardous waste, WEEE, metal, carton, paper, packing glass and impregnated wood. For customers, wood is the cheapest

paid material. There is a fee of 9 euros to one cubic meter of wood. Customers often bring only 200 liters, for instance, a dismantled book shelf, which amount has the minimum fee 1.80 euros. Renovators of apartments bring large amount of wood. The most brought material fraction, before wood, is mixed waste. It costs 20 euros for a cubic meter.

Renovators of apartments bring also a large number of sacks of mixed waste: laminates, plastics, styrofoam, plastic or furniture (unfortunately there can be pure wood or metal within). Private customers bring all kind of combustible items, for example, folders, carpets, folding mattresses, blankets, clothes, books, sports equipment, toys, and safety equipment.

Special and often brought items are divan beds, padded sofas and armchairs. Disposing of them can be a major challenge. These are items, which are often disposed of inappropriately in yards by waste bins of housing companies, or even to some remote places. Besides transportation, sofas have large volume, and the waste is charged by volume. They cannot be put to lower priced wooden waste because cloths and padding as metal springs and wires harm the crushing process to get pure wood chips.



Figure 4. Waste material beds in Kivikko Sortti Station

Each waste fraction has mostly three meter high metal beds (or open containers), lying lower than the customers' platform, where each item is dropped from above. One-ton-cylinder crushers roll loads sporadically flatter to get more space and increase loads. Thus, less drives are needed to waste processing plants. Hazardous waste is brought into a locked shed. Trucks lift full beds and transport them to their processors.

2.3.2 Functioning of Reuse Centre

The purpose of Reuse Centre's stores is to receive as much as possible reusable descent products to Reuse Centre's stores and keep waste material minimized. In reception of items there are different ways of sorting the received items to reusable and rejected products. There is a loading platform where workers receive the goods. Bags and boxes including small items such as books, toys or clothes will be received without finding out their quality. The process of selecting a large amount of small items in reception platform would be complicated and time-consuming. However, there is categorical rejection of certain items: folders, coat hangers, encyclopedias, VHS cassettes and safety equipment, which are rejected, when customer tells about them or they are noticed.



Figure 5. Instruction table in Nihtisilta Reuse Centre

Most selection happens in the warehouse by workers educated to make selections. Little less than a half of the donations are rejected straight. Specialists on books, music CD's and DVD's can be compared to keepers of second-hand bookshops. The flow of items is just much faster. Rejected books go to paper recycling to forest industry carried by Lassila & Tikanoja (L&T) company. It is one of the downstream actors.

Clothes have similar selection process to salable and descent, and non-salable. L&T operates baled clothes to be made solid recovered fuel (SRF). Bicycles are dismantled into their parts, cleaned and descent bikes are assembled again. A third of the bikes go for sale, a third to spare parts and rest to metal recycling operated by Stena Recycling Oy.

WEEE is received in all cases, although it is known they are out of order. Known to be non-usable can already be marked as rejected. Electric and electronic specialist tests the rest. Intact are hauled to the Kyläsaari store. About 25-30 percent of all equipment are in order. The rejected equipment are picked up by an operator to a plant used by so called producer organisation. In case of Reuse Center it is SERTY. A producer community cares after all WEEE of its participating companies. Companies can be, for instance, retailers of domestic equipment or electronic devices. Their customers pay a certain recycling fee for each bought new product. The money is used in managing the material recycling chain of used products. In Reuse Center Tramel Oy operates the small and Stena the large equipment. They are processed into separate materials.

2.4 Material Flows

Sortti Stations receive material about hundred times more material than what is the weight of rejected Reuse Center's material.

2.4.1 Sortti Stations' Material Flows

Sortti Stations received material according to Table 1 (HSY 2018). Mixed waste includes incombustible rock material.

Table 1. Waste material flows by fractions in 2017 in all five Sortti stations in tons and number of visits

Mixed waste	31 647
Metal	4 161
Other WEEE	2 971
TV:s and monitors	663
Refrigeration apparatus	705
Wood	19 973
Impregnated wood	2 224
Twists	4 591
Garden waste	6 337
Cardboard	462
Gypsum	1 633
Hazardous waste	859
Total	76 224
Paying customers	324 937
Free customer	114 323
Total	439 260

Mixed waste is the largest category. Nearly 32 000 tons is 42 percent of all waste is mixed. Second largest category is wood with proportion of 26 percent. Wood, garden waste, twists and gypsum are not received in Reuse Centers.

Mixed waste is categorized to combustible and incombustible shown in Table 2. Combustible material is half of the mixed waste.

Table 2. Mixed waste material flows by waste type in 2017 in all five Sortti stations in tons

Waste type	Tons
Rock material	8 790
Incombustible waste in other fractions	5 792
Combustible waste	17 065
Total	31 647

Incombustible waste in other fraction includes remarkable amount of metal.

2.4.2 Reuse Centres' Waste Material Flows

Compared to Sortti Stations amounts of recovered material are very small in Reuse Centers. There are about hundred or more donators per day in Nihtisilta Reuse Centre, when in Kivikko and Konala Sortti Stations it is about 600 visit per day in each of them. Roughly half of the material donated to Reuse Center's stores will be reused and other half goes to recovery. Amounts of non-reused material, which have to be put to material recycling are shown in Table 3. Amounts of the fractions, given by Ville Heinilä of Reuse Centre, are compared to all material recycling made by private inhabitants and small enterprises both to Sortti Stations and stores of Reuse Centre (Reuse centres) when there are matching categories.

Table 3. Amount of waste by fractions from Reuse Centre's stores and their proportion in combined recycled material of Sortti Stations and Reuse Centres in 2017

Fraction	Amount (tons)	Proportion (percents)
Metal	184	4,2
WEEE	660	13,2
Wood	205	1,0
Cardboard	38	7,6
Paper	409	
LD-PE plastic	4	100
Energy waste	224	
Mixed waste	228	0,7
Energy and mixed of total		1,4
Total	1952	0,4

The largest amount of Reuse Centre waste is WEEE with 660 tons in a year. Of all brought items to the reuse centres it accounts 4 percent and is 13 percent of all WEEE material left to Reuse Centre and Sortti Stations by households and small companies in Helsinki area. In mixed municipal solid waste in HSY area there was a roughly double amount of WEEE, 1500 tons, (HSY 2016), but it includes for example batteries and LED-bulbs and is thus not well comparable.

Paper is the second largest category with 409 tons in a year. Paper goes to recycling material in paper industry. In Sortti stations paper, which is not disposed of into paper collection box, goes to mixed waste.

Energy waste of reuse centres is mainly textiles. They are packed into bales and send to be fuel in incineration into heat. In Sortti stations textiles are put into mixed waste and incinerated in waste power plants. Besides, wooden items are dismantled in largest reuse centres to be crushed later into fuel. The amount of wood, other energy waste and mixed waste is small, about a percent of total waste in those fractions.

All furniture is checked in platform. Unfit, but not rejected, furniture goes mostly into the fraction of wood. If furniture is not accepted to the Reuse Centre, it is mostly advised to be brought to the Sortti stations. The customer can leave armchairs and sofas by paying a dismantling fee, which is about double what should be paid in Sortti stations, 32 euros for sofas and 16 euros for armchair. This is an incentive to bring the unfit furniture principally to Sortti stations. But received couches and sofas are in fact dismantled not anymore on the spot; they are sent to Vantaa waste power plant to be crushed there in the same way as the corresponding Sortti stations' sofas are treated. There are still pieces of furniture, which are easier to dismantle in the Reuse Centre's warehouse, such as shelves and tables, and this is still done. Metallic parts are removed from wooden material. In the Sortti Stations this is not done.

As in Sortti stations the wooden material from Reuse Center goes to energy power plants.

2.4.3 Comparison between Other Sources

In Sortti stations; there are also collecting boxes for waste paper like for packaging glass, but they are not operated by HSY Sortti Stations, and therefore not monitored. In fact, it is practice also in Reuse Centre. There is an ordinary collection box in the yard. The collecting boxes for paper and packaging glass are just ones among more than hundred in capital area operated by Rinki and Paperinkeräys. In Reuse Centers the paper comes mainly from rejected books. Rinki and Paperinkeräys recycling points' locations are marked in Figure 6.

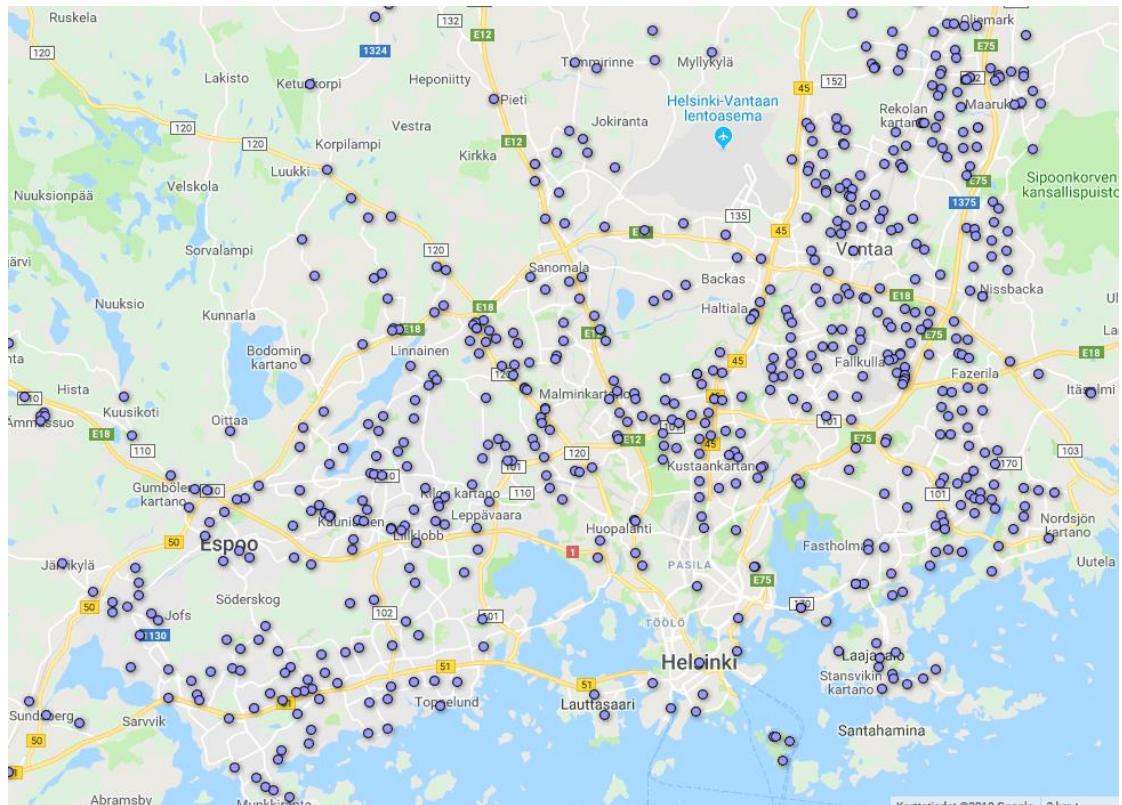


Figure 6. Recycling points for paper, cardboard, metal and packaging glass in Capital area operated by Rinki and Paperinkeräys <https://www.kierratys.info/>

There is extra information about material recovery made by Rinki Oy. Rinki operates 140 outdoor collecting boxes for metals, packaging glass, cardboard, paper nearby places, where people use to go (Figure 6). Boxes are meant to increase possibilities to recycling for those, whose residences don't have sorted waste collection to all or certain fractions. These are typically detached houses and small apartment house companies or housing co-operatives. Cardboard (Table 4) or carton have largest gains. Only small packing metal items fits through the holes of Rinki collection boxes. Despite that restriction, yearly accumulation of metal is a category, which is clearest comparable between different recycling flows being considered here.

Table 4. Accumulation of recyclable materials (in tons) in Eco recycling points operated by Rinki 2017

Carton	2 372
Glass	924
Metal	323
Plastic	378
Total	3 997

There are still recycling points in stores, mostly by inside parking lots of hypermarkets. Numbers are not included, but it is not expected that they are large. Shops produce large amount of cardboard themselves, but they are not included here and they have their own recycling systems. Only waste from private persons (and some small companies) is studied here.



Figure 7. Bed for metal collection including mainly bicycle parts in Nihtisilta Reuse Centre

Sortti Stations are a remarkable collector of metal, 4 161 tons in 2017. In HSY domestic sorted waste collection for metals from the residential and other real estate, there came 1508 tons metal in 2017 (HSY 2018). Figure 8 shows it is eight times more than the corresponding figure for the Reuse Centre, but one third of the amount of Sortti Stations.

However, there was found approximately, 4 800 tons of metal in mixed domestic waste according the 2015 study (HSY 2016). Now metal is a reject in waste power plant, and a part of metals, mainly ferrous, is striven to be sorted and recycled from bottom ash. Before 2014 non-sorted mixed waste was left to landfill in Ämmässuo. Now metal in mixed waste is still a problem because large parts can disturb the combustion process in the furnace.

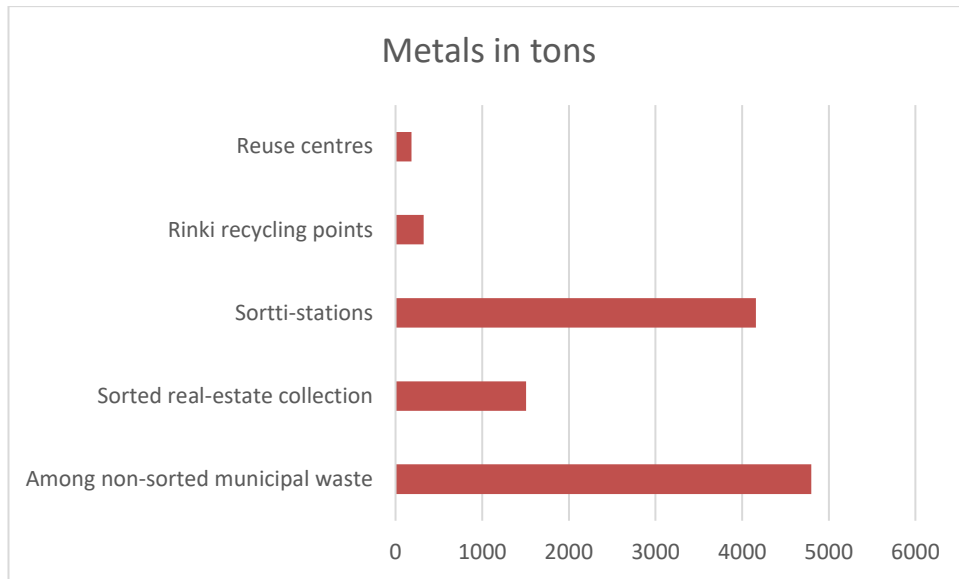


Figure 8. Yearly accumulation of metals by source in 2017. Amount of metals found in non-sorted municipal solid waste is estimation from 2015 waste study (HSY 2016)

It should be remembered that Rinki collects only small metal particles, which fit through the ca. 20 cm diameter hole. And Sortti stations receive also waste from small companies.

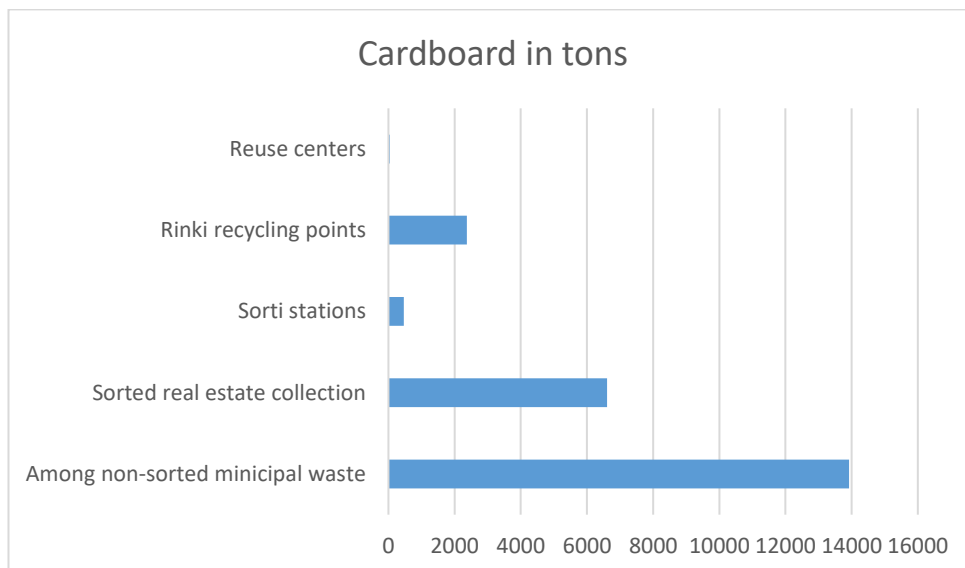


Figure 9. Yearly accumulation of cardboard by source in 2017. Amount of cardboard found in non-sorted municipal solid waste is estimation from 2015 waste study (HSY 2016)

Cardboard is another interesting comparable fraction (Figure 9). It accumulated last year 462 tons in Sortti stations, 6 609 tons from real estate cardboard containers, 2 372 tons from Rinki recycling points and 38 tons in Reuse Centers. Estimation for

cardboard in non-sorted municipal mixed waste is 14 000 tons (HSY 2016). Reuse centres and Sortti stations are marginal collectors of cardboard. Cardboard among non-sorted municipal waste is not recycled. It is recovered into heat in waste energy plant.

There is collection of LD-PE plastic in The Reuse Centre. The material is recyclable in production of new packaging plastic. In Sorttis there has been an experiment of collecting in Ruskeasanta station from 2017. Mixed waste of Reuse Centres consists of all rest material: leather, PVC plastic glass fiber and incombustible materials. The amount of mixed waste is very small, about one percent, compared to the amounts of corresponding materials in Sortti Stations.

When Sortti Stations are remarkable collectors of metal, still, if estimation made of 2015 study stands, most metal could be gained if the bottom ash from the Vantaa waste power plant is sorted well. The aim is to reduce remarkably the amount of metals going to the waste power plant among the mixed municipal waste.

2.5 Special Fraction: WEEE

WEEE refers to waste electric and electronic equipment. WEEE is a category where there is also remarkable material flow in Reuse Centres. It is also most complicated category for material recovery. Materials are valuable but much intertwined as very small veins.

Electric waste, like washing machines, is collected separately from metal waste so that the materials in the devices can be recovered. At the same time, also hazardous substances, such as lead and quick silver, can be recovered. (Vasilev 2015).

WEEE is treated by shredding the material and then separating small fractions. Electronic equipment is demanding because material is intertwined in small scales. Typical dismantling facilities consist of elements such as a shredder, a cyclone, a magnet and eddy current separators, and hand picking. (Vasilev 2015.)

Collecting and utilizing electric and electronic equipment are based on producer's responsibilities or, in other words, extended producer responsibility.

In Finland, the WEEE directive (2002) ordered a Decree on waste electric and electronical equipment already in 2004, renewed 519/2014), has given responsibility for the waste management of household appliances and it equipment from the municipalities to the importers and manufacturers of household appliances. The producers and importers of electric and electronic equipment have formed producer organisations, which have been called also producer co-operatives. Categories of WEEE are shown in Appendix 1. Ymparisto.fi (2018) lists current producer organisations as follows:

- Flip Association (WEEE category 5, lamps);
- ERP Finland (WEEE categories 1-10);
- ICT Producer Co-Operative (WEEE categories 3 and 4);
- SELT Association (WEEE categories 1,2,5-10);
- SER-tuottajayhteisö ry (WEEE categories 1-10)

Organisations manage the producer responsibility obligations for collection and recycling of WEEE material on behalf of its members. Reuse Center's main producer organisation is SER tuottajayhteisö (SERTY). Consumers can return a small EE appliance to a retail, when all dimensions of the appliance are under 25 cm. These small EE-appliances can be returned to a retail, which are either large supermarket type or a special store selling EE-equipment with at least 200m² of surface (Elker 2018).

HSY Sortti Stations and Reuse Centre have their own gathering organizations. There might not be need to combine these functions.

3 Interviews of Reuse Centre's Customers

The thesis investigates what kind of goods, how much is brought to the Reuse Centre and how far those who have brought goods to Reuse Centre, are ready to bring goods belonging to the Sortti Stations.

A part of the results are the answers from 247 customers in Nihtisilta in Espoo, and a smaller part of the answers was collected from 43 customers in Kyläsaari Reuse Centre in Helsinki. A wider range of respondents gives slightly more generalizable results. Answers only from Nihtisilta were used specifically for topics related to the location of the Reuse Centre.

Following issues were examined about Nihtisilta Reuse Centre:

- Number of visitors
- Visitors' distance to Reuse Centre and the district they live in
- Knowledge about Sortti sorting stations
- Usage of Sortti Stations and name of used Sortti station
- Distance to Sortti station

General data, including also data of Kyläsaari Reuse Centre visitors

Following variables were studied about all responders

1. Quantity of goods (3 ordinal classes)
2. Type of the goods (15 qualitative categories)
3. Distance to Reuse Centre (continuous variable)
4. Frequency of visits (8 ordinal categories)
5. Acceptance of goods (1/0)

6. Acceptance of earlier goods (1/0)
7. Knowledge about Sortti sorting stations (1/0)
8. Known Sortti stations (5 categories)
9. Usage of Sortti stations (1/0)
10. Used Sortti station (5 categories)
11. Distance to Sortti station (continuous variable)
12. Accepted maximum distance to Sortti station (10 mostly ordinal categories)
13. Age of the visitor (continuous or 6 ordinal categories)

3.1 Customers of Nihtisilta Reuse Centre

The Nihtisilta Reuse Centre is the central station of the Helsinki Metropolitan Area Reuse Centre Ltd (Pääkaupunkiseudun kierrätyskeskus Oy). There are large storage facilities and it has the largest store of all the reuse centres. The customers, who came to donate goods, were interviewed in five days during week 24 beginning from Monday 11th June, continuing Tuesday, Thursday and Friday and later in Friday 29th of June. It is estimated that there are daily well above 100 donators in Nihtisilta.

There were 248 respondents, on average, 50 per day. Not all answers were obtained from all customers. Sometimes there was no time for interview because donations happened overlapping.

The distances of the respondents to Nihtisilta were estimated either according to their estimates or much more often according to the district they reported to live in. The distances were then estimated based on the distance obtained with the Fonecta route guide from that district to Nihtisilta store. The estimation was made from the given centre of each district, which gives possible error to the real distance about one

kilometer. Fonecta highlights driving on the main routes, so in some cases the distance was judged by a shorter route.

The average distance traveled by the respondents (225) to the Reuse Centre was 6.2 kilometers. Figure 10 shows the number of different distances. 85% of the respondents came from a maximum of 10 kilometers. When compared to Swedish recycling centres, their typical user travels about 5 km by car and combines the visit with the other activities (Engkvist et al. 2016). It is quite similar distance.

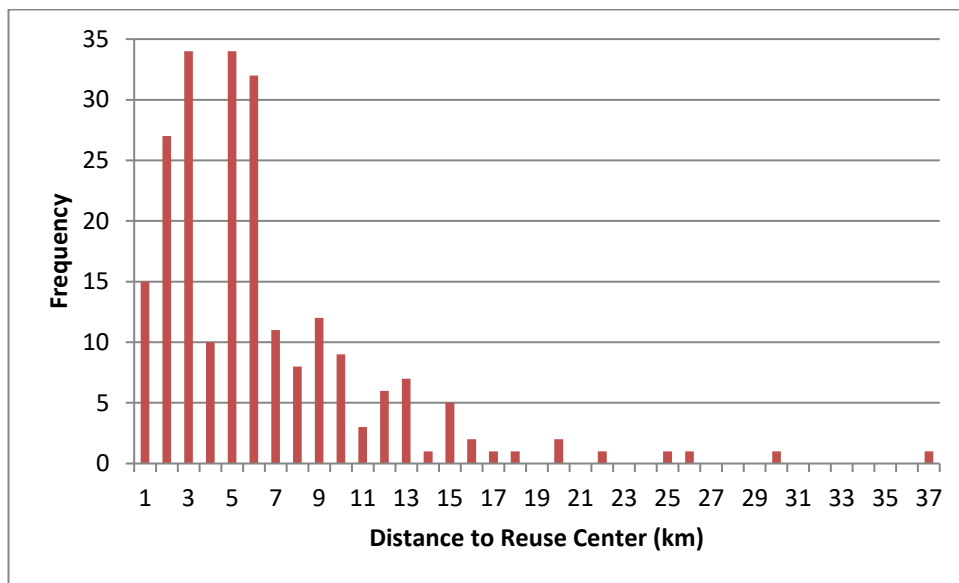


Figure 10. Frequencies of the distances that donators have to Nihtisilta Reuse Centre

The respondents were asked whether they knew about the Sortti stations and whether they could name any of them without any clues. If the respondent referred correctly to the location of the station ("What's by the Vihdintie", "in Malminkartano", "next to the filled hill"), the answer was accepted (Konala). Answers could be given to multiple stations. Table 5 shows the answers to the first-mentioned stations and all mentions of each station.

Table 5. Knowledge about Sortti stations

Station	Primarily mentioned	Proportion	All mentions	Proportion
Konala	113	46,5	131	53,9
Ämmässuo	68	28,4	92	38,3
Kivikko	15	6,2	19	7,8
Jorvas	7	2,9	11	4,5
Ruskeasanta	2	0,8	3	1,2
Other	2	0,8	2	0,8
Doesn't know	35	14,4	35	14,4
No answer	5	-		
Total	248	100,0 %	294	121,0 %

Of the respondents, 85.6% knew at least one of the Sortti stations. Konala Sortti Station was best known. Almost half mentioned it primarily. Ämmässuo was mentioned primarily less than a third. When looking at all stations' references, Konala was referred to by more than half of the respondents, and over a third of the respondents mentioned Ämmässuo. Kivikko in eastern Helsinki was known better than Jorvas station in Kirkkonummi, near South Espoo.

Table 6 lists the main districts, where items are brought from to the Nihtisilta Reuse Centre. The list includes areas, which have at least three customers. Knowledge of Konala and Ämmässuo Sortti Stations was exhibited by districts having more than 7 visitors.

Table 6. Main districts where items are brought from to Nihtisilta Reuse Centre, number of visitors and mentions of station

District	Visitors	Know Ämmässuo	Know Konala	Not any
Kauniainen	25	17	8	5
Mankkaa	17	9	9	1
Olari	11	8	5	0
Leppävaara	10	1	9	0
Viherlaakso	9	3	7	1
Tapiola	8	5	4	1
Kilo	8	5	5	0
Laaksolahti	7	0	6	0
Nearby	6			
Espoon kesk	6			
Tuomarila	6			
Espoo	5			
Munkkivuori	5	1	6 (With Munkkiniemi numbers)	
Laajalahti	4			
Munkkiniemi	4			
Way to work	4			
Henttaa	3			
Kannelmäki	3			
Karakallio	3			
Kirkkonummi	3			
Konala	3			
Lauttasaari	3			
Lippajärvi	3			
Ymmersta	3			
Others	74			
No answer	15			

Of the given urban areas the largest number of customers came from Kauniainen. Mankkaa and Kilo were also a few kilometers away. These were characterized by the fact that Ämmässuo was mentioned as a known Sortti station in at least half of the cases. In the east and north from Nihtisilta the most often known station was Konala. Nihtisilta is located in kind of traffic watershed. Ämmässuo's distance from the direct motorway from Nihtisilta is 15 km and Konala's slightly slower route is 10 km.

When data about districts located west from Nihtisilta up to Ring III highway are combined, there are 20 respondents. (Districts are Sepänkylä, Ymmersta, Tuomarila,

Espoon keskus, Suvela, Kaupunginkallio, Kuuriniitty and Muurala.) Of these 20 respondents, 9 knew Ämmässuo and 6 Konala. Nine did not know any station. Ämmässuo in the west was used by 8 and Konala by 3 persons. According to Table 7, choosing a station is consistent with knowing a station.

Table 7. Used Sortti station in the most significant donator districts

District	Konala	Ämmässuo
Kauniainen	7	14
Mankkaa	5	9
Olari	4	6
Leppävaara	6	1
Viherlaakso	6	2
Tapiola	4	1
Kilo	4	3
Laaksolahti	6	0
Munkkin./-v.	4	1

Figure 11 shows the location of users of Ämmässuo and Konala Sortti Station.

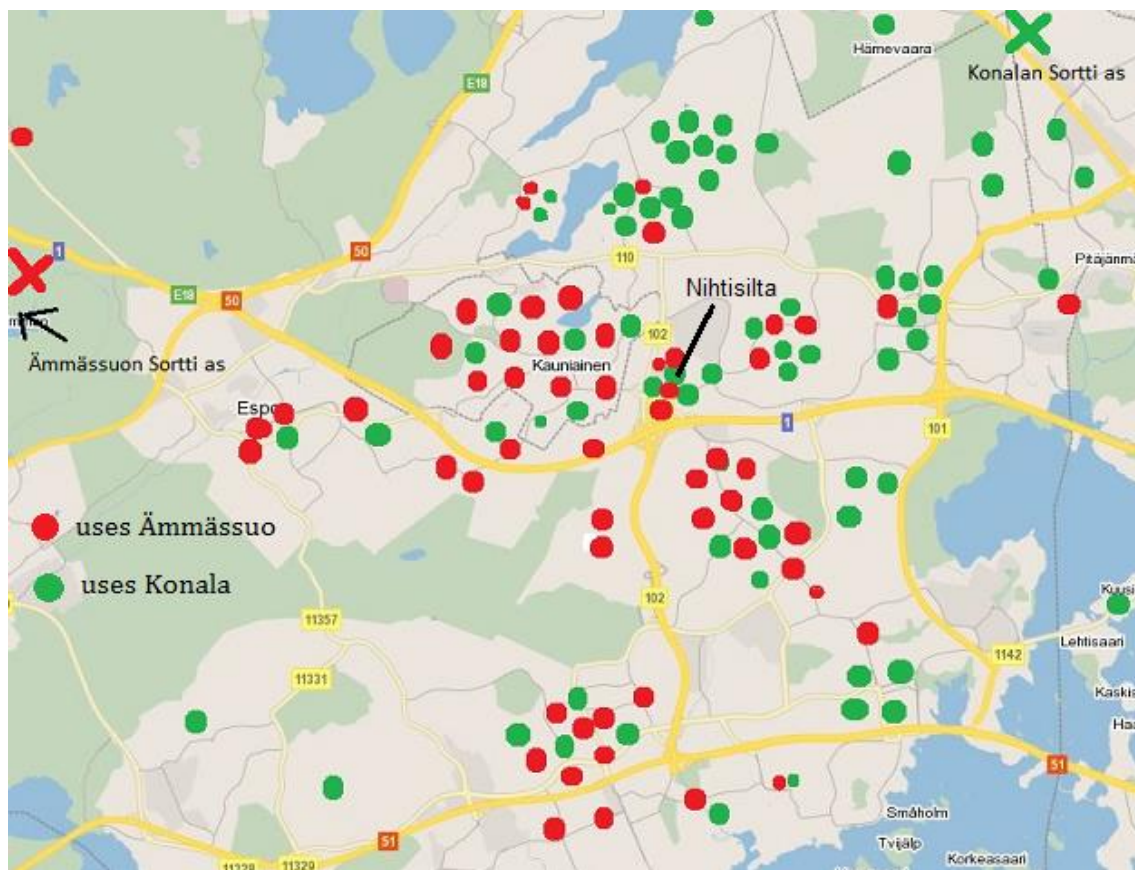


Figure 11. Location of donators from Espoo using either Ämmässuo (red) or Konala (green) Sortti Station

Most donating customers of Nihtisilta came from Espoo and Kauniainen (176, 76%). Thirty-three (13 %) of the customers of Nihtisilta came from Helsinki, 5 from Vantaa, 5 from Kirkkonummi, 2 from Siuntio and 1 from Vihti. 8 was on a way to work or otherwise along the way. The Helsinki residents mentioned they knew Konala 19 times, Kivikko 6 times and Ämmässuo 4 times. Konala was used by 16 and Ämmässuo by one person. Kivikko was used by 4 people.

All donators of Nihtisilta used Sortti stations according to Table 8.

Table 8. Used Sortti stations of all Nihtisilta donators

Station	Primary use	Proportion	All uses	Proportion
Konala	95	39,1	102	42,0
Ämmässuo	63	25,9	69	28,4
Kivikko	9	3,7	9	3,7
Jorvas	5	2,1	5	2,1
Ruskeasanta	2	0,8	2	0,8
Other	1	0,4	1	0,4
Not used	68	28,0	68	28,0
No answer	5	-	5	-
Total	248	100,0 %	261	104,9 %

72 percent of respondents have used a Sortti station when any Sortti station was known 86 percent. The most popular is the Konala station, which has been used by 42 percent and the next most popular Ämmässuo, fairly of the quarter (28.4%) of respondents.

The distance of Sortti stations was estimated by 199 respondents who knew about at least one Sortti station and whose residential district was known. The distance to first mentioned Sortti station was calculated by Fonecta route adviser. These accounted for 82% of all respondents. Distance could not be estimated by all users. The respondents had an average distance of 11, 8 km from their home to Sortti station mentioned known first. Thus, the Sortti stations are considerably further than the reuse centre, where the respondents have arrived (Figure 11).

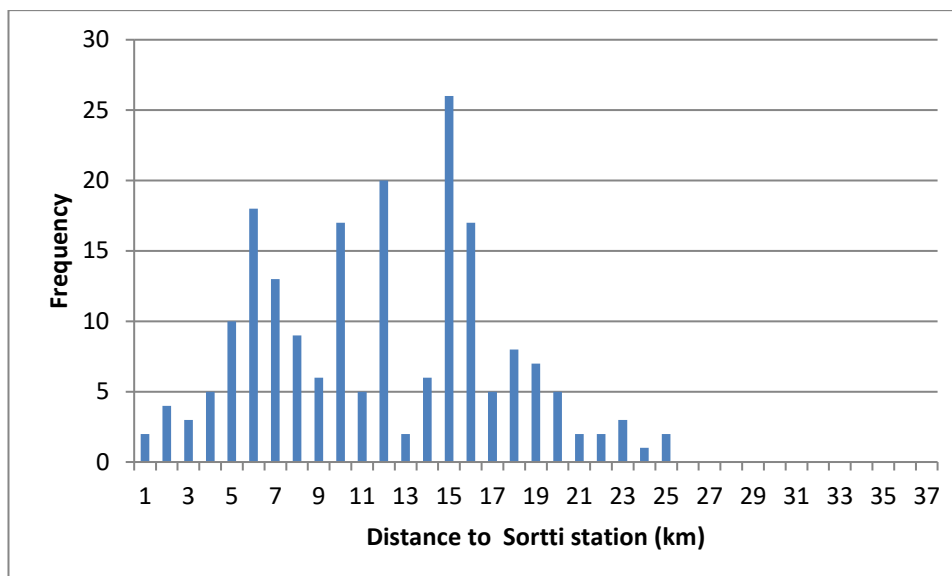


Figure 11. Frequencies of the distances donators have to their mentioned Sortti station

A reason to more far distance is that among respondents those living near Nihtisilta are slightly over-represented. And from Nihtisilta distances to Konala and Ämmässuo are 10 and 15 km.

The 44 per cent of the respondents who knew a Sortti station lived at a distance of up to 10 km. Almost all (95 %) lived within a distance of 20 km to the Sortti station. Those not knowing any station may reside even further, but there is no reason to suppose that these distances to the station would deviate significantly from the knowing stations.

All goods were accepted from 87 percent of the Nihtisilta donators, and respectively in 13 per cent of the cases there was some item, which was not accepted. There was no case where more than one item was rejected.

3.2 All Customers

Kyläsaari Reuse Center is located 5 km to north-east from Helsinki centre. 43 interviews were made during Wednesday 13th June. The data will be combined with Nihtisilta data. Donators' distance to Kyläsaari Reuse Centre was a little shorter, 5.3 km, than Nihtisilta donators' 6.2 km. Assumably, it takes more time to travel to Kyläsaari from the core city with slow traffic. The Sortti station most clearly mentioned by customers of Kyläsaari was Kivikko. 63 percent knew it. Konala was known by 16 percent; Ämmässuo and Jorvas was known by 1 person each, which is 5 percent

together; and Ruskeasanta by 3 (7 %). 19 percent did not know any Sortti station. Among all respondents, 85 percent knew at least some station. Average distance to a station is 10.1 km to Kyläsaari customers, while it was 11.8 km to Nihtisilta customers.

Sortti Stations has been used by 65 percent, which is little less than 72 percent of Nihtisilta customers. (In total Sortti has been used by 71 %.) Kivikko was clearly the most used station; 56 percent have used it and Konala only by 7 percent. Nobody had used Ämmässuo; and Ruskeasanta and Jorvas has both 1 user (ie 5 %). Sortti stations were slightly closer to respondents than in Nihtisilta, at a distance of 9.9 km.

3.2.1 Age

The average age of responders in Kyläsaari was 49.3 years, and in Nihtisilta it was about same, 51.6 years. Thus, combined average age was 51.3 years. Part of the responders said their exact age, while others indicated their age category. Thus, there is inaccuracy in reporting age, when the value of the age class has been rounded to the centre of the category. For instance, age category 50-59 gives age 55. Customers of Swedish recycling centres have similar age. The typical user of recycling centre is a man in 50s who lives in a house (Engkvist et al. 2016). The frequencies of age categories is shown in Table 9.

Table 9. Frequencies of age categories of the Reuse Centre donors

Age	Number	Proportion
18-29	23	8,6
30-39	33	12,3
40-49	68	25,3
50-59	61	22,7
60-69	56	21,2
70-	27	10,0
	268	100,0

Younger ages are represented less. This might be because they don't have collected yet so much stuff to get rid of.

3.2.2 Types of Goods

Customers were interviewed after they had given their goods to recipient workers of the Reuse Centre. Donators were asked first what kind of items they brought. Customers responded easily to this; they had just given their belongings to the recipients, mostly satisfied. They had just told to the recipients what they were bringing if the goods category could not be directly recognized. Therefore, it was easy repeat the answer.

The goods received were divided into 15 categories shown in table 10. The number indicates how many customers have imported goods of that category. Amounts of goods are not counted. In addition, the customer may have imported only one type or brought items belonging to several categories.

Table 10. Types of donated goods and frequency of reception of each type

Type of goods	Frequency	Specification
Clothes, shoes	93	
Textiles	37	fabrics, curtains, blankets, mattresses
Kitchen items	51	cutlery, dishes, all for cooking , utensils
Lamps, mirrors	37	
Ornaments	32	incl. pictures, flower pots
Furniture	70	
Small electrics/ electronics	68	also TV:s
Household appliances	12	washing machines, refrigerators
Toys	32	incl. games
Sports equipment	21	incl. bicycles
Books	61	incl. CD- and DVD-record
Instruments, tools	52	eg. bags, irons, strollers
Materials	22	Sortti Stations goods
Miscellaneous	17	phrase used by customer
	605	

The most commonly brought goods were clothing, clothes and shoes, brought by 32 percent of customers. Other significant types were furniture (24 %), electric and electronic goods (23%), books (21%) and household goods (18%). The Figure 12 shows the number of customers depending on how many types they have imported. Customers brought on average 2.1 types of goods. The largest group of customers, 124, donated only one type of goods.

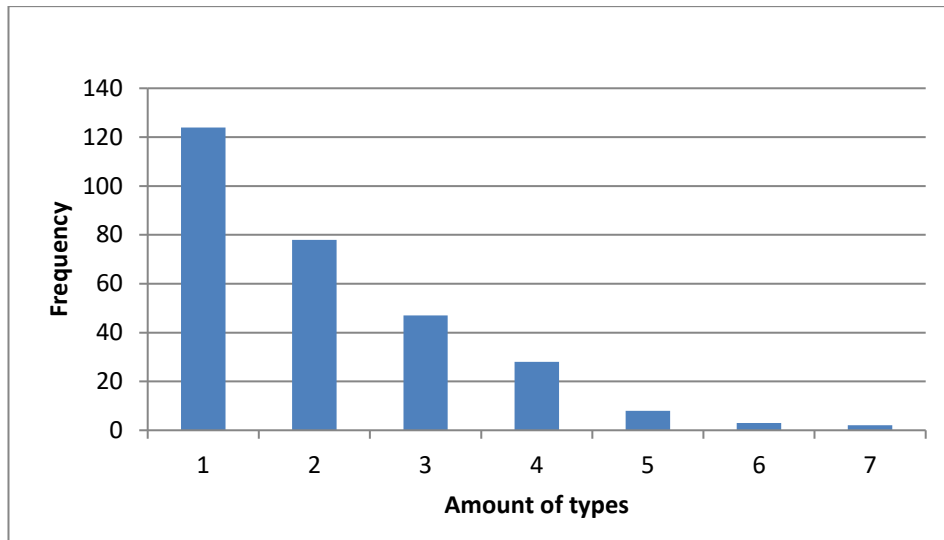


Figure 12. Number of donators' type of goods and their frequency

3.2.3 Amount of Goods

The quantity of donated goods was defined in three categories (Table 11). The first one includes hand-worn items, such as a bag or two of items. The largest category, Class 3, consists of goods carried by a trailer, van or by passenger car luggage compartment and back seat. The second remaining category consists of items that require delivery, such as the bringing of three boxes or multiple boxes, and goods are less than in the third category,

Table 11. Amount of goods (1= some, 2=intermediate, 3=much)

Amount	number	Proportion
1	103	35,5
2	132	45,5
3	55	19,0
Total	290	100

Kind of median for amount of brought items is four plastic bags or cardboard boxes, or a table.

3.2.4 Means of Transports

Goods were, in principle, brought by private cars. Vans were tagged in 12 cases and trailer in 3. There were 6 cases of coming by walking or by bicycle.

3.2.5 Frequency of Visits

Customers were asked how often they brought goods to Reuse Centre. The number of frequently visiting people are over-represented among the interviewees, as it is more likely that frequent visitors will hit the day of the interview than the sparse coming visitor. In reality most of all donators come seldom.

The extremes of the responses are visiting at least once a week, and visiting for the first time. If the respondent was now exceptionally frequent, they were asked to count the number of visits in the past. The customers' answers to the number of visits are divided into eight rankings shown in Table 12. Answers open to interpretation, such as "often" or "seldom", are not included.

Table 12. Donators' visiting frequency classes and number of persons in each class

Rank	Visiting frequency	Number	Proportion
1	First time	29	11,8
2	Less than once a year	19	7,7
3	Once a year	22	8,9
4	2 (or less) times a year	62	25,6
5	More than 2 - less than 6 times a year	64	26,0
6	Once a month - over 6 times a year	31	12,6
7	More often than once a month	11	4,5
8	Once a week	7	2,8
Total		245	100

The median of the answers is two times or less but more often than once annually. It is logical to assume that in reality the majority of the donors of the goods visit once a year or less, as these, as said, happen less often to attend the interviews. The order-scale responses do not include interpretative replies such as "often" or "seldom". The number of these is shown in the Table 13.

Table 13. Donators' qualitative answers about visiting frequencies

Answer	
"Seldom"	5
"Now and then"	2
"Often"	4
"Now often"*	14
Total	25
Not answered	21

*) No specifying question made

In order to get more observations to the analyzes "seldom" could be value of 2, that is, "less than once a year", "sometimes" value 5, "more than 2 and less than 6 times a year" and "often" value of 6. "Now often", which was not always specified in interviews, does not tell about the long period frequency.

3.2.6 Worthiness of Goods

The Reuse Centre accepted and received more goods than expected. For example, Reuse receives all electronics and domestic appliances regardless of their condition. The electric and electronic equipment found to be defective when checked in the storage hall, goes to material recycling. The condition or quality of books, clothing and textiles, and small items was also not evaluated at the time of receipt. The sorting of items to be sold is done in the storage hall.

87% of the donors got all their goods received, and 38 or 13 percent had some item, usually only one among others, not received (Table 14). Reuse Centre does not accept any safety equipment, such as bicycle helmets and child seats, folders, encyclopedias, VHS cassettes and coat hangers.

The furniture is left as the most interesting type rejected. Even small scratches and stains lead to rejection in the same way as all kinds of defects. Naturally, the products referring to antiques are received more flexibly. Furniture takes much storage and shop space. It is not worthwhile to afford cheap furniture in the limited space of the reuse centres. Therefore, only the best quality is sufficient for decent earnings to Reuse Centre.

Table 14. Items, which were not received in Reuse Center

Rejected items	Number
Not of acceptable type	10
Faulty furniture	20
Other things	8
Total	38

When some furniture were rejected in 20 cases and furniture was brought 70 times, it means in 29 % of the cases some furniture was rejected.

Customers were asked whether their goods were rejected, sometimes earlier (Table 15).

Table 15. Items, which were not received earlier to the Reuse Centre

Rejected items	Number
Not of acceptable type	15
Faulty furniture	39
Other things	6
Total	60

Many customers have also asked Reuse Centre to fetch their belongings by the vehicle of the Reuse. The collecting van has to comply with stricter criteria for the goods. Chipboard furniture, for example, is automatically rejected. When brought to the Reuse Centre by oneself, the principles are more flexible by different recipient workers and situations.

Items have been rejected earlier more often, 60 times, which is about 20% of customers, which is more often than 38 times in this time of the interviewing. The furniture is emphasized also in earlier rejections. Chipboard was mentioned in four cases. At the present reception of the Reuse, chipboard was not mentioned.

3.2.7 Acceptable Distance to a Sortti-Station

Donors were asked how far a Sortti station can be located so that goods would still be brought there. The question was difficult for many respondents, and it was initially unanswered in many cases. The question was concretized by asking how far one

would be willing to take a broken armchair. Customers did not often give an exact number. Answers were divided to ten categories in Table 16.

Table 16. Categories of acceptable distance to a Sortti station and their frequencies

Acceptable distance	Number	Proportion
1 Under 10 km	15	7,6
2 10 km	36	18,2
3 11-19 km	35	17,7
4 20 km	39	19,7
5 21-30 km, metropolitan area	18	9,1
6 50km	11	5,6
7 Doesn't matter	9	4,5
8 Must bring to any to distance	9	4,5
9 Conditional, if had a car	18	9,1
10 "Far" or similar	8	4,0
Total	197	100

Donators in the Reuse Center reported in their responses about readiness to take the goods relatively far. The largest answer class is "20 kilometers". 95 % of respondents live 20 km or closer to the Sortti station they know or use. Average distance is 11.5 km. Of the respondents 47 stated explicitly that they could export the item further than 20 km, with one response being "even to China". The Reuse Center's customers are, in principle, more than average motivated recyclers. Readiness to long distances can be explained by it.

Those answering 10 km or under 10 km may be considered slightly cautious or qualified. These were 51 persons (26% of answered respondents). There are 22 respondents who say that they are ready for a shorter distance than what they actually have to the Sortti station they use. This may be a travel assessment error. In any case, these respondents are not more willing to carry the items beyond their actual journey.

3.3 Relationships between Variables

It has been examined above, how single variables are distributed. There may also be some relationships between the variables. Overall, not many relations were found, and many were often in principle logical or conceptual connection to one another, as bringing many types of goods has direct relation with bringing large amount of goods. Analysis is made between two variables. There are many missing answers among the

respondents. The amount of subjects, who have answers to both studied variables, can be much smaller than amount of all respondents.

3.3.1 Age

The age of the Reuse Centre donators (average 51) is higher than the average age of the whole population (43). Those of the interviewed, who use Sortti Stations, are somewhat older than non-users, but the connection is not statistically significant in the t-test. What is significant is that the younger customers use reuse centres considerably less frequently. The correlation between the age and the frequency one visits is 0.29. Dependency is affected by the fact that among the young people there are lot more first-time visitors. Table 17 shows the dependency between age and visiting frequency.

Table 17. Age groups and number describing frequency of visits (Table11; Number 1 means first time)

	20-30	30-40	40-50	50-60	60-70	70-
1	10	5	6	2	3	1
2	3	3	7	3	2	2
3	2	1	7	7	3	2
4	1	10	20	13	10	6
5	5	6	11	17	18	5
6	0	2	12	5	9	3
7	0	1	1	3	2	4
8	0	2	0	2	1	1
	21	30	64	52	48	24

Averages of frequency number among the age groups

20-30	30-40	40-50	50-60	60-70	70-
2,43	3,97	3,98	4,48	4,63	4,75

This is partly a logical explanation. The new comers are mostly among the young, or when one is very young, one must have his or her first time. When the first time visitors were removed from the analysis, the age and frequency of visits were linked to a low correlation coefficient of 0.17. However, here are first-time people in all age groups, so it is important to take value first time within. And, if all young people, 20-29 years old, being, for example, 20, 21, 22 and so on, visited as seldom as once a year, only a tenth part of them on average would be expected to be for the first time in the Reuse Centre. The 20-years-old would be the only first timers. Others would have already visited. Therefore, it can be said, that vising a reuse centre is more frequent in terms of

age. The reason for this is undoubtedly the accumulation of goods to homes along aging and need to dispose of extra things.

The average number, which describes how frequently one visits the Reuse Centre, is also increasing by age groups. On average those over 60 years refer they visit Reuse Centre two times a year and the youngest not more than once a year.

A small, special age-related difference is in the distance where the respondents are ready to take their recyclable goods. There are two response classes of acceptable Sortti station distance, which have no limit of acceptable distance ("Doesn't matter" and "must bring anyway"). For these Sortti station can be at any remote distance and it would still be used. When Sortti station can be at any remote distance for the respondent, high age is emphasized. These 18 respondents, who do not care about distance of the Sortti station, are, on average, 62.5 years old when the average age of all respondents is 51.2 years. The difference is statistically significant. The reason could be high sense of duty or more free time. A major conclusion cannot be made because the age of those who accept more than 20 km and even 50 km did not deviate from the average age of all the respondents.

The amount of goods brought did not differ much or significantly, but from 40 to 49-years old brought, on average, the largest amount of goods and largest number of types of goods.

3.3.2 Using of the Reuse Centre

More frequently visiting donators of the Reuse Centre bring slightly smaller quantities of goods and the distance to the Reuse Centre is slightly shorter. This is already logical. Why would those having long distances to the Reuse Centre travel as often and with as small amount of goods as those living nearby a Reuse Centre. Frequently brought items are clothing and decorative items.

Those bringing furniture is the most distinctive of those bringing other types of items. Furniture was the most rejected goods group. Furniture bringers are less frequent visitors of the Reuse. Furniture is the most usual singly brought type of goods. When bringing furniture, not so many other types of goods are brought compared with bringing other types of goods. For example, when bringing household items, clothes, or

toys many other types are also brought. Clothing bringers bring more other types of goods

Table 18. Combined categories of accepting only 10 or closer distances and bringing furniture

Accepted distance	Bringing of furniture			
	Yes		No	
10 km or less	17	43,6	34	25,6
Over 10 km	22	56,4	99	74,4
Total	39	100	133	100

In Table 18 the groups accepting 10 km and the group accepting less than 10 km distance to Sortti station were combined into one group and the acceptors of other explicitly mentioned longer distances are combined into a second group. Furniture bringers emphasize acceptable distance of only 10 km or less than 10 km to Sortti station. Of the furniture bringers, 44 percent are ready for only 10 or less kilometers distance, the corresponding figure for non-bringers was 26% as most of them are ready for distances over 10 km

Classification is cross-tabled with the bringing of furniture. The relationship is statistically significant (chi-test, $p = 0.03$). Furniture bringers consider often that Sortti station has to be near. But, similarly, those who did not bring furniture emphasize relatively short 11 to 19 km distance compared to the furniture bringers. This does not appear in the table of combined categories. No strong conclusions can be drawn.

3.3.3 Using of Sortti Stations

It could be expected that Sortti users are older than non-users. However, those using the Sortti Stations are not significantly older (in average 52.2 years) than those not using (49.4). The use of Sortti Stations is related to the frequency of Reuse Centre visits and the amount of brought items to Reuse Centre. The three-step variable describing the amount of brought goods was averaged among the Sortti Station users and non-users. The difference in the t-test was statistically significant ($p = 0.019$). Sortti users brought larger amount goods to the Reuse Center. The difference between the averages of the variable describing visiting frequency (which has eight ordinal stages) was also significant between the users and the non-users ($p = 0.043$). Users of Sortti Stations bring more often goods to the Reuse Centre, as they brought this time larger

amount of goods than those who do not use Sortti Stations. The result is quite expected. Sortti visitors have usually car, by which bigger load can be carried, and they are more used to recycling when having made step to Sortti station.

It was also analysed whether those who have their items rejected would use Sortti Stations more. Whether or not an item was rejected this time in Reuse Centre does not have any significant connection with previous Sortti Station use. The fact that items have been rejected earlier does not either mean that Sortti station would have been used significantly more.

Another aspect studied was whether the distance to Sortti station prevented its use. Although users had some shorter distance than non-users, the distances to mentioned Sortti station is not significantly longer to no-users ($p=0.21$) than the users of the Sortti Stations. Thus, the distance does not have effect on the use of Sortti Stations. Practically this means that long distance is not a problem. In addition, it was studied whether distance would play a role for those who knew a Sortti station but had not used it. These 29 persons lived, on average, 12.6 km away from Sortti, which is only 1.3 km longer than those who use Sortti. There is no statistically significant difference either here ($p=0.20$). Distance to Sortti station does not explain use of them.

A yet another factor to analyse was whether there is a relation between the actual distance to Sortti station and the accepted distance to Sortti station. People, who have got used to shorter way to a Sortti station, would not to accept longer distances. However, when categories are combined to get most significant possible result, it does not give a significant relation. Those, who accept distance of only 10 km or less, are compared to all others. They do not have significantly shorter way to their nearest Sortti station (t-test, $p=0.08$). Their average distance to Sortti is 10.3 kilometers.

A special relation is that those who have not used any one of the Sortti stations are more likely to report about readiness to take their goods to any undefined remote Sortti station. In Table 16, there were 172 respondents who have reported the accepted distance and the eight categories. Now accepted distances are compiled to three sub-groups in Table 19.

Table 19. Acceptable distance to Sortti station among Sortti users and non-users

Distance	Use of Sortti			
	Used		Not used	
10 km or less	43	30,3	8	26,7
11-20 km	67	46,5	7	23,3
over 20 km	33	23,2	15	50,0
	143	100,0 %	30	100,0 %

30 respondents, who have not used Sortti, are analysed. Half of these non-users would be ready for long distances over 20 kilometer, while only a quarter of those using Sortti would be ready for so a long distance. In the selected analysis, the significance level of the khi test is 0.008. The experience of using Sortti Stations at a certain distance, mostly under 20 km, limits the readiness to travel to Sortti in a long distance. There is no reason to announce readiness to travel further than 20 km. In contrast, non-users can report long distances. Reasoning other way, distance is not the reason why non-users have not (yet) used Sortti. They are ready to go even further than the Sortti users are.

Konala and Ämmässuo Sortti Stations are most popular. The users of Ämmässuo and Konala stations differ by their age. The Ämmässuo users are slightly older with average age of 56 when the average age of Konala users is 50.5 years. (t-test, $p = 0.055$). Ämmässuo users distance to their station is very clearly longer, an average of 15.7 kilometers as the Konala users travel, on average, 8.8 kilometers (t-test, $p = 4 \times 10^{-19}$). Ämmässuo and Konala customers brought Reuse items as much.

4 Discussion

Of the customers, 71 percent had used some Sortti station, and 85 percent could name some. Older customers use Reuse Centre more often. In using Sortti Stations there is no difference. Those, who bring often and much goods to the Reuse Centre, use also Sortti Stations more usually. It would be special if that were not the case. Those who have accumulated goods to the Reuse Centre have also faced the need to export goods to the Sortti Stations. Both functions are part of personal recycling policy of promoting both reusing and recycling. Clothes and textiles along with household and

decoration items are most typical donated products. Median amount of donations is four full plastic bags or a smallish table. The Reuse Centre rejected items more seldom than was expected. An item was abandoned in only 38 cases, or 13% of cases. Furniture was the most critical group of items.

Average distance to a Sortti station was 11 km. Donators of Nihtisilta Reuse Centre, alongside the Kyläsaari donators, are mostly ready to carry their goods to Sortti stations beyond their actual distances. Sortti stations reside, on average, 11 kilometers from their homes, while 20 kilometers is some kind of average accepted distance. Distance to Sortti station seems not to be a preventing factor to use it. Actual distances of users and non-users are about same. In readiness in contrary, non-users can accept even longer distances to Sortti station than the users do.

The distance at which Sortti station was considered to be still available could have also been asked what would be the reasonable distance to the station. The answers could then be very short distances. The question could also have been spelled out by specifying the time limit, for example, asking: "How far away can Sortti station be if you need to bring this week an item, which is unsuitable for domestic waste bin and not reusable?" Questions about distances could also be asked elsewhere than at the Reuse Centre, whereby other than voluntarily recycling attitudes will emerge.

5 Conclusion

The locations of reuse centres and Sortti stations complement each other, thus making potential recycling sites network denser. How could co-operation between Sortti Stations and Reuse Centre developed?

There has been a profound study about recycling centres in Sweden. They differ from HSY Sortti Stations so that customers do not have to declare and pay for their items. In Sweden most users (80%) were positive about reusing products disposed of by others and most (67%) were also willing to let others reuse their own disposed products (Engkvist et al. 2016). This gave rise to suggestions for arranging a specific area for products to be reused (Eklund et al. 2010). In Sortti Stations there are already huts for items given for Reuse Centre.

At Swedish recycling centres where users can place products in separate places for charity organisations to collect and sell these items in specific shops. However, recycling centre employees have estimated that most of given products are disposed of by charity organisations at the recycling centre because being assessed to have no market value. But, at few recycling centres the municipalities either have their own stores and sell given products with profit, or let non-profit organisations collect useable waste and run a business close to the recycling centre. (Engkvist et al. 2016). In Helsinki area there is already basis for this with co-operation with Reuse Centre. There is also a problem that many products brought to reuse hut, are not worth selling. Reuse has to concentrate on items, which have monetary value, in order to not be overflowed.

Reuse centres could benefit if HSY Sortti Stations had some services in their area. In Nihtisillta this would mean mainly that there was a container or more for rejected products, which would be operated by HSY. Those containers would be most usable on Saturdays, when many bring larger amount of items and furniture, for example, when moving. Rejected furniture cannot be brought to Sortti stations, which are closed on Saturdays. In Nihtisilta there could be a place for a container. Now furniture is received in Reuse Centre with about double fee. Whether Sortti Stations operated in Reuse Centre, would items be charged according Sortti Stations' lower prices, is a question.

There could also be systematic reception of many kinds of rejected recycling material to the Reuse Centre. But Reuse centres cannot become Sortti stations receiving any amount of materials from people who want use it as closest Sorting station. To prevent overflow reception could be tied to bringing reusable products.

Material flows from Reuse Centre's non-reusable items are very much smaller than from Sortti Stations. Mixed waste and wood from Reuses is only about percent of the flows in Sortti Stations. Amount of metal is larger about 4 percent. Therefore, it is asked if HSY would operate transportations of these amounts or if the Reuse Centre would organise the transportations as they have done until now. There is relatively large flow of waste electric and electronic equipment. Where reuse centres could become also more like recycling centres is in WEEE. Now Reuse Centre receives 13 % of all WEEE. Customers could bring WEEE even more to reuse centres if they chose always the nearest site of disposal of WEEE.

Improving material recycling services in reuse centres could increase supply of reuse donations to reuse centres, when people had more reason to go in them. Problem with Sortti services is that there is enough space for them mainly in Nihtisilta. Smaller stores cannot receive more items. And as said above, reuse centres cannot become Sortti Stations.

Improving co-operation in Sortti stations might be more productive. Ira Kaipainen (2016) has studied in Ruskeasanta Sortti Station, how a guide presenting possibility to bring items for reuse improved the amount and quality of products. Room for reusable products could be widened. There could be more advice on bringing intact products to Reuse Centre's space.

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Appendix 1. Fractions of waste electric and electronic equipment

The electrical and electronic equipment cover all appliances that require an electric current, battery, or solar energy in order to operate. In addition, all lamps, excluding incandescent and halogen lamps, are regarded as electric and electronic equipment.

1 Large household appliances: Large cooling appliances, refrigerators, freezers, washing machines, dish washing machines, electric stoves, microwave ovens, electric heating appliances etc.

2 Small household appliances: Vacuum cleaners, carpet sweepers, other appliances for cleaning, sewing machines, mangles, toasters, fryers, coffee machines, shaving machines, hair dryers, electric tooth brushes, clocks, scales etc.

3 IT and telecommunications equipment: Computers, printers, displays, keyboards, mice, laptops, copiers, electric typewriters, pocket and desk calculators, faxes, telephones, mobile phones etc.

4 Consumer equipment: Radio sets, television sets, video cameras, digital cameras, video recorders, sound reproducing equipment, DVD players etc.

5 Lighting equipment: Luminaires for fluorescent lamps, straight fluorescent lamps, compact fluorescent lamps, flashlights, ceiling lamps, floor lamps and other equipment for the purpose of spreading or controlling light (NOT filament bulbs, they belong to regular household waste)

6 Electrical and electronic tools: Drills, saws and other equipment for tinning, routing, honing, sawing, cutting, welding etc.

7 Toys, leisure and sports equipment: Electric trains or motordromes, remote control toys, control terminals, video game devices etc.

8 Medical devices: Blood pressure monitors, thermometers and other devices for diagnosing, preventing, monitoring, treating or alleviating an illness, injury or disability.

9 Monitoring and control instruments: Fire detectors, thermostats, humidity monitors and controllers and UPS equipment.

10. Automatic dispensers

<http://www.elker.fi/en/WEEE-reception/consumers/what-is-WEEE>