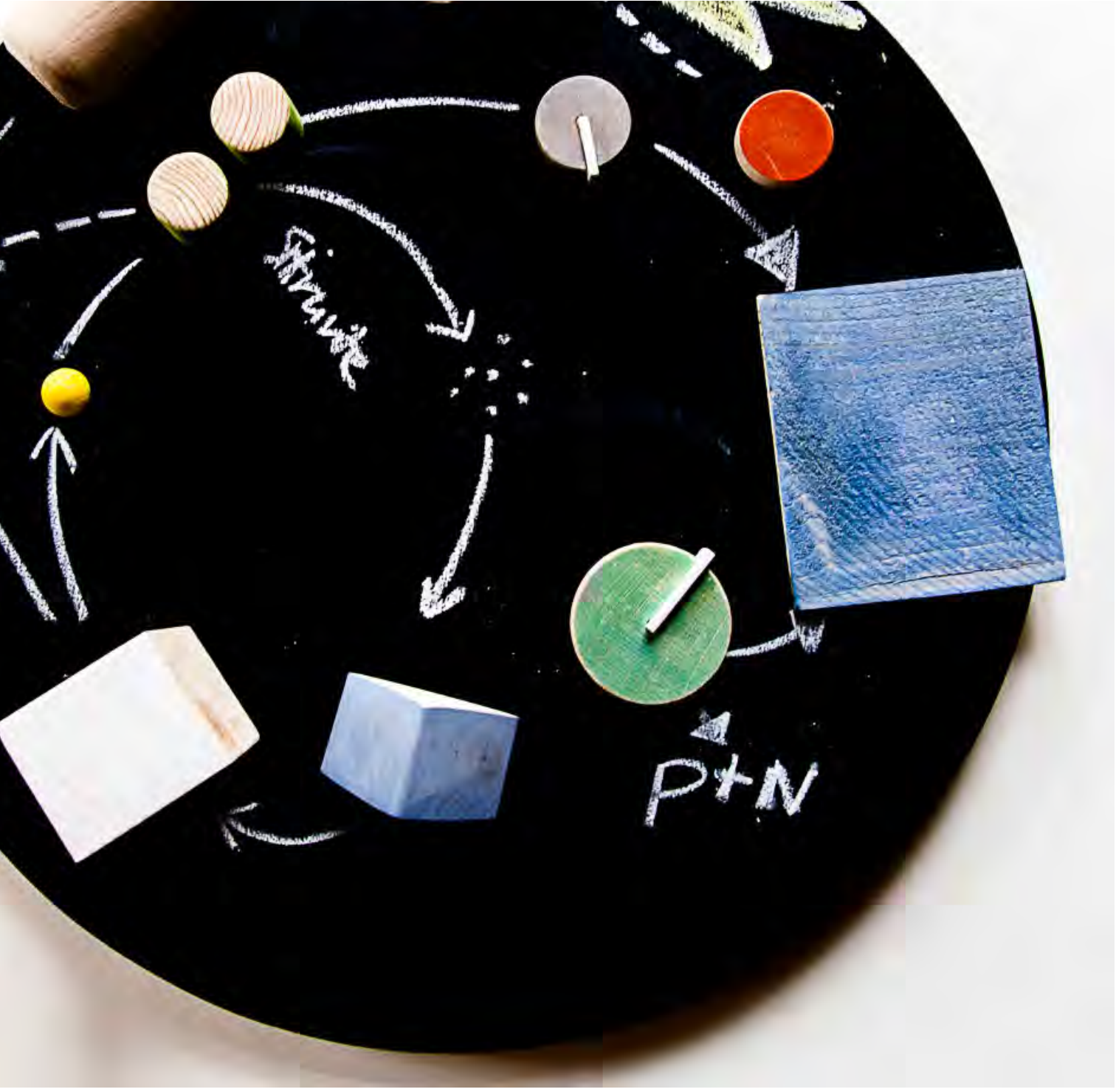


iSaS

integrated Sanitation System

ISaS
zusammenfassung

Mit sechs Litern Trinkwasser werden bei jeder Spülung kostbare Mineralien wie Nitrogen, Phosphor und Kalium in die Kläranlage gespült, von wo aus sie direkt in unsere Flüsse und Seen weiterfließen. Die Stoffe können in dieser Menge nicht nur für die Umwelt schädlich sein, vielmehr befinden sich darunter einige, die in Zukunft knapp sein werden, die der Mensch jedoch täglich verbraucht. Phosphor ist z. B. eine der Hauptkomponenten von Dünger, und stellt somit unsere Lebensmittelversorgung sicher, wird aber in 50 Jahren in die Minen aufgebraucht sein.

Doch gibt es seit einigen Jahren verschiedene Lösungen, um diese Stoffe aus unseren Ausscheidungen zurückzugewinnen. Trenntoiletten sind eine diese Lösungen. Diese ermöglichen es Urine und Fäkalien separat zu sammeln, und den Nährstoffe in die Landwirtschafft wiederzuverwenden. Leider sind diese Systeme bis heute noch sehr unbekannt und nirgendwo im öffentlichem Raum zu sehen.

Im Rahmen eines Kooperationsprojekts zwischen dem Masterstudiengang Umweltingenieurwissenschaften und die Masterstudiengang Nachhaltige Produktkulturen der Bauhaus Universität, haben sich vier Studierende mit dem Thema Integration von neuartigen Sanitärsystemen in der Westlichen Gesellschaft beschäftigt. Es geht besonders darum, das System der Trenntoiletten für den Nutzer akzeptabler zu machen.

Durch interdisziplinäre Austausch von Kenntnisse, gemeinsame Recherche und Kontextbetrachtungen, sind drei Entwürfe für eine öffentliche Sanitäranlage entstanden. Diese Entwürfe sind besonders für Campingplätze und Naturschutzgebiete gedacht. Diese Szenarien bieten nicht nur ein erste Möglichkeit zur Einführung des neuen Systems, sondern auch die Sanitäranlage für den Benutzer während seines Aufenthalts mehrmals zu benutzen und sich damit schneller daran zu gewöhnen, um der Implementation dieser Toiletten auch im privaten Bereich zu fordern.

In der Toilettenanlage, wird der Benutzer mit den wachsenden Problemen von Nährstoffe und gleichzeitig mit einer funktionierenden und realistischen Lösung für diese Probleme konfrontiert.

Drei Erlebniskonzepte werden erarbeitet, so dass es möglich wird verschiedene Einsatzbereiche und Orte zu bedienen. Um Vorteile aus den Interdisziplinarität in den Designansatz einzubeziehen hat sich das Team mit den gesamten Sanitäranlage und ihren Umgebung auseinandergesetzt. Dafür haben sich die Umweltingenieurwissenschaftsstudenten mit der Ressourcen Management beschäftigt und die Gestaltungsstudenten mit der User-Experience. Die beiden Disziplinen haben sich aber immer wieder überschnitten und deshalb war eine enge Zusammenarbeit sehr wichtig.

ISaS
summary

With six liters of drinking water we flush substances like valuable nutrients, but also hormones and problematic drug residues down the drain, several times a day. Our current treatment plants are unable to fully filter out these materials, so they end up in natural waters, consequently harming our ecosystem. This also endangers valuable resources such as Phosphorus. Modern agriculture relies on Phosphorus, in order to secure the worlds' food supply. In an estimated 50 years, Phosphorus supplies from mines will be at a critically low level.

Luckily there viable solutions to win such resources back. Fortunately there are some techniques developed to win these resources back. The No-mix toilet is a very effective one. These toilets divide the liquid from the solid waste material directly in the toilet bowl. By draining and treating these two material streams separately, valuable resource can be reused in our agriculture and makes us less depending on the depleting mines - winning phosphorus from urine can provide 20% of the phosphorus supply in the long term.

In context of a cooperation project between the master program Environmental Engineering and Sustainable product culture of the Bauhaus university, four students worked together on the implementation of innovative and sustainable sanitation in the western society. The main challenge was to make the sustainable sanitation system acceptable for this new group of users. Through knowledge exchange, a shared research study and building user-scenarios together, three concept proposals for public sanitation facilities were created by the designers.

The facilities are especially thought for campsites. This scenario contributes extra to a successful introduction as people on holidays are normally more open for experiencing 'new things', thereby the user will use the facility more than once and can accustom to it.

Also campsites are often located outside urban areas, in nature. There for the new material cycle can even be closed in the direct surrounding. This not only benefits the explanation of the new system but possible also the campsite self.

In the facility the user will be confronted with the rising problems around the way we use our resources but is directly introduced to a viable solution.

The three concepts all approach the information sharing unique ways and thereby serve different settings. Because of the two disciplines the team was able to integrate the facility in its surrounding. The Engineers were responsible for the material management and the designers dealt with the user-experience. A close cooperation was very important as the fields overlapped on many points.

The documentation

The document contains grey fields where one can read more about the interdisciplinary work-process of the ISaS project group.

The complete work process together with other relevant information and the work data can be found in the annex.

The Environmental Engineering students contributed the chapters 2.2 and 2.3.

The inprint can be found at the end of the documentation which gives insight in which discipline took responsibility for which parts in the ISaS project.

The ISaS project team

MS Environmental Engineering
Beatrice Decker
Philipp Exner

MA Sustainable product Cultures
Sylvia Debit
Anniek Vetter

Supported by:
Prof. Jörg Londong
Jürgen Stäudel
Faculty of environmental engineering

Prof. Martin Kuban
Prof. Wolfgang Sattler
Faculty of Design

Bauhaus-Universität Weimar

ISaS
foreword

The document before you reports on the ISaS project, an interdisciplinary project between the two master programs, Sustainable Product Cultures and Environmental Engineering .

The project was an initiative from the design students self and carried out as an official master project by the two faculties Art&Design and Civil Engineering of the Bauhaus University Weimar.

The project ISaS focusses on the implementation of sustainable sanitation systems in the western part of the world.

The project was directed by the students self and started with a wide-ranged research, focused on sustainable and western sanitation. From here the team defined a project statement, followed by choosing one specific context to develop the concept proposals in. These concepts are for public sanitation facilities that not only introduce the western society with an innovative and sustainable sanitation system, these facilities directly inform about the underlying demands for such a change.

Hereby we would like to thank our project supervisors, Prof. Londong, Prof Kuban, Prof Sattler and Jürgen Stäudel for supporting the initiative of the interdisciplinary project ISaS as well as for the support and advice during the project self.

The team received a lot of support from „Stiftung. Bauhaus.Eins“ and in particular Max Schreiner, for not only offering the team a workplace, but also giving us inspiring input. Thereby we would like to thank as well, Mr Kallweit, Mrs K., Mr Kluge and Mr Reichelt, Mr Holzapfel and Raimund who gave the team great input and inspiration for the development of the concepts.

Last but not least, our friends who supported us during the project.

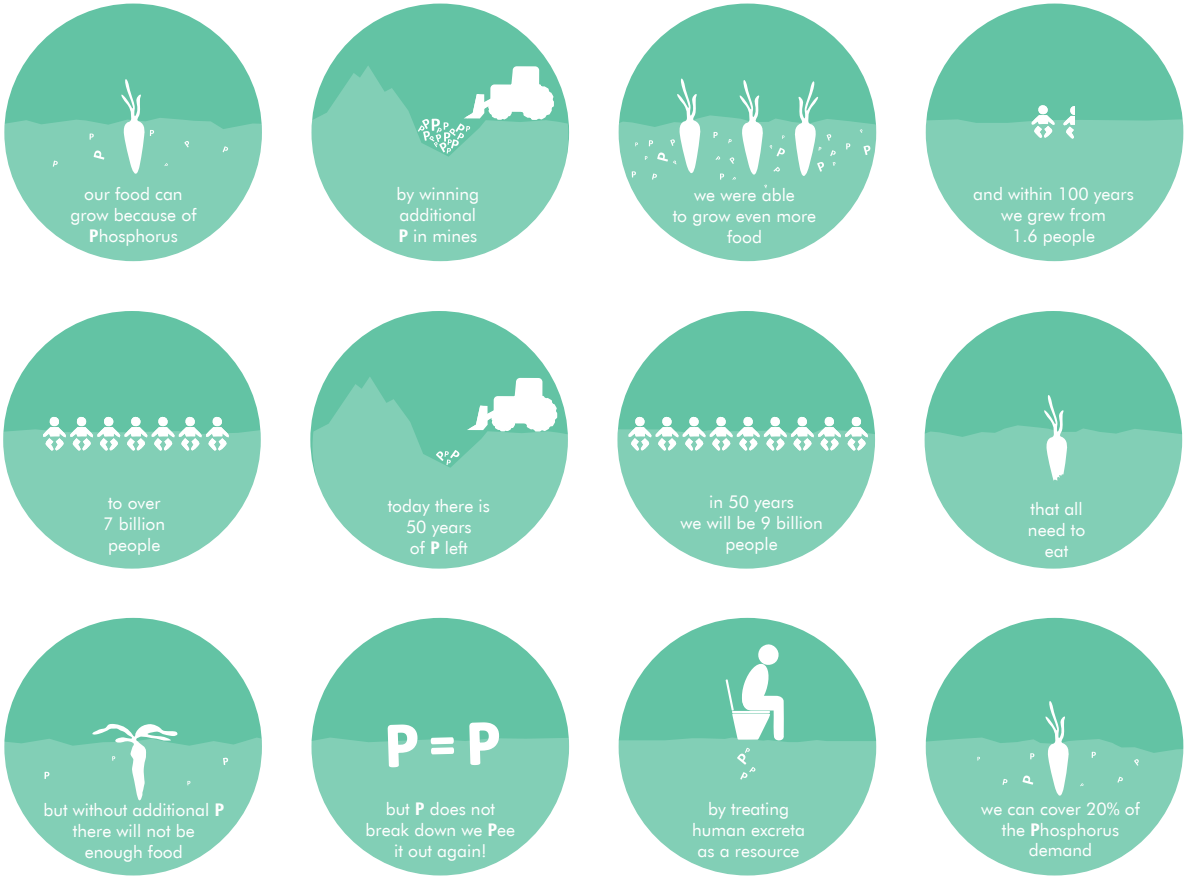
Sylvia Debit & Anniek Vetter,
June 2014

index

1

ISaS
integrated Sanitation Systems

This introductory chapter provides background information of the ISaS project. The motivation and the project description will be given. Furthermore the project team describes its own project aim, approach and introduces the work environment.



the phosphorus story

1.1 Motivation of iSaS

For several years now the professorship of urban water management and sanitation at the Bauhaus-University Weimar (BUW) has been working on integrated sanitation systems. By researching the field of sanitation and developing such systems in several countries all over the world they have gathered a fair amount of knowhow about the sanitation in different scenarios.

The importance of water quality seems to be growing hand in hand with the world's population, as the access to clean water is one of the basic necessities of life. A lack of clean water can cause a great amount of health problems with all kinds of consequences Diarrhoea for example is still the second largest cause of child death, worldwide. Water quality depends a lot on the quality of the sanitation systems. Apart from the scarcity of clean water a growing population, urbanization, demand for energy and material resources makes this a very interesting product & system globally.

Nearly all the other projects from the faculty engineering around this topic took place in developing countries. But sanitation is not just a third worlds topic, it is a worldwide issue. Water scarcity will face human beings worldwide. The demand for efficient and sustainable energy and material resources seems to be even stronger in the Western countries. Phosphorous (used in fertilizer) for example, is becoming rare and human excreta could be used as alternative source. The way people have been using sanitation and processing the collected materials should be improved almost everywhere on this planet.

Work place in „Stiftung Bauhaus Eins“

The communication in this project has three focus points. All three require research in aspects as culture, habits and expectations:

- communication inside the team
- communication with the stakeholders
- communication for the direct users

The first important task for environmental engineers is to generate a basic knowledge and terminology about the techniques, terms and science of sustainable sanitation. Furthermore the engineers advise and inform the designers about interesting techniques and facts around the topic; offer support on a technical and informative level with the concept development. And analyse the implantation of the created concepts.

A goal is to understand the other disciplines better by participating in some of the others activities, methods and techniques and the results can be discussed and summarised for different groups of participants (user, operator, decider etc.).

1.2. Project Description

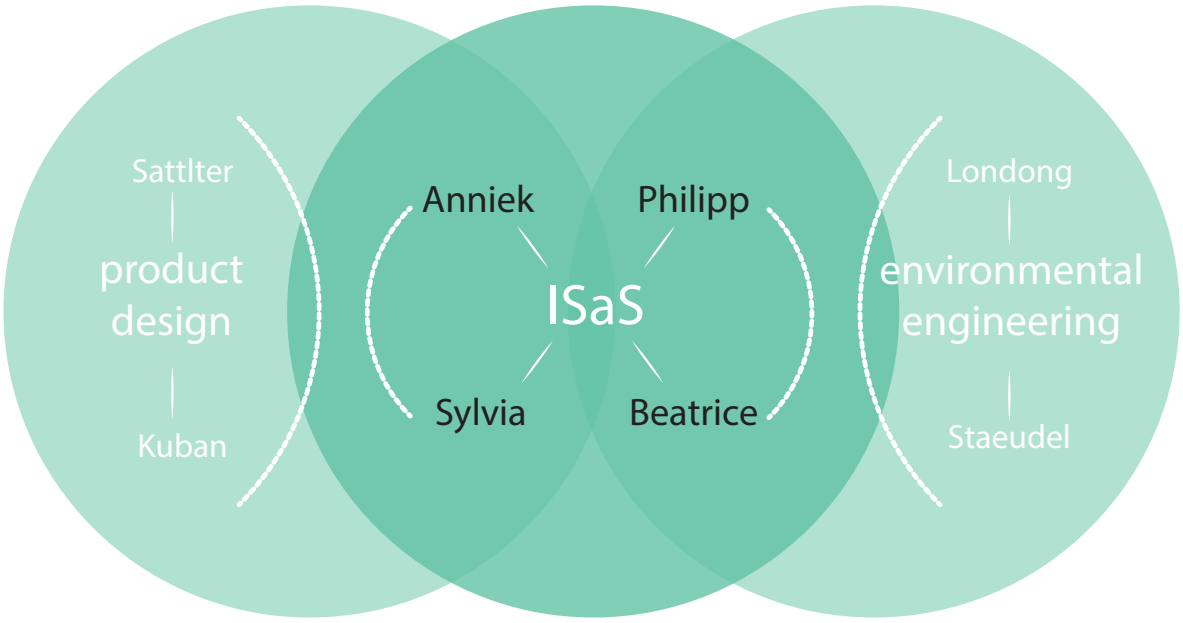
The project goal of iSaS is to define different criteria to implement an integrated sanitation system (iSaS) in the western society under different requirements: economic, ecologic and social. For this interdisciplinary project a team was formed out of students of the faculty product design and environmental engineering and science.

Designers can play a valuable role in the communication within the team and between the team and the different stakeholders. Design tools can be used to visualize and to communicate results, questions, problems and solutions. By (user-centred) design the interface of sanitation systems can become, understandable and acceptable in different kind of user groups, and settings.

1.2.1. Project aim of the Team

The challenge of the project does not correlate with the design of a toilet or the proposal of a closed loop. It is connected to the communication around this topic, how you can tell the story and create awareness. Focus lays on the user and the difficulties to implement the use of a new system.
The concept sensitizes people and the future user to a sustainable use of sanitation systems. The concept will communicate and show the use of no-mix toilets, responsible use of water and the value of the resources in human beings excreta. It enables the visitors to receive relevant information through an active experience.

In order to support the development around these concepts a work structure will be created that will make the cooperation between the two disciplines efficient and perennial.



Team Strucure and support

1.2.2. Project approach of the team

The project is seen as a pilot project between the two faculties. In order to make the two disciplines collaborate and support each other in their work. There will be a great interest in finding and also analysing the proper work methods and tools.
The complete work-process is documented and can be found in the annex. The chapters are linked with the chapters of this documentation and parts of the workprocess can also be found in the grey blocks.

This project documentation describes the projects phases. The research phase is especially detailed documented to exchange important knowledge dealing with the main topic. As a conclusion of the research phase, a statement for the development of the concepts was written. The context phase explains for which scenario the concepts are developed. The concept proposals are presented in the concept phase. The work methods are described and discussed in a work process documentation.

1.3. Work environment

The team exists out of the two Master students from Product Design, Anniek Vetter and Syvlia Debit. The two master students from Environmental Engineering Beatrice Decker and Philipp Exner were officially also part of this team from December till May 2014. They are supported by their tutors Prof. Kuban, Prof. Sattler, Prof. Londong and Jürgen Stäudel.

1.4. Project vision

Contribute to the implementation of sustainable sanitation in Europe by realizing a concept especially developed for this market.

The team aims to contribute to the implementation of sustainable sanitation in Europe by realizing a concept especially developed for this market which introduces its visitors to sustainable sanitation and the advantages of it.

The public facility has the ability to spark public awareness; it has the means to communicate to its visitors the realization that valuable resources are wasted through using conventional water sanitation.

Workplace
The workplace of the project team was located in 'Stiftung Bauhaus 1'. The studio the team members shared was 24/7 available and the ISaS workplace from February till the end of April.

Important contacts
During the project several persons and organisations apart from the University supported the ISaS project. The people in 'Stiftung Bauhaus 1', especially Max Schreiner supported the team not only by offering a workplace but also advised several times in directions, ideas and interesting contacts. For example the contacts with the community in Kromsdorf,
Furthermore the team gathered contacts via the Study Environmental Engineering as the contact with the company Holzapfel + Konsorten GmbH & Co. KG.
Other contacts that have played an informative and supportive role in the project were created by the team self, for example the City of Zwickau, the campsite Weida and the interview with the staff of a Public Facility.

2

Research

The research phase started at the beginning of the project and was carried on up to the last months. The research covers a broad range of aspects that can be linked with (public) sanitation.

The team started the research of sanitation from several angles,

- economic
- ergonomic
- social
- biologic
- psychological
- ecological
- demographic
- technical
- political

This made it easier to discuss and divide the discovered information and also pointed out how they influenced one another. It gave more insight in the complexity around (public) sanitation facilities. The results were meant to be presented from one discipline to the other. Which directly led to plenty discussions and questions which were in their turn used as guidelines for the rest of the research.
It not only led to a better understanding it also inspired how the project could continue. This was not cleared out at the start of the project but was seen as task for the team to discover during the process. The Environmental Engineering students contributed
the chapters 2.2 and 2.3.

2.1 The development of sanitation

The Old Roman Empire had a far developed sanitation system where water was used for flushing and sewages kept the cities clean. The oldest ruins of sanitation facilities date from 1700 BC. These toilets were constructed outside the house in the form of latrines. This is a wooden bench with a hole in it. They were first public. Later the society became wealthier and toilets became also for private use. There where separate facilities for men and women. Here they shared sponges to wipe themselves. The toilets were often built next to bathhouses. This water flowed together with the waste water from the latrines through the sewages into a nearby river.
In the middle Ages, those systems were still common in cities which had rivers. Public toilets were constructed above them. Though in other cities the public facilities disappeared and there were no toilets in the houses either. People used chamber pots. When this was full they emptied them through the windows into the street, so that the streets were full of human excreta mixed with animals excreta. The smell was strong and unpleasant and the city full with diseases.

Private toilets were luxury and were reserved for aristocracies. To wipe themselves, people used old pieces of tissues. Often, the people also urinated or defecated directly on the streets. Around 1800 a new public service was born when a few women started to walk around with two buckets and wearing a big cape. Hidden under this cape people could use one of the buckets in private and the excreta did not end up in the streets. This was the first profession link to the public toilet. During this period, squatting was more common than sitting. In areas like East-Europe and Small-Asian these services were still used to the 1920's.
As a result of the unhygienic circumstances, people (mostly in upper-classes) built pit latrines (also named 'Garderobes') at home to use as a toilet or to store their buckets full with excreta in it. Most of these toilets were made out of wood with a hole, like the Roman latrines. Up to now toilets are still mainly 'sitting toilets' in the Western world.
Up to the 19th century, farmers used the human excreta as compost (from faeces) and as fertilizer

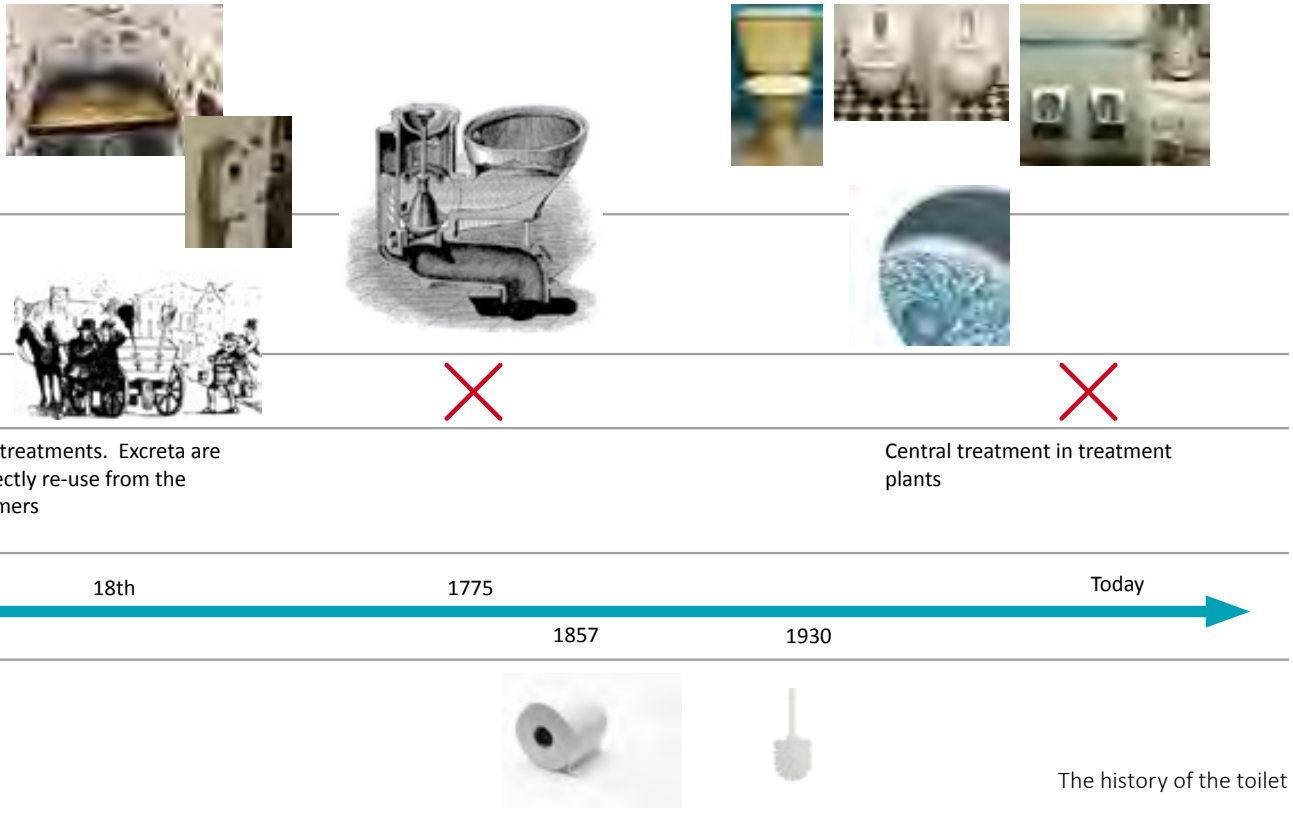
	Roman civilization	Middle age
Restroom/ toilet		
Flush		
Collection	✕	✕
Treatment	No treatments. Excreta are directly throw away in the rivers through sewers.	No treatments. Excreta are directly throw away in the rivers or stay in the street.
Accessories		

(from urine). Every night, the excreta was collected and brought to the famers by a pick-up-system with horse and cart and was called night soil.

The water closet, as we know it today (with the S-shaped pipe which works as a filter for unpleasant odours) was invented in 1775 by Alexander Cummings. At the end of the 18th century, the water closet became more common. Cities began to build plumbing systems to improve the sanitation conditions but at the same time excreta was started to be considered as waste and not as resources anymore.
One century later, the first packaged toilet paper was sold in America. Until in the 1930's when the first artificial toilet brush has been developed, people used brushes made from wood and animal hair for example the hair of horses.
Nowadays drinking-water toilets are seen as a symbol for welfare and represent the developed conditions of a country. Water closet and toilet paper are seen as the most hygienic standards of the toilet in the Western World and urine and faeces are still regarded as waste.

Public sanitation facilities appeared again around 1840 in Paris. First only urinals for men and later around 1860 also for women special kiosks with toilets were built. In 1880 these facilities became for both genders accessible and also water toilets were installed. Even the mobile sanitation service appeared again but this time with small water closets on a horse carriage. With a few interruptions public facilities developed further in the late 19 century. With a focus on pedestrians they were first located centrally. Because of the bad conditions of these public facilities and while more and more shops installed their own facilities - the popularity went down. The Public facilities came up again with the rise of modern transport, car, trains and airplanes. Especially the introduction of highway's later influenced the development of this public facility in our surroundings strongly.

Public sanitation developed based on two main reasons: Offering a service to the local population – that do not have private sanitation to their disposal or as a luxury service for travellers.



The history of the toilet

2.2 Excreta as resources

This chapter will clarify in a short way the importance of the essential elements nitrogen and phosphorous for all living organisms in context to the human excreta. It will show why it is important to use excreta, especially urine as a resource for these elements. Also a short overview about the topic of fertilization and its problems will be given.

It is a natural process that everyone urinates and defecates every day. Excreta help to excrete metabolism waste material, toxic material and also nutrients which cannot be utilized by the human organism.

Feaces
In average every human defecates between 100 to 200 g per day.
The feces mainly consist of water, gut bacteria, cells, solid and indigestible constituents of food, fat, starch and also around 0,7g phosphorous.
Because of some bacteria the feces are not easy to treat so the handling of feces will not be part at the project.

Urine
Urine regulates the fluid balance of the body and it serves clearing urea, uric acid and other waste material out of the body. Every healthy person has to urinate 1 to 1.5 liter in average per day. The daily urine volume of each person consists mainly of about 30g urea and 1g phosphorous additionally potassium, salts of calcium, proteins, hormone and scents. Normally healthy people have germ-free urine therefore it is low-risk to handle and an interesting leverage point for the project.

Because excreta contains important nutrients like phosphorus and nitrogen it can be used for fertilizer or compost material. Especially urine has a high phosphorus level and a low-risk level. Why this is interesting will be explained in the following text.

Every living organism needs nutrients for growing and for preserving vital functions.
Main elements in urine and feces are nitrogen, phosphorus, potassium and calcium which are also the most important nutrients for plants.

Phosphorus
Phosphorus is an essential element for all living beings because it is needed for structure building and regulating functions of organism. For example it is part of the DNA and arranges the cellular energy supply (ADP/ATP). Plants need this element also for the production of their biomass.
Phosphorous as element is also used in detergent and food additive etc.
Used as fertilizer it speeds up the growing of biomass.

Where does it come from?
The most common natural sources are deposits of phosphorus in form of phosphorous rich minerals mostly as apatite. There are also other natural sources in form of organic fertilizer, debris of plants and sediments.

How do humans ingest this element?
Phosphorus is part of nearly all our food. Rich of phosphorous is high-protein food like milk, milk-products, meat or fish.

Which problem causes this element?
The global annual input is approximately 14 million tons per year [Mt/a] whereby 90% of the global phosphorous production is only used for fertilizer products.
The cycle of natural sources generates approximately 3 Mt/a BUT the anthropogenesis input is 4 times higher. Whereas phosphates are only converted fast by plants. The animals-, humans- and biogeochemical cycle work very slowly. So it cannot be generated as fast as it is needed.

As a nonrenewable resource there are no replacements for it but it is essential as element for and of organisms. Phosphorus by itself cannot be lost in the earthly atmosphere but it is not usable in

every form. By the meaning of experts the resources of phosphates account for 15 billion tons. With a constant consumption the reserves will run out in 75 to 100 years. Indeed the peak of production will be reached in 20 years. Depending on how much the world population grows, phosphorous will be depleted even faster.
Furthermore most of the resources are saddled with cadmium or other radioactive heavy metals so it is unfeasible for agriculture fertilizer.

Another problem is that the occurrence is limited to few countries 5 countries own around 90% of the global phosphorous reserves. Morocco and China have the biggest deposits. Smaller deposits are in the United States, South Africa and Jordan. This situation could lead to political conflicts.
Europe obtains 90% of this material out of import. Israel, Russia, Morocco and Algeria are the most important suppliers for Germany.

It also must be mentioned that the degradation has a high energy consumption, which might lead to problems at the time of ending of fossil fuels. There still exist new technical solutions to filter out the phosphorous from wastewater and urine but these methods ensued mostly under high energy consumption and needs other chemical elements therefore they are expensive. Another technical solution of the future could be a new developed method by Frauenhofer IGB for the recoupment of phosphorous out of wastewater by an electro-chemical process. But for now this process is only in test phase.
Currently recovering phosphorous through the degradation of raw phosphates in mines is cheaper than the methods for recovering phosphorous from urine or wastewater.
For now there is no commercial impulsion for using alternative sources.

Another issue is that high concentrations of phosphorous in open waters induced by over-fertilization in agriculture leads to the process of eutrophication.

The Phosphorus Mines in the world

	Reserve [Mio t]	Percentage [%]
United States	1.400.000	2
Algeria	2.200.000	3
China	3.700.000	5
Iraq	5.800.000	8
Jordan	1.500.000	2
Morocco and Western Sahara	50.000.000	70
Russia	1.300.000	2
South Africa	1.500.000	2
Syria	1.800.000	3
Other countries	1.958.100	3
World total	**71.000.000**	

Nitrogen

Nitrogen is an essential element for all living creatures because it is part of all enzymes which regulate the metabolism e.g. DNA, proteins, amino acids, nucleic acids.

Where does it come from?

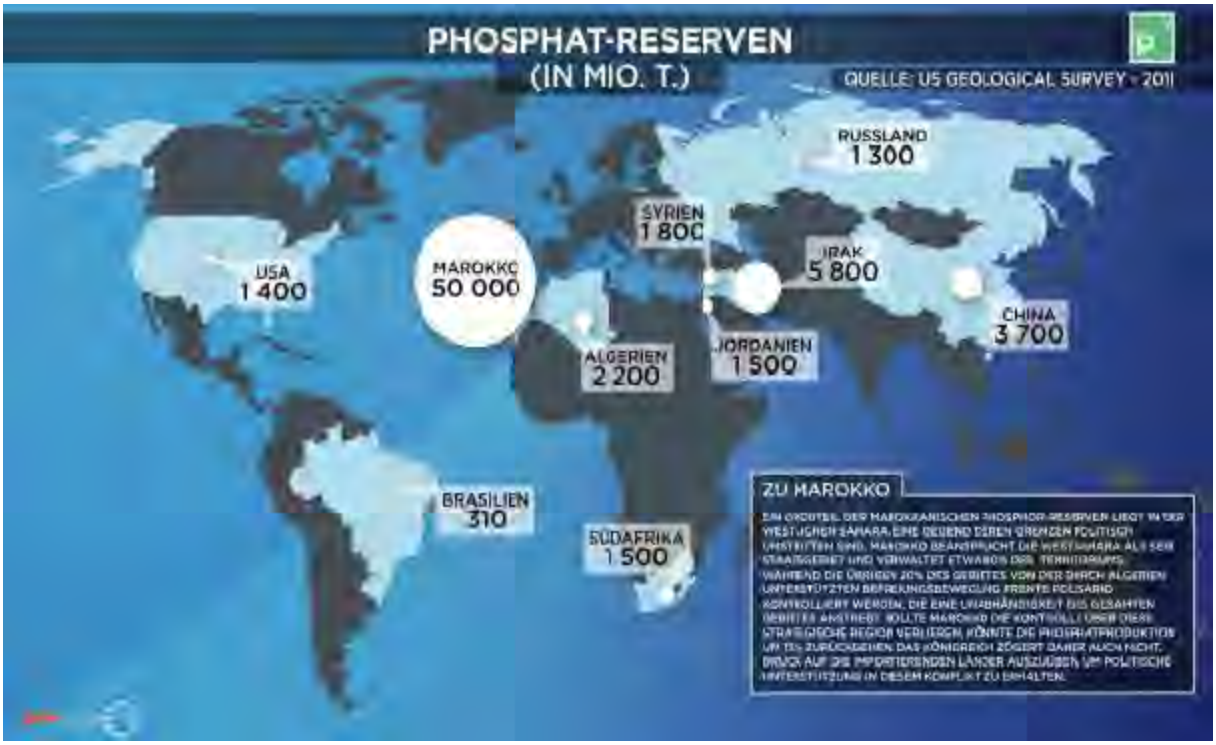
Nitrogen is all around us. About 78 % of the air consists of nitrogen. But only a few plants can assimilate the nitrogen from the air by the help of nitrogen-fixing symbionts (e.g. nodule bacteria). Other plants need ammonia- or nitrate compounds for the nitrogen-assimilation which are available in the soil for example through dead plants. On the other hand inorganic bound nitrogen in the earth's crust is rare and is not relevant for the growth and preserving vital functions of organisms.

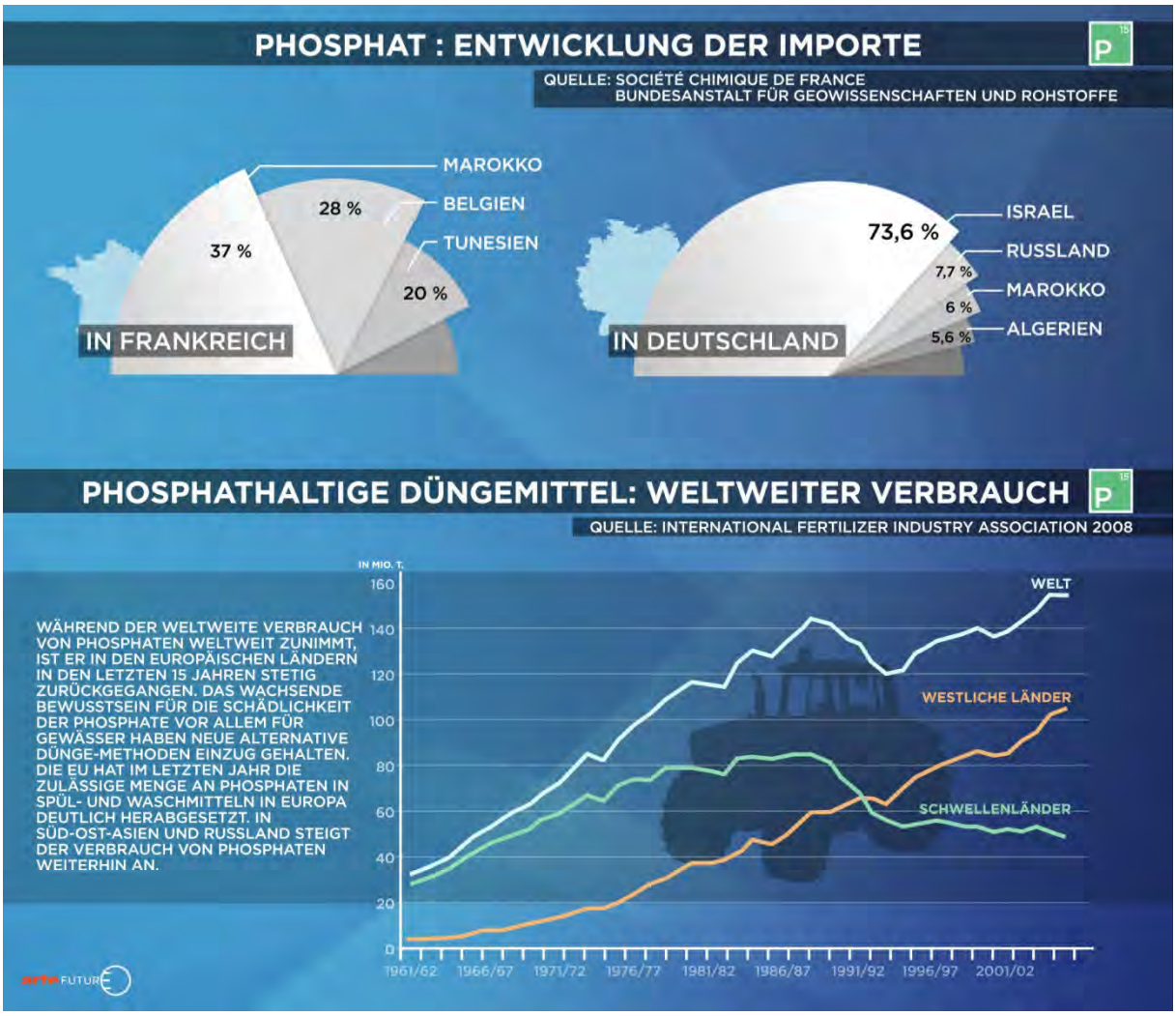
There is also a technical solution named Haber-Bosch process for the production of plant available nitrogen in industrial fertilizer which is a very energy-intensive process.

How do humans ingest this element?

Because humans are not able to utilize nitrogen out

The Phosphorus reserves in the world





The Phosphat: development of imports and use worldwide

of the air they have to consume it mainly through proteins over their food. On the one hand they can eat animal proteins which are part of fish, meat, eggs or milk-products on the other hand there are vegetable proteins as part of nuts, cereals or legumes. The benefit of vegetable proteins is that they are easier to use for the human organism.

Which problem causes this element?
The production of nitrogen fertilizer with the Haber-Bosch process is also a very energy- intensive process. Another problem is if there is too much nitrogen in the soil bacteria are able to transform N-compounds into nitrous oxide (N2O) which is an aggressive greenhouse gas and harmful to the climate.
Also nitrate (NO3–) which is eroded by water and reaches drinking water is unwanted because dangerous nitrite-formation can appear.
One more issue is that high concentrations of nitrogen in open waters induced by over-fertilization in agriculture leads to the process of eutrophication just as phosphorous.

2.2.1 utilization of urine with n, p

Urine as fertilizer
The project is focused mainly on the utilization of urine because at the first moment it is easier to handle (because of bacteria), it contains more nutrients and the averseness of the people against urine is lesser as against feces.

Urine contains the most important nutrients which

plants need for growing and living. These are the elements nitrogen, phosphorous, potassium and calcium. So it could be used as a complete natural fertilizer.

If urine should be used as fertilizer it is necessary to disinfect and sterilized the fluid. This process is described as “hygienisation” in the following. The hygienisation of urine works in an easy way on its own. It has to be stored over 6 months at a temperature of 20° C. During this time urine degraded with the help of an enzyme called urease which is contained in urine into ammonia and CO2. Because of that chemical process the pH-value of the staled urine changed to alkaline whereas the pH-value of the fresh fluid prone to sour. All bacteria will be destroyed by the chemical degradation process therefore it is sterilized. The nitrogen from the formed ammonia can be easily metabolized by plants.

It is to point out that if urine will be used as fertilizer the concentration of nutrients would be too high concentrated in it. The undiluted fluid would be toxic for plants and there is a hazardous of salination consequently the dunged plants can die off. But urine can operate as a high-output fertilizer if it is diluted with 8-10 times with water.

Other sources for organic fertilizer are for example liquid manure, debris of plants or dung.

Industrial fertilizer contained mainly the nutrients N, P, K also S, Ca and Mg which are trace elements. These fertilizers are also called NPK-fertilizer or complete fertilizer. N, P, K and also Ca are components of urine! So urine is also a complete fertilizer.

The big problem is that methods (e.g. the production of stuvite) for recovering phosphorous from urine or wastewater are more expensive than degradation of raw phosphates in mines.

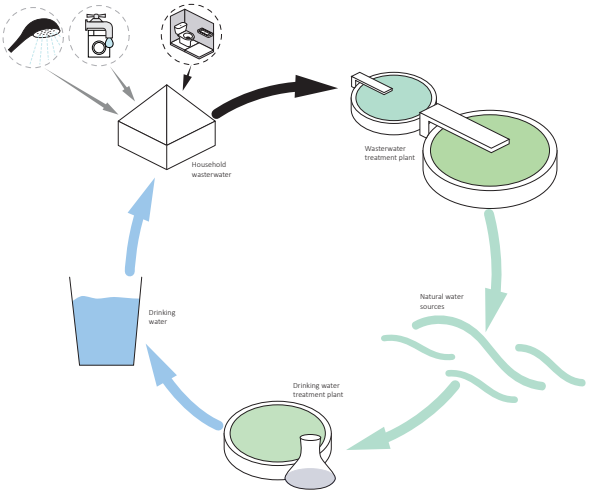
Conclusion

In conclusion it should be clear that there will be a problem mainly with phosphorous as resource in the near future. So the recovery of phosphorous or rather phosphates will become more important because of the ending of the natural resources and its essential relevance for all living organisms!

But this chapter also showed that there still exist some solution approaches. Of course these solutions will not cover the need of phosphorous completely but it can help to slow down the ending of the resources. For the success of these possible solutions it is important that people start to rethink the problematic and their behaviors.

2.3 sanitation system

2.3.1 Common human water cycle



The human water cycle

The first contact, people mostly have with drinking water is in their homes. They use the drinking water for lot of different things in their kitchens, bathrooms or gardens.
Water which is used in taps, showers, washing machines and bathtubs and which flows down the drain after use is called grey water. All the water which is used for flushing the toilet will be transformed into

black water. All these actions need around 120 liter drinking water per person each day in Germany.
The grey and black water are brought together and travel via the canalization and intake channels to the municipal wastewater treatment plants.
If it is cleaned up there it is feed into natural waters like rivers or seas.
Drinking water treatment plants draw freshwater from such natural waters or dams.
The treated water flows back to residences over pipelines for drinking water.
In that way the “human water cycle” is closed.

The following will examine the relevant parts of the human water cycle. It will help to understand the individual steps better.

	l/d
Sanitary Purposes	
Personal hygiene, bath, shower	44,5
Flusching the toilet	33,5
Household	
Washing car, cleaning processes, gardening	7
Washing the dishes	7
Doing the laundry	15
Food and drinks	5
Total	**112**

This table gives a little overview about the water consumption with its distributions in Germany 2008.
K.Schwister, Taschenbuch der Umwelttechnik 2010

Common restrooms in residents
The drinking-water flushing toilet is the most used collecting tool for human excreta in Germany. Urine and feces are falling directly into water. The mix of excreta and flushing water is called black-water.

In most cases 6-9 liter of water are consumed during one flushing process. By using a water-saving toilet the water consumption ranges from 2-4 liter.

With the help of gravity the black-water runs through pipes to the canalization. Mostly the waste-water is transported by the canalization system to waste water treatment plants. In some cases it is stored in cesspits before and collected by vehicles regularly.
All the black water reached over a sewerage system to a municipal wastewater treatment plant.

Flows of the common toilet system

Municipal waste water treatment
Wastewater treatment plants combine different physical, biological and chemical processes to eliminate inorganic and organic contaminants of the water. Mostly it only a physical and biological treatment is used. The purified water is environmentally sustainable. The separated solid waste and sludge could be deposited, burned or used as fertilizer.

1) 1st physical process
The wastewater treatment starts with a mechanical purification. The water is screened by screens to eliminate coarse materials and sieves fine fibrous materials. Subsequently a sedimentation tank is used

to filter out the sand in the wastewater which gets through rain into the canalization.
Coarse and unsolved substances like papers, hygienic article, leaves, food waste etc. in water will be separated and collected in containers. These substances can be deposited or reused after another treatment.

Afterwards the wastewater passes a primary clarifier. It is used to separate organic material. Oils and fats swim at the surface. Particles which are heavier sink to the bottom. A scraper separates these materials from the water and it is also collected. This step helps to reduce the organic freight for discharging the following biological process. Additionally it needs less oxygen at the activated phase.

2) Biological process
Generally the biological process is needed to reduce high energy organic compounds (carbohydrates, fats, proteins) into low energy inorganic material. At the end of this process only CO2 and H2O left. Thereby biomass is produced. The particular metabolism steps operate through bacteria and enzymes.
The importance of this step is also to reduce the concentration of nitrogen and phosphorous at the treated water.
A specific concentration of N and P is necessary for the process otherwise the biological degradation would be inhibited. A minimum constitution should be BOB5= 100 : N= 5 : P= 1.
But it is known that the average concentration of N and P in municipal wastewater is with a constitution of BOB5= 60 : N= 11 : P= 2 grams per inhabitant and day [g/EW d] around to times higher than the optimum. These numbers mean that every inhabitant discharges around 11g N and 2g P per day.

So it is really needed to eliminate these elements partial. Because if there is a too high concentration of these elements in treated water which flows into natural waters it causes the unwanted process of eutrophication.

The biological way for the elimination of phosphorous works through metabolism activities of microorganisms. There are also special microorganisms which are able to accumulate more phosphorous. The other opportunity is the use of chemicals.
The elimination of nitrogen ensued through the biological steps is called nitrification and de-nitrification.

3) Chemical process
With the help of precipitating agents the solved phosphorous could be transformed into unsolved separable components. That heavy particle will be precipitated and separated.
Light weight unsolved particle swims at the surface through the process of flocculation.
This step of the elimination of phosphorous can take place before the preliminary clarification happens, similar to the biological treatment process or at the secondary clarifier. Phosphorous of the precipitating product can be re-used.

4) 2nd physical process
Finally the water is treated at a secondary clarifier. This is mostly a typically round basin with a scraper-bridge. At this step the bacteria which get to the secondary clarifier through the treated water (from the activated phase) will be separated. The bacteria sludge will be collected through sedimentation at the bottom of this basin. One part of this sludge flows back as return activated sludge to the activation basin for stabilizing this phase. The other part will be concentrated and treated.
The treated clean and clear water will be feed back to natural waters. At this moment it is no drinking water because it contains germs already but it is nonhazardous for nature.

Drinking water treatment
Waterworks combine different physical, biological and chemical processes to eliminate extraneous materials and pathogens from raw water and it is also used to add a minimum of minerals to the drinking water. Mostly the raw water is generated from groundwater or surface water.
The most commonly used steps at waterworks are filtering, sedimentation, iron-removal/ manganese removal, deacidification, degasification, decarbonization and disinfection/ sterilization.

At the end of the treatment chlorination is necessary for the storage and transportation.
The combination of these processes depending on the quality of the raw water.

The treatment steps in general:
1) Pretreatment/ 1st filtration
2) Addition of chemicals
3) Filtration
4) Disinfection
5) Fine filtration
6) Conservation/ storage

Filtering
The filtering process is used for the elimination of particulate materials and unsolved particles. Gravel filters and sand filters with different grit sizes are commonly used.
Solved organic material will be adsorbed on activated carbon or the biological reduction of these compounds through special „slow-filter". Also the process of infiltration can be used.
At the process of drinking water treatment up to 3 steps of filtering are used.

Sedimentation
Sedimentation is also a process used for the elimination of unsolved particles which works through gravity.

Iron-removal/ manganese removal
Through abiotic (use of chemicals) and bitotic (use of special bacteria) oxidation solved bivalent iron- and manganese ions will be transformed and precipitate as solids. These solids can be filtered out. In most cases ozone is used for the precipitation reaction.

Deacidification
This step will be required for the elimination of so called aggressive carbon dioxide with the help of aeration or chemicals. Otherwise carbon dioxide acts corrosive. Deacidification is also needed to regulate and stabilize the pH-value.

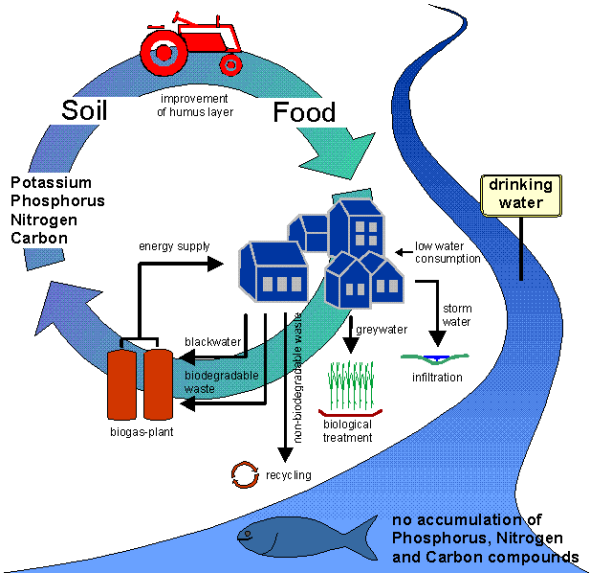
Degasification
With the help of aeration gases and volatile compounds could be steam out.

Decarbonization
If there is a high concentration of carbon the step of decarbonization has to be operated to reduce the water hardness otherwise it would lead to unwanted calcinations.
Magnesium- and calcium ions will be precipitate with the help of chemicals or eliminate through ion exchangers.

Disinfection/ Sterilization
All verifiable pathogens and other microorganisms have to be deadened by ultrafiltration or ozonization.

2.3.2 Alternative sanitation system

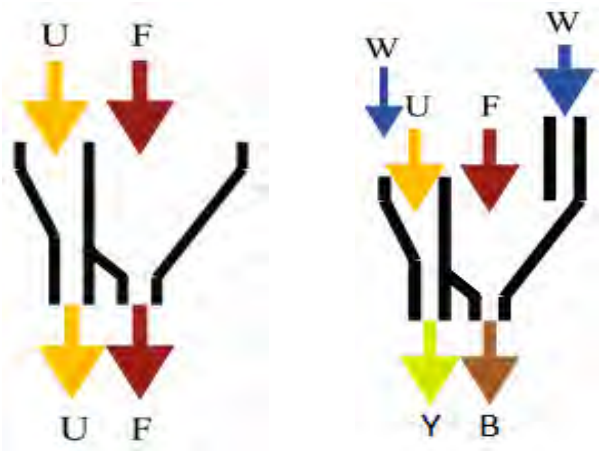
Since the end of the 20th century renewing and changing our existing sanitation system has been discussed. By the cooperation of universities, engineering offices and operating companies some testing-projects are already running and new concepts



Closed sanitation loop

are tested. These concepts are called alternative, ecological or decentralized sanitation systems. Parts of the systems are the collection, transport, storage, treatment and use. The aim is to full fill sustainable future requirements. Important tasks are the use and reuse of resources and materials, showing cost effective possibilities and to increase the supply of different technical solutions for several needs.

In this project attention is given to no-mix toilets. Here the excreta are collected separately. There are dry and wet types of this kind of toilets. Wet no-mix toilets consume 4-6 litres for removing faeces and 0.1-0.3 litres for removing urine. If urine is removed by water the out coming material is called yellow-water, in case of faeces it is called brown-water. Also the urinal should be listed here. Mostly they are used by men but there are some concepts for female urinals, too.



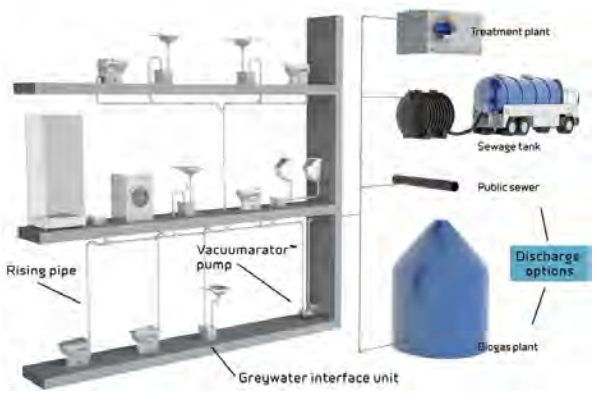
Alternative sanitation systems flows

Here just the urine is removed.
To keep the material separated they can be transported through pipes to several storage tanks on-site the area. Depending on their size, the tanks can be carried by human or discharged by vehicles. When excreta are stored often unpleasant odour can occur. Adding ash or sawdust to the faeces a reaction between the solid and liquid material is avoided due absorbing water or urine. A good aeration-technology in the storage-system can also prevent restrooms from odours.

Collecting- and transport systems can also work by using low pressure techniques. It could be the basic for an innovative no-mix canalization system.

There are important tasks which alternative treatment methods have to full fill [DWA]:

- keeping legal regulations for releasing material in the environment



constant vacuum system (CVS)

- recovery of nutrients
- production of fertilizer or energy by biogas
- full fill hygiene standards, pathogens die-off
- reuse of treated water (e.g. irrigation, flushing)
-

The several materials faeces, urine and also used water (called grey water) can be treated together or separately by mechanical, chemical or biological methods. Here well probed treatments for each resource are described.

Dehydration by adding drying material (chalk, ash, sawdust or sand) is the simplest treatment in order to transform faeces into a product that is safe for reuse or disposal. Urine and cleaning water should be kept separate from faeces in order to keep it dry. The duration is 6 months up to 2 years for pathogens to die-off. This treatment can take place either on-site in dehydration chambers or off-site in dehydration beds. It requires a constant source of drying material and a further use or treatments like composting or

dehydrated faeces

digestion.
Composting is one well known process to treat organic matter. This aerobic break down is caused by microorganism like fungi or specialized bacteria. To run this process different conditions have to be fulfilled. Through mixing up excreta with biowaste or sawdust a good rate between carbon and nitrogen is realized. The C/N-rate lies between 30-35. A moisture of 50-60% is optimal. To kill pathogens a temperature of 50-70°C is necessary. In case the amount of the liquid phase is too high one can add absorbent material like sawdust. Depending on hygiene regulations and realized temperature the duration of composting lies between some weeks to years. Is the process executed under wrong conditions unpleasant smell and bugs can occur. Using "composting toilets" where the place of the treatment is directly on-site, creating compost piles or using vermi-composting are technical solutions. A well working ventilation system is required to obtain good results in the composting process. The volume of the solid waste can be reduced to 30% of

Self made compost

the incoming material. The produced compost can be used in gardening and agriculture as fertilizer or for soil improvement.
Human excreta can also be treated without oxygen through *anaerobic digestion.* During this biological process the organic matter is broken down and transformed to biogas and sludge. It is better to keep the urine separate from faeces because on one hand there is no carbon in it and biogas cannot be produced. On the other hand the C/N-rate can cause problems in the operation. The faeces could be collected and transported with other organic material (dung, maize or biowaste) to special biogas plants. In these biogas reactors the temperature is 25-35°C (mesophilic) or 45-55°C (thermophilic). The several temperature effects on the duration of gas production which is 10-20 days. Approximately 1.8m³ of biogas can be produced out of 1kg carbon. There

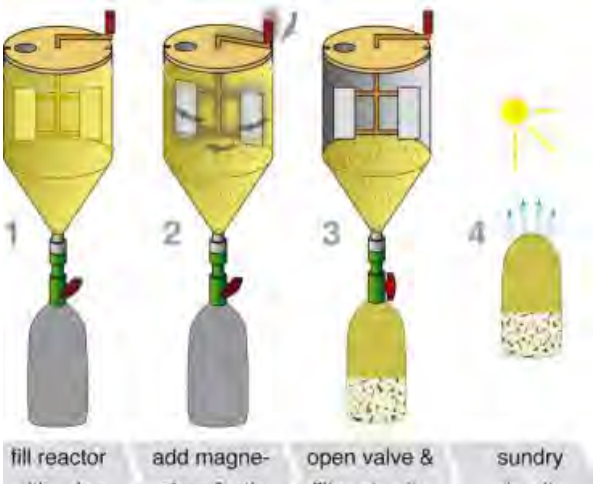
small- scaled biogas-reactor on household level

are also some small-scale biogas reactors designed for the use at home but also here the construction and maintenance requires skilled persons.
To use urine directly as fertilizer it needs to be disinfected before reuse. To kill pathogens and recover nutrients *extended storage* is a simple, cheap and most common method to treat urine. The removal of pathogens and further use depends on duration of storage (1 or 6 months), temperature (4°C or 20°C) and pH-value (pH >9) concentration. For example urine can be used as liquid fertilizer for all food crops and

large-scaled urine storage tanks

processed crops when it is stored for 6 months and 20°C. It has to be mentioned that during the storage unpleasant odour can occur.
A solid kind of fertilizer produced from urine is

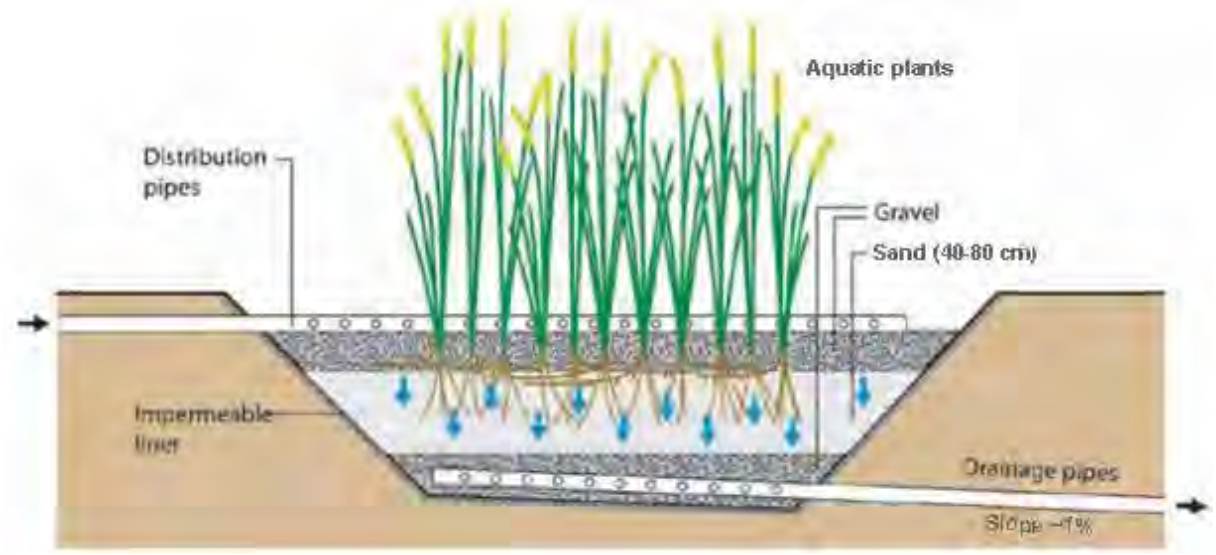
called *struvite*. It is the tradename for magnesium-ammonium-phosphate-hexahydrate (M-A-P).
By adding magnesium oxide more than 90% of phosphorus and approximately 3% of nitrogen precipitate as a white odourless powder. Struvite is fertilizer that is bioavailable and slow-release. It can be stored and transported easily. Producing struvite



Struvit-reactor

is an easy operation and does not need high-end technology.
Constructed wetlands can be used to treat brown water together or without grey water from households. The waste water is cleaned by biological processes. The microorganism live on the roots of the plants or at the surface gravels. Sand is used here as soil filter. It is a low operated and maintained treatment without using any chemicals or electricity. By building up wet lands with locally available material it can also be aesthetic. The effluent can be used for aqua- or agriculture. But the operation of this method can be vulnerable to cold climates. It needs much space and it may lead to mosquito breeding.

Constructed wetland



2.3.3 Pilot projects

In the following chapter examples for low-tech-solutions and high-end solutions are given. There are two sustainable sanitation systems described. On the one hand there is a project in Oyibi in Ghana, as an example for developing countries and actually there are two in Hamburg, Germany.

Urine diversion dehydration toilets (UDDT) at Valley View University in Oyibi, Ghana

Project Frame

In a case study of the "sustainable sanitation alliance" a project in the Greater Accra Region in Ghana is described [SuSanA; 2013]. The Accra Region is located in the South of Ghana. The project started in 2008, the main executing instituted were Berger Biotechnik GmbH from Hamburg and the Valley View University of Oybib in Accra. The Bauhaus-University is mentioned as a planning institute. The main motivation of this project is based on a lack of water and electricity in this region. That means water closets are unviable.

Front and back view of the sanitation system

Applied Technologies

The technology is designed by Berger Biotechnik GmbH. It is affordable, easy to build and constructed for high urine and hygienic faecal matter collection. A separation of urine and further composting of faeces are included in the sanitation system. The different sanitation components are the urine collection, treatment and reuse; the rainwater collection, treatment and reuse; the urine and faeces separation, collection, treatment and partly the composting of the excreta.

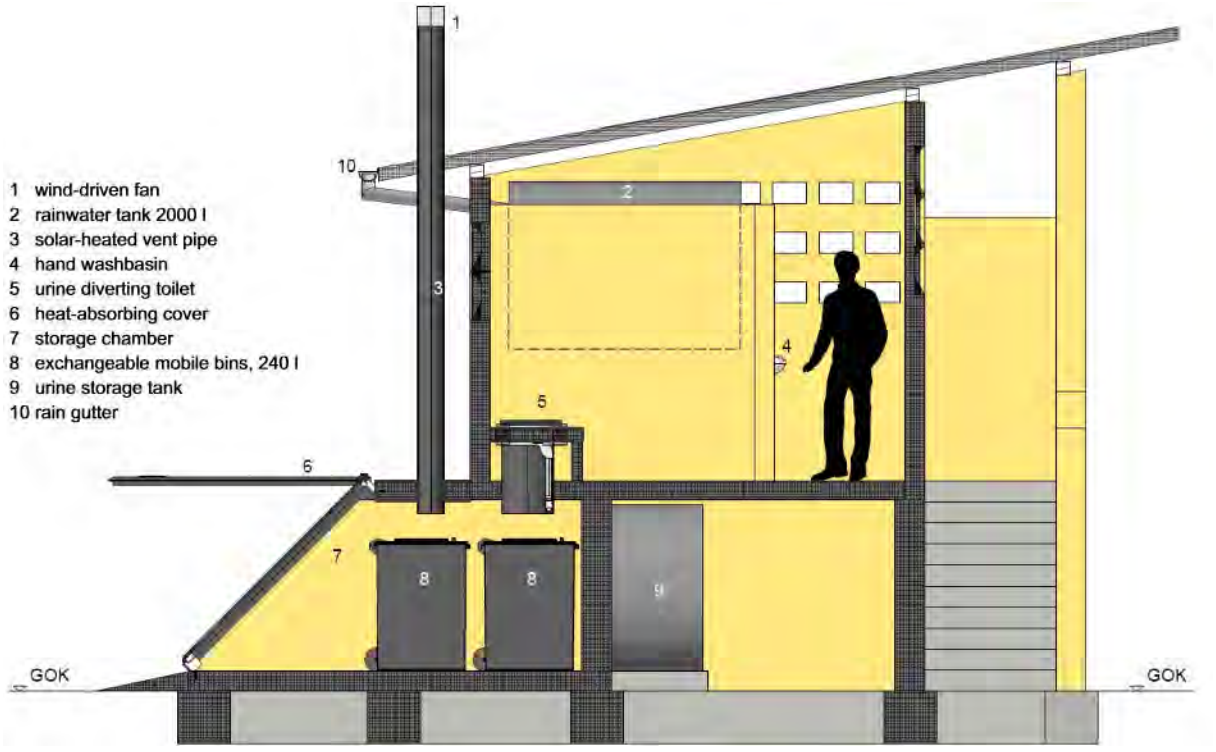
The urine is collected from 6 UDDT and 3 waterless urinals. They are connected to plastic storage tanks which are placed under the toilets. The treatment is done simply by storage for a month. The treated urine is used as fertilizer at university´s farms, but only for trees and non-leafy vegetables.

Designed Urine Diversion Dehydratation toilte (UDDT)

The rainwater is collected and treated by filter. The water is then used for cleaning and maintenance of the toilets or for washing only their hands.

The separated faeces are collected in wheeled bins placed under the toilets for easier transportation to the composting chamber. There a two bins, one

for storage and one for drying after being filled. By adding saw dust the water in the bins is adsorbed and the moisture is low. The collected faecal matter is composted with grass or degradable matter like bio waste.



Designed Sanitation System

Ecological Settlement in Allermöhe in Hamburg, Germany

Project Frame

In the district of New-Allermöhe-Eat consists of 36 single-family houses with around 140 inhabitants. The project started in 1983. It was planned as a model settlement. Main goals of the projects are the construction of compact building under ecological architectural criteria, the implementation of a closed-sanitation loop for independence from common sewage system and to degree the involvement of the users in the planning, design and maintenance process.

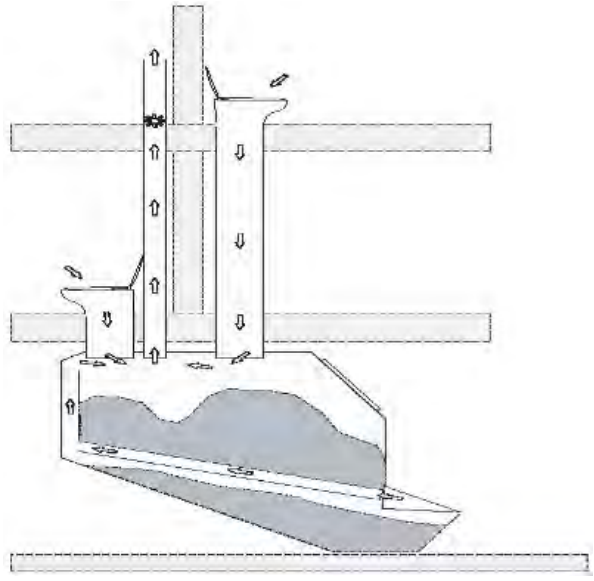
Applied Technologies

All households have a composting toilet. Here human excreta, toilet paper, organic kitchen waste and garden waste can be composted together.

For a correct aeration of the composting chamber the toilets have to be closed tightly. The urine and water is

Composting toilet System (left), composting chamber (right)

evaporated through ventilation pipes.
The grey water is treated in constructed wetlands (also called reed bed) and led to bordering channels and not reused. Rainwater is collected from the roofs of the houses in underground cisterns. The faeces in the compost container is treated and stored there for two years. The produced compost is used as fertilizer in the gardens and green areas.



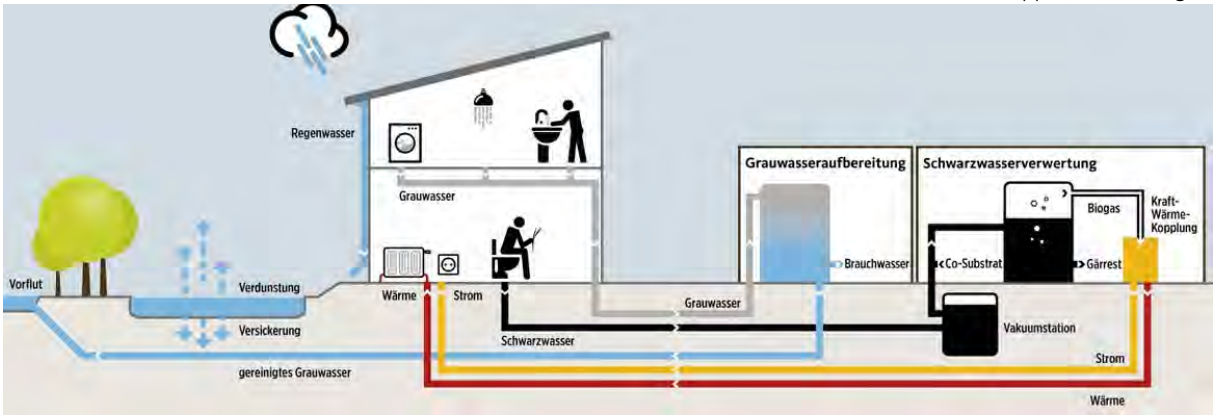
Side view of the composting toilet system

KREIS research project – Jenfelder Au Quarter in Hamburg, Germany

Project Frame
The German research project KREIS developing and researching on innovative concepts and technologies in wastewater engineering in combination with regenerative energy production. It is planned to build a new district on former barracks in Hamburg. 770 new households, necessary social, cultural and commercial infrastructure will be constructed. During this project six academic institutions and four partners from the industry participate in the project. The Bauhaus-University is one of the leading research partners during the project.

Applied Technologies
Urine, faeces and flushed water are collected together as black water by using vacuum mix toilets. It is led into an anaerobic treatment. Here the black water and organic waste is transformed into biogas. The gas is converted into electric power and heat. Residuals of the treatment are used as fertilizer. Grey water is treated in decentralised systems before leading into open water.

Overview of applied technologies



2.4 The restroom experience

The restroom is more than a toilet; it contains several objects that support the user in its use. How positive or negative this interaction is, relies not only on the restroom itself but also on the facility or service the restroom is part of. *Is the location well maintained; is it guarded; does it belong to another facility?*
When designing a new facility, it is important to understand which aspects affect the experience in a positive or negative sense. To gain more insights on which aspects exactly, this chapter deals with several themes that influences the experience of a restroom.

1. The restroom
2. The use process
3. The biological factors
4. Ergonomics factors
5. Physiological factors: habits and behaviour
6. The other user: maintenance of the facility
7. Misuse
8. Technique affects interaction

2.4.1 The restroom

Public sanitation facilities
Public sanitation is a facility that offers the possibility for passengers to use a restroom in public space. You can find them in all possible sizes and settings, from a shopping centre to an airplane or the one in your office. The atmosphere in these facilities can diverse from one another. This can also affect the use which is described in the next chapters.
Often, the user have to pay a fee to use the public facility (based on the observations these were between 20 cent and 1,-€).

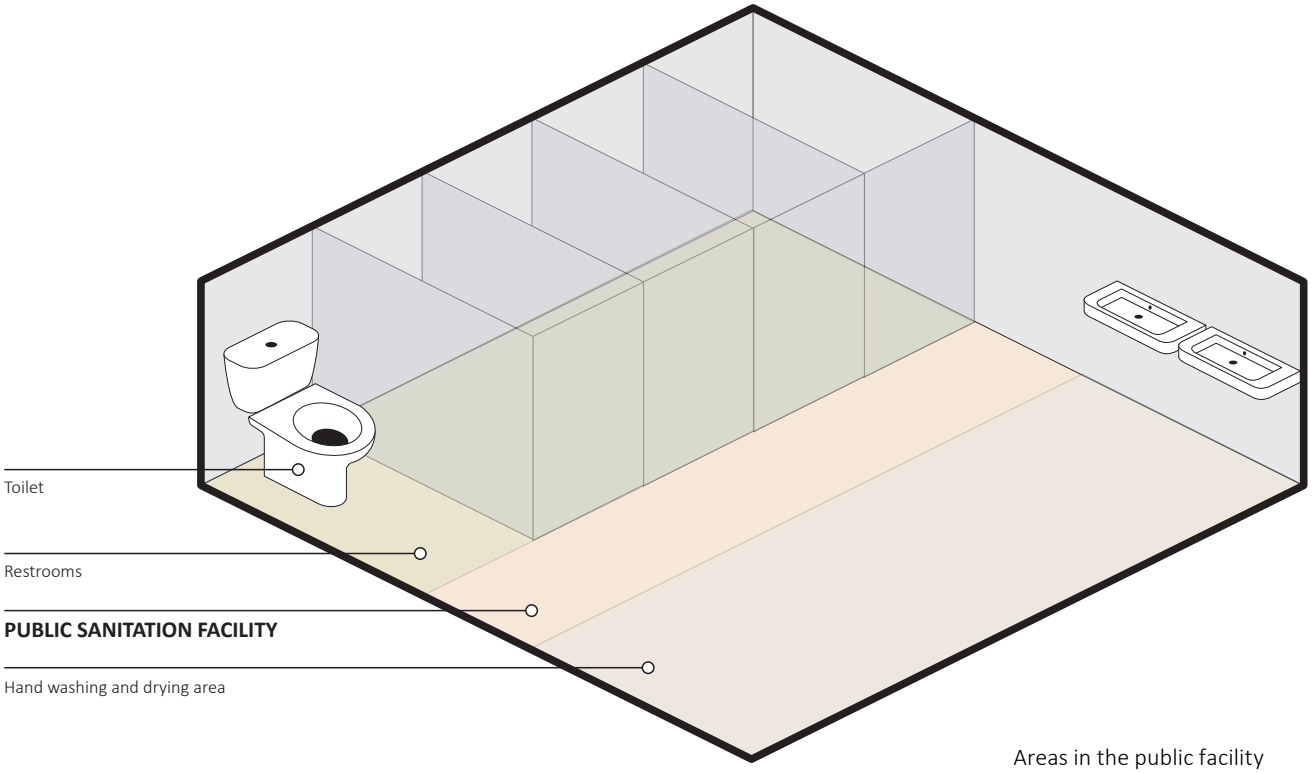
Construction
In general these facilities are located in other public buildings or in smaller buildings especially for this facility. Most of the time there are separate restrooms for men or women, often there is also a special restroom for disabled, elderlies and parents with young children.
The facility exists out of two areas – one where the restrooms are located and one where people can clean their hands after the use of the restroom. These two areas are separated with a passing or waiting area.

Technology level
The technical level of the facility depends on the providers, the location, and the use frequency or user group.

The low level
Everything is manual, like opening the door, flushing the toilet, turning on the water-tap for washing the hands.

The middle level
There are some sensors that minimize the touching points. This can be sensors to flush, to turn on the water-tap, to dry the hands or to turn on the light.

The high level
All elements are constructed to avoid all contact during the use, for example a self-cleaning toilet seat by sensors or automatic door opener.



Areas in the public facility

Facility furnitures

The restroom is the name of the room where the toilet is placed in the European culture. Restrooms often have the same functional appearances; a closed, small room without (big) windows. In general standard toilets are for a sitting position and flushed with water.

A light which provide safety and comfortable use at any hour

A door with a lock which provide intimacy and security

A toilet with a seat to sit on

A flush system which is activated after pushing the flush button or sensors (infrared or move sensors)

Toilet furnitures and contact points

These are the basics but without other accessories, the use of the toilet would be uncomfortable. For instance the brush for cleaning the toilet, the paper for cleaning the body it self and the bin in the women toilets for disposing hygienic products and other waste which can not be throw in the toilet.

In the facility:

- A sink with water and soap to wash the hands
- A dry machine or a towel to dry the hands
- A mirror above the sink

Contact points

In public facilities, like at home, there is several contact points with objects which could be possible infection transmitters.
There is different possible contacts points in a toilet.

In public facilities there are two known risks for infections. The first risk is related to the formal visitors who could have left tracks for example via the door handle. The second risk is related directly with the use of the toilet and possible contacts with excreta through the brush or the toilet seat.

Cultural transmitters

Cultural transmitters in the sanitation facility

The cultural transmitters are signs or objects that are reflecting special use habits. They are recognizable and identifying a culture. In the restroom, there are some of these cultural transmitters that are reflecting the cleaning habits on one hand and the personification on the other hand. Public facilities consist out of a minimal amount of objects because of the risks of vandalism (more about this in the chapter misuse) It makes the public facilities impersonal, unfamiliar or even clinical.

In private restrooms, some objects reflect the personality of the owner by decorating the room and making it more intimate. These can be directly elements of the construction like tiles, colors on the walls, the color of the toilet, light effects and so on. These objects are changeable in time: photographs, posters, plants, reading material, a carpet and other small elements. They can contribute to a good user experience as they can support in feeling safe, comfortable and in a familiar environment up to a certain level.

In case the facility does not have this personal and private atmosphere the user will possible act les responsible.

Also the materials of the elements can contribute to this atmosphere. Though toilets are standardly made out of white porcelain, stainless steel is becoming the standard for a lot of independent public facilities because of vandalism; this material has a better price/ resistance ratio.

2.4.2 The restroom use process

Normally infants start training the control over the urination and defecation process after reaching 18 months until the age of three or four. Because the use of the toilet is a learned process it should be possible to re-learn meaning. So People can make some changes in it.
Although this physical process is (with most of us) a very steady and daily routine it can be easily disturbed. Especially by the change of diet, sickness or not using the toilet often enough. Mental states can also effect strongly. Anxiety, fear or illnesses are examples of factors that can disturb this self-trained reflex system.

The use of a restroom exists of a sequence of activities, based on a biologic process and a physical reaction to this. These physical reactions can be analysed and described by ergonomic studies. Thereby they are influenced by personal behaviour and habits. In the following chapters some of these factors are looked into in more detailed.

Standard sequence
Although this activity-sequence can change or extend with personal habits like reading, preparing or cleaning - depending on the location and the person - this sequence is quite standard and based on the use of a sitting toilet in a public restroom.

Urinating

How long	it takes 21 seconds (+/- 13 seconds) to empty a bladder
How often	every 3 to 4 hours – 4 to 8 times a day

Children, elderly and pregnant women have a higher risk for bladder problems in the sense that they have to go more often and/or have less control.

Defecating

How long	unknown - diverse strongly per person
How often	from three times a week up to three times per day

time spend in the facility
In general the use of a restroom takes from 0 upto 5 minutes per person.
In and out: people tend to use a public restroom quicker than a private one.
Men spend in average 1.5 minutes in the facility apart from the act of excreta. The time that especially women sometimes need longer is probably spent infront of the mirror. 30% Of the women defecates only at home.

The time spent on a toilet strongly relies on the person, location and situation.

Activity	underlying factors	interaction points between user and facility		
		Touch	Sight	Smell
feel physical pressure : the need for a toilet	biological process			
Control by contraction of certain muscles	biological process			
Look for a restroom	cognitive ergonomics		Alert to standard restroom signs	
Enter the public facility	physical ergonomics	Door and user	Gender signs, fee signs	
Look for a (clean and free) restroom	cognitive ergonomics		-alert to locked locks	
- alert to tracks from formal users	aware of tracks from formal users			
Open the door	physical ergonomics	Door and users hand		
enter the restroom	physical ergonomics			
(create light)	physical ergonomics	Light switch	Light switch	
close the door	physical ergonomics	Door and users hand		
lock the door	physical ergonomics	Lock and users hand		
check the restrooms setting	cognitive ergonomics		Alert to tracks from formal users	
React if necessary: replace toilet paper, clean the toilet	physical ergonomics	Several possibilities		
Place yourself in front of the toilet	physical ergonomics			
Undress	physical ergonomics	clothes		
get in position	physical ergonomics	Possible touch points with the toilet seat		
defecating and / or urinating	biological process			
Time to look around you, to read, to notice things etc.	cognitive ergonomics		Floor, side walls, door, part of toilet, legs and feet	feedback of your own act
(stand up)	physical ergonomics			
take toilet paper	physical ergonomics	Toilet paper and holder		
clean yourself	physical ergonomics	Your own private parts		
(stand up)	physical ergonomics			
Dress	physical ergonomics	Clothes		
while looking at the toilet and see the result	cognitive ergonomics			feedback of your own act
Clean the toilet and the restroom (flush and / or brush, cleaning of the seat, air sprays etc.)	physical ergonomics	Possible: Flush Brush, seat , air sprays	Toilet seat, bowl and floor	Create a refreshing Smell
unlock door				
(possible by covering the hands with toilet paper, or sleeve)	physical ergonomics	Lock and users hand	Door lock	
open the door				
(possible by covering the hands with toilet paper, or sleeve)	physical ergonomics	door and users hand	Door handle and panel	
(switch of the light)	physical ergonomics	switch	Light and switch	
Close door behind you	physical ergonomics	Door or door handle	Door handle and panel	
When used, throw away the toilet paper that was used for opening the door			bin	
Look for the cleaning facilities	cognitive ergonomics		Alert to standard symbols	
Place yourself in front of the sink	physical ergonomics		Possible reflection in the mirror	
Use the soap (if available)	physical ergonomics	Hands interact with soap (dispenser)		Feedback of an refreshing odour
Turn on the water	physical ergonomics	Hands interact with tap		
wash your hands	physical ergonomics	Hands interact with water		
Close the tap	physical ergonomics	Hands interact with tap		
Look for a possibility to dry hands	cognitive ergonomics		Alert to standard symbols	
Dry hands	physical ergonomics	Hands interact to get dry		
Look in the mirror	cognitive ergonomics		reflection in the mirror	
React on what you see (make-up)	physical ergonomics	Hands interact with face, make-up, clothes		
Leave the public facility	physical ergonomics	Repeating the entering process		

2.4.3 The biological process

Both urine and faeces are waste products from the body and the consistence and colour depends on the person's diet and can inform about the persons health. The urination and defecation process differs from each other and are briefly described here. More information can be found in the enclosures.

Urination

The body liquid urine is basically filtered blood which contains waste compounds or by-products from the metabolism that require elimination from the blood stream. Urine is produced by the kidney in a constant process.

Storage	Urine is temporary stored in the bladder
Voiding	A voluntary signal is sent from the brain to begin urination. This signal (firing of neurons) causes the wall of the bladder to contract and the sphincter to relax which makes the urine flow out of your body.
Path	kidney - bladder – urethra

People averagely urinate every 3 to 4 hours, accept for the nights. The voiding of the bladder continues until it is empty, this takes in average 21 seconds with a standard deviation of 13 seconds.

Urine

- The body produces in averaged 1 to 1.5 litter of urine per day
- Smell, consistence, colour, and volume depend on the diet of the person
- Urine consists out of more then 95% water, with the remaining constituents, in order of decreasing concentration urea 9.3 g/L, chloride 1.87 g/L, sodium 1.17 g/L, potassium 0.750 g/L, creatinine 0.670 g/L and other dissolved ions, inorganic and organic compounds.

Defecation

Defecation is the final phase of the digestion process where solid, semi-solid or even liquid material is eliminated out of the body. In the digestion process food is processed in order to gain energy and nutrients for the human body to function. This process consists out of the physical digestion where food is broken down into molecules, in order to be secreted and absorbed via organs as the stomach, the small and large intestines. Faeces are the indigestible substances that are left over after the digestion process.

Storage	The faeces are temporary stored in the anal canal and the rectum
Voiding	Voiding happens after a certain time passes or when the rectum is full and pressure inside the body rises. Muscle waves in the walls of the rectum push the faeces towards the canal where it is pushed down by other peristaltic waves.
Pressure	This process can be assisted by taking a deep breath and expel the air downwards to create extra pressure.
Path	mouth - stomach - small intestine (liver, gallbladder, pancreas) – large intestine – rectum - anal canal - anus

The defecation process, also known as the stool or the bowel movement, can vary strongly per person from a few times per week up to a few times per day.

Faeces

- One dung is 100-200 mm and has a diameter of 15-40 mm
- Smell, consistence, colour and weight depends on the diet of the person
- faeces consists in general out of:: 65% water – 10-20% ash – 10-20 % soluble substances – 5-10% nitrogen and also 0,7 gr phosphorus.

A person often also urinates during the act of defecating. For both genders it is impossible to control this. For men it is difficult to achieve control because the two muscles lie very close to one another. This makes controlling them separately difficult. Women have also troubles controlling because of their autonomy - the connection between the two exist creates the urge of urinating while defecating.

The private body parts of human beings are vulnerable. It is even possible for example for women to get infections by the use of a toilet. Even by hovering over a toilet infections can be transported by aerosols or back splashing water.

2.4.4 Ergonomic factors

The first part of this chapter goes briefly into the ergonomics and the effect on the interior of the complete facility. The other part of this chapter focuses on several possible positions. The position affects the urination and defecating process. After this the person has to clean him or herself in or after taken this position. During these activities the person has a specific view and receives all kinds of sounds and odours, produced by him or herself or via other users.

There are several existing 'product groups' that support these positions. Because of the differences between men and women, these devices sometimes differ. This part of the research also looks into several points that could be taken into account with the design of these types of products.

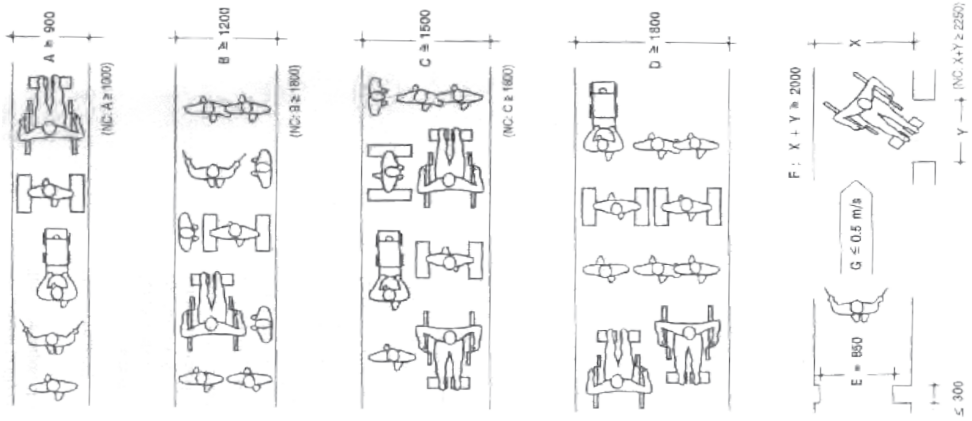


Image of the 'European Concept for Accessibility'

The facility

The size of the facility and the amount of restrooms relies on the expected users. Thereby the setting and the expected use-tendency influence the design.

The facility requirements and which elements should be present, depends on the setting self. In some cases as less elements as possible is required because of possible vandalism. Other cases a more luxury facility (e.g. extra storage space or decoration) suits the setting. These specific requirements come with the planning of a facility for as specific setting and are often published in form of a project briefing for possible contractors. These documents contain specifications for the particular situation and location. An example can be found in the enclosures.

Because of the diverse range of public facilities the team only used very basic interior rules, based on the standards from Neufert or the European Concept for Accessibility as shown in the image above and from the book Inclusive public design - Public Toilets.

Noticeable requirements

Space standards in facilities also accessible for disabled should at least accommodate modern pushchairs and be as generous as is possible both for manoeuvres inside the toilet block and for access to and around the building.

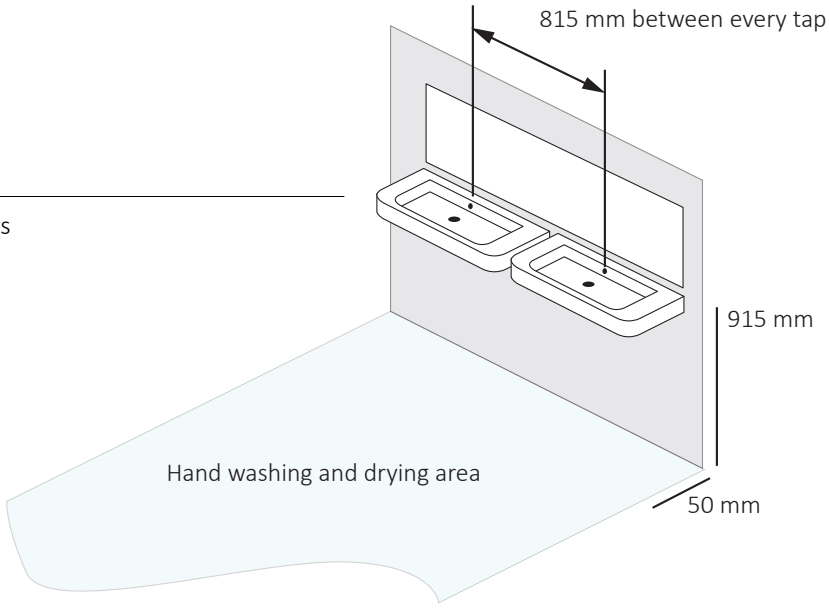
Very careful thought should be given to the organisation of male and female toilet areas to enable separation but also unisex access to facilities for caretakers.

In defining more appropriate standards for cubicle dimensions, some of the best guidance comes from the Women's Design Service. WDS has recommended 900 mm by 1700 mm including 200 mm of ducted cistern and integrated sanitary receptacle with a 750 mm door, resulting in only 1500 mm depth, which is much more modest than the author's ideal, but pragmatically practical and much better than many any existing local authority toilet restrooms.

The author's proposed standards are much more commodious, in order to accommodate everyone including the abled, dis-enabled and a considerable number of disabled people too. Toilet cubicles should be a minimum 900 mm wide by 1700 mm deep, but up to 1110 mm by 2050 mm would be an ideal maximum giving lots of space for everyone.

If a toilet provider is considering an alternative to sit toilets in the Ladies, squat toilets should be considered rather than female urinals.

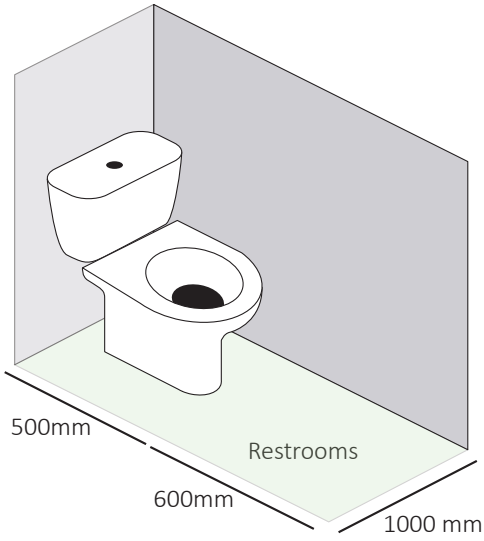
• As self-cleaning as possible, sinks where the draining water directly cleans the sink for example
• As little contact as possible while using improves the use (for example by foot or sensor)



graphic washing and drying area

washing and drying area

After the use of a restroom the users can wash their hands at the washing and drying area. There are often much more restrooms then there are water taps, space in front of the mirror and hand dryers. Which is logical, this part of the facility can be used quite quick. Important is that all elements of the cleaning process should be in a logical order which supports a quickly and intuitive use.
The hand dryers should be directly located by the sink – walking around with wet hands leads to drops on the floor which does not look hygienic. A common problem is also that there are not enough hand dryers, which leads to extra lines or people not drying their hands. Drying your hands is important, water drops can make bacteria easily spread and survive.
Thereby it should be taken into account that if there are people lining up for one of these elements, the lines should not cross with one another – there should be enough space.



graphic restroom

restrooms

People prefer often complete closed restrooms when it comes to privacy. In public it is rather more important to have open restrooms as possible which support safety and the cleaning process. Standard these panels are 300 mm from the floor and up to 1700 mm, this diverse per location and situation. Too much space under the panels makes it able to notice other users by seeing their feet; this is not preferred because it interferes with people's privacy.

The squatting position

Squatting is the most natural position and it is also the ideal and the healthiest position. A squatting position automatically leads to the relaxing of the puborectalis, part of the pelvic floor muscles. This creates a less strong angle in the anal canal and makes the elimination of the faeces easier - they slide down instead of being pushed over the angle that this muscle normally forms. Because the squatting position needs less pressure and empties the anal canal better, it is seen as the healthiest and easiest way for defecation.

A common problem with squatting in western culture is the clothing (especially the trousers) and the position itself, people are not used to sit in this position and are often not able to stabilize themselves. There are full squatting positions and half squatting positions, the latter would be more practical for a society that is not used to this position, although it still can cause problems with clothes especially while urinating.

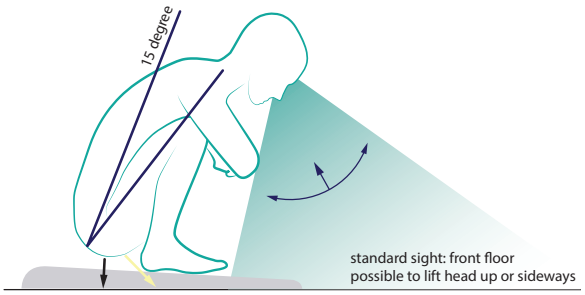
in a full squat position:

- the distance from the buttocks to floor is between 150 and 200 mm
- the feet should be placed flat on the floor so that the upper body can lend forward - to create a stable position

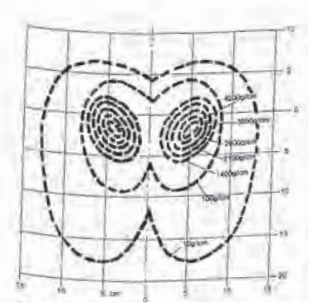
in a half squat position:

- the distance from the buttocks to floor is between 230 and 280 mm
- The stability comes from balancing on the ball of the foot and the upper body be straight up which makes it easier to keep balanced in this position.

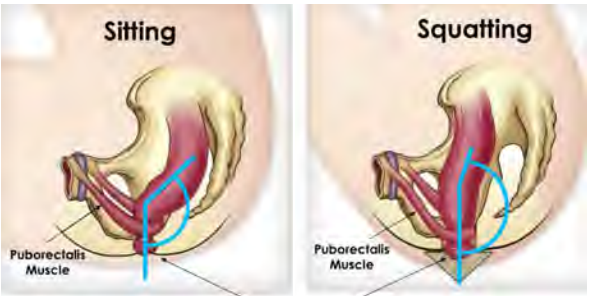
The position affects how the body weight is divided over the under body. The body weight in a sitting position is divided over the complete buttocks
In a squatting position the weight concentrates only on the seat bones. This position separates the directions of the urine and the faeces stronger, as the body points more forward then with the sitting position, the urine is also more forwardly directed. The faeces fall down linear. This could support the function of the no-mix technique described in chapter 2.5 for sitting toilet. In case of a to small model it can also lead to wet feet and ankles.



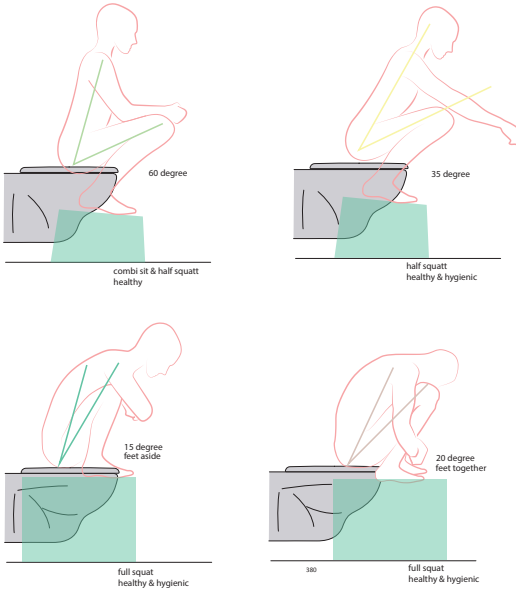
squatting position



pressure



squatting vs sitting



different squat positions

Existing supporting products

Full squat toilet

Full squat toilets are common and seen as the standard in most Asian countries. They can also sometimes be found in south European countries. The first time people cross another model they sometimes try to use their regular position on the different type of toilet, which is maybe for them at that moment their only way. Someone squatting on a standard toilet can even break a 'sitting' toilet. These situations led to notes and descriptions like the squatting warning. Apart from being in the healthiest position the squatting position is also more hygienic since the user does not have to touch any part of the toilet with their hands or body. Only the feet are placed aside from the bowl.

Half squat toilet

The toilets for a half squatting position are lower then a standard toilet but still have a place to sit (or in this case squat) on. Several toilets especially for these positions were designed but are not common or easily available. One known example which is also is the in 2012 Red Dot award winning 'WC health' from GÜRAL | VİT and is available via their website.
The toilet supports a half squat position. Known problems with such toilets are,

- lifting the legs up after sitting is falling/leaning backwards first
- tight clothes can keep the legs together which makes it difficult to place them

The 'squatty potty'

An alternative to use this position is the add-on the 'squatty potty'. A relative new product in the sanitation field and especially known in the US. Although brand-less stools are often also used, also before the squatty potty entered the market. The squatty potty is a simple tool that one can place in front of the toilet. A person can sit first and then place their legs. It is possible to place the legs sideways or in front of you. This product is used in private atmospheres and supports the user especially during the act of defecating. Since this position automatically relaxes the muscles
The unique selling points of the squatty potty is that the body is emptied better because

- The elimination is quicker
- The elimination needs less pressure from the body
- The process is cleaner – use less toilet paper

images (left to right):
standard squat toilet
the squatting warning
squatting toilet Le Penseur
the squatty potty
Wellbeing Toilet
GÜRAL | VİT toilet

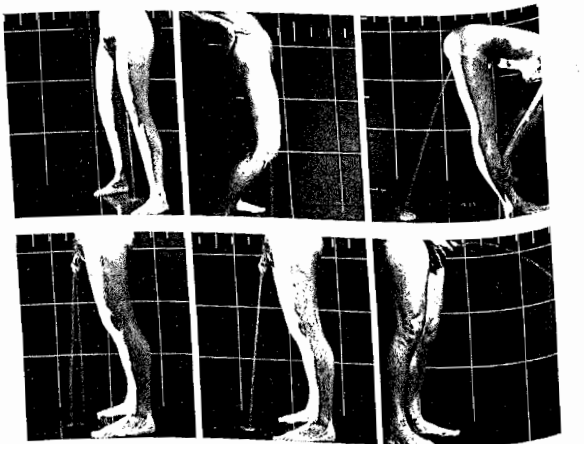
women's urinal on a festival

The standing position

Standing up straight while urinating is for men so common and familiar, that it is sometimes even difficult in situations where it is not preferred like regular toilets at home, to convince men to sit down. For women in the Western society this is the complete opposite. The urinal is only collecting urine and there are already good functioning dry-urinals for men looking, a perfect product for a separate sanitation system and therefor very interesting for this project. The ISaS team mainly focusses on the women's position and product examples.
People only stand for urinating. For both genders it is impossible to control the urinating while defecating, so the devices for a standing position are only designed for urinating.

Standing positions for women

- Women can urinate standing straight, bending forward or backwards, in all positions it is difficult to aim; backwards because the person is not able to fully see; urinating standing straight the urine comes down very closely to the body and when the hips are pushed forwards the stream can be straight when the bladder is full and pressure is used - when the bladder is getting empty it comes back close to the body.
- In all these positions the clothes, and especially the pants, of the women can be a problem.
- Because of the location of the urethra it is difficult to aim or control a straight 'urine stream' especially for an adult women.
- There are some tricks for women to urinate while standing (described on several forums on the internet: sources), where the urine flow/stream is coordinated with the hand. Although this is questionable on hygienic and intimate grounds – especially in public atmospheres.
- The backward bending positions is similar as the hocking over the toilet seat that women use in public toilets where they bend downwards in order to control the urine stream. (see hovering)



Woman urinating in a standing position

Existing supporting products

women urinal

There are several urinals especially for women designed although they never have been successful and market-breaking. Or they might have been there briefly and then left the market again.
The reason for these urinals is to offer women the same luxury and hygienic option to urinate in public as men. The positions that are used for women's urinals are hovering (position explained in the next part) and standing with two legs aside. The latter often lead to problems caused by clothing. The first does have potential since women often use this position for urinating on toilets already. Clothes are no problem and even defecating is possible in this position (which of course make it a normal toilet it again). It is however difficult to hold this positions and to aim in this position. Here the design could be a great support.

Why the women urinals never succeeded could have to do with the following reasons. Urinals for men are cheap, there is no restroom required. Dividing panels between urinals are more affordable then a complete restroom with door. The urinals can easily be waterless. The cleaning is easier, and they need less space and the use takes less time. The position that women use for the use of a urinal still requires a closed restroom, in that sense one can directly install a standard toilet. Which makes the entering of the market possible difficult and the investments risky. Thereby the use might not be so attractive. Urinals would make sense in public space (since people often just urinate in these facilities) though trying out a new toilet designs in public space might be scary since you cannot clean yourself if something goes wrong.

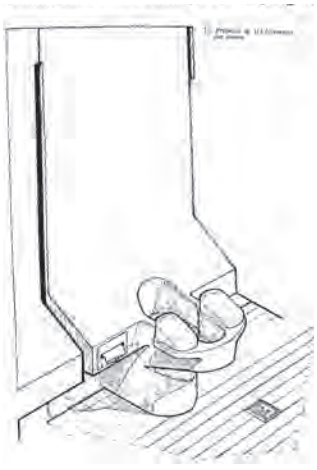
FUD female urination device

The portable urinal is like a funnel that can be used for women to urinate standing without using their hands. It is a portable device that you carry with you. They come in disposable and long-term use versions. The latter is criticised based on hygienic grounds. It is a popular device used during extreme sports, festivals, travels and other circumstances where a decent toilet is hard to find.

Men urinal

Designs and devices for men are very popular and well known and come in various shapes and designs. They are often placed in public spaces. People mostly use the facilities in public just for urinating and urinals are easier to install, easier to clean, quicker in use, take in less space and do not require a full closed restroom. Thereby the urinals can work easily without water. In the enclosures are a few points summed up that could be taken into account with the design of a urinal for men but also for women.

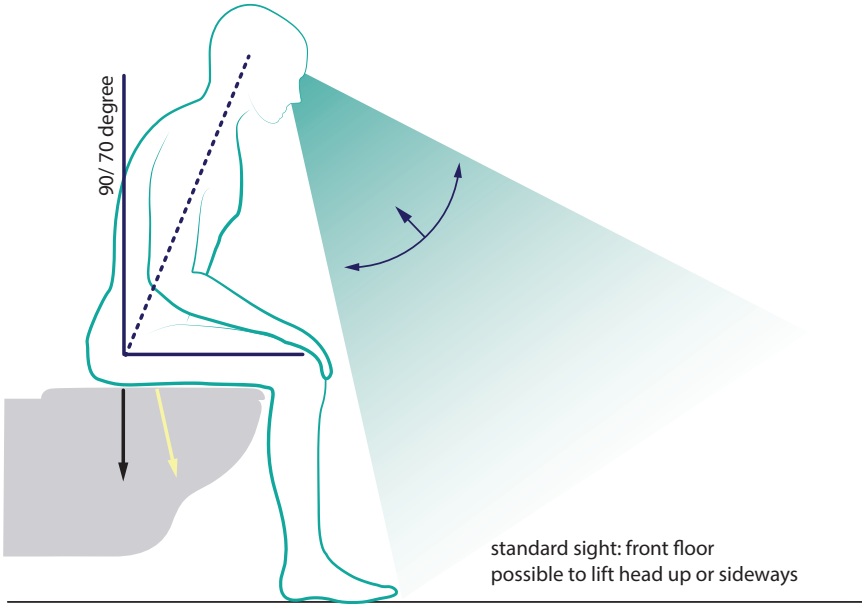
FUD female urination device



sketch of a women's urinal

SANISTAND FIXTURE. This wall-hung Sanistand urinal for women simplifies rest room cleaning, affords greater sanitation and convenience. Also available are a pedestal model of the Sanistand fixture and a tank model for installations where direct pressure valves cannot be used. All models come in white and a variety of colors.

advertisement women's urinal



sitting position

The sitting position

It is possible for both genders to excrete in the sitting position. The toilet designed for this position is - together with the men's urinal - seen as the standard in Europe.
Therefore the points are directly summed up with the points that could be taken into account with the design of a 'sitting toilet'.
The position affects the direction and how the excreta comes out. Faeces (normally) fall straight down. Urine has more pressure and often comes in the direction in which it is aimed (the body is). How closer urine is released to bowl for collecting the less its makes sounds and splashes.

The 'sitting' toilet

The toilet is designed for this position and with the men's urinal seen as the standard in Europe. In the annexes are a few points summed up that could be taken into account with the design of one.

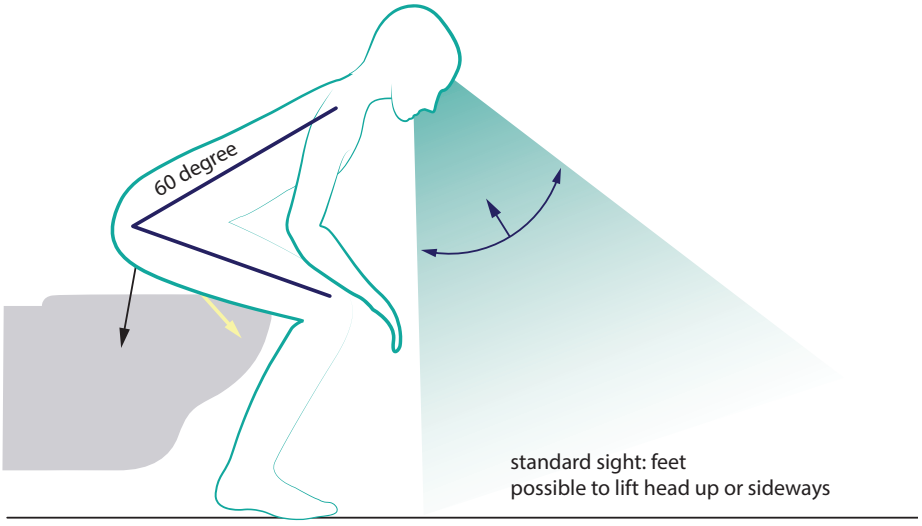
- modern toilet is often too high, which makes the act of defecating difficult and prevents complete emptying; the toilet seat should be under the knee height.
- the body weight in a sitting position is divided over the complete buttocks
- Toilet seats have often a conical profile which do not serve the comfort but is rather done out of a decorative reason. A concave profile would support the contact surface of the body better.

toilet for standing

Although the toilet is often also used to urinate while standing by both genders; men incline to do so with private toilets where there is no urinal present; women especially in public space, where the toilets are often not clean or just out of habits. (2.4.4.4) In both cases this can result in splashes around and on the toilet seat.

- The toilet is not designed for this, only the seat can be lifted to prevent a dirty seat for the next toilet user. Men are accustomed to do this, women are not.

ergonomic toilet seat



hovering position

Hovering

Hovering over the toilet is a position where the person not completely sits down but hangs above the seat which requires some strengths in the legs. Hovering is a more hygienic way of using the restroom. Especially women that use public facilities use this technique to avoid touching the toilet seat. In that sense hovering is a reaction to a badly chosen product for the particular setting.
Although this is a safer position in sense that the person has less risks on infections it is hard to completely relax in this position meaning that the bladder might not be completely emptied. A few times per week urinating in this position will not do much harm although when a bladder is regularly not emptied completely this can lead to infections.

Existing supporting products

Examples and critical point to designs for this position are summed up with the design points of the women's urinal.

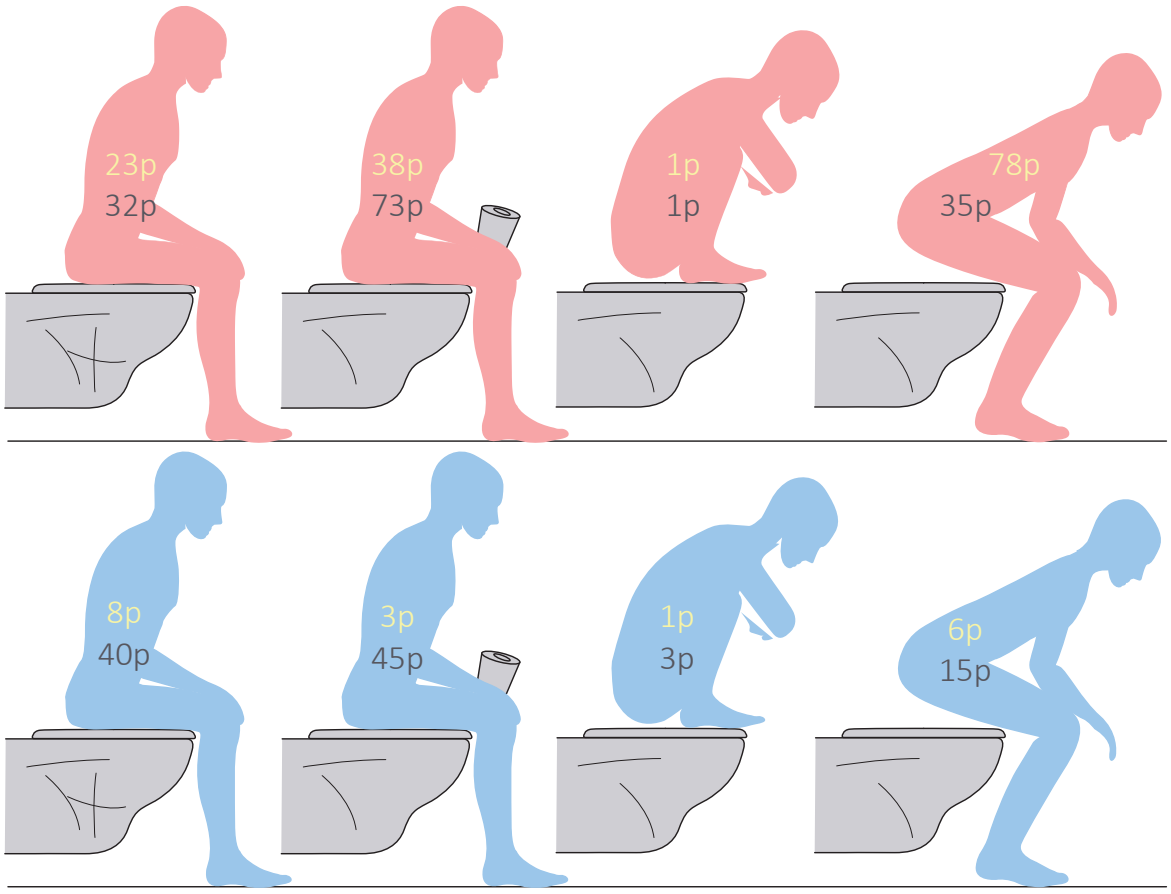
Cleaning yourself

In the western culture it is standard to clean yourself after the act of excreting with toilet paper which is after that disposed in the toilet bowl together with the excreta and flushed with water into the black water sewage.

Cleaning with water (especially after the act of defecating) is preferred over toilet paper since it is a more thorough way of cleaning. In other cultures there are toilets that have a shower installed with the toilet to clean with water. One known and trendsetting model is the Japanese Washlet from the company Toto. This model is slowly entering the European and American markets mostly in private atmospheres.

The cleaning process with toilet paper is often from aside or from behind while sitting down. There are several ways to take toilet paper roll it, cloth it or fold it. The holder for the toilet paper should be placed slightly in front of the toilet, so that the user does not have to twist to reach for it. An alternative is wet toilet paper although this is not found back in public facilities but more used in private spheres. This paper should be disposed in a bin after use.

The Japanese Washlet from the company Toto



used positions in public restroooms, based on the ISaS survey 2013

Positions used in public toilets

The positions that are explained in the previous chapters are all used by people during the use of a public restroom. The outcome of the survey done by the ISaS team shows which positions in public facilities are favourite under the participants.

For hygienic reasons people improvise their position in restroom toilets. Especially women also use a standard toilet for urinating rather not sit down and physically touch the toilet self.

- The most common improvisation is hovering above the toilet.
- Another less used position is hocking directly hocking on the toilet seat.
- Other options are cleaning the toilet seat with toilet paper or covering the seat with toilet paper to sit on. Men have it often a little bit easier, they can urinate standing.

A more precise insight in positions used by a more diverse audience and in more defined types of public restroom requires a more comprehensive survey.

Extraordinary users

Special adjustments for elderly, children and people with a disability are just looked into briefly, since these focusgroups lie outside the project scope. For all of them it is possible that special adjustments to the design of the final design are required.

- Elderly that have physical problems, often use the disabled toilet on public toilets (interview public toilet staff)
- Supporting items for elderly (in west Europe) are higher toilet seats and extra grips installed around the toilet which helps them to sit down and get up again.
- Children that use toilets designed for adults is questionable because of their smaller proportions only when the feet are placed on to something it is possible for your reflex system to work correctly.
- There are all kinds of supporting items that make it possible for them to use the standard sized toilets like smaller toilet seats and small stools where to place their feet on.
- For people with a disability there are all kinds of supporting items and adjustments possible like bigger restrooms, grips and lower sinks.

Squatting test

After the ergonomic research studies the team became curious to different positions and the products that are available in the European market. The squatting position that by many sources is pointed out as the healthiest position could even become the most hygienic position if the supporting product is designed well. Though the same sources point out that the reason for failure (full or half squat) are the European cloths.
To get a better understanding how this position actually affects the act of excretion and where the difficulties come in (position and cloths) the team decided to use rapid prototyping to quickly discover if this ergonomic aspect is an interesting approach for the project before researching the topic in more detail.

The conclusion of the squatting test was to leave the ergonomic approach for the project. People do not seem to be interrested of changing their positions at home – a test with squatting combined with hovering in public restrooms would probably be an interesting next step. Although the test clearly pointed out that clothes really can make it difficult and this is especially in public space - where there is no option to quickly change - a main reason to leave the full and half squat position.

Rapid prototying

Several sizes of stools were build (image x) and placed in the restrooms and bathrooms of two student houses.

Test situations
house 1: Only one toilet on the bathroom – A big stool was rotated with one small stool which can be easily positioned differently.
House 2: One restroom with a big stool and one bathroom with a small stool, which can be easily positioned differently.

In total 2 groups of potential test persons, 5 persons and 3 persons

Approach:
All persons were informed about the project self and the testing stool. At the restrooms there was a poster explaining how it worked. It was up to them if they wanted to try-it out or not.

Result:
After a few weeks every person was asked if they used one of the stools

People who did not tried the stool : 1 (test house 2)
- not attractive to use, asking about it made the person uncomfortable
- the person was big the reason for not testing - understands the reason in general but not in case for the person self.

People who tried the stool once / a few times: 4 (both test houses)
- tested once and noticed no differences and were not curious to see if that would change in long term
- difficult and uncomfortable position physically
- difficult and uncomfortable because of clothes, wearing tight trousers

people who tried the stool frequently: (both test houses)
- noticed a differences during the act of excretion - directly at one of the first try's
- had sometimes difficult and uncomfortable because of clothes, wearing tight trousers

After the reviews the stools stayed at the student houses (from the end of January till the end of June)

3 out of the 8 test persons kept on using them frequently. All three test persons still noticed a different positive affect.
- Two persons only used the stool when they thought about it and when it was there; when they were wearing comfortable clothes and when they were not in a hurry.
- One out of the three test persons got really used to it and even misses the stool, when being not at home.
Side note: In house 1 the big stool was almost always placed, which made the only toilet in the house always have a big stool in front of it, which supported the use of it. House 2 the small stool in the bathroom was often put to the side, people did not used it. This toilet was the most used toilet in the house.

Review material
the small stool: with the feet in front of the toilet instead of at the side.
- the small size made it possible to change positions – depending on the type of trousers the person was wearing
- having the feet in front was physically more comfortable
- one can easily first sit and then lift the feet up

the big stool: with the feet more at the side of the toilet
- the stool was big and people did not move the stool self
- the surface was much bigger so the feet where differently place able
- feet at the side where causing more problems with tight trousers.
- one can easily first sit and then lift the feet up with normal trousers

Conclusion

People really do not care of changing their positions at home, a test with squatting combined with hovering in public restrooms would probably be an interesting next step. Although the test clearly pointed out that clothes really can make it difficult and this is especially in public space - where there is no option to quickly change - a main reason to leave the full and half squat position.

The technique

Rapic or Quick & dirty Prototyping is a technique to discover quickly if and how an idea could work. As the term already explains, it's a rough way of testing. Often this is enough to say if an idea is worth looking into deeper and saves a lot of time and developing. Although it does not have to be so black and white, it can also be used to point out how an idea can be successful, in which direction to continue.

2.4.5 habits an behaviour

The use of a toilet is in the western culture seen as something private. People use the restroom alone and even in private spheres - people lock the door to make sure no one can come in. There are more psychological factors like this that come with the use of this facility. This chapters looks into several types of behaviour and habits especially around aspects like hygiene, the use of toilets and public sanitation facilities.

Typical Habits

• In general how quickly we will adjust to a new system the quicker we will accept a new system – longer waiting will make change even more difficult. [30]

• The toilet is taboo. Of all daily cleaning routines from our own bodies, our genital parts are the less talked about, less taught about and thereby less known about. [30] [45]

• In general it is uncommon to discuss the use of the toilet and the act of excreta. Women can even ignore it completely by saying they need to go powder their nose. [30]

• Your own body fluid is less dirty then that from other people [30] [46]

• All human 'waste' is found negative: finger nails, hair and so on. While the process of removing is found positive –the outcome is found disgusting. [30]

• Children do not have this reaction which means we develop this attitude toward our own waste material. [30]

• Directly after using the toilet we want to make the results disappear [30]

Typical Habits men

• The cleaning of the private parts by men is less done and also less discussed (educated). They often do not use toilet paper after urinating [30]

• 40 % of the men do not wash their hands after the use of a urinal [30]

• Men lay more value on a quick and easy accessible urinal over privacy or intimacy. The only problem that can appear is when the facility is shared and female users pass by. In this case both genders can feel invaded in their privacy. [30]

• The men's restrooms are often cleaner then the women's restrooms. Because men mostly use the urinals and these restrooms are less used by children [44]

Typical Habits women

• Women are more familiar with cleaning themselves in general but also after the act of excreting. [30]

• Female users are more critical to the restrooms they use. Other than male users they do not have the luxury of urinals, there restrooms are often less clean by improvised positions and thereby they are more vulnerable for catching an infection [30]

• Therefor they are maybe also less open for experimenting which would explain the results shown by the pilot project in EAWAG where 51 % of the women in the pilot facility automatically choose normal toilets over the test-toilets. [36]

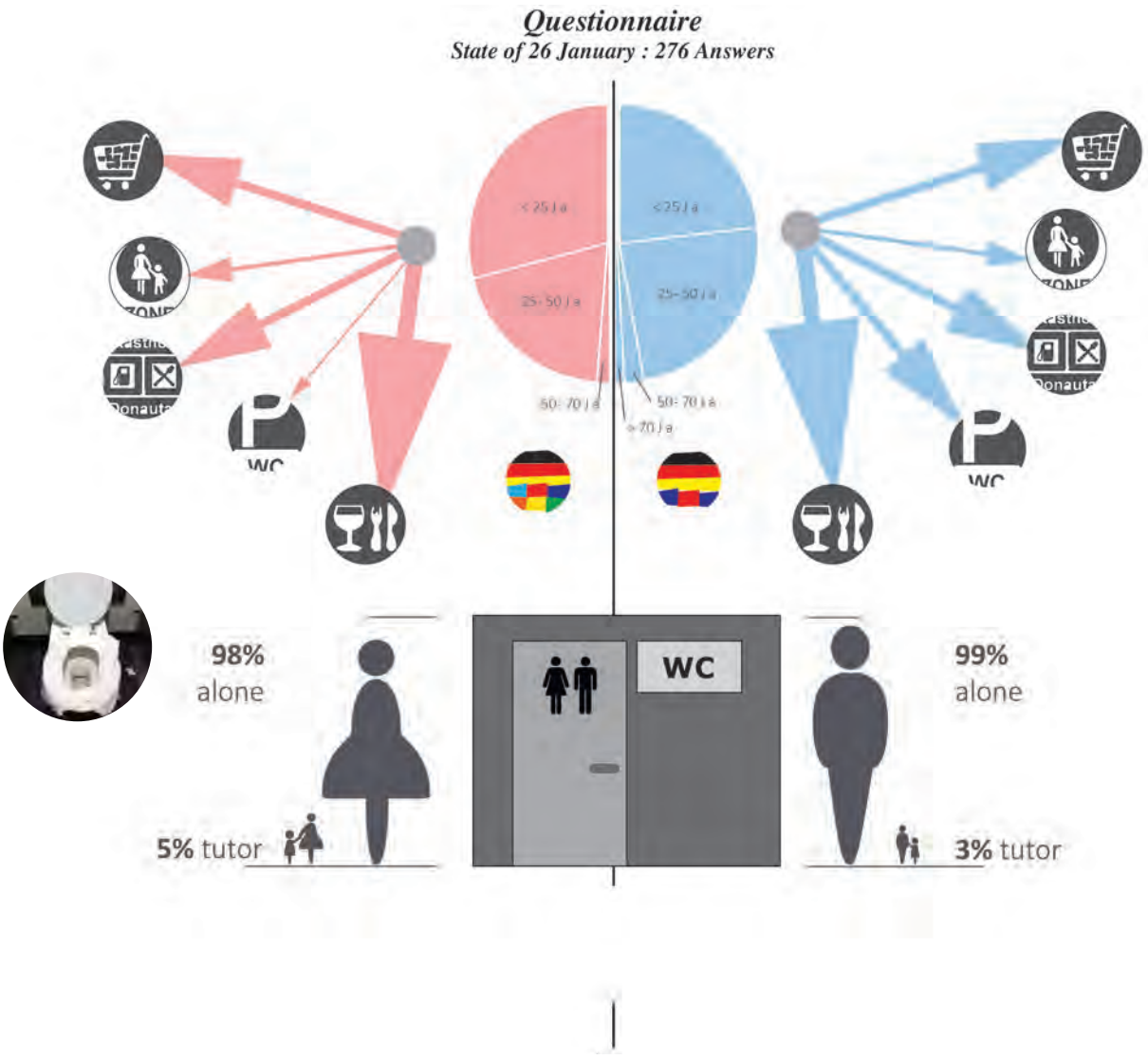
• Most female users do not sit on the toilet seats. Although this depends strongly on what kind of public space (in a small office or on the train station for example) .Researches lead to complete different percentages (American research Sani-seat: research 60% never sits down – public toilets)(English research das Badezimmer: 96% does not sit down) (Swiss EAGWAG : pilot test 72% of the women sit down-public toilets in school) [30] [36] [44]

• Reasons why women do not sit down but hoover or even hock directly on the toilet seat are:

- Scarred for catching a disease or infection
- finding touching the seat unpleasant and unhygienic (especially when there are drops or hairs from formal users) [30] [44]

• Female users tend to hold up their bladders up as long as possible when they are in public areas. This makes the pressure of the urine stronger and leads to

unisex sanitation



more splashing especially during hovering. [30]

• Women can have problems for asking where the toilet is – they see it as a more intimate activity then men. [30]

• Women have a special ritual of going to the toilet together. In this case they often use the facility to discuss something in private. For men this is unusually to do or even 'not done' [44]

Behaviour in the public facility

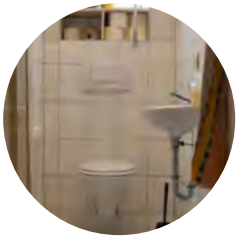
A property is either private order public, though the use of it is often more diverse. Also with restrooms there are also quite some varieties, as a private restroom can be experienced public and public restroom can be experienced private. The facility affects and changes people behaviours.

How more familiar people are with the location how stronger they trust the hygiene and safety. The real problems turn up with the use of facilities located for example in train stations, near high-ways or city parks where you have no idea about who used the restroom before you did. [30]

People have a reserved attitude towards public sanitation facilities based on hygiene, comfort and financially. This reserved attitude can even be caused by underlying feelings based on religious, ethnical and racism prejudices and anxieties towards strangers in general. [30]

The table on the next page gives an overview to different private and public situations and how these affect the restroom experience for the user. This table is made by the team after visiting and observing several public toilets.

The public private table



	private / private	**private / public (Private shared)**	**public / private (Public shared)**	**Public with staff**
location	At home	facilities like, residential communities, small offices or small schools	Public facilities like hostels, camping's, schools, gastronomy	Public facilities like train stations, city centres, museums, shopping malls etc.
context	private toilet used by one person or family	sharing with people you know	sharing with one group of strangers	public with present staff
owner	users	owner building or organisation	owner building or organisation	public facility or city
user	owner (or renter)	Group of people that know each other well	Group of people that know each other not (well)	The users before you are unknown
use	Daily	Daily	Daily (for a period of days)	Now and then
User	Water, energy & maintenance toilet paper and cleaning materials	cleaning material and toilet paper (rest inclusive, employment terms or contribution)	inclusive (employment terms or contribution)	Free up to 1.00 euro
cleaning	by users	organised by user group	Service in shifts	service present / on demand
	Maintenance (service) via users	Maintenance (service) via user group	Maintenance service via users	Maintenance service via cleaning service
guarding	users (local security)	Guarded by facility	Guarded by facility	guarded by staff
responsible on location	users	Security Facility	Security Facility	Security Facility
changes to toilet-use process (based on use process, 2.4.2)	The use is routine. clean toilet after use Not always wash hands afterwards (feel responsible)	The use is routine. Expected the toilet to be hygienic/ clean clean toilet after use can feel as your private space (in a public place)	Possible improvise the position	By feeling pressure – hold up their needs as long as possible walking in by following the guidelines in the facility (pay, enter, clean hands etc.) improvised use Wash hands thoroughly
The users notices and reacts	unclean toilet (smell, drops, hairs) makes the user clean the toilet before using it. changes in surrounding (uncommon) sounds in the house, outside the bathroom	unclean toilet (smell, drops, hairs) makes the user clean the toilet before using it. changes in surrounding (uncommon) sounds in the house, outside the bathroom	tracks of other people using the facilities makes the choose another restroom. sounds of other people using the facilities	tracks of other people using the facilities makes the choose another restroom. sounds of other people using the facilities
conclusion	these types of toilets can feel – be your private room for a while			

Public with camera	**public / public (unguarded)**
Public facility like train stations, city centres, museums, shopping malls, libraries, etc.	Remote places like tank stations & autobahn
public without present staff monitored by clearly visible camera's and/or security gates.	public without present staff and no (visible) camera's
public facility or city	public facility or city
The users before you are unknown	The users before you are unknown
Rarely	Rarely
Free up to 1.00 euro	Taxes
Service in daily shifts	Service in daily shifts
Maintenance service via cleaning service	Maintenance service via cleaning service
monitored or guarded by clearly visible camera's & gates	Not or an invisible camera and or time lock on the doors.
Security system and security staff	
By feeling pressure – hold up their needs as long as possible walking in by following the guidelines in the facility (pay, enter, clean hands etc.) be on one's guard improvised use Wash hands thoroughly	By feeling pressure – hold up their needs as long as possible walking in by following the guidelines in the facility be on one's guard improvised use Wash hands thoroughly
tracks of other people using the facilities makes the choose another restroom. sounds of other people using the facilities	tracks of other people using the facilities makes the choose another restroom. sounds of other people using the facilities

This types of public restrooms are only used in high need

typical points for the use of public sanitation

• Although it is possible to feel 'at home' in a very luxury public sanitation facility as soon as one crosses tracks from formal users like hairs, drops or toilet paper on the floor, this atmosphere is directly broken. As at home you will have an different reaction to tracks like these. [30]

• Public toilets are often 'hidden' in the buildings or surrounding with the reason to give the user a more private atmosphere. Sometimes they are hidden so well people cannot find them easily. [30]

• People in public spaces especially like offices or schools can experience the use of the restrooms for this particular time as their own private space and time.

• In and out: people tend to use a public restroom quicker than a private one [30]

• Especially women are known to use especially the mirror for doing their making, this can hold up the line, extra mirrors apart from above the sink are required

• When confronted with the one who has to clean the restrooms people leave them behind more cleaner (interview Cleaning staff)

• clean the restrooms people leave them behind more cleaner (interview Cleaning staff)

Improvised behaviour in public restrooms

• Use toilet paper to cover hands before touching something in the restroom ([44] & own conclusions)

• Use clothes to cover hands before touching something in the restroom ([44]& own conclusions)

• Using feet to open doors, lift up toilet seats and lids and to flush. ([44]& own conclusions)

• Use toilet paper to create a toilet seat

• Use toilet paper to wipe the seat clean

• Some people (mostly women) carry anti bacteria gels or seat covers with them, in case they need to use a public toilet [44]

• people probably do not stop the flush in public facilities to save water (Own conclusions)

• The first restroom in a row is often the least used meaning they are probably the cleanest and have the most toilet paper left [44]

• The first restroom in a row is often the least used meaning they are probably the cleanest and have the most toilet paper left [44]

2.4.6 The other users

Other user groups that come in close contact with the facilities and the techniques are in charge of the maintenance of the building. How comfortable the tasks for the people are that work in these areas relies on the design as well. There are two forms of maintenances. One is the regularly cleaning of the facility, done by a cleaning staff. The other one is the maintenance of the technique and the building by technicians as well as the occasionally reparation when something is broken.

Although the maintenance in form of technical reparations or building maintenances are very important inputs to the design of the facility, it falls for now out of the scope of the project.

The tasks of the cleaning staff however are looked into since they are a main part of the service. Even when the cleaning service is done in shifts, how the facility is experienced relies on if it is clean or not.
Be as it may – a unique design or a perfect flushing technique all means nothing when it is not clean. Thereby this staff caries apart from the task of cleaning, also the tasks of guarding the facility and collecting the fees people pay.

Weimar, interview with the cleaning staff

who	Mrs K., employee of cleaning service
where	shopping centre Atrium, Weimar, January 2014
team	observation and interview by Anniek (only place for 1 observer)
reason	gain insights in the cleaning process of a pubic restroom
use	The cleaning lady

The cleaning lady

A clean, welcoming restroom facility - big black and white tiles, big mirrors with sinks of natural stone, glass panels and a cleaning lady at the entrance - give the facility a bit of a luxury feeling. The bright light, no windows and 'shopping mall sounds' in the background have the opposite effect.
The entrance of two glass panels, the first thing you see is a high black side table with a plate on it with coins. There is no sign present which makes it seem that it is a voluntary contribution.
Left side ladies, right side men, and straight ahead a toilet for disabled people and to change diapers.
Out of side at the entrance is a glass panel which tells the visitor for the use of a restroom a contribution of 0.50 cents is appreciated.

The cleaning lady - Mrs K. - allows us to interview her and to observe the facility for a while. Unfortunately it is not possible to mention the name of her, the company or the locations.

Impression staff

Mrs K. seems shy, is clearly aware of the image her job has. She is kind of surprised but seems also flattered by the interview. She is planning on leaving within a year, when she finds herself a new living place with a lower rent. For now, the job is necessary to pay the bills.

Service

To make the facility look extra customer-friendly the cleaning staff is trained to have a specific attitude and behaviour towards the visitors. These directions do not only come from their employer, but also from the management who runs the building were the facility is located.
For example it is not allowed for the cleaning staff to point visitors who do not pay the sign of 0.50 cent. Thereby the cleaning staff cannot sit down when there are customers. An active approach makes the visitors leave the used restrooms more clean behind and are less reluctant to pay for the service.

meet mrs K.

66 years old, widow
retired from the DB
today a member of the cleaning staff

salary	€ 5.00 per hour
team	3 female colleagues
shifts	6 hours - without a offical break 8.30-14.30 & 14.30-20.30

- a few social contacts

- underpaid
- cleaning up for people – that don't have any respect to her or her job
- the image of the job
- very strict control
- physical work – standing for 6 hours

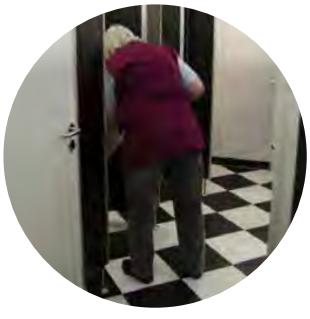
uniform
dark red armless vest with a company logo's button & 1 cleaning hand-shoe

Job description

- keep the facility clean and usable
- help out and support customers (especially elderly or children)
- collect the contributions and puts them away

cleaning rhythm

1. walk from toilet to toilet
2. check the situation
   if it is bad, clean the complete toilet) otherwise
   - clean toilet seat
   - pick up papers or other things that dropped on the floor (tampons etc.)
3. After the toilet round she mops the floor around the sink & entrance
   Especially in winter times this becomes very dirty and slippery.
4. And then , this round starts again



from toilet to toilet

clean toilet seat and pick up trash from floor

cleaning floor around the sink

cleaning methods

• For the standard round the staff carries a cleaning cloth and antibacterial spray - she sprays it on the cloth and cleans the seat.
• The mop is always ready to use, no soap – just to dry up the water drops around the sink
• cleaning a complete toilet is standard like at home:
• the bowl is cleaned with the brush next to the toilet and soap
• the lid and seat are cleaned with a cleaning cloth and soap or antibacterial spray

tools

All is delivered by the firm according to special norms. There are no strong chemicals in the soaps which could lead to any irritations according to Mrs K.

ergonomics

The physical work causes several problems for Mrs. K:
• feet from standing all day
• back from bending over to clean the toilet and to pick up paper stripes
• Sometimes very uncomfortable situations visual or with bad smells - it comes with the job

Intimacy

There are no problems with intimacy on her side with cleaning the men's restroom or the women's restroom.

Offending situations

Mrs. K sometimes had situations where she felt or could feel disrespected, they come from these activities:
• Youth often do not pay and can completely ignore her
• There is one unique designed urinal at in the men's room. Mrs K did seem to get quite used to it. She only had one visitor with his child who complained about the impropriate design in a public space. Other customers find it mostly just funny.
• When people do not pay or only leave a few cents
• People that ignore her presence
• People that leave the restroom unclean behind (more then drops on the seat but unclean or unflushed toilet bowls for example)
• Her pay check

urinals in the facility

Conclusion

The interview itself gave more insights in the profession. The circumstances for the staff could be more pleasant.

A study in how to influence the circumstances in order to upgrade image of this profession would be very interesting taking into account that cleanliness & hygiene are strong critics users have on public facilities. Communication and design could play a role. An inspiring example abroad is the 'clean team' part of an IDEO org. project where they were able to upgrade the imago of this profession by approaching it a serious one (Including business cards, uniforms, professional gear and a good salary)

Noticeable observations

- For a clean public place a person might feel little responsible and leave the restroom clean behind. If the place was dirty in the first place they will not care and probably even leave it even dirtier behind because of improvised positions and techniques to avoid touching elements in the unclean restroom.
- Especially female users often do not use the toilet seat. They simply hoovers over the toilet. This leaves often drops on the seat and around the toilet on the floor. The cleaning staff needs to clean up afterwards (which requires bending over) all the time. A solution would be lifting the seat up. But this is according to Mrs K. no option -it would not look welcoming to the user.
- There is nothing in the restroom that belongs to one of the members of the cleaning staff and that makes the place personal. Not even in their private office / storage room.
- The cleaning staff uses the toilet brush per toilet to clean the bowl – the visitors never use the brush according to Mrs K. One brush for the whole facility would not be optimal because the staff would have to walk around from restroom to restroom with the brush which do not look fresh or hygienic.
- The bowl for contributions is presented like it is directly for the cleaning staff. But it is not. It goes to the firma first. According to Mrs. K this is the only cash flow and the complete facility relies on it, including her pay check.

Support via design

Design affects the cleaning process it can either support it or stand in the way; this list sums up some of these points.

- Hanging panels make the floor cleaning easier
- Shiny surfaces are looking quicker dirty, for example the mirror or glass
- As self-cleaning as possible, sinks where the draining water directly cleans the sink for example or toilet bowls that leave as little marks as possible
- A smart interior design that for example prevents lines in front of the sink, dryers or people walking around with wet hands and dropping on the floor.

Clean team IDEO

2.4.7 misuse and vandalism

In public space the restroom facilities are often the most private place available, which explains why these facilities are sometimes also used for other activities.

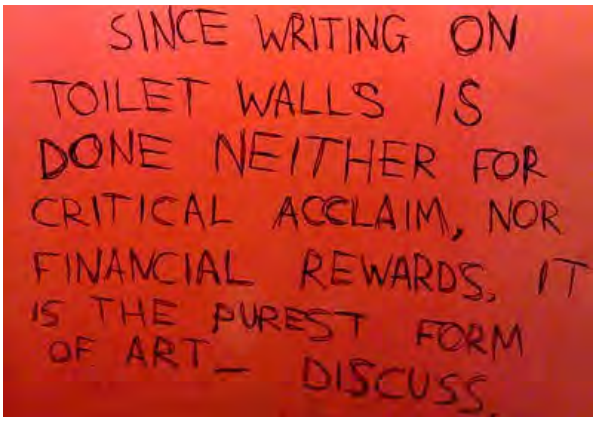
Examples of misuse:
- Smoking cigarettes
- Sex
- Taking and/or dealing drugs
- Express personal or political opinion's (by gratifies and engravings)
- Express creativity (by gratifies and engravings)
- Sleeping place for homeless people.
-

Extreme forms of misuses
- Sexual or physical abuse
- terrorism – public toilets are even used for leaving bombs
- Theft – stealing from other users

In the public area this behaviour affects the choice of materials for the facility. Like the use of stainless steel for example. As well as it affects the use for other users, the cleaning staff and the maintenance team. Thereby a present cleaning staff will not only keep the facility clean but also affects the behaviour of people. They will for example leave the restrooms more clean behind and are less reluctant to pay for the service. (interview cleaning staff and [30]

There are also milder acts of misuse, activities that might not even be seen as misuse by the people who do it. Some of these activities seem to have become almost standard in public facilities. Although private spheres one will notice these tracks and clean up afterwards. In a public restroom people do not feel this responsibility. Therefor it is considered as misuse.

- urinate or defecate on the toilet seat or around the toilet self
- leave toilet paper on the floor
- leaving the toilet bowl unclean or without flushing
- extreme use of toilet paper (which is not environment friendly and can cause problems with flushing)
- extra flushing



message in the restroom

- not paying when this is requested

Some of these acts are quite extreme and others can be easily prevented. Known arguments are based on comparing the maintenance and replacement costs with the costs of for instants a cleaning team. Often extra guarding is organised, also sometimes by video camera's or safety-ports though misuse can also lead to completely removing the service.
Although for privacy reasons restroom facilities are often 'hidden' in architecture [44] it might be better in order to prevent these types of misuse to give the facilities a very clear and present place in public space.
Vandalism is not a misuse. It's directly the choice of someone to destruct the facility and to deprive the others of the use of the facility.

Example of vandalism:
- Depriving– taking for example the toilet paper, paper towels or soap
- Vandalism – breaking elements in the facility like mirrors, heating, sink or dryers
- Theft – stealing the collected money

2.5 Market research

For the implementation of a new system it is important to be aware of the current state of the market. The team looked into several fields.

Roevac no-mix toilet

2.5.1 The no-mix toilet

For innovative sanitation systems as described in chapter 2.3 different toilet designs then the standard water closet are required. The no-mix toilet was invented in 1990 in Sweden. Most of these toilets are part of pilot projects though the no-mix toilets are quite far developed and serve as good instruments for such pilot projects. Some are even available for the consumer market. (like Dubetten or Wostman)

Especially Scandinavian companies are far in the development of no-mix systems. In these regions the no-mix technology is often installed compared with other European countries. This started with sustainable neighbourhoods and locations with no sewage connection and is getting more and more known in these regions.

In most trial projects the team crossed, urine-separating flush toilets are used instead of urine separating dry composting toilets. It is believed that flush toilets make the no-mix technology easier accepted. Also confirmed by Mr. Holzapfel, he explains for this reason he decided to add a vacuum toilet to the assortment to make the systems more appealing by creating a bridge between the standard toilets and the dry no-mix toilets.

Designs

Some no-mix toilets are developed by known companies in the field of bathroom design like Gustavsberg. But most of these toilets are developed by firms that are specialised in the no-mix or dry sanitation techniques. An overview of the most common models (water & dry systems) can be found on the next pages.

Apart from these existing no-mix toilets there are also alternative concept-designs that try to tackle the critical points for example with innovative forms like this design 'Piet' by the designer Theo Brandwijk.

The no-mix toilet

No-mix technology can be combined with single flush, dual flush systems and dry systems (composting toilet). These toilets collect urine separately from faeces. Therefor they have two different drains, one for urine (or urine with water) and one for the faeces, toilet paper and the water.

Prices lie around 700 euro for a no-mix toilet which are higher than standard toilets but do not diverse so strongly [60] Different from a standard toilet is that with the installation of a no-mix toilet also a urine tank is installed. Urine tanks are from plastic or concrete. Metal is not suitable because of corrosion. The tank and installation also add up to the investment costs.

In general the no-mix toilet uses less water than a standard water toilet. This is because the small flush uses even less water; it only flushes the urine with a little bit of water away. This table (SwedEnviro, 2001 and [57]) gives an insight on which kind of model uses what kind of amount of water. This is based on an average use per day which consist out of five times urinating and one time defecating.

	Per flush / L	Big flush / L (faeces)	Small flush / L (urine)	Total per day
Water saving toilet	0.6 – 1			6-Mar
Vacuum toilet	0.8 – 2			4.8 – 12
No mix toilet		6-Apr	0.2	7-May
Standard toilet with two flushes				14
Standard toilet	12-Jun			36-72

Criteria

Selection of criteria used in other projects for the selection of a no mix toilet

- Comfortable and easy to use with low odour potential [59] [57]
- Comfort is comparable with standard toilets [57]
- Bowl should allow for men to stand up during urination, otherwise they may avoid using the toilet correctly [59] the ability for men to stand up while using this unit without excessive urine loss through splashing (hygienic and resource collecting reasons)
- Appealing design [57]
- Easy to clean [57] [59]
- low flush for urine [59]
- easy to install [57]
- minimal maintenance (comparable with standard toilets) [57]
- System should contain no metal (unless stainless steel) in contact with the urine[59]
- (very) limited risk for blocking [57] and in case of blockages it should be easily reparable ([59]: urine drain should be cleanable with a 'mechanical snake')

Common critic

on no-mix toilets (with water flush)

- Depending on the type of model
- problems with toilet paper blockages in the part for urine
- urine mixed with water
- splashing when men urinate (with some models)
- flushing for just the toilet paper (urinating)

Piet' by the designer Theo Brand

reviewing excisting no-mix toilets WITH WATERFLUSH

Ecoflush

Wostman 1991 (Sweden)
specialised in watersaving and nomix sanitation systems
motto: We also think that the "alternative" toilets should feel like "regular" toilets and have the same hygiene standards.

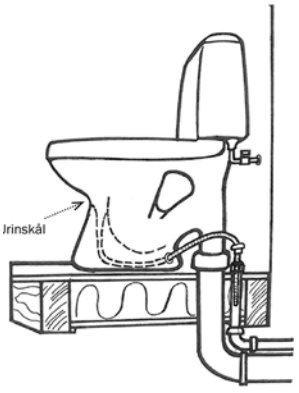
Product	consumer market, available via dealers in europe.
working	Separates urine and faeces with a no-mix toilet bowl and 1 watersaving flush per part.

urine flush	0,3 L
feaces flush	2.5 L
material	porcelain
price	989,00 euro (*in 2001 around 600,00 5,525SEK)*

[47]

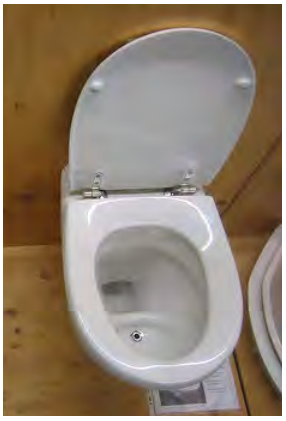
The small flush comes from the front half into the urine bowl and flows over the edge to the faeces outlet. It´s essential that the water flows over the edge for highest possible hygiene.

The amount of water for flushing can be contolled by pushing shorter or longer.



review

- problems with toilet paper blockages in the urine department [57]
- urine is mixed with quite a lot of water [57]



Nordic

Gustavsberg Sweden (holding of Villeroy & Boch since 2000)
specialised in bathroom furniture

Product	used in several residential areas Sweden no info available on website or catalogue
working	Separates urine and faeces with a no-mix toilet bowl and one water flush for both parts.

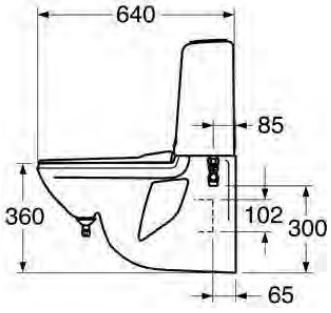
small flush	2L
big flush	4L

10% of the flush water volume ends up in the urine bowl.

material	porcelain (with special easy clean surface)
price	around 700,00 EUR based on pilot project Meppel (NL)

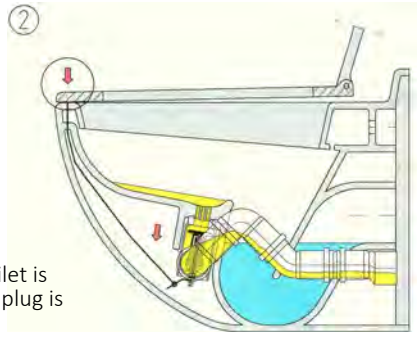
[48]

a little bit of flushing water enter the urine pipe, which avoids clogging of assemblies.



review

- a lot of water is used for flushing [57] [60]
- the seperation is easy[57]
- urine is mixed with water [57]
- the urine drain tube is securely mounted[57]
- the firm optimizes the model frequently (several versions) [57]
- easy to install [60]
- cleaning is the same as with convention toilets [60]
- the ability for men to stand up while using this unit without excessive urine loss through splashing



As soon as the toilet is flushed the urine plug is closed

Roevac no-mix toilet

Roediger (Germany)
specialised in vacuum & houshold techniques

project originally developed for the project Ecosan (Roediger) and today often used for several pilot projects, also in private spheres.
no info available on website or catalogue

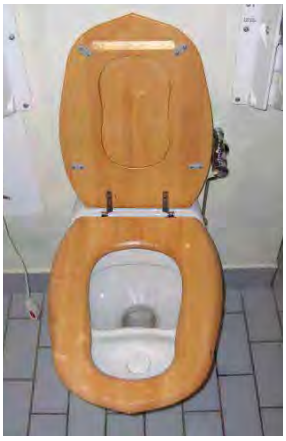
working Separates urine and faeces with a no-mix toilet bowl. The part for the faeces is flushed, urine falls down when the valve is opened.

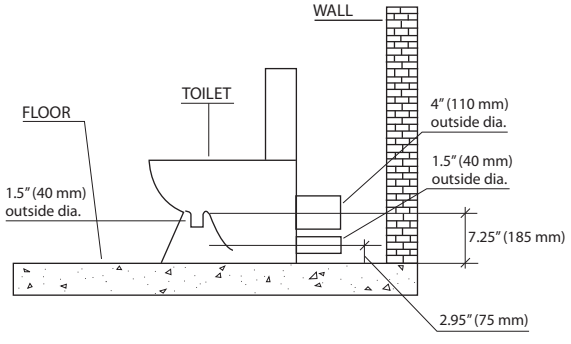
flush	6 L (old model)
material	porcelain
price	around 700 euro

[49]

review

- urine is not mixed with water [57]
- the seperation is easy [57]
- the urine drain tube is securely mounted [57]
- an older version had difficulties flushing all feaces - not clear if it is solved [57]
- roevac was prefered over dubetten in an long-term EAWAG pilot [57]
- man have to sit down for urinating - to activate the valve [57] [60] This could either stimulae people to sit or not and less urine is collected.





Dubetten

by BB Innovation & Co AB 1991 (Sweden)
specialised in watersaving and nomix sanitation systems

project originally developed for the project Ecosan (Roediger) and today often used for several pilot projects, also in private spheres.
no info available on website or catalogue

working Separates urine and faeces with a no-mix toilet bowl and 1 water flush per part.

urine flush	0.5 L
feaces flush	4 L
material	porcelain
price	around 680 euro (installation set 130 seat 130 -45)

[50]

review

- urine is mixed with water
- Different measurements standard toilets [57]
- specific art deco- style [57]
- problems with toilet paper blockages in the urine department [57] [60]
- also diliverable with urine storage tank [57]
- cleaning is more difficult [57]
- the wooden toilet seat makes the toilet usable for small children although this feature also has a bad review[57]

reviewing excisting no-mix toilets WITHOUT WATERFLUSH

Eco Dry™

Wostman 1991 (Sweden)
specialised in watersaving and nomix sanitation systems
motto: We also think that the "alternative" toilets should feel like "regular" toilets and have the same hygiene standards.

Product	consumer market for the holiday house, available via dealers in europe.
working	Separates urine and faeces with a dry no-mix toilet bowl and collect it in containers.
collection	containers flush option for urine
material	porcelain
price	646,- euro with box for faeces

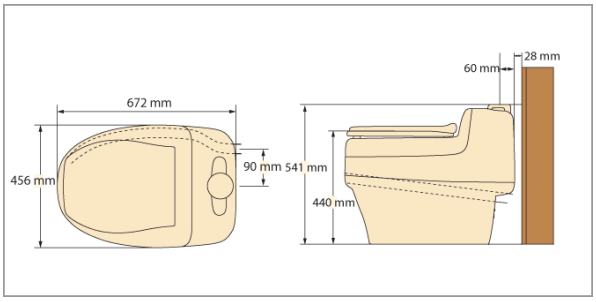
[51]

Villa 9000

Separett AB (Sweden)
specialised in nomix sanitation and compost systems

Product	consumer market for the holiday house, available via dealers in europe.
working	Separates urine and faeces with a dry no-mix toilet bowl.
collection	23L bucket with a compostable bag
material	special polypropylen
price	749,- euro

[52]



review

- aeration working all the time, 2 speed
- the bag has to be replaced regurlarly

Zircone

Ecodomeo (France)
specialised in dry nomix sanitation systems

Product working: consumer market, available via dealers in europe. Separates urine and faeces with a conveyor system under the toilet

collection: containers

material: plastic (no more information on the website)

price: 2499,- euro incl. technic

[53]

review

- not odour free (tested)
- technical risks of bad seperation
- without bedding
- needs a lot of place

TLB Biolan

Biolan (France)
specialised in dry nomix sanitation and compost systems

Product working: consumer market, available via dealers in europe. Separates urine and faeces

collection: containers (2x 18L)

material: plastic (no more information on the website)

price: 699,- euro incl. technic

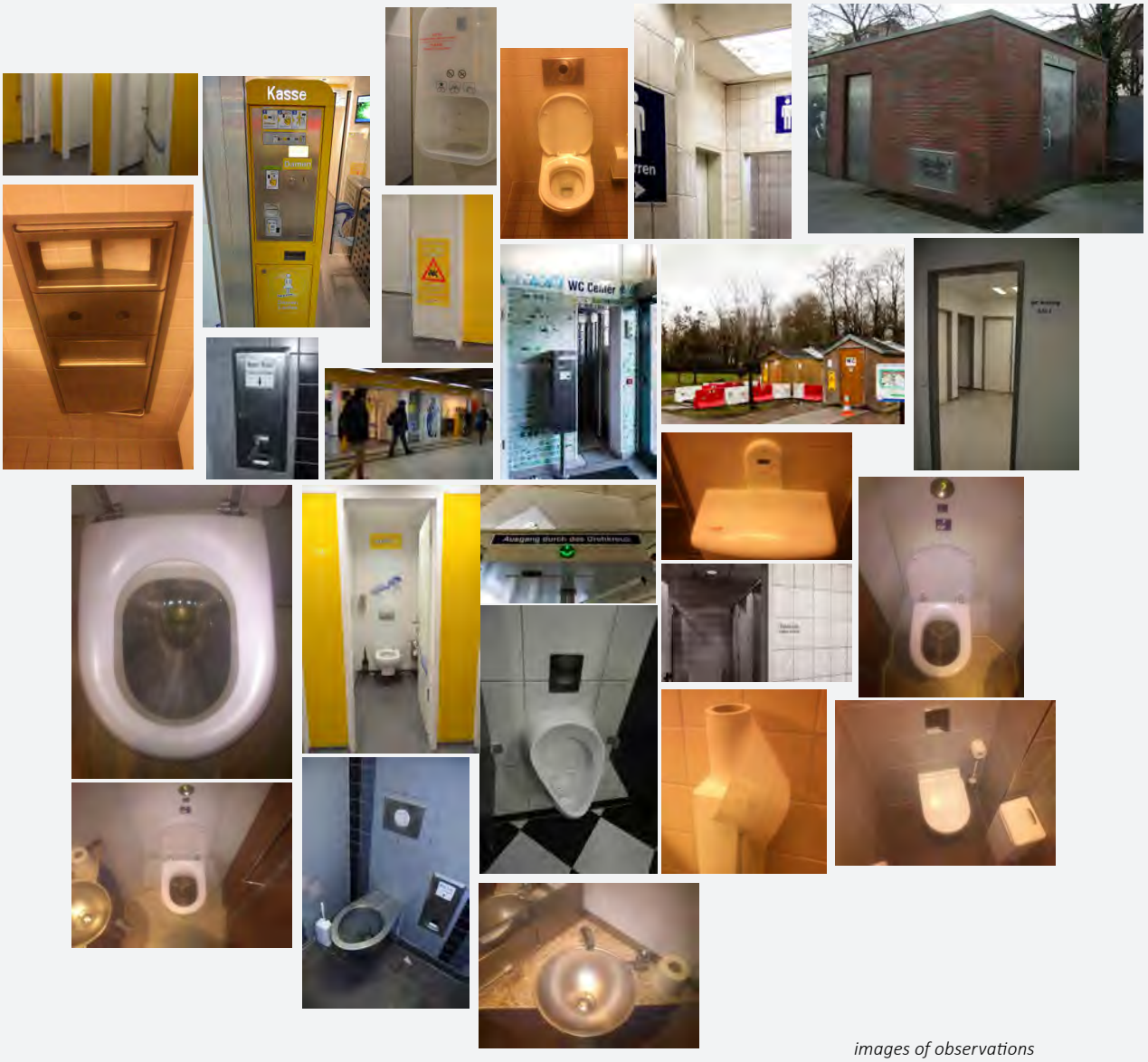
[54]

review

- movable
- big
- use with bedding for the faeces

2.5.2 The public facility

To get a better understanding which aspects make the use of a public sanitation facility pleasant or contrariwise unpleasant several facilities on different locations were visited. Because all facilities are different regarding service and design, standard criteria were defined and ranked to serve as a tool for observing and comparing. The criteria reflect on parts of the complete facility, the restroom and the toilet self and make it the facilities comparable and were used out of the designers own perceptions.
This study mainly served to make the different factors discussable within the team and sanitation facilities in general discussable by the collected observation material. It also led to the public private table. Moreover, the observations inspired the concept developing.



images of observations

the tool

This table was used for the observations. By ordering all the factors the team was able to make the observations individual and compare the results together. Details on the criteria can be found in the enclosures.

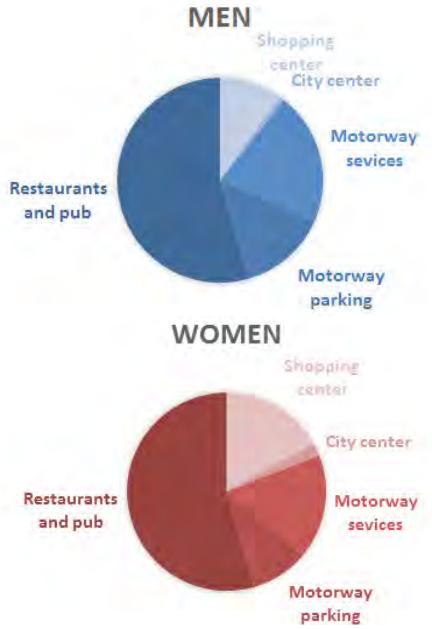
factor	1	2	3	4	5	6
safety	sharp edges & unsafe design	to dark	glippery floor	normal	safety handles	helping staff
infection point	tap, soap, towel, flush, seat, lock, doorhandle	flush, seat, lock, doorhandle	seat, lock, doorhandle	lock, doorhandle	doorhandle	no infection points
security	abandoned place	bad light / lock	crowded place	camera's	security gate, door	guarding
Intimacy	see & hear eachother	hear eachother	semi-walls	private room, hear yourself	private room with sink	private room with sink + hear something else
costs	> 1,00€	< 1,00€	> 0,50 cent	> 0,30 cent	own donation	free use
Efficiency	a lot of water	water	recycled water	vacuum	no water, dry toilet	seperation toilet
Cognitive ergonomic	see tracks from formal visitors	see tracks on the seat	smell formal visitor	hear other people using the toilet	hear yourself	hear nothing, something else
Cultural transmitters	clean design	own commercials	commercials	cultural or traditional items	art or design items	specific theme
position	standing	squat on toilet seat	above seated	seat	half squat position	full squat position
extra's	nothing	toiletseat	paper	brush	bin	storage space

2.5.3 Acceptance in the society

The new sanitation system as described in 2.3, consist out of different phases and interactions were the role of people changes.
The implementation of a new system depends on the acceptance by society. This acceptance is influenced by several factors like the settings self but also the understanding of the idea for example.
Studying the acceptance allows to identify the points that are important for the user in order to improve the design, the interaction and the experience of the use and at the end improve the acceptance itself.
The acceptance is based on sociological research commonly in form of interviews or user surveys.

In this chapter the results of two surveys will be discussed:

- A survey conducted from the ISaS team during the project
- A survey from a pilot project of Novaquatis conducted in Switzerland and exciting out of six parts. Here NOVA 1 will be discussed, which focused on the use of no-mix toilets and NOVA 6 which focused on the re-use of human excreta.



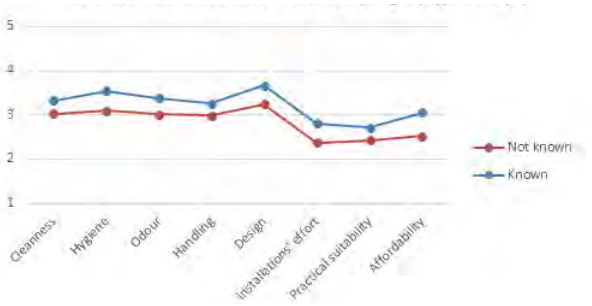
Graphic: Where do you use often the facilities?

The acceptance around innovative sanitation

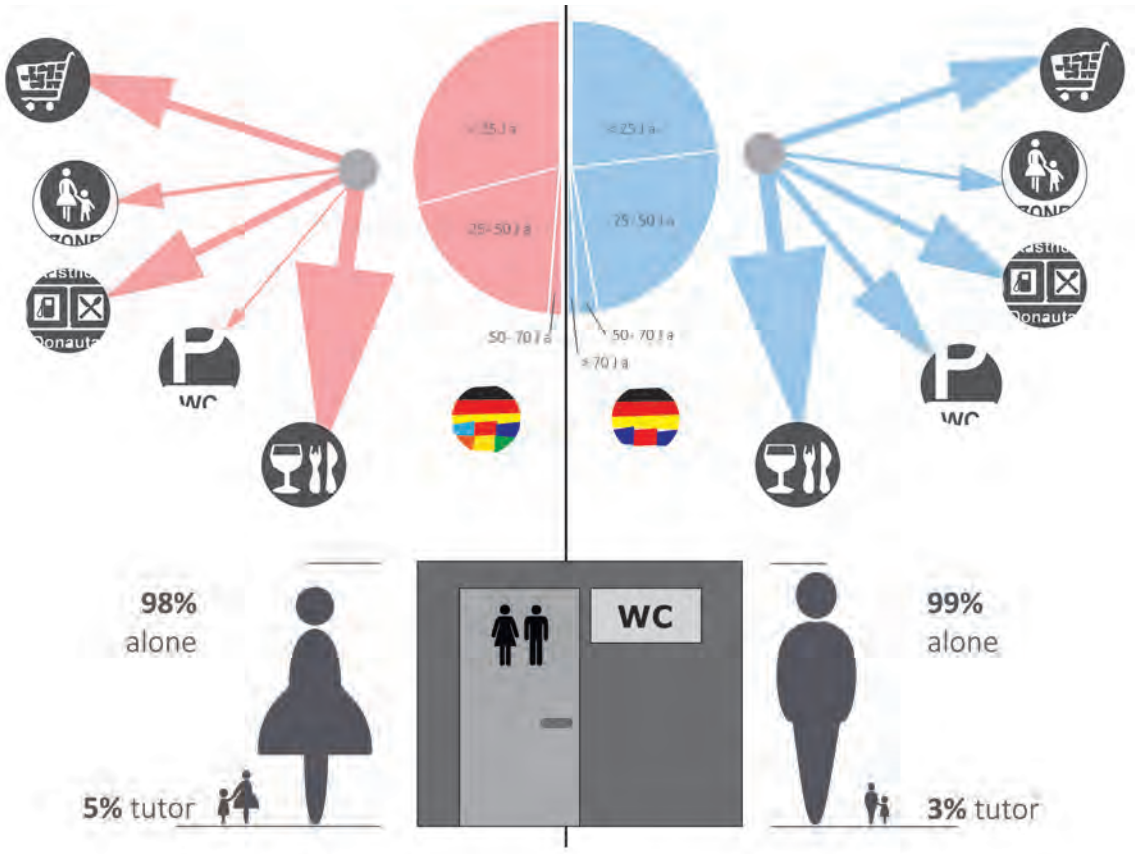
iSaS Survey

In context of this project, the team conducted a survey that lasted 20 days in January 2014. Most of the 288 participating people have an academic background, were young and German. Though the survey is clearly not representative for the western society, it confirmed several expectations and showed new insights in the use tendency of public sanitation facilities; how they are perceived and how innovative sanitation could be received in western society.

The first questions were around the setting of a public restroom. Most of the participants have no problems using the sanitation in gastronomic facilities. The use of facilities in more public settings is avoided as much as possible. The gastronomic setting has clearly the most private atmosphere and is used by a smaller group of strangers that are already sharing the same gastronomic service as well.
The next questions were about innovative sanitation systems. The main reason for re-designing our todays' sanitation system was for 87% of the participants 'to protect our environment'.
Dry toilets are by 48% of the participants known and from 43% of them already used. However, the positive perception regarding design, cleanness, hygiene and odour was low. Vacuum toilets are also by 50% of the people known, but the perception is in this case better.
The no-mix toilet was, the most unknown of these innovative sanitation systems, 79% of the people did not know this technique.



Graphic: Doubts about no-mix toilet (very high 1, none 5)



Graphic: overview use tendency of public sanitation facilities , based on the ISaS survey 2013

Pilot Project about the use of the no-mix toilet

The next points come from a pilot project of Novaquatis conducted in Switzerland and focused on the use of no-mix toilets.

NOVA 1 Results publication: considering user attitude in early development of environmental friendly technology: a case study of no-mix toilets, 2006

Nova 1 is the part of the study that focusses on the acceptance and users' attitudes towards the no-mix technology. Two different methods were used: on one hand, 44 volunteers composed of women, men and children were informed about the urine separation' benefits through an interactive tool and then visited a no-mix toilet at Eawag. On the other hand surveys were conducted in relation to two pilot projects in Switzerland: the testing of no-mix toilets at a vocational school and at the offices of Eawag.

Volunteer group:

In the group of 44 volunteers, the acceptance was very high:

79% thought the no-mix toilet would be a good idea

84% would move into an apartment equipped with a no-mix toilet if the costs, maintenance and cleaning efforts are not higher than for conventional toilets.

72% would even buy food produced with human's urine-based fertilizers.

51% would buy a no-mix toilet if the price is not significantly higher than for a conventional toilet.

An extension of the study was conducted in 4 private apartments where no-mix toilets were installed for a longer time. In this case, several points were criticised from some of the users:

In general the no-mix toilet required more cleaning efforts the men were not always willing to sit down and not at least, the children had difficulties to meet the right part of the toilet what lead to more effort for cleaning.

Quantitative Survey
The surveys totalized 1249 answers between 2002 and 2004 and the results were published in 2006.

Settings
In the school, one toilet of the women and men facilities was replaced with a no-mix toilet first from Roediger and later replaced by a model of Gustavsberg. At Eawag, two conventional toilets were replaced with no-mix toilets from Dubbletten and the users were asked to dispose the toilet paper in a bin after urinating.

In both organisations, users had access to information via a poster in the bathroom, as well as instructions about the use directly in the restroom. After responding to the questionnaire for the first time, they received an extra information leaflet about the no-mix toilet.
Two different surveys were conducted: a short questionnaire, for the users who visited the no-mix toilet only a few times and a long-term use questionnaire, for the one who used the no-mix toilet for a few months.
In each questionnaire, these types of questions were asked: demographic data, length and frequency of use of no-mix toilets, acceptance, perception and use regarding design, hygiene and smell, knowledge and information sources, reasons understanding the idea behind the system.

Respondents
At the school, respondents are young people with lower education level. At Eawag, they were employees of the organisation who respond to the long-questionnaire but also visitors who respond to the short-questionnaire. Here the settings was unique, since Eawag is strongly supporting urine separation by carrying out the project Novaquatis.

Acceptance and perception
Acceptance of no-mix toilets was in both organisations high: *72% of long-term users found the idea convincing, 86% were willing to move into apartments with no-mix toilet.* However, only 28% were willing to pay significantly more a no-mix than for a conventional toilet.

At the school, *the argument "environmental friendly" was the most important for the purpose of a no-mix toilet* and was also the reason for liking the idea. Furthermore, the no-mix toilets were perceived by around 80% of the users as equivalent or even superior to conventional toilets regarding the design, hygiene and odour. However, the perception was lower by the Eawag employees. Users noted the technical problems and were thereby not convinced from the idea.
Thereby it is important to notice that at the school 51% did not visit the no-mix toilet. During the project the use of the restrooms was measured six times with the help of automatically door counters.

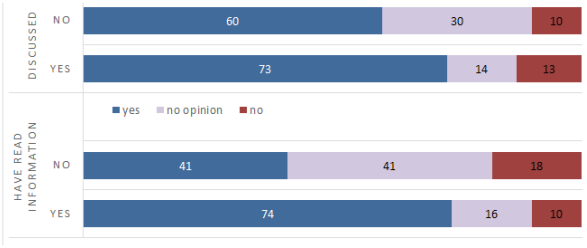
Behaviours
The well-functioning of the no-mix toilet depended on if the users sat and disposed the toilet paper into an extra bin. At the school, 72% of the women sat down. At Eawag, even 81% of the users sat down if they read information about the purpose of no-mix toilets. In both organisation, only 15% of the respondents said that they had to sit differently. Most of them moved further to the front of the toilet in order to urinate in the correct part of the bowl.
This shows that most users were willing to change their habits if they understood that the technology would work better that way.
The results about the disposing of the toilet paper in an extra bin were less convincing. 40% of the users did not dispose the paper in the bin, although this was clearly instructed in the restroom. At Eawag this was the same percentage. The reasons for not using the bin were hygiene (55%) or habit (23%).

Importance of information
A higher acceptance correlates with a good perception of the no-mix toilet regarding the design, the hygiene and the odour. Furthermore, information also influences perception and acceptance: *18% of the users that did not read any information found the hygiene worse than with a conventional toilet, were as in case the user had read the information this was only 6 %.* The same goes for the smell, 31% vs. 9%.

The main information was presented in form of a poster in the facility self and an instruction inside of the restrooms. *94% who read information understood the purpose and the underlying idea of the no-mix sanitation system.*

From the people who did not read these instructions, 31% did not understood the purpose of the toilet. It is unclear from the research results if they also did not understand the use of the toilet self.
This shows that informing the user contributes positively to the acceptance and the willingness to use it: as pointed out before, at Eawag 81% of the users sat correctly on the toilet if they have read the information which is remarkable in public facilities as well as the willingness for disposing the toilet paper in a special bin.

The next diagram confirms this hypothesis.
Discussion is also an influential factor of the perception: if users discussed in a negative manner with others, the perception and the acceptance were lower.



Graphic: Do you think that no-mix toilet is a good idea?

It also points out that the information inside the restroom and the communication around the project - directly with the facility self- has a big impact and should be used.

The ISaS Survey

As the team decided on working on the public sanitation facility, they conducted a survey to get statistics on the perception of the user on public restroom design, innovative sanitation systems and reuse of human excreta. The questionnaire had a total of 32 questions. Most of them were multiple choice questions in order to ease the analysis of the response. The questionnaire was divided in the following categories of questions:
Demographic data (7), Use of public sanitation facility (11), Perception of innovative sanitation systems (11), Perception of human excreta (3).

Review

The survey outcome is not representative for the user of public sanitation facility as the respondents are in majority young people. The team spread the survey through the university mailing, their contacts and their social network. The respondents are mostly people from an academic environment. As the questions were mostly multiple choice questions it is not reflecting the reality. There were 50/50 of response from women and men. The questionnaire was organized in a too short time and the question were not always correctly formulated, or the formulation could influence sometimes the response. For example: “How high are your scruples over the technic regarding the following criteria? “ The question already give a negative perspective.

Response	289
Period	from 11th – 26th January 2014
Reason	gain insights in the user behaviour, the image and knowhow around new sanitation techniques and human produced compost and fertilizer.
Use	market research & use experience

The detailed results can be found in the enclosures

Kromsdorf and the use of the home-made fertilizer

The acceptance level around the Re-use

The output of the sustainable system is different as well. It is no longer a waste-material but can be reused in forms of fertilizer (urine), compost or biogas (faeces). Normally these products not directly consist of resources coming directly from the human beings excreta.

In the past it was much more common to re-use our excreta. All over the world different uses can be found, some of them are still used or are now re-used.

The participants of the iSaS Survey were also asked about the imago of the excreta of human beings. People were asked how they will name their own excretion material; the majority saw it as a waste-material instead a resource material.

On the other hand, people could imagine eating food that was fertilized with human's urine-based fertilizer, 69% of the women, and 82% of the men.

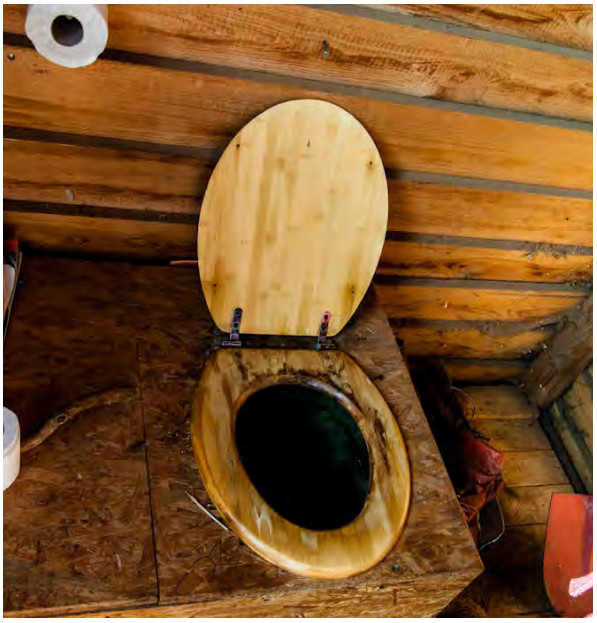
In 2000, the pilot project Novaquatis conducted another survey, this time with Swiss farmers to measure the acceptance level of human's urine-based fertilizer. They collected 127 answers, distinguished in four categories: organic or integrated farming, and with or without vegetable production. The results are not representatives but provide initial tendencies. 57% of the respondents viewed the urine-based fertilizer favourably, and 42% would buy such products. However, none of the farmers would be willing to pay more than for conventional fertilizers. The consumers would also buy food produced with human's urine-based fertilizers, of course only when it is hazard-free.

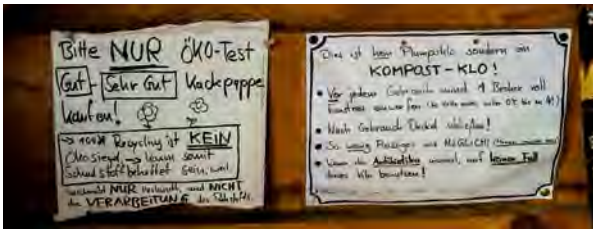
Re-using human beings' excretion
Examples of common utilization are listed up here.

Urine
In the past urine was used in all kinds of fields, some of them listed up here. The main possibility for the re-use of urine is fertilizer for agriculture. The resources of urine will be used very sustainable. This will be the main focus for this project.

- Urine was used for soap, if urine oxidizes it leaves a dry version of ammoniac [30]
- Eskimo's used it as soap for cleaning their kitchen utilities [30]
- North-American Indians used it directly on each other before taking a steam bath [30]
- Ladies used urine to clean their hands and make them soft [30]
- Urine can be used in medical context because it is disinfecting [30] or all sorts of therapeutic forms [66]
- Urine can be used for dying textiles as colour and fixation. [30]
- Hormone medication - The urine of pregnant women is used for a hormone medication, which helps women that have difficulties getting [65]
- tanneries as corrosive fluid [64]

Faeces
It was also common to re-use Faeces. Though in functional aspect they were only used for compost material, in the 'Orient' this was common untill WW2. There was also a symbolic use of faeces. For example people from Tibet and Mongolia saw the feces of the Dalai lama as holy and carried it around in small amulets. In Hinduism the feces from the holy cow was material to clean yourself with. [30]





Kromsdorf compost toilet

Use & reuse

Kromsdorf, interview with a community about their sanitation system

After reading a lot of material about the different technologies and the valuable product transformed from excreta, the team aim to discover the reality of a usable dry toilet that is collecting and treating human excreta and the final product. Raimond is a product designer who is living in a community camp in the north of Weimar. They try to live in a self-sufficient model by producing their own energy with solar panels, reusing wastewater, or producing their own food.

"We are around 10 people on the camp. We are leaving with the same standards as in a conventional house, but we produce our energy independently. The dry toilet was a natural solution as we do not have a connection to water. We produce compost that is sometimes mixed with horse's excreta. This year, we will try for the first time to reuse the compost in our garden. No one has difficulties with the toilet or the odour which is stronger with higher temperature"

Who	Raimond, citizen of the camp
Where	Circus car camp, kromsdorf, 6th march 2014
team	excursion by Sylvia, Phillipp and Beatrice
reason	gain insights in the re-use possibilities and the attitude towards it
use	market research & use experience

public sanitation facility Zwickau,

2.5.4 The stakeholder analysis

The stakeholder analyses gives insight in the decision making process around public toilets. This can point out possible interests for the implementation of the no-mix sanitation in the public domain. If so, it can automatically create contacts with interested parties for sustainable and innovative solutions.
The Stakeholder map gives an overview of the connections between the direct and indirect actors around sanitary facilities.

General information

Cities and states in Germany are not obligated to organize and build public sanitation services. Services are organised voluntarily, either to make the city more attractive for visitors or for the citizens themselves. It sometimes also happens on demand of a group of citizen. When facilities are build they do however have to meet the norms. After constructing, the public health authorities are in charge of the control of the facility's quality and hygiene. Each country in Europe has its own norms about sanitation installation.

The German norms:

- VDI 3818 – Public Sanitary facilities

This norm resumes the requirements (constructional, technical, hygiene, protective, operative) for the construction of public sanitary facilities

The implementation of a public toilets

This implementation process is based on the interview with the city Zwickau and also this city's requirements. These are as shown on the pictures and function independent.

1. The decision

Build a new public toilet:

- because of the gastronomy offered in the area
- because of events that happens regularly
- because of tourismus
- because of a demand from the citizens, for example in a commercial or green area

2. The location and setting

- is be based on these criteria
- on the day it has to be visible and identifiable
- accessible at night time
- it has to be integrated in the city's landscape
- other facilities in the surrounding

3. The financing

Most of the time, public sanitation facilities are financed by private companies on commercial grounds, like Sanifair for example. In this case the use-costs (like water and water treatment, energy and

so on) are covered by the sanitation company via the user's contributions or via the contract they have with other stakeholders. In other cases, they are financed by the city self. In this case the costs are covered via taxes or also by a contribution per visit.

4. The technologies
The technology used in the public toilet has to be solid, hygienic, safe and vandalism resistant. The technologies influence how the service quality is perceived.
New technologies, like sensors for a contactless use, are less accepted by elderly who are unknown to these technologies.
The toilets have to be planned for a normal city activity use but they also should be adequate for special events.

5. The maintenance
There are two types of maintenances. One is the regularly cleaning of the facility done by a cleaning staff. (the use of this users is described in more detail in chapter 2.5.6) The other one is the maintenance of the technique and the building by technicians as well as the occasionally reparation when something is broken. The design of the facility should support these types of use as well.

management public sanitation facility

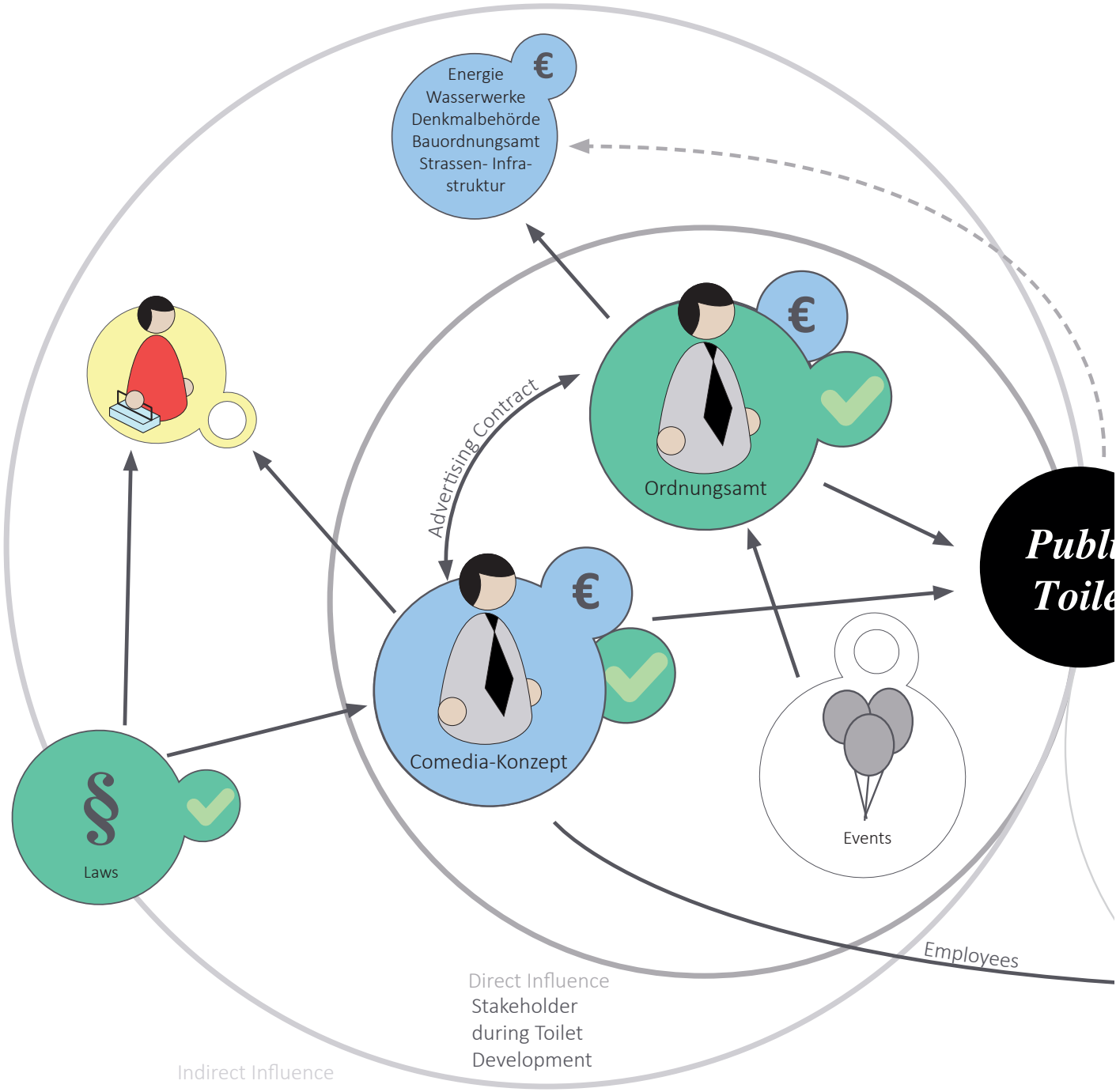
Zwickau, interview with stakeholders

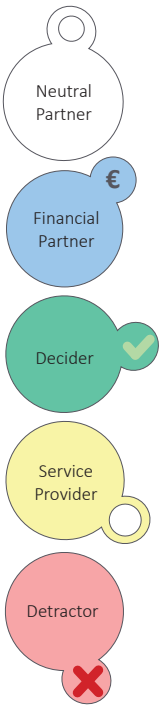
For the group it was important to get an overview of all the actors that are around the public sanitation facilities. This interview helped the group to understand the process of building up, managing and maintaining a public sanitation facility. The group asked about the economic and social challenges of the facilities.
Visualize the stakeholder network was also an aim of the interview. Mr Kallweit is responsible of the Building Office in Zwickau and thereby of the implementation of public facility. The city has a contract with Mr Neef who is in charge of proposing complete solution of sanitation facility.

"The public facilities are not profitable in a direct economic sense, but they are supporting the marketing strategy of a city and thereby its attractiveness. This is a long-term planning vision. By implementing a new facility, it's important to define well the location because it is an intimate activity."

who	Mr. Kallweit, municipal Office of Zwickau and Mr. Neef, Comedia Konzept
where	city of Zwickau, 28th January 2014
team	interview by Sylvia and Philipp
reason	gain insights in the different aspects and stakeholders of a public restroom
use	in the stakeholder overview

inside the public sanitation facility Zwickau,


Energie
Wasserwerke
Denkmalbehörde
Bauordnungsamt
Strassen- Infra-
struktur
€
Advertising Contract
Ordnungsamt
€
Comedia-Konzept
€
Laws
§
Events
Employees
Direct Influence
Stakeholder
during Toilet
Development
Indirect Influence



A case study in Zwickau

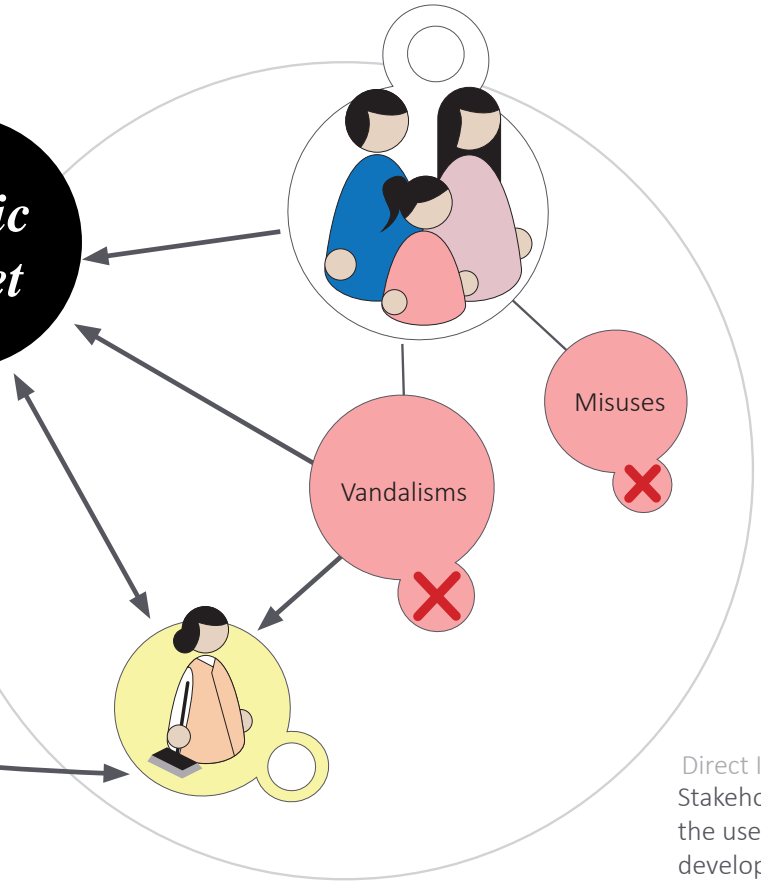
This analyses is based on interview with Mr. Kallweit (regulatory authority in Zwickau) and Mr Neef (Comedia Konzept) In Zwickau (90 000 h.) there are six public restrooms: 3 in the centre, 1 in the Cityhall, 1 next to the river, 1 in the park and 1 in the south quarter of the city. The last restroom that was built (2012) was on the demand of the citizens that used the park and required a facility there.

The city has a contract with the company 'Comedia Konzept', in return they are partly responsible for the planning and organising of the facilities.

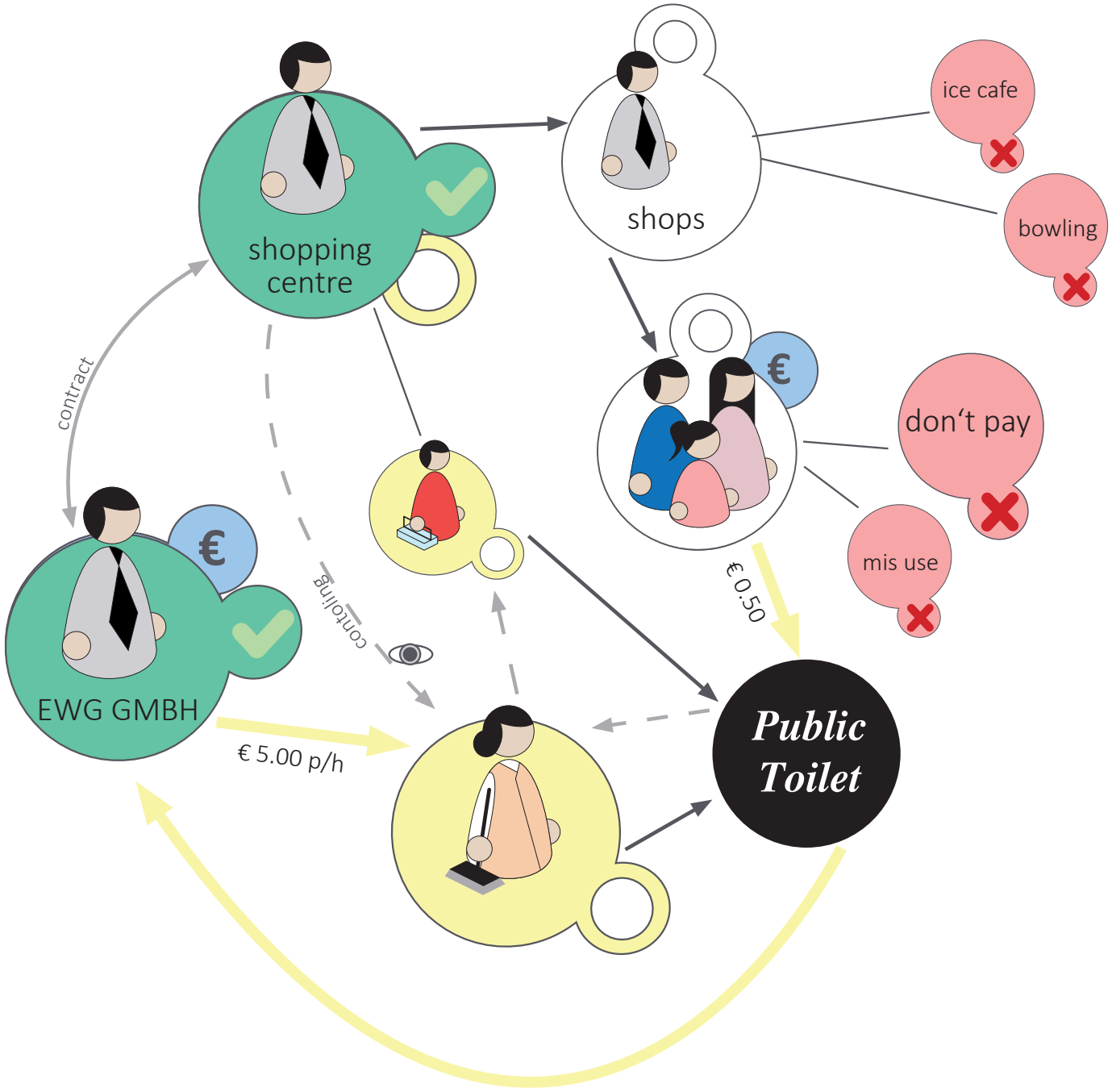
For the regulatory authority, it is important to propose public toilets for several reasons:

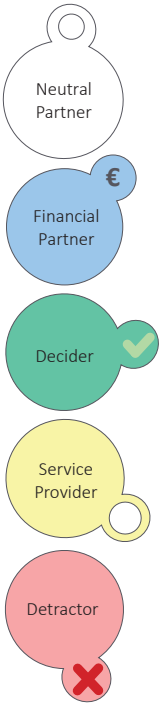
- a primary service by special events
- it supports the quality of urban life in Zwickau
- it supports tourism

It might not be a direct commercial service in the common sense, but a social service that support the commercial activity of the city. These are often long-term planned projects where profit is not directly visible. The cleaning staff in Zwickau is not only responsible for the cleaning but they also have a kind of guarding role, when they are on site.



Direct Influence
Stakeholders during the use of the developed Toilet


shopping centre
shops
ice cafe
bowling
contract
€
don‘t pay
mis use
€ 0.50
controlling
EWG GMBH
€ 5.00 p/h
Public Toilet



A case study public facility

After the observation and the interview at the public sanitation facility (2.4) an analysis was made based on the recieved information from the cleaning staff.
It points out the complexity of the organisation; the role of public sanitation in a city centre; in this case the only sanitation in a big shopping centre; and how other facilities are depending on such services.

shifts

The early shift starts by cleaning up the mess from yesterday evening: the facility stays open during the night. The facility is kept clean according the cleaning rhythm. At the end of the day the toilets are left clean behind

Situations

situation: broken toilet - call maintenance service from atrium
situation : elderly often use the toilet for disabled
situation : handicap go to the toilet for disabled
situation : displeased visitors complain to her (about unclean toilets)
situation : aggressive, angry visitors never happened
situation : visitors that do not pay happens often, but she is not allowed to say anything, it is officially a voluntary contribution
situation : extreme users, mostly in the evening when no there is no staff present, all you can do is clean up.

It is not possible for the staff to see which visitor (men, women or age) will leave the restroom clean or unclean behind.

Green Urine stunt waterweek Amsterdam

2theloo public sanitation facility

festival urinals directly in straw

2.5.5 Trends and developments

This chapter gives an insight in trends and developments that can affect the development of public restrooms.

Awareness projects

Although the no-mix sanitation is still an unknown technique in the Western part of the world, there are some remarkable projects that introduce new sanitation systems or (shows) the possible re-use.
Examples new sanitation systems

- stunt waterweek Amsterdam [67]
- festival urinals directly in straw [76]

Conscious trend

There is a strong sustainable development within our society where people lay value on honest and transparent products. Consumers are more and more curious in aspects like production; effects on the surrounding; use of materials; re-use possibilities; sharing options and origin.
This points out opportunities how to communicate and introduce an unknown but more sustainable sanitation system. [72] [73]

Public Restroom trends

Public restrooms can have an eye-catching architecture and design and even a story behind them. Here are some trendsetting and inspirational examples.

- Playing with the public / private atmosphere on public toilets.
- Luxury restrooms become meeting places. An example is the unisex restroom of the Supperclub in Amsterdam; instead of attending to stop people meeting up in restrooms make it transparent and open. [68]
- Luxury public toilet like the '2theloo' toilet store started in Amsterdam [69]
- Toilet is business – more and more (paid) restroom facilities show up around travel stations with the rise of the use of public transport.
- Many online City maps showing locations of public toilets and ranking them on cleanness and costs, for example the website gratispinkeln.de or the mobile phone application Bathroom Scout. [70][71]

Toilet design

Standard toilets are further developed with a focus on aspects like athletics or hygiene and easily cleaning. An open rim or special surface treatments make the cleaning of the toilet easier. Also removable toilet seat to clean separately supports this. Other selling points that are used for bath are luxuries like mechanisms for the seat to make it close softly or a unique design.

Demographics

Developments in society can affect the use of the public space and thereby also the public facilities.

The population is growing

- *the forecasted world population for 2050 is more than 9 billion people [74]*
- The world population is increasing – *though Europes and Germany's population will decrease*
- *In 2050 Germany will have 10 million people less, its population decreases with 13% [74]*
- in 2010 11% of the world population was living in Europe, in 2050 this will only be 7% [74] *Most people will still be living in Asia. Africa will increase the most.*

The Population is getting older

- *one-in-six people is expected to be 65 and older by 2050, double the proportion today. (from 530.5 million in 2010 to 1.5 billion in 2050) [74]*
- In Germany the proportion of people older than 65 will increase with 12% in 2010 up to 32.7% in 2050 [74]
- The number of children younger than 15 is expected to increase by only 10%, from 1.8 billion in 2010 to 2 billion in 2050 [74]

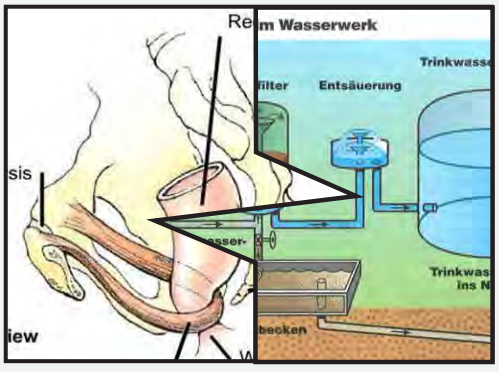
People moving around the globe

- *The largest migration in history is changing the face of nations [75]*

History tells us public sanitation developed based on two main reasons; Offering a service to the local population – that do not have private sanitation to their disposal; or as a luxury service for travelers.

Our society is getting older. Elderly have more trouble with going in public without having the guarantee of a clean and proper sanitation facility as they are less able to control.

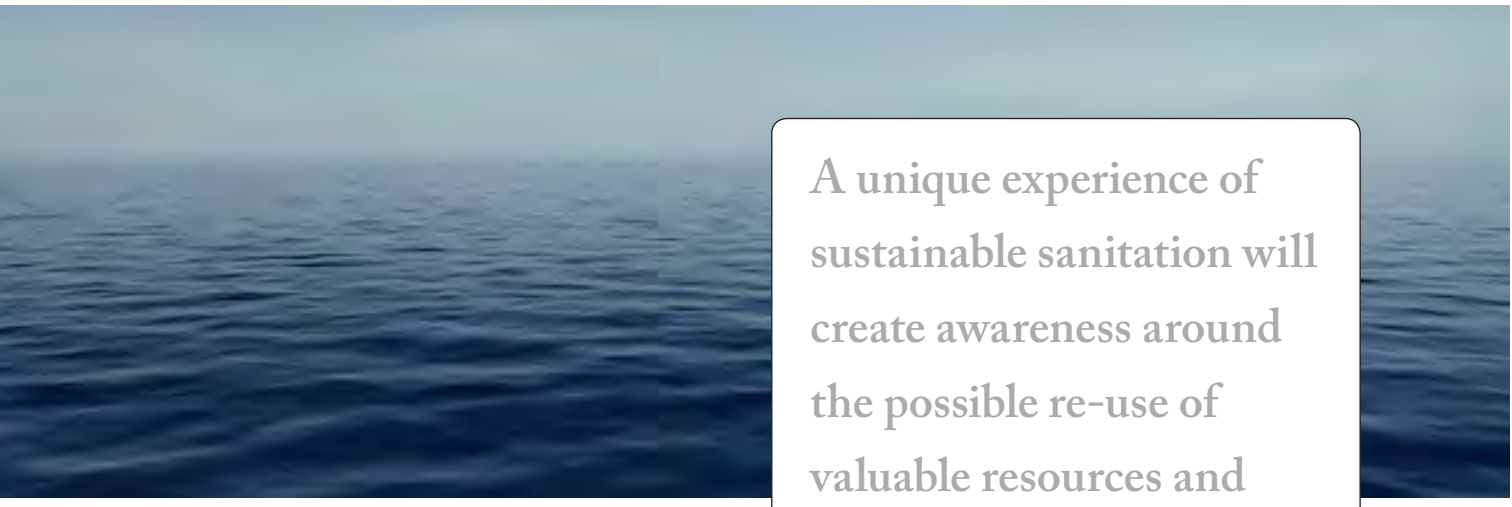
There are possibly more caregivers that support elderly in public facilities, which can lead to problems which restroom (men/women) to choose.



Knowledge exchange

During the research phase knowledge was exchanged via meetings and small presentations. See the work-process for more details.

2.6 Project Vision



> A unique experience of sustainable sanitation will create awareness around the possible re-use of valuable resources and will positively support the implementation of no-mix toilets in the Western market.

Western sanitation systems are degrading ecosystems and wasting valuable resources.
No-mix sanitation actually collects these resources and when integrated in a sustainable managed material system, these resources can be re-used - which directly prevents them from ending up in our ecosystems. However, these sustainable sanitation systems - as well as the underlying reasons - are unknown in western society.

A successful implementation of a new system highly relies on its support and acceptance from society. And whether or not you will accept a new system depends if and how you've experienced it.

By creating a positive and remarkable experience we aim that the people will see the sustainable sanitation system as an opportunity.

A service-friendly facility that is well-integrated in its surrounding will create a good first introduction and support the spread of information. The person might be confronted with a serious environment issue – he or she will directly be presented with a valuable solution without giving in on comfort.

If we continue as we do today - we will have to deal with the serious consequences on our food security and ecosystems in the near future.

Thankfully there is an acceptable alternative - All we have to do is change!
The project iSaS aim to make it understandable that the no-mix toilet has to be part of the future sanitation.

Chapters 3 and 4 (pp. 88-154) are removed.

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5

Evaluation

Chapter 5 looks at how the project could be continued in chapter 5.1 and analyses the project and the interdisciplinary work process.

5.1 Sustainable sanitation

We see two possible ways how the ISaS project could continue.

option 1
Develop in cooperation of campsite or a camping organisation – a sustainable sanitation suiting to their demands and at the same time creating a first introduction.
The focus lays on sustainable sanitation especially for this particular setting
The first implementation step as described in the documentation is seen as a quick win for campsite; by using the men urinals as a first collecting system the campsite can experience with the new technique.

option 2
Develop the concepts into mobile versions especially for events or to stay on locations where. (this could also be a campsite). Cooperation with either or both a company specialised in the technique and organisations that are committed to environmental issues like sustainable resource management, long-term food security and clean and accessible water.
The focus lays on the information aspect and spreading the new technique

Other directions
The research phase led to an insights and input for the development of the tree concepts. It also pointed out there are more or other interesting directions were design or/and environmental engineering could play a role
- Misuse and vandalism in city toilets - for example in cooperation with cities, via the city Zwickau
- How to upgrade the cleaning profession – for example in cooperation with a public or private sanitation
- The development of the no-mix toilet with focus on a waterless collection of urine
- The development of hock toilet
- Designs and forms that would stimulate and support the re-use possibilities (for example development of a struvite processor for smaller settings to make the process local)

5.2 The interdisciplinary work process

ISaS was a pilot project between the two master programs Sustainable Product Cultures and Environmental Engineering of the Bauhaus University. In this chapter we reflect on the combination of these two fields and the teamwork itself.

Reflect on the combination of the two fields
Both disciplines expected a more intensive exchange of knowledge. The designer students expected that the development of an innovative project could only happen if the both disciplines work on all the project phases together and both organise inputs from their own background. This appeared to be not optimal solution (for this project team) as it led to a different work rate and automatically to a different level in motivation.
Though as the documentation hopefully has pointed out, the two fields can lead to great input for one another, the developments in environmental engineering are very inspiring for design.

Reflect on work process
As mentioned before the team tried to work together on all the project phases. This happened to be not the best way because of the different work ethic and expectations between the two disciplines. The next points can be learned from the work process.

- The workshop-format worked well most of the time because the goal was clear and the tasks were also defined. Moreover it is a playful way to work in an interdisciplinary team and thereby it helps to find a common vision on the expect result of the session. Although organising these workshops took a lot of time and energy for the design students.
- We did not have a shared kick-off meeting, which led to misunderstanding the aim of the project and the shared work but also about the individual tasks. The teambuilding-workshop took place quite late in the project, this should have happened at the beginning and before dividing tasks.
- The team building workshop should have been the first work session at the early beginning of the project. It contributes to find a common vision on the project

and on the results of each tasks and activities.
• The process would have gone smoother if all the members could have put in the same energy and if we had similar time schedules.
• After the research phase the team could have clearly defined a shared developing goal and tasks per discipline. Instead the designers aimed to develop something with the input from the research phase. Were the engineers believed they only needed to write a work-process documentation. However both aims are not successfully achievable without the other discipline participating.
• The team discussed before the team building workshop that the team would not work with one person to monitor and manage the project. This to prevent that the project would go in one disciplines' direction and with the expectation that the on discipline would not understand completely the capabilities of the other discipline – which at that point seemed to be necessary in order to stir the team an project well. The opposite happened. Also by not clearing out who is in charge of the organisation – team members all have to participate in the organisation self and point out to each other what they need it from one another. Which often lead to difficult tensions in the team as well disappointments in how and what the other discipline did or did not do (both sides).

In this setting, with this particular team, the process would have probably gone smoother if activities and a defined goal were cleared out. These meetings and activities would have been the milestones in the process. Such an approach would enable it to define own tasks better, they would lie closer to what people are used to do and you would avoid to be so depending on each other; you would be able to work more dependent.

Reflect on team work

- a different Work ethic and approach-

The team tried to work together by sharing a workplace and participating in weekly meetings. It did not work as expected which probably has to do with the different work approach.
The Designers waited for the Engineers to take initiatives - the Engineers were waiting for the designers to ask them direct questions and give them specific task. Unfortunately the unequal share in the project was late noticed and discussed, after that an actual change seemed to be impossible. The design students initiated several workshops and excursions during the development phases also in order to improve the team work. However the results were not so positive since the expectations different and unclear.

In general it is important for teamwork to know each other well enough to avoid misunderstanding in communication and decision making. It is also important that everyone understands it means to compromise sometimes to his or hers own expectations. Since the engineers students already worked on a similar topic during several semesters they were not expecting to discover or even learn something new. For the design students the topic was quit new and it motivates them to research even more as the project needed

What the team could have done sooner is
• Analyse work process sooner to understand the weak points quicker and make this discussable, possible with one of the tutors present to moderate.
• Accept the different work ethic
Curiosity and enthusiasm are main drivers for designers to study research and finding unique solutions. These are so to say required characteristics. Where engineers often work in one field for a longer period and do not need this type of motivation but rather specific and answerable research questions to do their tasks.

Conclusion

The ISaS project was a very open project with a product-defining character. Although the teamwork did not always went well we still see such projects very positive as they can lead to unique solutions. In order to find them both the disciplines should be able to discuss and question each other. A better preparation and a clearer project structure will support for the next project.

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- message in the restroom http://www.blogcdn.com/www.urlesque.com/media/2010/08/picture-6-1281489350.png

Market research

- Piet' by the designer Theo Brand: http://typischtheo.nl/
- Nomix overviews : http://www.roevac.com/page/en/page_

- ID/54?PHPSESSID=2860e0c7986b066c67e66dd4a0f645ec
- ID/54?PHPSESSID=2860e0c7986b066c67e66dd4a0f645ec

Ecoflush http://www.wostman.com/ecoflush.html
Nordic / Gustavsberg http://www.gustavsberg.com
Roevac http://www.roevac.com/page/en/page_ID/54?PHPSESSID=2860e0c7986b066c67e66dd4a0f645ec
Dubbletten http://www.dubbletten.nu
Eco-dry http://www.wostman.com/ecoflush.html
Villa 9000 http://www.separett.de/villa-9000-de
Zircone http://www.ecodomeo.com/presentation/
Biolan http://www.kotiliving.com/toilettes-seches-populett-200-et-300-l-biolan-pour-camping,fr,4,TS.cfm

Public facility

- Observation pictures are all made by the ISaS team

acceptance

- Kromsdorf of the use of the home-made fertilizer, pictures ISaS Project
- Kromsdorf compost toilet, pictures ISaS Project

Stakeholders

- public sanitation facility Zwickau, pictures ISaS Project
- inside the public sanitation facility Zwickau, pictures ISaS Project
- Stakeholder maps , graphic ISaS Project

Public toilets

pictures public sanitation facilities pictures ISaS Project
Acceptancegraphics. ISaS Project
Graphic: Where do you use often the facilities?
Graphic: Doubts about no-mix toilet
Graphic: overview use tendency of public sanitation facilities
Graphic: Do you think that no-mix toilet is a good idea?
¬¬
Images trends
2theloo public sanitation facility http://www.2theloo.com/2thelookandfeel
festival urinals directly in straw http://inhabitat.com/l-uritonnoir-turns-festival-goers-pee-into-rich-compost/faltazi-luritonnoir/
stunt waterweek Amsterdam, picture Chris Toala Olivares
http://www.agv.nl/actueel/nieuws/archief/2013/november/inzamelactie-green-urine-voor-1-hectare-daknatuur/
the mobile phone application Bathroom Scout http://beste-apps.chip.de/android/app/toiletten-scout-oeffentliche-wcs-in-der-naehe-finden,de.mobilino.gotoilet/
image from the webside gratispinkeln.de www.gratispinkeln.de

chapter 4 camping

- Long term Campers
- Casa Mobile, Photographer Alain Breyer & Text Claude Javeau, Professeur émérite de sociologie, De l'Université Libre de Bruxelles http://www.alainbreyer.be/index.php?page=2009-2013-casa-mobile [2014.04.04
- Special theme campsite with Tipi tents
- Family activity on the campsite

chapter 5 concept

- Classification and analyse of the ideas, ISaS project
- Post it of the brainstorm session, ISaS project
- images on this page: material tests for information design, ISaS project
- all concept renders, ISaS project
- the yellow caravan, http://s201.photobucket.com/user/dragonhead00/media/VW%2520diecast/VW-30-1937-w_caravan_yellow.jpg.html

Inprint

This inprint explains which discipline took responsibility for which parts in the ISaS project.

Project		
Phase	*Task*	*discipline*
Organisation		
Workspace	Organisation and preparation room	Product Design
Communication	Organisation meetings	Product Design
	Organisation Consultations	Product Design
	Communication with Professors	Product Design
Project management	Time plan	Product Design
	Project phases including methods, workshops and activities	Product Design
Work methods and Tools		
Workshops	Preparation and moderation	Product Design
Excursions	Search	Product Design
	Contact	Max Schreiner (stiftung Bauhaus 1), Jürgen Stäudel, both disciplines
	Interviews	Both disciplines
Market research	Survey	Both disciplines
	Observation Public Toilets	Product Design
Ergonomic experiments	Toilet stool prototyping and testing	Product Design
Interdisciplinary communication tools	Digital and physical communication models of sanitation systems	Product Design
	Lexicon	Product Design - *unfinished*
Concept development		
Idea generation	Implementation steps	Both disciplines
	Workshop brainstorm session	Both disciplines
	Idea generation	Product Design
Conceptualisation	Concept	Product Design
	3D and Visualisation	Product Design
	User Experience concept	Product Design
	Technical points	-
Final presentation	Preparation	Both disciplines
	presentation slides	Product Design
	Summary exhibition	Product Design

Documentation		
Phase	*Task*	*discipline*
Graphic conception	Lay-out & editing	Product Design
	Pictures, graphics and visualisations	Product Design
Redaction		Product Design Environmental Engineering contributed the Chapters 2,3 and 2.4 and in the Annex
Correction intern	Content and understanding Spelling and grammar	Product Design
Correction extern	Spelling and grammar Chapters: 1, 2.4, 2.5, 4.1	Contact via Environmental Engineering

iSaS annex

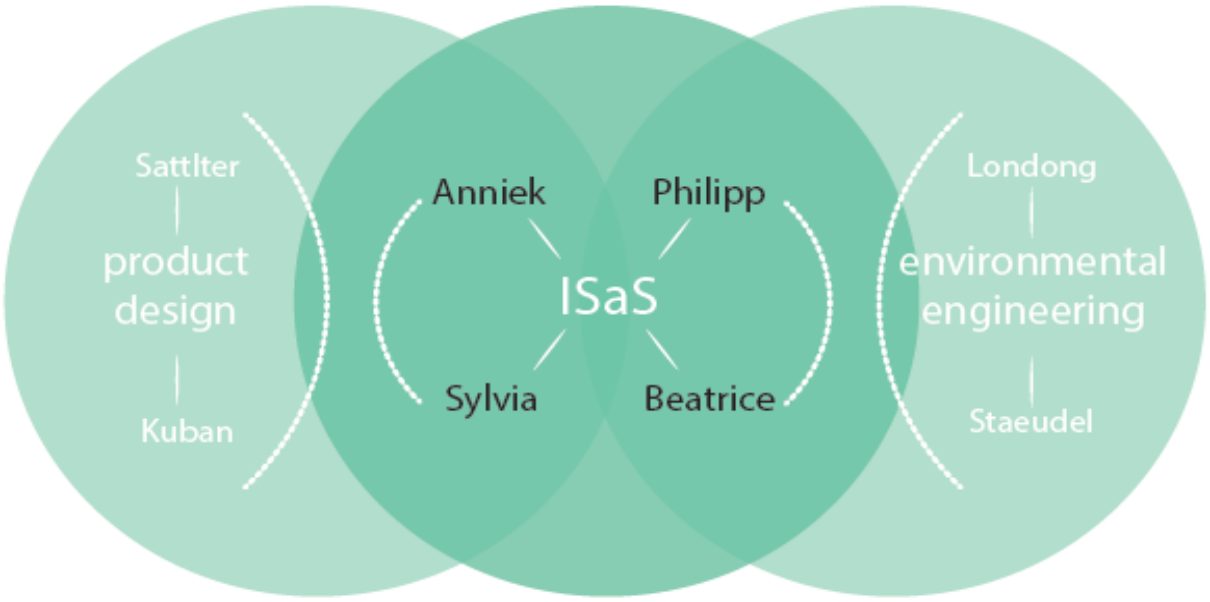
ISaS annex

This document contains the complete work process of the ISaS project, inclusive the supportive information and the important work data like the ISaS survey , which can be found on the last pages.

index

iSaS WORK PROCESS

The students' project ISaS between the two faculties Art & Design and Civil Engineering in the winter semester 2013 was a Pilot project. The work process between the students from two different disciplines was documented in order to be analysed and useable for other interdisciplinary projects. This documentation briefly describes and reviews several team-activities, work methods and tools. All activities and tools in this documentation will be explained and reviewed.



1 Kick of iSaS

1.1Initiative

The initiative for this project came directly from the students from the Design study who participated of the ISaS project. Later on the project was formed and 2 students of Environmental engineering joined the project. The general idea of the project is to create a long-term cooperation between students of the faculty of environmental engineering and the faculty of design.
After the agreement for the interdisciplinary project iSaS between the two faculties it took almost 2 months to create the project structure and the project team.
Here is an overview of the steps and meetings that were made before the official kick off with the complete project team on 6 December 2013.

1.2 Motivation of the Students

The motivation from the students for participating in the project is described in the next paragraphs.

Motivation of students from product design

Anniek Vetter and Sylvia Debit

Sanitation systems in European context have a questionable resource loop, the alternatives mean a different experience for the user. This system however, lies very closely to the individual in an almost untouchable context – which makes changes (probably) quite difficult. The combination of these two aspects makes it an interesting project (for a designer) - how can you contribute to create positive changes in this field without having the user feel like he or she is forced or has to compromise.

Although we worked on several projects linked with sustainability in the sense of reusing, rethinking and circular programs, we never experienced working directly together with students from such a specific specialty. Designers are for example trained to think out of the box, lay connection between fields and make research visible and discussable – it is very exciting to do this directly in collaboration with another discipline and discover the kind of outcomes to which this can lead. We can try out several roles designs can play whether this is in communicating, pure product design, concept development - or any other form. We see this as a creative opportunity to not only gain experience in interdisciplinary work that is according to us something that we will face in 'the professional world' anyway. It also allows us to discover how these types of projects suit us and if this field inspires us as designers. Especially for designers like us that put strong focus on sustainable development an experience like this can be very valuable.

Motivation of students from environmental engineering

Beatrice Decker and Philipp Exner

Researching on innovative, alternative and sustainable sanitation systems requires an extensive knowledge of nature science and technical understanding. We learned these "hard skills" during our bachelor and master studies. In our opinion these are just the basics. We have to spread them and discuss with other people.

During our studies we took part in several projects dealing with environmental contexts. We learned different working methods to reach a defined goal successfully in a group. But every time only engineers took part at these projects.

This project is a chance for us to experience new and different working methods, visualizations and approaches to solve topics. Furthermore it is a good "playground" to improve different interdisciplinary skills. We can make mistakes now and not during the coming work life. Another motivation is to explain and transfer knowledge of environmental science to students who are not dealing with these topics every day.

2 Work environment

2.1 Workshop Teambuilding

Team-building

At the beginning of the team-work it is important to characterise the group and its members. An organized "Teambuilding" workshop helped the team members to introduce themselves and made subjective characterisations. Also neutral, scientific and objective methods were tested. The results of the team building workshop helped the members to judge themselves, their role in the group and divide tasks accordingly. This could either be based on people's strengths or based on their personal learning aims.

For a successful teamwork it is important to know the members of the group with their strengths and weaknesses. It is also helpful to get an overview about the basic knowledge the members have about the topic "sustainable sanitation" and what kind of working methods and structures are known by the members.

Therefore the iSaS team prepared a teambuilding workshop which was divided into different parts and aims:

Workshop parts and steps:

1. Self-presentation: a 3 min presentation of yourself and your profession (pecha kucha style)
2. Personality- test (MBTI based):
   - At home: for getting an insight on what kind of type someone is
   - For one other team member: for discovering how well do we know each other
   - Comparing the test result someone got on his own with the test result one of the team members did for you
   - discuss MBTI test by going through the power point questions: for making the test results discussable and discover the teams strengths together
3. Characterization: evaluate and discover each other's weakness and strengths
4. Bio-structure-analyze "Structogramm": another scientific personality test to estimate strengths (and weaknesses) someone has in a special work environment
5. presentation professional and academic background: an extra presentation focused on education and formal projects

2.1.1 Self-presentation

The first activity of the workshop was for getting to know each other better. Therefore every member prepared a short presentation of oneself. Beforehand the team decided together on one style: as maximum a three minutes talk in "pecha-kucha" style. Every member presented in an individual way so the others got automatically a first impression from the other team member.

It was helpful that everyone used pictures (personal pictures and pictures which should visualize their weaknesses or strengths) and talked about their strengths and weaknesses. It brought a first impression of the character and personality of each member supported by the own styled presentations. The context of the presentations is summarized in the following table.

Goal: get to know each other's personal backgrounds (and formal projects)
Initiative: together
Preparation: discussed the form together, preparation of own presentations

Team member	Context
Anniek Vetter	from Eindhoven/Netherland; spoke about her family background and her Bachelor degree with a Cradle to cradle project
Sylvia Debit	from Roanne/France; spoke about family background and her Bachelor degrees in Eco design
Beatrice Decker	from Erfurt/Germany; spoke about her family background, her passion for Sport and her links to her friends and nature
Philipp Exner	from Naumburg/Germany; spoke about his family background, his home town, and how he is linked to this region

2.1.2 Personality- test (MBTI based)

In order to get an objective and scientific characterization of the team and its members and to understand how someone sees him or her selves, the Myers-Briggs Type Indicator (MBTI) was prepared by the students.
The MBTI test was developed by Katharine Briggs and Isabel Myers. The test method was published in 1962 in the United States. The results of this test are a classification into different types listed in the following table.

Goal: discover own strengths and weaknesses, supported scientific
Initiative: Design
Preparation: everyone received a test and the background information about the test well in advance

Classification	Description
Introversion (I)	concentrated; intensive
Extraversion (E)	sociable; wide interested
Intuition (N)	general-oriented, work on relations between several factors
Sensing (S)	detail-oriented, working on specific factor
Feeling (F)	personally, morally evaluating
Thinking (T)	rationally, objectively evaluating
Judging (J)	systematic, methodic, adapted decisions; disciplined; controlling
Perceiving (P)	Long open-minded for new impressions; spontaneous, flexible, changeable decisions

As preparation all team members did an internet test, based on the MBTI methodology, at home. These results are listed in the table under “own evaluation” and marked in the type overview.
Later on these results were compared with how the other team members saw you.

Team member	**Type “own evaluation”**
Anniek Vetter	ENFP
Sylvia Debit	ISFJ
Beatrice Decker	ENFJ
Philipp Exner	ESTJ

ISTJ	ISFJ	INFJ	INTJ
"DOING WHAT SHOULD BE DONE" Organizer • Compulsive Private • Trustworthy Rules 'n Regs • Practical MOST RESPONSIBLE	"A HIGH SENSE OF DUTY" Amiable • Works Behind the Scenes Ready to Sacrifice • Accountable Prefers "Doing" MOST LOYAL	"AN INSPIRATION TO OTHERS" Reflective/Introspective Quietly Caring • Creative Linguistically Gifted • Psychic MOST CONTEMPLATIVE	"EVERYTHING HAS ROOM FOR IMPROVEMENT" Theory Based • Skeptical • "My Way" High Need for Competency Sees World as Chessboard MOST INDEPENDENT
ISTP	**ISFP**	**INFP**	**INTP**
"READY TO TRY ANYTHING ONCE" Very Observant • Cool and Aloof Hands-on Practicality • Unpretentious Ready for what Happens MOST PRAGMATIC	"SEES MUCH BUT SHARES LITTLE" Warm and Sensitive • Unassuming Short Range Planner • Good Team Member In Touch with Self and Nature MOST ARTISTIC	"PERFORMING NOBLE SERVICE TO AID SOCIETY" Strict Personal Values Seeks Inner Order/Peace Creative • Non-Directive • Reserved MOST IDEALISTIC	"A LOVE OF PROBLEM SOLVING" Challenges others to Think Absent-minded Professor Competency Needs • Socially Cautious MOST CONCEPTUAL
ESTP	**ESFP**	**ENFP**	**ENTP**
"THE ULTIMATE REALIST" Unconventional Approach • Fun Gregarious • Lives for Here and Now Good at Problem Solving MOST SPONTANEOUS	"YOU ONLY GO AROUND ONCE IN LIFE" Sociable • Spontaneous Loves Surprises • Cuts Red Tape Juggles Multiple Projects/Events Quip Master MOST GENEROUS	"GIVING LIFE AN EXTRA SQUEEZE" People Oriented • Creative Seeks Harmony • Life of Party More Starts than Finishes MOST OPTIMISTIC	"ONE EXCITING CHALLENGE AFTER ANOTHER" Argues Both Sides of a Point to Learn Brinkermanship • Tests the Limits Enthusiastic • New Ideas MOST INVENTIVE
ESTJ	**ESFJ**	**ENFJ**	**ENTJ**
"LIFE"S ADMINISTRATORS" Order and Structure • Sociable Opinionated • Results Driven Producer • Traditional MOST HARD CHARGING	"HOST AND HOSTESSES OF THE WORLD" Gracious • Good Interpersonal Skills Thoughtful • Appropriate Eager to Please MOST HARMONIZING	"SMOOTH TALKING PERSUADER" Charismatic • Compassionate Possibilities for People Ignores the Unpleasant • Idealistic MOST PERSUASIVE	"LIFE'S NATURAL LEADERS" Visionary • Gregarious • Argumentative Systems Planners • Take Charge Low Tolerance for Incompetency MOST COMMANDING

Analyze the test results together

Because the MBTI methodic is used as a base for many coaching tests there are a lot of supporting tools to find online. The team used a workshop to analyze and discuss the results together. During the workshop the team members became a better understanding what the results were about. For example the common way of thinking or reactions to several situations that where specific for a character where presented. The team discussed this with the results of the team members.

Goal: make the test results understandable and discussable
Initiative: Design
Preparation: looked up and shared the workshop slideshow well in advance

2.1. 3 Characterization

The next part at the workshop was an exercise to characterize each other. Therefore everyone wrote the characteristics of the others on cards. No names were mentioned. Only expected and observed strengths and weaknesses of every member were listed on the cards. Afterwards the cards were mixed and everyone had to guess which card was meant for them. It was a kind of test for seeing a member judges the others and oneself.

Surprisingly every member found the right cards. This showed that it was clear what the others thought of the other ones and also that the group members judged each other well.

These parts mentioned above were a very personal and subjective characterization with the disclosure of personal strengths and weaknesses and also the social

and familiar background.

Goal: how well can you evaluate strengths and weaknesses of the others and yourself, discussing personal strengths and weaknesses
Initiative: Engineers
Preparation: spontaneously

2.1.4. Bio-structure-analyze “Structogramm”

The “Structogramm” was another test-method to get more objective and scientific characterization of the team members. This bio-structure-analysis was developed by the German anthropologist Rolf W. Schirm in the late 1970s.
This method is a personality test used in the business world which should evaluate the parts “feeling”, “emotion” and “rationale” of a personality. These different components correspond with different parts of the human brain. Questions like “Who I am?” and “How do I appeal to others?” will be answered quickly. The test was realized with the help of documents from a soft skill module by the FH-Jena. The results of this test are also classified into different types listed in the following table.

Goal: discover strengths (and weaknesses) someone has in a special work environment
Initiative: Engineering
Preparation: spontaneously, test documents prepared at home, took place a day after the workshop

Group member	Philipp	Beatrice, Sylvia	Anniek
Criteria/attribute	Green component	Red component	Blue component
Relationchips to other people	*Contact:* - the desire for human proximity - talent in contact with humans - very popular	*Dominance:* - endeavour to superiority - natural authority - disposition to competition	*Distance:* - endeavour to safe distance - restraint - disposition to reticence
Orientation in times	*Past:* - depend on familiar things - experiences based action - avoiding radical changes	*Present:* - capture the moment - acting impulsive - activity and dynamic	*Future:* - consider the consequences - act tactical - precise timing
Mindset and work structre	*Sense:* - intuition - sensing subconscious signals - - reliable first impressions	*Comprehension:* - concrete and practical thinking - recognizing quick doable things - tend to try sth. - talented for improvisation	*sequencing:* - systematical thinking - high level of the ability to abstract things - addicted to linguistically precession
Success through	***Sympathy***	***Thrill***	***Convince people***

2.1.5 Present your professional background

This third part of the workshop should help to get an overview and impression of hard and soft skills which are learned in the university courses. It should also disclose which work structure the members use and inform about basic knowledge which was learned and maybe correlate with the topic of this project.

Environmental Engineering
The environmental engineers Beatrice and Philipp studied "Process integrated environmental protection" at the FH-Jena so they learned the same subjects and had a similar work structure. Both members communicated the important things of their studies as a cleared structured power point presentation.

Product Design
Both members communicated important things of their studies with the help of pictures and an relaxed conversation.

In conclusion this step clarified which focus areas the members had during the education and which hard and soft skills were mediated. The product designers learned more soft skills and different working methods than the environmental engineers. Unexpectedly both disciplines learned similar methods for a structured work.
It helped to understand the working methods and structures of the disciplines better and brought an overview about basic knowledge.

2.1.6 Review

This workshop brought impressions about the personal characters, work principles and basic knowledge the members have in general and around the topic of the project. It also helped to create a personal and open-minded atmosphere for the students. Strengths and weaknesses of each person were filtered out so everyone could find a role in the group. Because strengths and weaknesses were balanced the team members could complement one another.

A teambuilding workshop at the beginning of a project can help to start a successful work. Because of external effects and disagreements the group did this workshop 3 months after the beginning of the project.

It could also be helpful if such a workshop is supported by professionals.
It has to be consider that the impressions are not only objective also subjective and behaviour could be changed.

It should also be mentioned that the workshop in the way it was realized (in such a personal way) by the group this might only work with students. The students work on a more personal level than for example fellow workers.

Positive
- The workshop created a personal and open-minded atmosphere
- People got to know each other better
- Discovering and rethinking of own strengths and weaknesses
- Everyone participated in the workshop with full energy and interest
- Difficult topics became discussable, for example unknown work methods, planning, time and management
- People understood when they could ask the other members for help and on which points they could support the other member

Negative / change for next time
- The workshop was realized a long time later after the beginning of the project
- Not all material was prepared and managed in time
- Not all parts were professional, for example the characterization was invented by our own
- The activities where quite intensive and fruitful though the results might have been used better – for clear task dividing and project planning if the team had taken more time for that

2.2 Expertise

This third part of the workshop should help to get an overview and impression of hard and soft skills which the others learned in the university courses. It should also disclose which work structure the members use and inform about basic knowledge which was learned and maybe correlate with the topic of this project.

Environmental Engineering
The environmental engineers Beatrice and Philipp studied “Process integrated environmental protection” at the FH-Jena so they learned the same subjects and had a similar work structure. Both members communicated the important things of their studies as a cleared structured power point presentation.

Product Design
Both members communicated important things of their studies with the help of pictures and an relaxed conversation.
The design students started with presenting the material they showed at the beginning of the project which explained what the role of a designer could be. This was expanded with several common design methods and tools like design thinking, cradletocradle, and biomimicry.

In conclusion this step clarified which focus areas the members had during the education and which hard and soft skills were mediated. The product designers learned more soft skills and different working methods than the environmental engineers. Unexpectedly both disciplines learned similar methods for a structured work.
It helped to understand the working methods and structures of the disciplines better and brought an overview about basic knowledge.

Review
In conclusion this step clarified which focus areas the members had during the education and which hard and soft skills were mediated. The product designers learned more soft skills and different working methods than the environmental engineers. Where the engineers knew more about sustainable sanitation. Both disciplines learned similar methods for a structured work.
It helped to understand the working methods and structures of the disciplines better and brought an overview about basic knowledge.

2.3 Workplace

Workplace
One of the first methods that we tested for an intensive, effective and creative interdisciplinary work was the use of a shared work place.
This workplace led to:

- less organisation steps for the group work
- create an own work atmosphere (own tables, plants etc.)
- access and meet 24h/7d
- create an own style of communication (using walls etc.)
- do not need to consider other people (loud discussions etc.)
- leave and store thinks there (books, worksheet)
- a presentation room for consultations or meetings
- easier to organise workshop and test methods together
- valuable contacts

The team had the chance to rent a work room at the house of Stiftung.Bauhaus.Eins.Weimar. This is a model house which should show how architecture and design could play a part in the rehabilitation and renovation of a German house in order to make it autonomy in the production and consumption of energy and resources.
Moreover the management team of Bauhaus 1 provided the team with important contacts via their own network that supported the project and helped it to develop.
Because the project also focused on the interdisciplinary work, it was important to invite interesting people and tutors in the room in order to show the tested methods and developed tools.

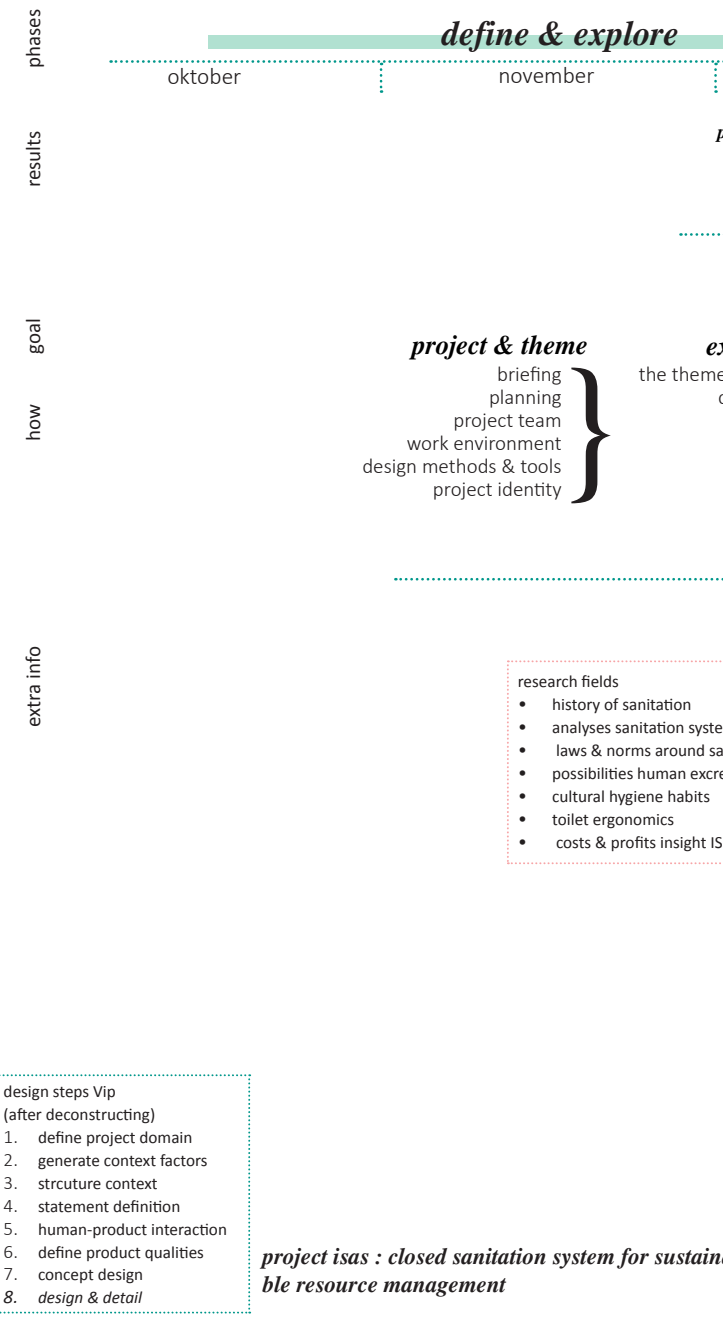
2.4 Time management

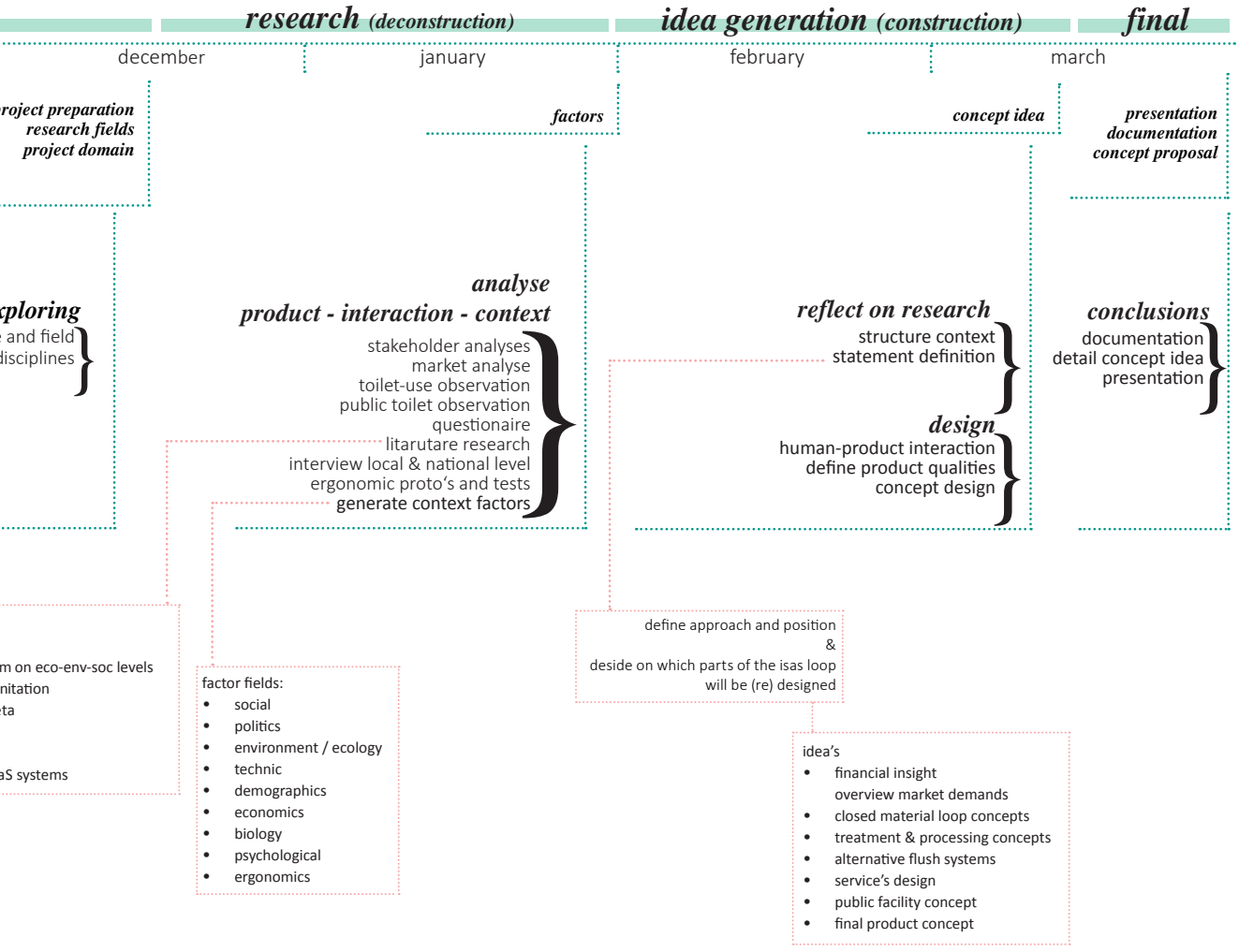
The first picture shows a proposal time plan how the team wanted to reach several project goals and in which duration. This plan was made at the beginning of the project December 2013 and does fit the project overall though. After the research phase the team could have used a more detailed plan.

The plan

The timeline shows the different phases of the project. In the first phase the project was defined by the students of product design and tutors of the faculties of product design and environmental engineering. After that the research phase started. Different topics dealing with the theme of the project were analyzed. It could also be referred to as “deconstruction” phase. It was planned, that this is going to be the longest phase. The “mid-presentation” at the end of January summarized the results and explored fields of this phase. Here different results and factors were presented.

As result of the research phase several fields and factors would come forward that could be used for the concept developing. The idea phase was automatically divided in a first context phase followed by a concept phase (construction phase) and took much longer then calculated in December. The final phase was planned to finish up the documentation and presentation material. This phase took also much longer than planned.




research (deconstruction)
idea generation (construction)
final
december
january
february
march
project preparation
research fields
project domain
factors
concept idea
presentation
documentation
concept proposal
xploring
e and field
disciplines
analyse
product - interaction - context
stakeholder analyses
market analyse
toilet-use observation
public toilet observation
questionaire
litarutare research
interview local & national level
ergonomic proto's and tests
generate context factors
reflect on research
structure context
statement definition
design
human-product interaction
define product qualities
concept design
conclusions
documentation
detail concept idea
presentation
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aS systems
factor fields:
social
politics
environment / ecology
technic
demographics
economics
biology
psychological
ergonomics
define approach and position
&
deside on which parts of the isas loop
will be (re) designed
idea's
financial insight
overview market demands
closed material loop concepts
treatment & processing concepts
alternative flush systems
service's design
public facility concept
final product concept

a-

The reality

The second picture is a kind of project management plan and shows how the time management developed. It points out a weekly time-scale which includes also team and university activities. The phases were called almost the same like in the previous plan. Just the idea generation was separated in a context phase and concept phase. In the context phase the factors and results of the research were defined. In the concept phase a concept for a public sanitation facility was created. As you can see the research phase went over into the context phase. That was a result of the mid-presentation because new project criteria appeared. So it was necessary to analyze new research factors. During the project the team organized some activities like different workshops, excursions and weekly team meetings. Not every meeting was attended by all members. The numbers of participated team members are listed in the plan. Especially at the beginning of the project the team was not complete all the time. During March, when no lectures had to be visited by the students, most workshops and excursion took place. Daily team meetings were organized with all members. It was the most work-intensive productively time. Another activity was the preparation of the working-place during the research phase. It lasted 2 weeks and was organized and done by the students of product design. At least there were activities at the university, which consisted of separate meetings between tutors and the students. The time plan also shows that there are no meetings with all tutors of both faculties at the beginning. The first meeting with all participated students and professors was at the mid-presentation.

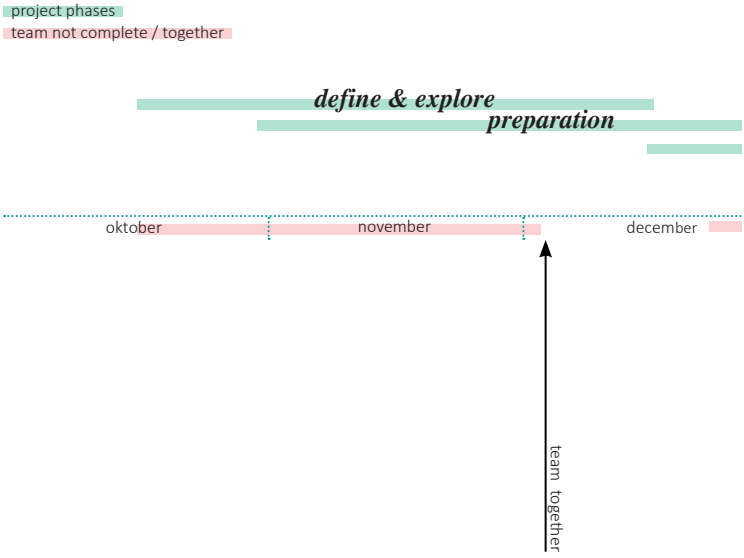
REVIEW

The project took much longer than planned. There were several points which influenced and delayed the time planning. The biggest problem was that both disciplines had very different study plans. The engineers had lectures that took place regularly and other project groups whereas the designer only had to work for projects. So it was difficult to find much time together during the semester.
Another difficulty was that at the beginning of the project the project goal for the disciplines was not clear therefore the team did some unproductive work.

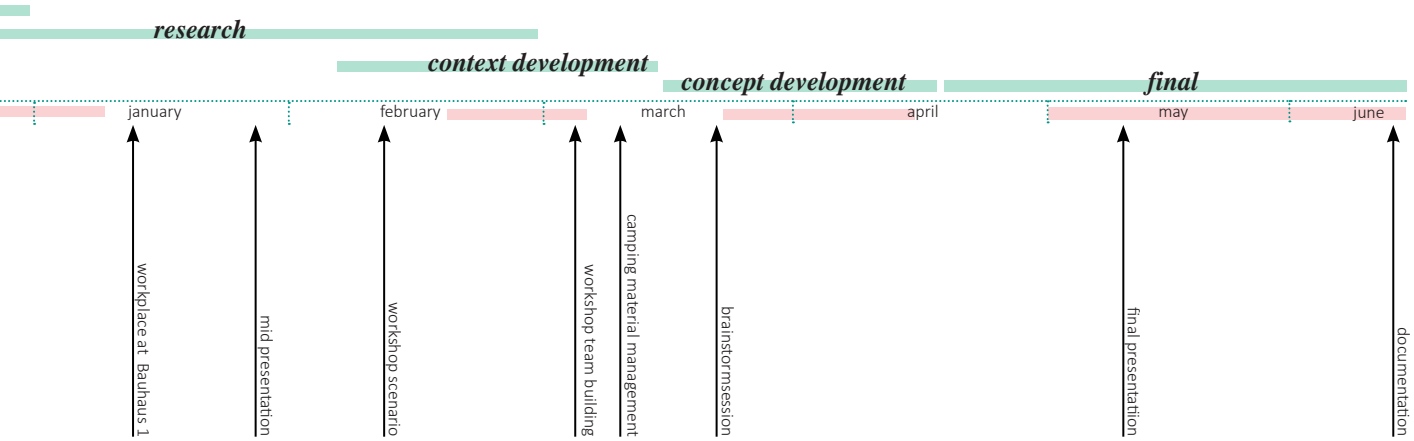
Also the distribution of the work was difficult because of the different number of credit points given to the engineers (12) and designers (18) for the project.
An additional problem was that the first planning was created only by the design students in the beginning of the project and presented to the engineers. But this plan was not conclusive in every way for the engineers so it was rarely used. Making a plan together and in more detail would probably make it more usable for all members.

planned project time line

project time line

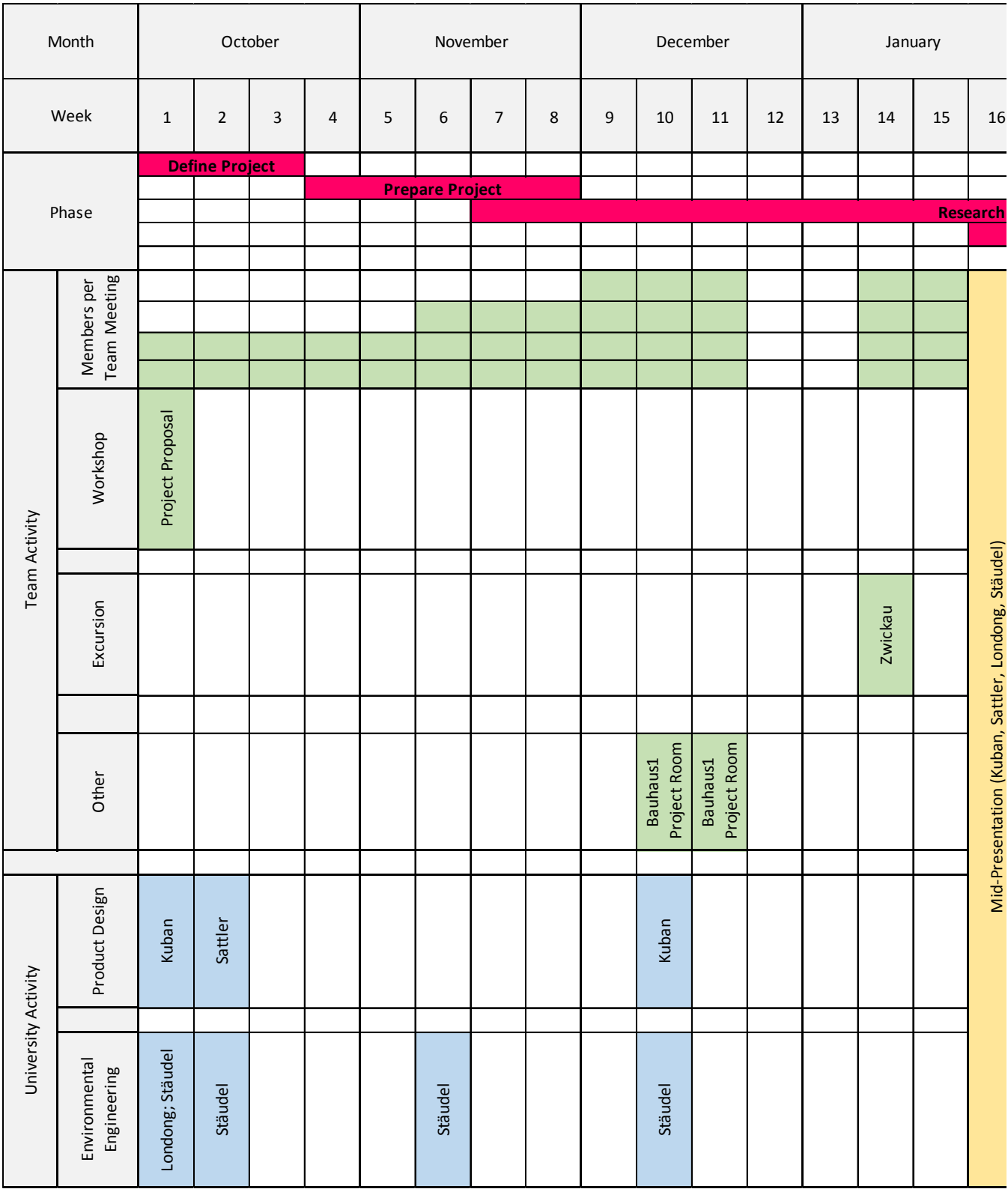



research (deconstruction)
idea generation (construction)
final
january
february
march


research
context development
concept development
final
january
february
march
april
may
june
workplace at Bauhaus 1
mid presentation
workshop scenario
workshop team building
camping material management
brainstormsession
final presentation
documentation

reflect time work table

project time line -in details



	February				March				April				May	
	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Phase														
Context Phase														
									Concept Phase					
														Final Presentation (Kuban, Sattler, Londong, Stäudel)
	"Scenario"					"Teambuilding"	"Visualisation"	"Brainstorming"					"Prototyping"	
						Ehringsdorf	Kromsdorf	Weida						
		Sattler						Kuban		Sattler		Kuban		
	Londong; Stäudel					Londong		Stäudel						

Communication Tools

During the project several communication tools are used, apart from standard email and phone (both main communication tools the group (intern). These tools were chosen all with a certain reason and expectation. An overview of the use and the results by these tools are listed up here.
Both students groups sharing a disciplines work more together, have their own contacts, meetings and task dividing.

iSaS mail address

Expectations: The email address was used for the questionnaire as an official contact address for the interested people.

Results:
- no one contacted the team about the survey via this email address
- all questions or remarks where directly addressed to the members personally
- team members used their own email addresses for correspondences, intern as extern.

Suggestion:
- use during long-term projects
- no mix-up with other personal email
- easier to re-trace emails

shared online Calendar

Expectations: linked the project planning directly with personal planning in order to make it easier to find dates to meet or to work together

Results:
- once filled in the calender
- only the design students used a digital and shared calender so there was no point
- no-one was responsible for it
- organisation via email and after the meetings

Suggestion:
An online calendar is a chance for organisation but not absolutely necessary

electronic notice board

Expectations: To share a pinnboard with mind maps, matrix's and links digital, so everyone can participate and use it where ever.

Results:
- enabled it to create all kinds of maps together without being on the same place (digital) which was usefully at the beginning when there was no shared workplace.
- not used by everybody (mainly the design students)
- sharing via personal messages and during meetings

Suggestion:
- personal messages work quicker and is a more time saving method
- make it clear for everyone what is on the pinnboards
- gets quickly messy; has to be cleaned up regularly

Meeting reports to do lists

Expectations: summarizes results, and discussions of meetings and write tasks down. It is a method to also update the tutors and to use later on for the documentation.

Results:
- not everyone found the notes usefull after the meetings (mainly the engineer students)
- if the task was done, it was cleared during a meeting if and who would make the notes (mainly by the design students)
- not regularly madenot asked by the tutors
- helpful for the documentation

Suggestion:
- define responsible person
- all use the same structure

Sharing data via Dropbox®

Expectations: Common program, every member is able to use it. It is a fast way of sharing data, not for messages.

Results:
- used by everyone
- sharing data limited by different memory space
- data got missed or were not transferred

• risk of deleting data from other members

Suggestion:
• organisation has to be define at the beginning
• back-up copies are important, by one responsible team-member or by everyone on themselves

lexicon
Expectations : tool to explain disciplinary and technical terms

results
• only the design students used the lexicon, they were also the once who had difficulties with the technical and German terms
• the engineer students did not understand / found it interested to support in this process and to clear up the lexicon regularly - even after discussing this several times within the team.

Suggestion:
• Its a very strong tool in interdisciplinary projects but it has to be regularly updated by the persons who are actually used to these terms (the disciplines can share this task)

3 Research Phase

This chapter describes the methods used during the research study of the iSaS team. Both disciplines introduced a few methods in to the group that could be used in the project. Especially in the research phase, where information has to be shared and valuated - a structure or method that all know and use, can support the communication.
The different research approach is described in the first chapter, the other chapters describe several research activities in more detail.

3.1 Research approach

The team divided the research fields under the disciplines, which both did there research in their own ways. The knowledge exchange was in that sense more important. Two methods where used to explain the research approach and the support in structure.

3.1.1 Shared methods

Design thinking –product design

Vip method –product design
The ViP method and graphics were used to explain the research approach of design. The research study 'deconstructs' the old model of sanitation, - the product itself, the interaction with this product and finally in which context this all takes place –in case of ISaS: the toilet, the interface and interaction with it and the context, the public facility. In the constructing phase, the concept is developed by first setting the new context, ; then deciding on the type of interaction and finally design the product (or service) that supports this aimed interaction in the set context. The ViP method was only used to explain the approach of design in a project with a long-term goal and not as a strict method. It also does not provide the tools for this.
The step from deconstruction to construction is done by among other things, rephrasing research results in one sentence. This was used for the 'workshop scenario' the way we did this was also inspired by the first semester project of Anniek.

REVIEW
- the method did support in explaining the research approach for design
- Some research results were prepared for the workshop Scenario and printed on small card, though not used. The participators already knew the research results or they were not relevant. Thereby there was no time in the workshop to go through the factors.

3.1.2 Standard research approaches

Engineer students

- use mainly scientific sources, like the faculties research book & ..
- use own calculations in order for example to value possible economical profit

Design students

- use scientific sources on ergonomics,
- use observations to discover certain patterns and habits
- use forums, discussions and small interviews to gain better an insight about user behaviour and the attitude towards new sanitation and re-use
- Studies in market research by reading other pilot-projects and product or project documentation from several companies and organisations

3.2 Knowledge exchange

Apart from shared research activities as will be described in the next chapters, Both disciplines had their own research studies as is explained in the first chapter. The outcome of these studies had to be shared in order to discus and analyse it together. This would led to more an

Several techniques were used to support the knowledge exchange

Technique: Presentations
frequency : happened ones from both disciplines
participants: complete team
reason: Share basic knowledge
From engineer to design: knowledge about sanitation, waste water plants, and environmental issues
From design to engineer: knowledge about the ergonomics, use-behaviour, restroom aspects
review: the presentation was use full and for the amount of information shared also suitable

Technique: the question document
frequency: the document was updated with questions & answers frequently
participants: Sylvia, Philipp and Anniek
reason: during the research designers ran into questions –s haring them via a shared document was the best and structured solution. Sharing all information's via email was chaotic and therefor this shared document was created.
review: Worked well for some participants

Technique: meetings
frequency: infrequent and not all members were present
participants: team (depending on present members)
reason: update and discuss open questions
review: The results could have been better shared if the meeting started by a small update per person or discipline, about the activities from the last week – not everyone did this.

3.3 Excursions + Interviews

Excursions and interviews were for the team a method to understand the practical conditions of what they read in the theory. It's also a quick way to get new inputs and contact.

management public sanitation facility
Zwickau, interview with stakeholders
For the group it was important to get an overview of all the actors that are around the public sanitation facilities. This interview helped the group to understand the process of building up, managing and maintaining a public sanitation facility. The group asked about the economic and social challenges of the facilities.
Visualize the stakeholder network was also an aim of the interview.
Mr Kallweit is responsible of the Building Office in Zwickau and thereby of the implementation of public facility. The city has a contract with Mr Neef who is in charge of proposing complete solution of sanitation facility.

"The public facilities are not profitable in a direct economic sense, but they are supporting the marketing strategy of a city and thereby its attractiveness. This is a long-term planning vision. By implementing a new facility, it's important to define well the location because it is an intimate activity."

Who: Mr. Kallweit, municipal Office of Zwickau and Mr. Neef, Comedia Konzept
Where, time: city of Zwickau, 28th January 2014
team: interview by Sylvia and Philipp
reason: gain insights in the different aspects and stakeholders of a public restroom
use: in the stakeholder overview

maintenance public sanitation facility
cleaning staff public sanitation facility
Weimar, interview with the cleaning staff
The cleaning personal is a part of the service but moreover cleaning the facility is the second daily use. It gave a new perspective on the product and the facility to see the work condition.

"I do this job because my pension fund is not enough. I have to stay here 6 hours in a row, I'm not allowed to sit it's a very physical job. The visitors are sometimes disrespectful, but I still have to clean their dirt."

who Mrs K., employee of cleaning service
where shopping centre Atrium, Weimar, January 2014
team observation and interview by Anniek (only place for 1 observer)
reason gain insights in the cleaning process of a pubic restroom
use The cleaning lady

Producing & installing (dry & no-mix) sanitation
Eringsdorf, interview at with Holzapfel + Konsorten
Behind the quality of the service, there are a technical part that has to function well, otherwise the use experience would be strong negative influenced. The team aim to learn more about the technical challenges of the no-mix technology like flushing, dealing with odour, separating correctly the urine from the faeces… Mr Holzapfel is an environmental engineer. He's developing concepts of dry no-mix collection solution: no-mix toilets and no-mix collectors. He also built a mobile sanitation facility for event.
"No-mix toilet proposed the same comfort standard as conventional toilets regarding odour for example. They are much cheaper in the use phase and are the best sustainable solution. However the people are not ready yet to change their habits or to accept new material for the product. For example, I build my toilet with wood because this material is more hygienic and does not spread bacteria as much as plastic or ceramic."

Who: Karsten Holzapfel (Holzapfel + Konsorten)
Where Ehringsdorf, 11th march 2014
team: interview by Sylvia, Anniek and Philipp
reason: gain insights in the market and insight of the no-mix technique used in public space
use: market research & use experience

Use & reuse
Kromsdorf, interview with a community about their sanitation system
After reading a lot of material about the different technologies and the valuable product transformed from excreta, the team aim to discover the reality of a usable dry toilet that is collecting and treating human excreta and the final product. Raimond is a product designer who is leaving in a caravan camp in the north of Weimar. They try to live in a self-sufficient model by producing their own energy with solar panels, reusing wastewater, or producing their own food.

"We are around 10 people on the camp. We are leaving with the same standards as in a conventional house, but we produce our energy independently. The dry toilet was a natural solution as we don't have a connection to water. We produce compost that is sometimes mixed with horse's excreta. This year, we will try for the first time to reuse the compost in our garden. No one has difficulties with the toilet or the odour which is stronger with higher temperature"

Who: Raimond, citizen of the camp
Where Circus car camp, kromsdorf, 6th march 2014
team: excursion by Sylvia, Phillipp and Beatrice
reason: gain insights in the re-use possibilities and the attitude towards it
use: market research & use experience

Review
All interviews and excursions did not only gave great input for the project. The activities were interesting, motivating and broad the team closer with one another (team-activity)

3.3 Market Research

The market research was there to gather information about excisting public restrooms, to make the deveopment of one better discusable, see what kind of ellement affect eachother and the experience.
The table as also shown in the documentation structured all factors that the team found interresting and were also comparable - this enabled it for the complete team to gather information and make it discusable together.

Review

The graphic on the next page shows a try-out of comparing the settings, the team did not continued with this. Though the tool was extra made to enable the complete team to join in the observations, only used the designers of the team worked with it.

where	restrooms on Germany, Netherlands and France during the first months of the project
team:	Sylvia and Anniek
reason:	gather observation material
use:	market research & use experience

3.3 Survey

Quantitative Survey

As the team decided on working on the public sanitation facility, they conducted a survey to get statistics on the perception of the user on public restroom design, innovative sanitation systems and reuse of human excreta. The questionnaire had a total of 32 questions. Most of them were multiple choice questions in order to ease the analysis of the response. The questionnaire was divided in the following categories of questions:
Demographic data (7), Use of public sanitation facility (11), Perception of innovative sanitation systems (11), Perception of human excreta (3).

REVIEW

The survey outcome is not representative for the user of public sanitation facility as the respondents are in majority young people. The team spread the survey through the university mailing, their contacts and their social network. The respondents are mostly people from an academic environment. As the questions were mostly multiple choice questions it is not reflecting the reality. There were 50/50 of response from women and men. The questionnaire was organized in a too short time and the question were not always correctly formulated, or the formulation could influence sometimes the response. For example: “How high are your scruples over the technic regarding the following criteria? “ The question already give a negative perspective.

Response:	289
Period:	from 11th – 26th January 2014
Reason:	gain insights in the user behaviour, the image and knowhow around new sanitation techniques and human produced compost and fertilizer.
Use:	insight in the user behaviour

3.4 Rapid prototyping

Quick & dirty Prototyping is a technique to discover quickly if and how an idea could work. As the term already explains, it’s a rough way of testing. Often this is enough to say if an idea is worth looking into deeper and saves a lot of time an and developing. Although it does not have to be so black and white, it can also be used to point out how an idea can be successful, in which direction to continue. It is often used in the idea phase but in this case the iSaS team saw it as a use full research tool.

More on how quick and dirty prototyping works can be found for example here: http://www.designmethodenfinder.de/quick-and-dirty-prototyping

The squatting test

Several sizes of stools were build (image x) and placed in the restrooms and bathrooms of two student houses.

Test situations:
house 1: Only one toilet on the bathroom – A big stool was rotated with one small stool which can be easily positioned differently.
House 2: One restroom with a big stool and one bathroom with a small stool, which can be easily positioned differently.

pictures!
In total 2 groups of potential test persons, 5 persons and 3 persons

Approach:
All persons were informed about the project self and the testing stool. At the restrooms there was a poster explaining how it worked. It was up to them if they wanted to try-it out or not.

RESULT:
After a few weeks every person was asked if they used one of the stools

People who did not tried the stool : 1 (test house 2)
- not attractive to use, asking about it made the person uncomfortable
- the person was big the reason for not testing - understands the reason in general but not in case for the person self.

People who tried the stool once / a few times: 4 (or3?) (both test houses)
- tested once and noticed no differences and were not curious to see if that would change in long term
- difficult and uncomfortable position physically
- difficult and uncomfortable because of clothes – wearing tight trousers

people who tried the stool frequently: (both test houses)
- noticed a differences during the act of excretion - directly at one of the first try's
- had sometimes difficult and uncomfortable because of clothes – wearing tight trousers

After the reviews the stools stayed at the student houses (from the end of January till the end of June) 3 out of the 8 test persons kept on using them frequently. All three test persons still noticed a different positive affect.
- Two persons only used the stool when they thought about it and when it was there; when they were wearing comfortable clothes and when they were not in a hurry.
- One out of the three test persons got really used to it and even misses the stool, when being not at home.

Side note: In house 1 the big stool was almost always placed, which made the only toilet in the house always have a big stool in front of it, which supported the use of it. House 2 the small stool in the bathroom was often put to the side, people did not used it. This toilet was the most used toilet in the house.

Review material
the small stool – with the feet in front of the toilet instead of at the side.
- the small size made it possible to change positions – depending on the type of trousers the person was wearing
- having the feet in front was physically more comfortable
- one can easily first sit and then lift the feet up

the big stool – with the feet more at the side of the toilet
- the stool was big and people did not move the stool self
- the surface was much bigger so the feet where differently place able
- feet at the side where causing more problems with tight trousers.
- one can easily first sit and then lift the feet up with normal trousers

CONCLUSION
People really do not care of changing their positions at home – a test with squatting combined with hovering in public restrooms would probably be an interesting next step. Although the test clearly pointed out that clothes really can make it difficult and this is especially in public space - where there is no option to quickly change - a main reason to leave the full and half squat position.

4 Context phase

This chapter describes the methods used during the context phase of the project iSaS.

4.1 Workshop “choosing a scenario”

The team started the project within public space. This was seen as a perfect way to introduce as many people as possible. During the mid-presentation the scenario ‘highway’ as scenario in public space was presented and discussed with the supervisors/tutors. This discussion led to the decision to find a new scenario. Based on these reasons:

- The restrooms near highways are so unpleasant that even with an interesting design
- The collcection of urine

Working with scenario is a common tool in design development. It means defining the implementation context of the product and thereby the user group or at least the stakeholders and for which time period. Moreover it allows working with real situations and conditions. Imagine stories for personas around this scenario helps get an overview on the big system and identifying problems. A scenario can also be used forquickly testing the usability of a product.

The team organised a workshop to decide on the scenario they wanted to work with. The form of a workshop allows to discuss all the possibilities in a limited time and a creative atmosphere.

Preparation:
Selection of 8 scenario possibilities for the field public sanitation facilities: train station, motorway, school, campsite, office, train, city centre and shopping centre. For these 8 scenario possibilities, we visualised the present situation regarding economic, ecologic and social strengths and weaknesses.
The aim was to select the scenario that fit with the project goal and vision the best, but also the scenario which was for all the members the most interesting.

Workshop
Time: 7th February 2014, 8am – 1pm
Schedule:
. 9.00
Define the team goal: why do we want to work on dry and no-mix toilet?
Task: analyse what are the niche where we could work
. 9.30
Present settings: analyse the settings of today - what forms the context and the experience
Task: analyse with boards
. 10.00
Threats and opportunities
Task: From the present situation, analyse the threads and opportunities of each scenario
. 10.30
Visualize the scenarios
Task: play with personas and imagine a story for each scenario that reflect the SWOT analyse
. 11.00
Break
. 11.15
Bring the research in the visualisation, look for concept ideas
Task: start drawing, brainstorming, selecting pictures, and analysing ideas
. 11.45
Presentation / conclusion
Task: everyone present his/her story and argument the scenarios
. 12.15
Discussion
Task: start to choose a scenario interests and opportunities

Result: the team has chosen the scenario campsite. The reasons are explained in the product documentation.

Evaluation:
The workshop was rushed through according the design students..?
Not all members participated in best shape, which is quite important to have a positive and productive atmosphere
.

Participants: the complete team
Preparation and organisation: Design
processing information: design

4.2 Visualisation tools

In an interdisciplinary and international team it is important to be sure that everyone is talking about the same topic/object to avoid misunderstanding. Visual tools that use common form language allow the members to show ideas very quickly in order to save time. To make the visualization of situations, context and ideas understandable and discussable the designers developed two tools for the topic sanitation system.
These tools were especially intern communication tools within the team members.

Digital tools
First a set of icons was developed. It represents all the elements of the steps of the nutrients and water loops, from the collection to the reuse. It allows creating graphics, visualizing options and material flows. It also helps to visualize how the elements effect on each other's.
The icons are as simple as possible to avoid wrong interpretation.
Preparation and processing: design
Use: visualization of facts and information from the field research

Sanitation wood game
While the digital icons help to visualize results or facts, the wood game was developed to help during the creative phase. During brainstorming or workshops it made the visualization and communication of ideas easier and quicker. Moreover it supported the creative atmosphere of these session by making the work more playful and thereby more motivating. However the digital icons were used as a legend.
Preparation and processing: design
Use: make ideas understandable and discussable during the context construction and the concept phase

4.3 Field research

Campsite
Weida, excursion to a 'nature campsite
After choosing our scenario to develop a concept, the team looked up several campsites in the surrounding of weimar to gain an insight in the settings of a campsite. It was also a good way for the team to get real information concerning the volumes of urine and faeces that are produced in a year in the campsite. The team had then good basis to begin the concept developing phase.

"We built our own connection to the standard wastewater system 20 years ago. It was a big investment. Although if the sustainable sanitation systems are interesting and attractive solutions, it would be impossible here. But technically, it could actually work. We have enough space and we already have waterless urinals that are working great! Generally, the people like to check the sanitary facilities if they don't know the location yet before they book their place."

Who:	Mr Kluge and Mr Reichelt, owner of the campsite
Where:	Natur-campingplatz Weida, 11th March 2014
team:	excursion by Sylvia, Anniek and Beatrice
reason:	gain insights in the possibilities around the campsite and (if possible) data about used resources
use:	scenario camping and implementation steps for the camping

5 Concept Phase

This chapter describes the methods used during the concept phase of the project iSaS. The last phase was mainly carried out by the two design students of the team.
Most activities and methods in this phase are quite standard for design development; these will not be described and reviewed in details as the shared activities.

5.1 Brainstorm session

During the research phase, the members of the team got many ideas. The brainstorm session allows drawing all the ideas down on post it to make them discussable and to develop new ideas from them. It's important during the brainstorm session to have a creative atmosphere and that all the members feel confident to present their ideas.
The aim is to get lot of ideas on the wall in a short time (3 hours)

1 putting your own idea's in
2 brainstorm about other idea's together
3 discuss them with questions: how can you..? (Turn comments into concepts)

Rules:
Yes and …
Make your members feel like winners
Be visual
Be quick
Quantity
Stick it – Move it!
Write all ideas down

Time: 26th march 2014

Results: After the session the team categorised the idea's and discuss them to see which fit the best to the scenario and project aim. More details can be found in the product documentation.

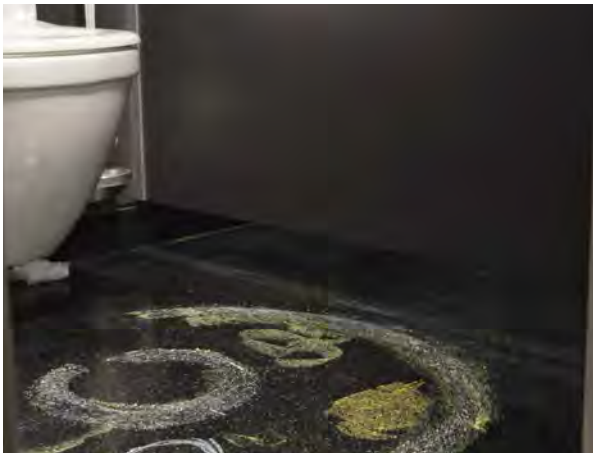
Evaluation: The session led to a valuable input for the following concept phase.

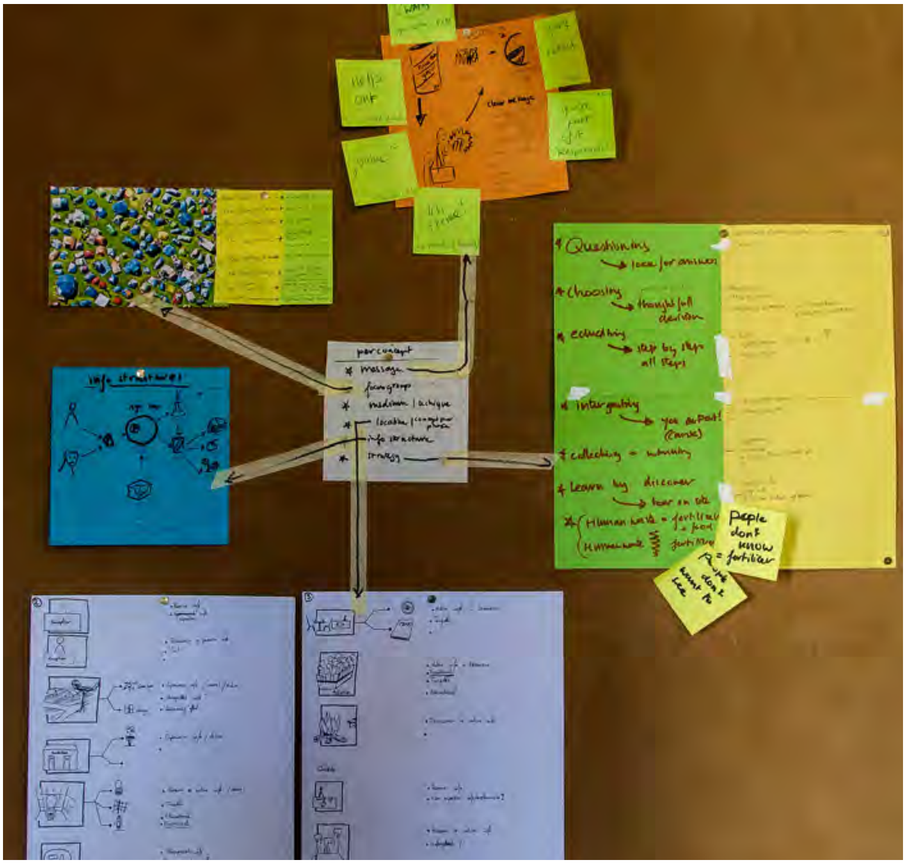
Participants: the complete team
Preparation and organisation: Design
processing information: design

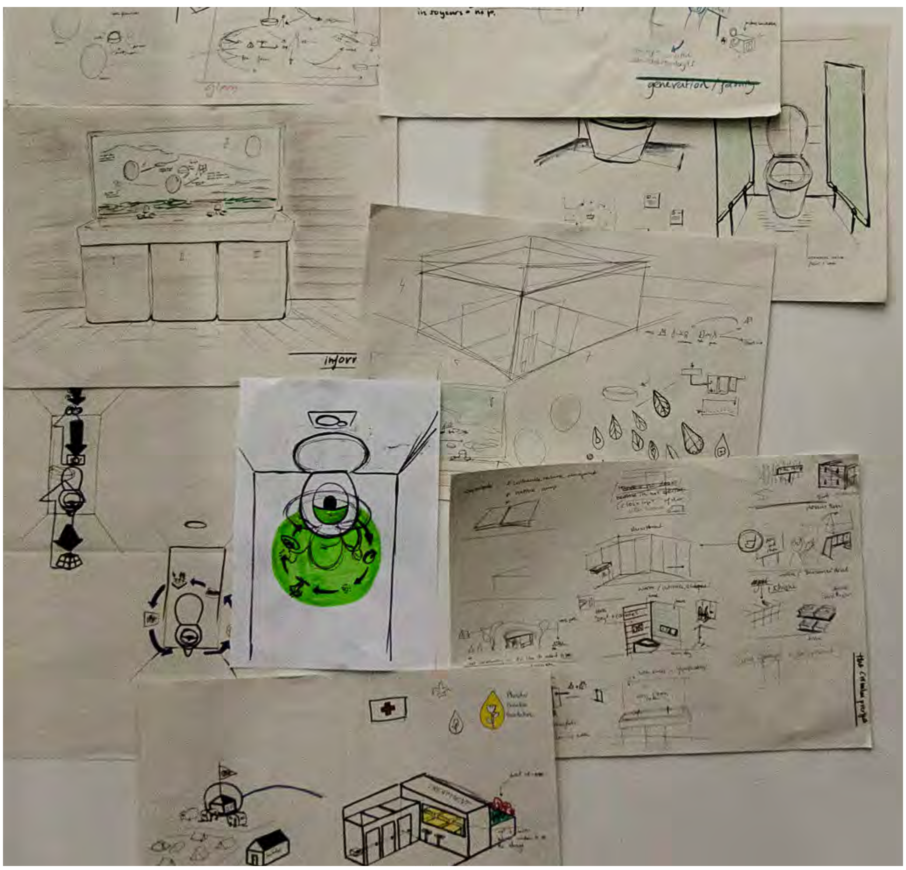
5.2 Other design methods

Unfortunately the other discipline did not had much time to support in the development of the concepts. Therefore most of this phase was carried out by the design students. The concept structure was used to present and inform the other students from the design development, and made it understandable. One of the Engineers was interested in design tools throughout the project and was interested in participating in the 'quick & dirty prototyping' due to time and planning he could not join.

- Idea and concept sketching
- Concept structure
- Quick & dirty "prototyping" (material test, restroom model)
- Style folders (Moodboards)
- Rendering



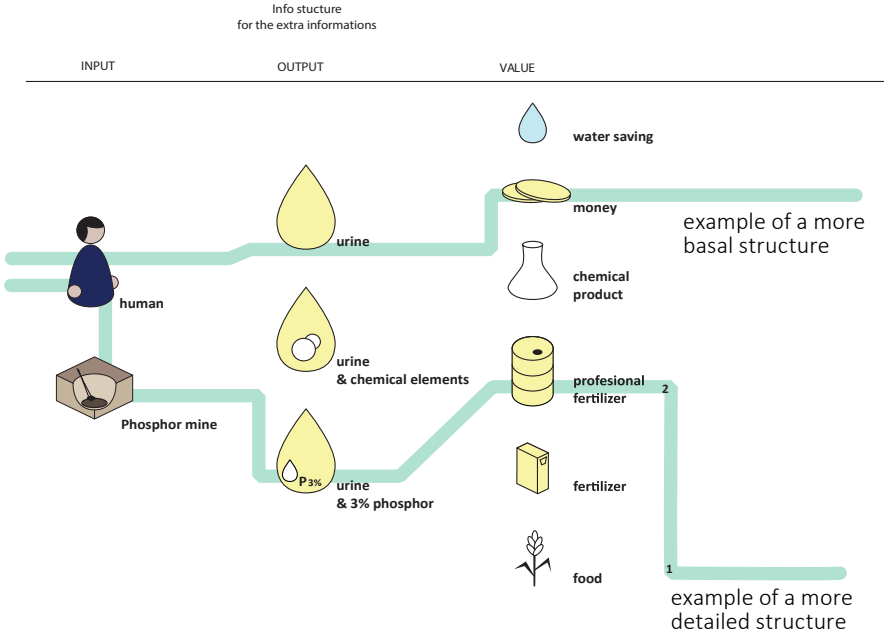

per concept
Questioning
look for answers
Choosing
thoughtfull decision
educating
step by step
all steps
Interpreting
collecting
Learn by discover
People dont know
= fertilizer



The concept structure was mainly based on these five aspects.

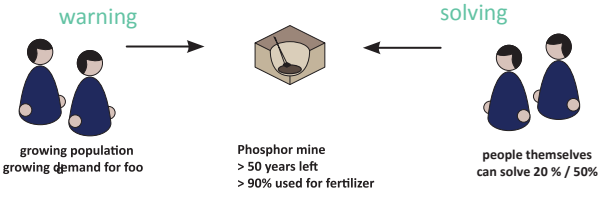
information structure

On what level is explained that the collection of human excretion is important? How is the value for example explained to the visitors and on what level do you go into detail on the consistence of urine.



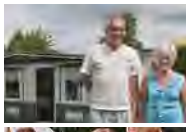
The message style

What is the colour of the message, warning or solving style?



examples:

- *you are part of it (responisble)*
- *you are needed (direct)*
- *Ich trenne (be part of the trend)*
- *help out (good deed)*
- *value – go collect!*
- *save water (easier to explain then P+N?)*



Personas

Who is informed and what are his or her interests and attitude

The survivalist	Hard-core survival
Young family	Activities for the whole family
the travelling millenniums (18-30)	Youngsters from '90/'00
the 'bingo champ'	Win - play – have fun / relax and simplicity
The experience collector	Discover new things: see, take & post
the unstoppable senior	Time is no problem, quality and free??
the big family (3 generations)	Activities for everyone in the family (0-99)
The couple	Together (or with other couples)

experience structure:

message style

focus group

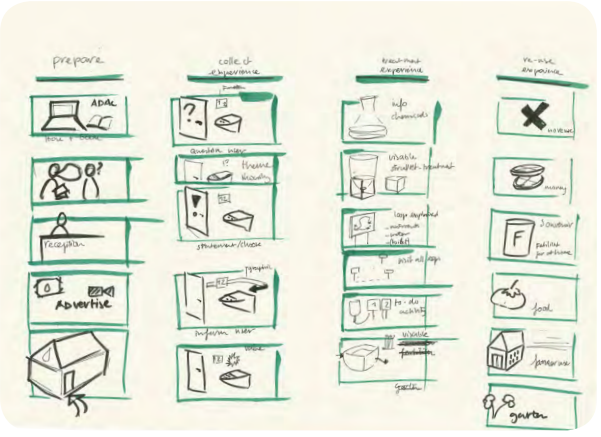
phases & medium

info-structure

strategy

Phases and medium

when and in what form is the visitor informed about the sustainable sanitation – via the booking website or in a conversation at the reception.



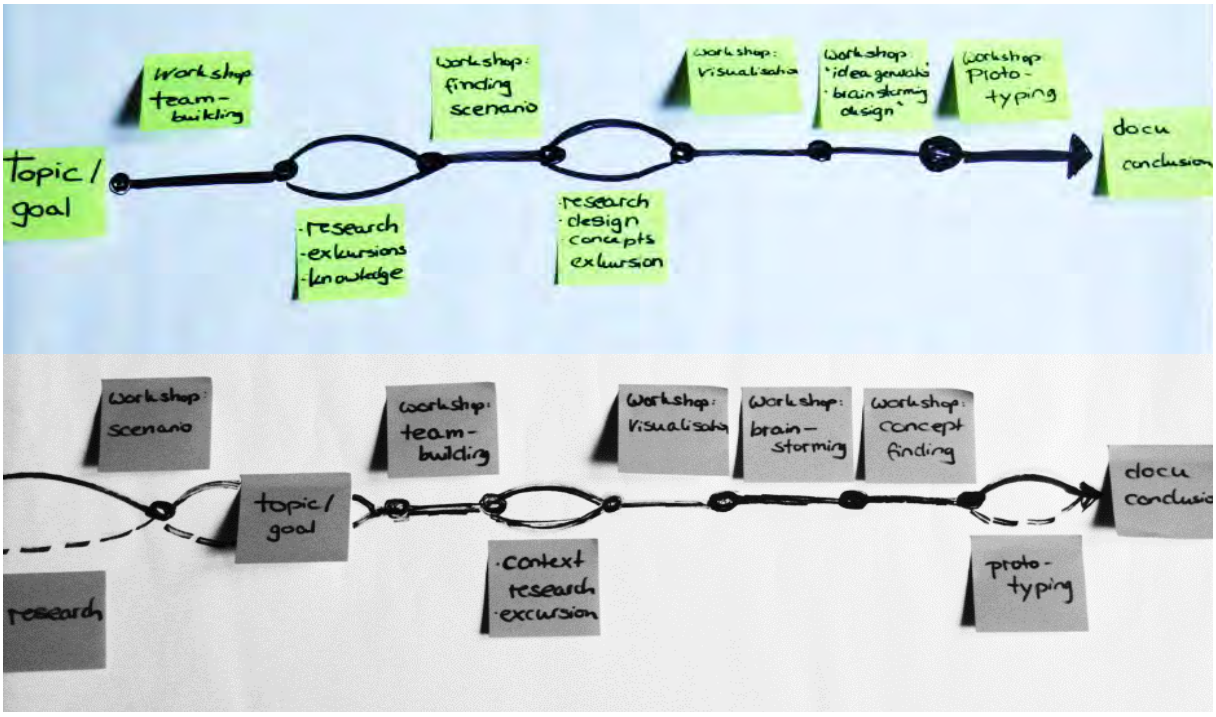
strategy / trigger

Creating awareness – creating the 'aha' moment! Making the user curious and willing to look into more information about this topic can be achieved in several ways.

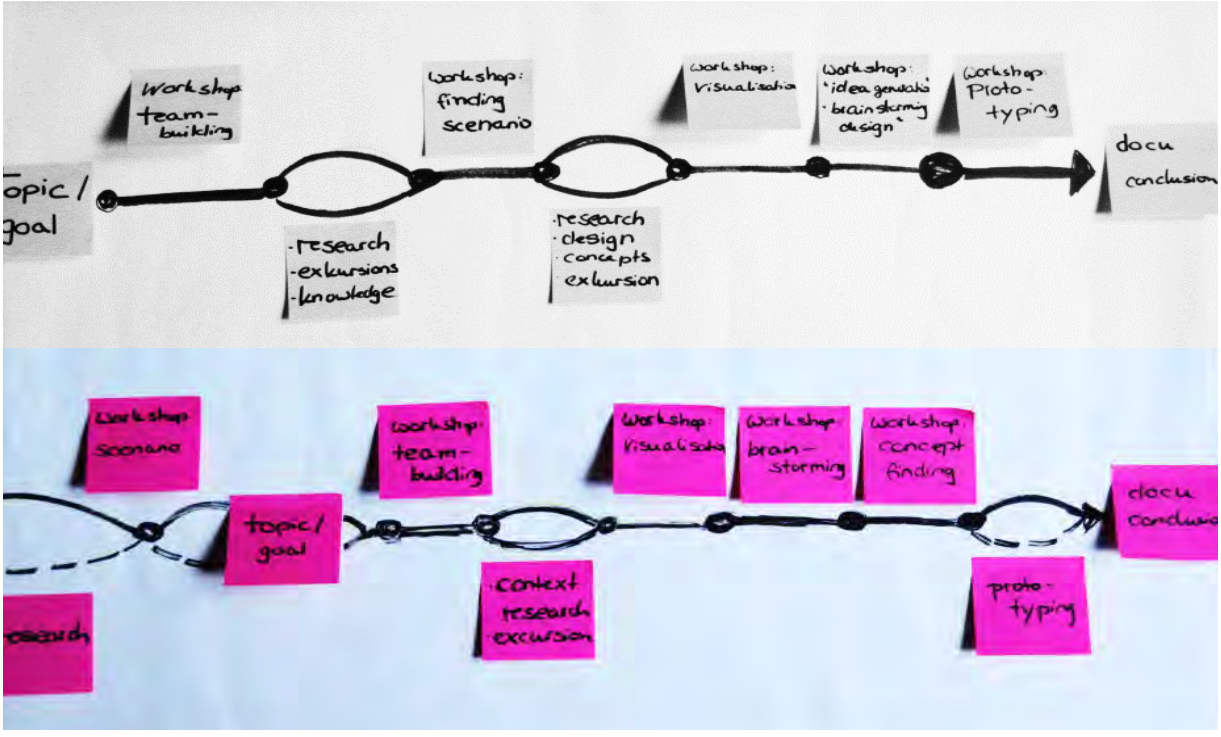
- Questioning the user (whether or not with something the user thought about before)
- Present the user an alternative (force the user to decide)
- Integrate the user – explain the user plays an important part of the resource loop
- Surrounding the user with the theme
- Collect = profit
- Educate
- Learn by discovering

Conclusion and Outlook

An intention of the project “integrated Sanitation Systems - iSaS” was not only to create a product, afterwards it offered a good chance for students to practice interdisciplinary work between students from different faculties of the Bauhaus-University of Weimar. The students had to create on their self a work process for a successful teamwork. Workshops were realized to characterise the team, decide the working field and design different concepts. There was the possibility showing design or visualization methods by students of the faculty of Product-Design. Otherwise students of environmental engineering tried to communicate the topic of sustainable and innovative sanitation systems. For supporting there were different workshops conducted and excursion were organized by the group. This team activities are a positive result of the work-process and they are proposed for further student projects. But there were significant factors which influenced the efficiency of the team work in negative ways.
The project was initiated by students of the faculty of product design and discussed separately with the professors and tutors of the faculties. The project topic was announced very quickly. During this definition phase there was no participation of students form the faculty of environmental engineering.
As you can see in the time plan 2 in the chapter “time plan” a collective meeting with all professors and all students at the beginning of the project is missing. There was no chance to clarify the different expectations between the faculties and the students. The mid-presentation was the first meeting where all participants of the project took part. After this presentation some research fields were cancelled, for example a public questionnaire or economic analysing of different sanitation systems. In addition to the researches on the topic “sustainable sanitation systems”, several working methods had to be created, because it was clarified that the interdisciplinary work-process was an important expectation of the faculty of environmental engineering. The designing of a product should be just a testing field for self-created working tools. For the faculty of product design the created product and the working process were equal rated. For further project there has to be a collective meeting with all participants. Here the different expectations, research fields, workloads and roles of faculties have to be defined for good start conditions. Another important thing which has to be improved



is the support during the project phases. It means that there have to be a regular meetings with the tutors and professors of the faculties. When there were meetings mostly consisting out of a tutor of one faculty and the students of the same faculty. Just at the beginning of the project and after the mid-presentation there were meetings were one tutor and all students took part. For further project it is proposed that there are meeting regular with one tutor and all students. This is an opportunity to give the tutors a constant overview about work progress, intended steps and students can solve existing difficulties together with their tutors earlier. Otherwise tutors can control the work process of the group, for example by limiting the different research fields, give advice for balanced workload of the different disciplines and support students by exchanging their different knowledge and working methods.
It was difficult to organise constant team meetings during the semester. Because of the different lesson plan a weekly meeting with all team members was either not possible or very short between the lessons. As you see in the time plan 2 a lot of team activities happened during March. There were no lessons and for example workshops were organized and mostly all excursions happened in this time, because there were no time limits. For interdisciplinary projects it could be helpful when project days or weeks during the semester are implemented in the lesson plan of all faculties. But not only is a same time management necessary. A same work place should be also available. The workplace of the students was a room in an example house of “Stiftung.Bauhaus.Eins.Weimar”. These are not rooms of the university and was organized and prepared by students themselves. At the library of the university students can rent meeting rooms, but just for some hours and can´t leave their work material not in there. Furthermore the students of the faculty product design got the opportunity to work in studios in the buildings of the university. Students of environmental engineering don´t got this opportunity.
Based on the results of the work process of this pilot project it is proposed to prepare the several project goals and topics together with all members of the participating faculties. A collective meeting at the beginning and separate meeting between the students and tutors have to be realized. The support by the faculties and university, as it is written before like work places, time, and tutor meetings have to be improved.



Notes biological process

These are notes and direct text copies which supported the chapter biological process. The sources match the list under this text.

The steps of these processes are placed here, directly copied/ coming from various sources. More explanations about body parts and processes can be found in the Lexicon. (the numbers behind some of the text block match the same sources)

Urinating
production of urine
Urine is produced (diuresis) by the kidney, this occurs constantly. (2)

storage
the urine is stored in the bladder. As the bladder becomes full, afferent firing increases, yet the micturition reflex can be voluntarily inhibited until it is appropriate to begin voiding. (2)

release moment
The state of the reflex system is dependent on both a conscious signal from the brain and the firing rate of sensory fibers from the bladder and urethra.[6]
Then a voluntary signal is sent from the brain to begin urination, (2)
Physiologically, urination involves coordination between the central, autonomic, and somatic nervous systems. Brain centers that regulate urination include the pontine micturition center, periaqueductal gray, and the cerebral cortex.[2]
Release the release depends on a reaction from the brain and the contraction of the bladder and the urethra

voiding phase
Normally, people urinate every 3 to 4 hours (3)
Voiding continues until the bladder is empty. (2) An average of 21 seconds (standard deviation 13 seconds. (2)
A voluntary signal is sent from the brain to begin urination. This signal (firing of neurons) causes the wall of the bladder to contract; the urinary sphincter to relax (7) and then the urine starts to flow out of the urethra. The urine flows through the urethra to the urinary meatus outside of the body. [2]

control of the bladder
more on http://en.wikipedia.org/wiki/Urination#cite_note-Roughgarden.2C_2004-2
http://en.wikipedia.org/wiki/Defecation

bladder control muscles:
pelvic floor muscles

Defecating
(pooping) Defecation is the final act of digestion, by which organisms eliminate solid, semi soid, and/or liquid waste material from the digestive tract via the anus.(4)

{ digestive system is responsible for taking whole foods and turning them into energy and nutrients to allow the body to function, grow, and repair itself. The six primary processes of the digestive system include:
1. Ingestion of food
2. Secretion of fluids and digestive enzymes
3. Mixing and movement of food and wastes through the body
4. Digestion of food into smaller pieces
5. Absorption of nutrients
6. Excretion of wastes
Prepared by Tim Taylor, Anatomy and Physiology Instructor
(S http://www.innerbody.com/image/digeov.html#full-description)
Excretion
{The final function of the digestive system is the excretion of waste in a process known as defecation. Defecation removes indigestible substances from the body so that they do not accumulate inside the gut. The timing of defecation is controlled voluntarily by the conscious part of the brain, but must be accomplished on a regular basis to prevent a backup of indigestible materials. } S http://www.innerbody.com/image/digeov.html#full-description)

{Waves of muscular contraction (known as peristalsis) in the walls of the colon move fecal matter through

the digestive tract towards the rectum.
When the rectum is full, an increase in intra-rectal pressure forces apart the walls of the anal canal, allowing the fecal matter to enter the canal.
The rectum shortens as material is forced into the anal canal and peristaltic waves push the feces out of the rectum. The internal and external anal sphincters along with the puborectalis muscle allow the feces to be passed by muscles pulling the anus up over the exiting feces
The external sphincter muscles relax. The anal and urethral sphincter muscles are closely linked}.

creating presure process
Defecation is normally assisted by taking a deep breath and trying to expel this air against a closed glottis (Valsalva maneuver). This contraction of expiratory chest muscles, diaphragm, abdominal wall muscles, and pelvic diaphragm exerts pressure on the digestive tract. Ventilation at this point temporarily ceases as the lungs push the chest diaphragm down to exert the pressure. Thoracic blood pressure rises and as a reflex response the amount of blood pumped by the heart decreases.

Experiment: defecating without urinating
Experiments by Dr. Harrison Weed at the Ohio State University Medical Center have shown they can only be contracted together, not individually, and that both show relaxation during urination [citation needed]. This explains why defecation is frequently accompanied by urination. (4) (no good source in wiki)

Sources Biological process

http://www.webmd.com/urinary-incontinence-oab/frequent-urination-causes-and-treatments
http://en.wikipedia.org/wiki/Urine
2 http://en.wikipedia.org/wiki/Urination
3 http://www.wikihow.com/Strengthen-Your-Bladder-and-Urinate-Less-Often
http://www.livescience.com/39453-urine-chemical-composition.html
http://www.babycentre.co.uk/x548924/when-should-i-start-potty-training

Tietze, H. W. (1997) ‚Urine the holy water' Australia: PHREE BOOKS ISBN 1876173041 // p24
13 Kira, A. (1987) 'Das Badezimmer ' (translation of 'the bathroom')Dusseldorf: Krammer Verlag ISBN 388382044X
defecation
http://www.innerbody.com/image/digeov.html#full-description
4 http://en.wikipedia.org/wiki/Bowel_movement
5 http://en.wikipedia.org/wiki/Constipation

Notes ergonomic factors

There was a lot of information found about ergonomic factors around the use of a sanitation facility.
Here are the points listed up that where left out of the documentation as they did not directly where used in the development of the three concepts.

Directions in general
- faeces (normally) fall straight down
- Urine has more pressure and often comes in the direction in which it is aimed (the body is)

> how closer urine is released to bowl for collecting the less its makes sounds and splashes

The urine stream is thin and rotates every 100 /150 mm around its own as. When it comes down in the urinal it divides into a conical shape. The size is depending on the pressure eg. How full the bladder is this form is bigger or smaller.

Design requirements facility

Design points washing and drying area
- Arbeithohe handen 915 / beckenhohe 915
- Sink broad 380 /430
- Wasserquelle up to the backwall 100 / 125 mm
- 815 mm between the next spot to wash your hands

As self-cleaning as possible, sinks where the draining water directly cleans the sink for example
- As little contact as possible while using improves the use – for example by foot or sensor

- A water temperature switch not necessary or to much
- The tap shuts ¬¬down after 45 to 60 seconds

Soap is not always present – a dispenser is the most hygienic and accepted form. Drying the hands : rubbing your hands under a drying make the bacteria spread even better, air blades (like Dysons) avoid this although fabric towels or paper towels e are favourite: quick, hygienic, different usable although these have to be refilled.

standing position
Standing positions – men
- Men are used and many prefer to urinate standing. Different angles can be reached whether or not the penis is supported by the hand.
- For little boys it is necessary to support the process with the hand otherwise they urinate straight forward

Men urinal
Designs and devices for men are very popular and well known and come in various shapes and designs. They are often placed in public spaces, people mostly use the facilities in public just for urinating and urinals are easier to install, take in less space and are cheaper. In the enclosures / here are a few points summed up that could be taken into account with the design of one.
- The place around the urinal for the person to stand is often limited by screens in between them which only have a specific depth to make sure the man stands closely to the urinal to avoid splashing.
- isolate or prevent sounds – for example by not having water standing in the urinal (urine on porcelain instead of urine in water)
- the shape of the urinal can prevent minimal 'back' splashing of urine
- The urine stream is thin and rotates every 100 /150 mm around its own as. When it comes down in the urinal it divides into a conical shape. The size is depending on the pressure eg. How full the bladder is this form is bigger or smaller.
- Minimal height 610 mm from the floor
- an opening of minimal 200x200 mm
- the smaller the angle between the urine stream and the landing surface the less splashing (desirable is 30 degrees) More points on the design and sizes can be found in Badezimmer
- stream is thin and rotates every 100 /150 mm around its own as. When it comes down in the urinal it divides into a conical shape. The size is depending on the pressure eg. How full the bladder is this form is bigger or smaller.

2.4.4.5 Cleaning yourself

Bidet
A more old fashioned way of cleaning is using a bidet These are often placed in bathrooms in private homes, were people baths only the under part of the body with water. The use of a bidet is not necessarily, cleaning these body parts regularly while cleaning your body is good enough. The use of a bidet is seen as extra or as replacement of cleaning the complete body >> conflicting with page 112 cleaning with water Is recommended..!
Bidet with shower is unhygienic : The bidet with a vertical shower
shower is been discussed on hygiene aspects, because the water goes partly back in the shower head and could cause trouble with bacteria's..

notes no-mix technology

Known brands for no-mix sanitation systems
- Dubetten http://www.dubbletten.se/wc-dubbletten-en.html
by BB Innovation & Co AB http://www.dubbletten.nu/about-us.html
- ROEDIGER
review http://forum.susana.org/forum/categories/34-urine-diversion-systems-includes-uddt-and-ud-flush-toilet/3406-roediger-nomix-toilets-good-or-bad-and-saniresch-final-report-urine-diversion-project-with-ud-flush-toilets-and-treatment-reactors-in-eschborn-germany
- Gustavsberg
- Wostman
- Roevac vacuum

dry no-mix sanitation systems
- Eco san http://www.ecosan.co.za/index.html

Different no-mix sanitation systems
Aquatron
The ecological toilet system Aquatron is a composting toilet utilizing ordinary Water Closets.
Sweden http://www.aquatron.se/index-2.php

Known brands consumer / Market leaders for toilets and bathroom design

Villeroy & boch www.villeroy-boch.com
Sphinx http://www.sphinx.nl/nl-NL/Zoeken.aspx?q=toilet
Duravit http://www.duravit.nl/website/home_be-nl/producten.be-nl.html
Axor
Keramaghttp://www.keramag.de/en.html
Laufen http://www.laufen.com/wps/wcm/connect/laufen_com/en/home/
ROCA http://www.roca.com
http://www.bcdesigns.co.uk/
Gustavsberg http://www.gustavsberg.com/en/private-consumers/
a holding of Villeroy & boch
Franke http://www.franke.com/ Known brands professional (public space)
Wisa
Loggere
Hansa
Stone Forest
Dornbracht
TOTO
Pearl
Kohler
Hansgrohe
Bear Creek Glass

example design requirements public facility

Chapter 11 Public toilets

Contents

11.1 Introduction

(1) This chapter outlines the following in the design of public toilets:
(a) design and construction standards;
(b) advice about satisfying assessment criteria in the City Plan.

(2) This chapter applies to stand alone buildings designed primarily as public toilets on Council owned land, such as parks.

11.2 Location

Public toilet buildings are located:
(a) near adjacent pedestrian paths, roads and facilities, with entrances facing onto most active space;
(c) in an area highly visible from most directions;
(d) in an area where there are activity generators (e.g. picnic facilities);
(e) so that vegetation around the building is an appropriate type and size;
(f) so that the buildings are responsive to crime prevention through environmental design principles.

11.3 Design standards

11.3.1 Building design

(1) Unisex toilet facilities are desirable for areas identified for low use.

(2) Gender-specific toilet facilities are desirable for areas of high use.

(3) If 1 x cubicle is provided, it is a unisex toilet.

(4) If more than one cubicle is provided, a minimum of 1 x cubicle is designed to be accessible.

(5) No screened lobby or any type of enclosed communal lobby is provided to public toilets.

(6) Solid, fully-enclosed buildings with a single common access are not appropriate.

(7) Cubicles are self-contained including a hand basin and open directly onto public space.

(8) If a cubicle is not large enough to accommodate hand basins (e.g. for ambulant facilities), the cubicle opens directly onto public space and hand basins are located outside in the public space.

(9) If a hand basin is located outside a cubicle, it is not screened.

(10) Provision of a translucent lightweight screened approach or hand basin lobby with continuous gaps to ground level is appropriate to ensure maximum visibility.

(11) Direct entry to cubicle configuration ensures:
(a) entry into a cubicle is to be through cubicle door only;
(b) the vertical design plane is assessed to eliminate wherever possible 'steps' or 'ladders' that could aid access and provide the opportunity for people to climb.

(12) Internal and external walls have a continuous gap of approximately 50-75mm at the bottom.

(13) A permeable screen is incorporated between the top of all internal and external cubicle walls and doors and the underside of the roof to assist with ventilation.

(14) Walls are solid and durable.

(15) Sprung door closers incorporated into hinges or pivots are provided with a gap (75-300mm) to the underside of cubicle doors.

(16) Roofing of a cubicle that opens directly onto a public space has generous overhang or a veranda.

(17) All building finishes are robust, impact-resistant, weather-resistant, easily cleaned, graffiti-resistant and comply with relevant Australian Standards.

(18) The floor of a public toilet:
(a) is of a mid-to-dark colour to hide dirt and grime;
(g) is easy to repair and maintain (e.g. broom-finished concrete);
(h) is a resilient, hard surface conforming to the required Australian Standard;
(i) is slip resistant;
(j) slopes down to a drain, to avoid the accumulation of water inside.

(19) Exterior and interior finishes and treatments are treated to minimise graffiti and vandalism.

(20) If brick or concrete, interior and exterior walls are rendered and painted or treated with an anti-graffiti coating.

(21) An exterior wall is a dark base colour.

(22) Multi-coloured murals that are consistent with the surroundings, or treatments that vary the materials, colours and surfaces, are used to disrupt smooth, blank continuous surfaces on exterior walls.

(23) Internal door faces have a protective anti-graffiti coating or stainless steel finish.

(24) Lighting levels are consistent along the main path of travel and around the building.

(25) Lighting is provided according to the use of the facility (i.e. daytime only or 24 hour hours).

(26) External lighting meets the requirements of Category P3 of AS/NZS 1158.3.1:2005 Lighting for roads and public spaces - Pedestrian area (Category P) lighting - Performance and design requirements.

(27) External lighting does not adversely impact on adjacent buildings and activities.

(28) External finishes do not generate obtrusive glare and reflection for surroundings.

(29) If a public toilet facility is to be used at night, internal and external lighting is provided.

(30) Skylights are used where possible for natural light.

(31) The minimum illumination level inside each toilet cubicle meets the relevant Australian Standards.

(32) Light fittings are energy efficient, high-mounted and vandal resistant.

11.3.2 Fixtures and fittings

(1) Stainless steel basins with vandal-resistant fixings and stainless steel or chromed brass drainage pipes.

(2) Porcelain fixtures are not used.

(3) If the risk of vandalism is high, stainless steel water closet (WC) pans are provided with an integrated seat and vandal-resistant fixings.

(4) If the risk of vandalism is low, separate toilet seats (PVC or porcelain) can be used.

(5) Drainage pipes under hand basins are concealed within a stainless steel enclosure with vandal-proof fixings that is able to be accessed for maintenance.

(6) Supply and drainage pipework is concealed in ducts where possible.

(7) Urinals are not installed.

(8) Tapware is robust and vandal-proof, fitted with spring shut-off valve function to regulate water consumption.

(9) Tapware replacements are readily available from major manufacturers.

(10) All plumbing fixtures and fittings are selected, installed and managed with water conservation as a priority.

11.3.3 Other design considerations

(1) A continuous path of travel is provided from a toilet facility to source of demand consistent with AS 1428.1-2009/Amdt 1-2010 Design for access and mobility - General requirements for access - New building work.

(2) Directional signage considers use by people with vision impairments in accordance with Disability Standards (Access to Premises – Building), Part D4 – which includes the use of braille characters on all signs.

(3) The designation (gender use and mix) is clearly signed in language and symbol.

(4) Shrubs and garden bed species are selected and maintained to grow to a maximum of 700mm high.

(5) Tree species are selected and maintained to eliminate branching and foliage below 2m high to maintain sight lines to the building.

(6) Vegetation selection considers:
(a) reduced future garden and building maintenance;
(k) future root invasion of footings and pipes.

(7) Low-level landscaping is provided along walls to provide a buffer.

(8) Exposed cisterns are avoided.

(9) Door hardware:
(a) is robust and vandal-proof;
(l) replacements are readily available from major manufacturers;
(m) identifies when a toilet cubicle is in use.

(10) Clothing hooks are not provided in ambulant.

(11) Mirrors, if provided, are stainless steel unless specifically requested otherwise.

(12) Toilet roll holders are robust and secure.

(13) Basins with flat surrounds also serve as shelves.

(14) Shelves are not provided.

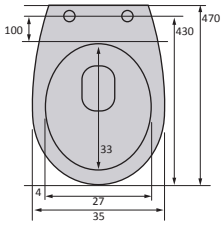
(15) If the risk of vandalism is low, and paper towel dispensers are not provided, a sensor-activated hand dryer can be installed.

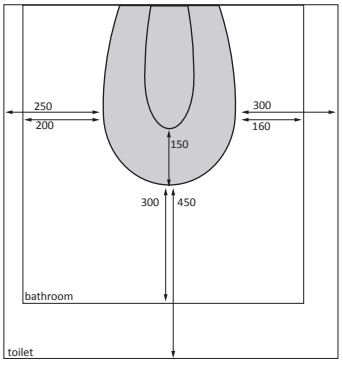
11.3.4 Accessible toilets

An accessible public toilet is designed in accordance with AS 1428.1-2009/Amdt 1-2010 Design for access and mobility - General requirements for access - New building work and includes:
(a) a hand basin inside the cubicles;
(b) grab rails secured to the structural frame or solid blockwork.

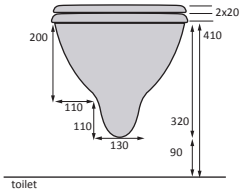
measurement toilets at home

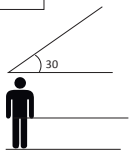
for quick and dirty prototyping



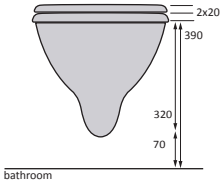


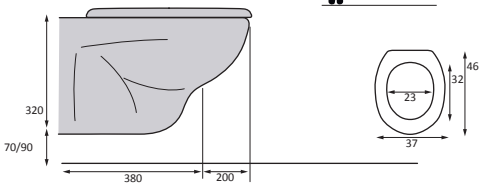

toilet

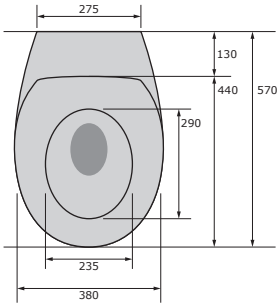


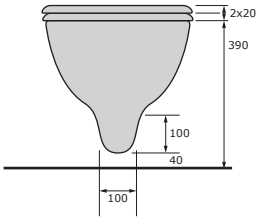


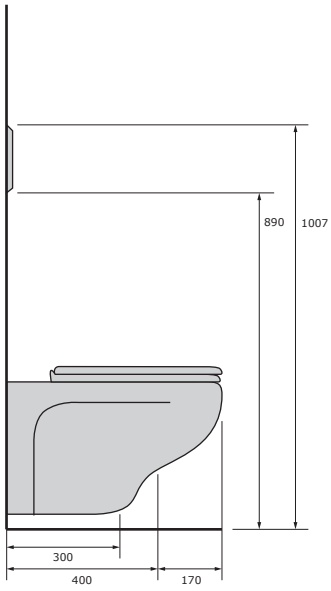

bathroom





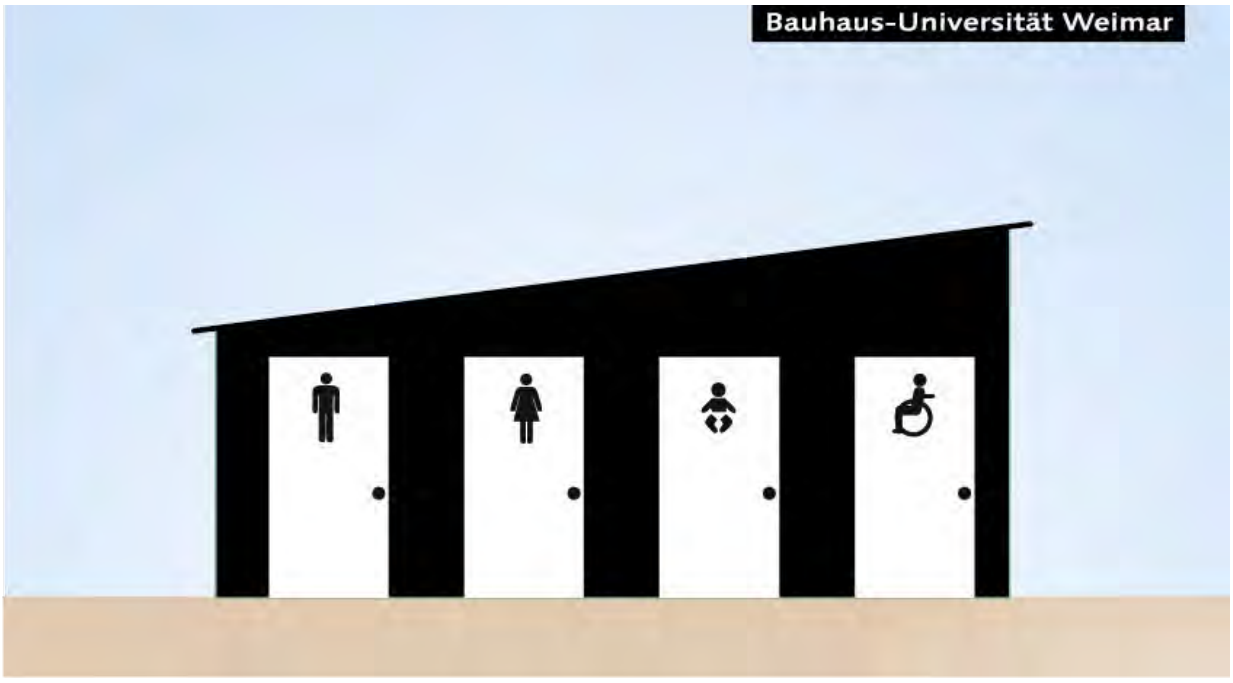






questionnaire - questions

for user and market research



Im Rahmen unseres studentischen Projekts, befassen wir uns mit der Integration von Sanitäranlagen bzw.- systemen. Diese Umfrage soll dazu dienen die öffentliche Meinung aufzugreifen, da diese eine wichtige Rolle für uns spielen wird.
Im ersten Teil möchten wir Ihnen Fragen rund um öffentliche Toiletten stellen. Bitte beachten Sie, dass es sich dabei um festinstallierte und langfristige Anlagen handeln soll, wie z.B. Autobahn- und Bahnhofstoiletten oder Toiletten in Fußgängerzonen.
Der zweite Teil dient uns dazu einen Einblick in das allgemeine Bewusstsein über neuartige Sanitärsysteme zu bekommen.
Danke für Ihre Teilnahme.

Allgemeine Fragen zu Ihrer Person

Wie alt sind Sie? *

Pflichtfrage

- ◯ < 25
- ◯ 26 - 50
- ◯ 51 - 70
- ◯ > 70

Was ist Ihr Geschlecht? *

Pflichtfrage

- ◯ Frau
- ◯ Mann

Was ist Ihre Nationalität?

Haben Sie einen Migrationshintergrund?

- ○ nein
- ○ ja

Wenn ja, welches Land?

Sind Sie dauerhaft körperlich eingeschränkt? *

Pflichtfrage

- ○ ja
- ○ nein

Wenn ja, was und welche körperliche Auswirkungen entstehen dadurch für Sie?

Welche	
körperliche Auswirkung	

Allgemeine Fragen zur Nutzung öffentlicher Toiletten

Benutzen Sie öffentliche Toiletten? *

Pflichtfrage

- ☐ nie
- ☐ selten
- ☐ oft
- ☐ nur wenn es keine andere Alternative gibt

Wie ist Ihr Nutzungsbedarf?

- ☐ für mich alleine
- ☐ als Begleitung (Baby, Senior, Eingeschränkte)

Ist es Ihnen unangenehm die Toilette und Armaturen zu berühren? *

Pflichtfrage

- ○ ja
- ○ nein

Wie benutzen Sie öffentliche Toiletten? *

Pflichtfrage

	ich sitze	ich hocke mich ÜBER die Toilette	ich hocke mich AUF die Toilette	ich stehe	ich wische die Brille vorher mit Papier ab	ich lege Papier auf der Brille aus
Urinieren	☐	☐	☐	☐	☐	☐
Koten	☐	☐	☐	☐	☐	☐

Bewerten Sie öffentliche Toiletten hinsichtlich folgender Kriterien! Welche Gewichtung hat das jeweileige Kriterium für Sie? *

Pflichtfrage

	1 sehr gut	2	3	4	5	6 sehr schlecht	Gewichtung ++ sehr wichtig -- sehr unwichtig --	-	+	++
Sauberkeit	○	○	○	○	○	○	○	○	○	○
Hygiene	○	○	○	○	○	○	○	○	○	○
Geruch	○	○	○	○	○	○	○	○	○	○
Handhabung/Bedienung	○	○	○	○	○	○	○	○	○	○
Barrierefreiheit	○	○	○	○	○	○	○	○	○	○
Ästhetik und Design	○	○	○	○	○	○	○	○	○	○
Komfort	○	○	○	○	○	○	○	○	○	○
Intimität	○	○	○	○	○	○	○	○	○	○
öffentliche Sicherheit	○	○	○	○	○	○	○	○	○	○

Machen Sie nach der Nutzung die Toilette sauber? *

Pflichtfrage

- ○ ja, immer
- ○ ja, wenn es schon sauber war
- ○ ja, wenn es kostenlos war
- ○ nein, wenn es vorher nicht sauber war
- ○ nein, wenn ich bezahlt habe
- ○ nein, es ist mir egal

Welche Art der Bedienung finden Sie besser? *

Pflichtfrage

	Hand	Fuss	Automatisch
Spülen	○	○	○
Putzen	○	○	○
Öffnen/Schliessen	○	○	○
Armaturen	○	○	○
Eimer für Hygieneartikel	○	○	○

Was finden Sie gut an öffentlichen Toiletten?

Welche Störfaktoren gibt es für Sie?

Allgemeine Fragen zu neuartigen Sanitärsystemen

Aus welchen Gründen müssten wir uns mit neuartigen Sanitärsystemen auseinandersetzen? *

Pflichtfrage (Sonstiges bitte eintragen)

- [ ] Umweltschutz
- [ ] gesellschaftliche Verantwortung
- [ ] wirtschaftliche Vorteile
- [ ] Neugierde und Interesse
- [ ] Nachhaltigkeitsgedanke
- [ ] kein Interesse
- [ ]

Kennen Sie folgende Technik?

Regenwassernutzung für Toilettenspülung *

Pflichtfrage

- [ ] kenne ich nicht
- [ ] kenne ich
- [ ] schon mal benutzt
- [ ] würde ich ausprobieren

Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Pflichtfrage

	sehr groß	groß	klein	sehr klein	gar keine
Sauberkeit	○	○	○	○	○
Hygiene	○	○	○	○	○
Geruch	○	○	○	○	○
Handhabung/Bedienung	○	○	○	○	○
Ästhetik und Design	○	○	○	○	○
Installationsaufwand	○	○	○	○	○
Praxistauglichkeit	○	○	○	○	○
Bezahlbarkeit	○	○	○	○	○

Kennen Sie folgende Technik?

Grauwassernutzung (Waschwasser) für Toilettenspülung *

Pflichtfrage

- ☐ kenne ich nicht
- ☐ kenne ich
- ☐ schon mal benutzt
- ☐ würde ich ausprobieren

Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Pflichtfrage

	sehr groß	groß	klein	sehr klein	gar keine
Sauberkeit	○	○	○	○	○
Hygiene	○	○	○	○	○
Geruch	○	○	○	○	○
Handhabung/Bedienung	○	○	○	○	○
Ästhetik und Design	○	○	○	○	○
Installationsaufwand	○	○	○	○	○
Praxistauglichkeit	○	○	○	○	○
Bezahlbarkeit	○	○	○	○	○

Kennen Sie folgende Technik?

Trockentoiletten (wenig bis gar keine Wassernutzung) *

Pflichtfrage

- ☐ kenne ich nicht
- ☐ kenne ich
- ☐ schon mal benutzt
- ☐ würde ich ausprobieren

Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Pflichtfrage

	sehr groß	groß	klein	sehr klein	gar keine
Sauberkeit	○	○	○	○	○
Hygiene	○	○	○	○	○
Geruch	○	○	○	○	○
Handhabung/Bedienung	○	○	○	○	○
Ästhetik und Design	○	○	○	○	○
Installationsaufwand	○	○	○	○	○
Praxistauglichkeit	○	○	○	○	○
Bezahlbarkeit	○	○	○	○	○

Kennen Sie folgende Technik?

Trenntoiletten (seperate Erfassung von Urin und Fäzes) *

Pflichtfrage

- ☐ kenne ich nicht
- ☐ kenne ich
- ☐ schon mal benutzt
- ☐ würde ich ausprobieren

Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Pflichtfrage

	sehr groß	groß	klein	sehr klein	gar keine
Sauberkeit	○	○	○	○	○
Hygiene	○	○	○	○	○
Geruch	○	○	○	○	○
Handhabung/Bedienung	○	○	○	○	○
Ästhetik und Design	○	○	○	○	○
Installationsaufwand	○	○	○	○	○
Praxistauglichkeit	○	○	○	○	○
Bezahlbarkeit	○	○	○	○	○

Kennen Sie folgende Technik?

Vakuumtoiletten (Abführen der Fäkalien mittels Vakuumtechnik) *

Pflichtfrage

- ☐ kenne ich nicht
- ☐ kenne ich
- ☐ schon mal benutzt
- ☐ würde ich ausprobieren

Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Pflichtfrage

	sehr groß	groß	klein	sehr klein	gar keine
Sauberkeit	○	○	○	○	○
Hygiene	○	○	○	○	○
Geruch	○	○	○	○	○
Handhabung/Bedienung	○	○	○	○	○
Ästhetik und Design	○	○	○	○	○
Installationsaufwand	○	○	○	○	○
Praxistauglichkeit	○	○	○	○	○
Bezahlbarkeit	○	○	○	○	○

Bezeichnen Sie die Produkte einer Toilette (Abwasser, Fäkalien, Papier etc.)! *

Pflichtfrage

- ◯ Abfall
- ◯ Ressource

Würden Sie benutztes Toilettenpapier in Behältern sammeln? *

Pflichtfrage

- ◯ ja
- ◯ nein

Würden Sie mit menschlichen Urin gedüngte Produkte kaufen und verbrauchen? *

Pflichtfrage

- ◯ ja
- ◯ nein

Die Umfrage ist beendet. Vielen Dank für Ihre Teilnahme.

Haben Sie Fragen zur Thematik oder möchten Sie uns noch auf weitere Dinge aufmerksam machen, die es Ihrer Meinung nach zu beachten gilt, dann können Sie uns gerne eine E-Mail schicken. Auch für ein kleines Gespräch stehen wir Ihnen gerne zur Verfügung.

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Allgemeine Fragen zu Ihrer Person

1. 1. Wie alt sind Sie? *

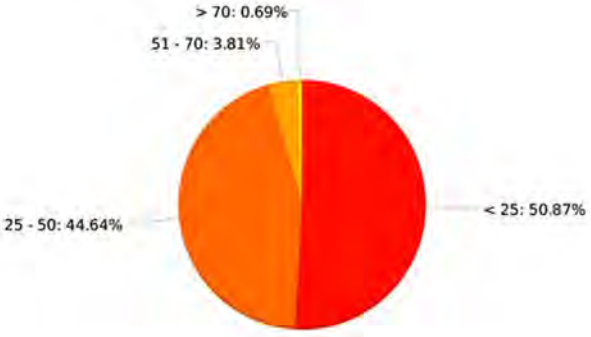
   Anzahl Teilnehmer: 289

   147 (50.9%): < 25

   129 (44.6%): 25 - 50

   11 (3.8%): 51 - 70

   2 (0.7%): > 70



2. 2. Was ist Ihr Geschlecht? *

   Anzahl Teilnehmer: 289

   142 (49.1%): Frau

   147 (50.9%): Mann

3. 3. Was ist Ihre Nationalität?

   Anzahl Teilnehmer: 276

   Antworten:

   Alle 241 vorangegangenen Antworten anzeigen

   - deutsch
   - deutsch
   - Deutscher
   - deutsch
   - deutsch
   - deutsch
   - Deutsch
   - deutsch
   - deutsch
   - deutsch

4. 4. Haben Sie einen Migrationshintergrund?

Anzahl Teilnehmer: 281

266 (94.7%): nein

15 (5.3%): ja

5. 5. Wenn ja, welches Land?

Anzahl Teilnehmer: 14

Antworten:
- Türkei
- -
- Deutschland
- I
- Russland
- Kasachstan
- Vietnam
- Israel
- England
- Spanien

6. 6. Sind Sie dauerhaft körperlich eingeschränkt? *

Anzahl Teilnehmer: 289

1 (0.3%): ja

288 (99.7%): nein

7. 7. Wenn ja, welche Art der Einschränkung haben Sie und welche körperliche Auswirkungen entstehen dadurch für Sie?

Anzahl Teilnehmer: 3

Art der Einschränkung
- -
- -
- nein

körperliche Auswirkung
- -
- -
- nein

Allgemeine Frage zur Nutzung öffentlicher Toiletten

8. 8. Benutzen Sie öffentliche Toiletten? *

Anzahl Teilnehmer: 244

	nie (1)		selten (2)		oft (3)		nur wenn es keine Alternative gibt (4)		Ø	±
	Σ	%	Σ	%	Σ	%	Σ	%		
Kaufhaus/Geschäft	23x	9,43	145x	59,43	46x	18,85	30x	12,30	2,34	0,81
Fußgängerzone	119x	48,77	60x	24,59	5x	2,05	60x	24,59	2,02	1,22
Autobahnrastätte	7x	2,87	144x	59,02	61x	25,00	32x	13,11	2,48	0,76
Autobahnparkplatz	34x	13,93	104x	42,62	38x	15,57	68x	27,87	2,57	1,04
Restaurant/Café	1x	0,41	56x	22,95	178x	72,95	9x	3,69	2,80	0,49

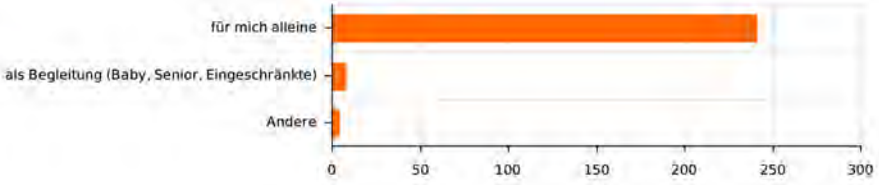
9. 9. Wie ist Ihr Nutzungsbedarf?

Anzahl Teilnehmer: 244

241 (98.8%): für mich alleine

8 (3.3%): als Begleitung (Baby, Senior, Eingeschränkte)

4 (1.6%): Andere



10. 10. Ist es Ihnen unangenehm die Toilette und Armaturen zu berühren? *

Anzahl Teilnehmer: 244

173 (70.9%): ja

71 (29.1%): nein

11. 11. Wie benutzen Sie öffentliche Toiletten? *

Anzahl Teilnehmer: 244

	ich sitze		ich hocke mich ÜBER die Toilette		ich hocke mich AUF die Toilette		ich stehe		ich wische die Brille vorher mit Papier ab		ich lege Papier auf der Brille aus	
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%
kleines Geschäft	33x	13,52	95x	38,93	2x	0,82	114x	46,72	36x	14,75	43x	17,62
großes Geschäft	78x	31,97	59x	24,18	5x	2,05	1x	0,41	100x	40,98	129x	52,87

12. 12. Basierend auf Ihren Erfahrungen bewerten Sie öffentliche Toiletten hinsichtlich folgender Kriterien! Welche Gewichtung hat das jeweileige Kriterium für Sie?

Serviceanbieter ist vor Ort (Reingungskräfte etc). *

Anzahl Teilnehmer: 244

	1 sehr gut (1)		2 (2)		3 (3)		4 (4)		5 (5)		6 sehr schlecht (6)				
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±	G
Sauberkeit	27x	11,07	121x	49,59	62x	25,41	24x	9,84	10x	4,10	-	-	2,46	0,96	91%
Hygiene	22x	9,02	102x	41,80	76x	31,15	28x	11,48	14x	5,74	2x	0,82	2,66	1,04	93%
Geruch	18x	7,38	83x	34,02	75x	30,74	40x	16,39	23x	9,43	5x	2,05	2,93	1,17	74%
Handhabung/Bedienung	21x	8,61	119x	48,77	84x	34,43	18x	7,38	2x	0,82	-	-	2,43	0,79	50%
Barrierefreiheit	19x	7,79	71x	29,10	86x	35,25	51x	20,90	15x	6,15	2x	0,82	2,91	1,06	42%
Ästhetik und Design	3x	1,23	44x	18,03	98x	40,16	58x	23,77	36x	14,75	5x	2,05	3,39	1,05	35%
Komfort	7x	2,87	49x	20,08	100x	40,98	52x	21,31	28x	11,48	8x	3,28	3,28	1,10	46%
Intimität	19x	7,79	52x	21,31	93x	38,11	42x	17,21	33x	13,52	5x	2,05	3,14	1,19	73%
öffentliche Sicherheit	28x	11,48	88x	36,07	87x	35,66	31x	12,70	7x	2,87	3x	1,23	2,63	1,02	61%

13. 13. Basierend auf Ihren Erfahrungen bewerten Sie öffentliche Toiletten hinsichtlich folgender Kriterien! Welche Gewichtung hat das jeweileige Kriterium für Sie?

Serviceanbieter ist NICHT vor Ort (Reingungskräfte etc). *

Anzahl Teilnehmer: 241

	1 sehr gut (1)		2 (2)		3 (3)		4 (4)		5 (5)		6 sehr schlecht (6)				
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±	G
Sauberkeit	9x	3,73	12x	4,98	51x	21,16	71x	29,46	61x	25,31	37x	15,35	4,14	1,27	90%
Hygiene	8x	3,32	14x	5,81	42x	17,43	69x	28,63	71x	29,46	37x	15,35	4,21	1,26	91%
Geruch	5x	2,07	12x	4,98	39x	16,18	66x	27,39	84x	34,85	35x	14,52	4,32	1,18	72%
Handhabung/Bedienung	7x	2,90	66x	27,39	107x	44,40	47x	19,50	11x	4,56	3x	1,24	2,99	0,94	51%
Barrierefreiheit	12x	4,98	48x	19,92	89x	36,93	60x	24,90	29x	12,03	3x	1,24	3,23	1,09	44%
Ästhetik und Design	4x	1,66	18x	7,47	60x	24,90	75x	31,12	63x	26,14	21x	8,71	3,99	1,15	34%
Komfort	3x	1,24	20x	8,30	73x	30,29	74x	30,71	52x	21,58	19x	7,88	3,87	1,13	47%
Intimität	13x	5,39	41x	17,01	79x	32,78	61x	25,31	37x	15,35	10x	4,15	3,41	1,21	71%
öffentliche Sicherheit	8x	3,32	36x	14,94	71x	29,46	70x	29,05	38x	15,77	18x	7,47	3,61	1,23	63%

14. 14. Machen Sie nach der Nutzung die Toilette sauber? *

Anzahl Teilnehmer: 244

92 (37.7%): ja, immer

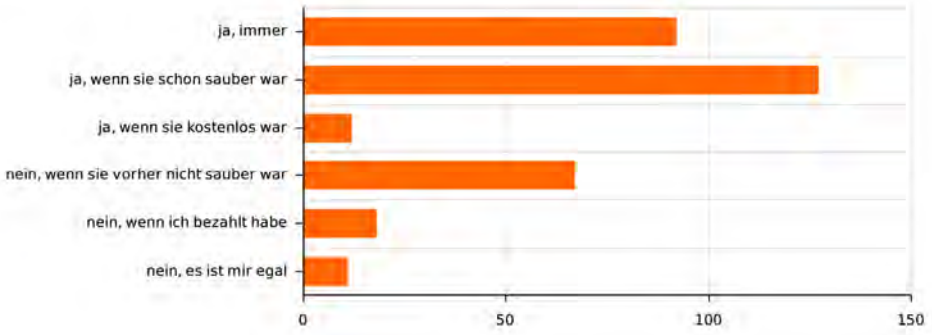
127 (52.0%): ja, wenn sie schon sauber war

12 (4.9%): ja, wenn sie kostenlos war

67 (27.5%): nein, wenn sie vorher nicht sauber war

18 (7.4%): nein, wenn ich bezahlt habe

11 (4.5%): nein, es ist mir egal



15. 15. Welche Art der Bedienung finden Sie besser? *

Anzahl Teilnehmer: 244

	Hand (1)		Fuss (2)		Automatisch (3)			
	Σ	%	Σ	%	Σ	%	Ø	±
Spülen	38x	15,57	62x	25,41	144x	59,02	2,43	0,75
Reinigen	28x	11,48	26x	10,66	190x	77,87	2,66	0,67
Öffnen/Schliessen	82x	33,61	59x	24,18	103x	42,21	2,09	0,87
Armaturen	59x	24,18	32x	13,11	153x	62,70	2,39	0,85
Eimer für Hygieneartikel	29x	11,89	138x	56,56	77x	31,56	2,20	0,63

16. 16. Was finden Sie positiv an öffentlichen Toiletten?

Anzahl Teilnehmer: 109 Antworten:

Alle 74 vorangegangenen Antworten anzeigen

- In der naehe
- Verfügbarkeit.
- Dass es sie gibt. Sonst wäre es als Frau manchmal schon sehr schwierig, falls man dringend auf Toilette muss.
- Die Möglichkeit seiner Notdurft nachzukommen, wenn man unterwegs ist.
- leicht zugänglich
- Das es sie gibt.
- wenn man doch mal muss, ist was da
- für die äußerste Notdurft ist eine Möglichkeit vorhanden
- positiv ist, dass man sich keinen wald suchen muss
- das es sie gibt
- Helfer in der Not
- dass es sie gibt
- Das es sie gibt.

17. 17. Welche Störfaktoren gibt es für Sie?

Anzahl Teilnehmer: 118 Antworten:

Alle 83 vorangegangenen Antworten anzeigen

- - große Menschenansammlung
-keine Privatshäre
- Hohe Geruchsbelästigung und sehr unsauber
- mangelnde Hygiene, dafür jedoch zu hohe Preise
- Geruch/mangelnde Sauberkeit
- zu viele, u.a. die Sauberkeit,
wenn die brille vom Klo rutsch und man fast runter fällt
- sauberkeit udn Hygiene
- schmutz und mangelnde hygiene
- Unsauberkeit
weite Wege
keine hygieneartikelvorhanden
- Meistens wird Geld verlangt und dennoch ist die Sauberkeit der Toiletten nicht gewährleistet. Zudem wird viel zu oft mit ein und dem selben Lappen alles "gereinigt". Toiletten mit einem Drehknauf zu schließen, ist meiner Meinung nach ebenso unhygienisch und unpraktisch. Türen zum Verlassen der Toiletten sollten automatisch öffnen und schließen, sodass man nach dem Händewaschen nicht gezwungen ist, den Türgriff anzufassen. Man sieht immer wieder, dass sich einige nicht die Hände waschen und dann eben diesen Türgriff anfassen, den man somit auch anfassen muss.
- Das "Verständnis" von Sauberkeit anderer Menschen.

18. 18. Schätzen den Wasserverbrauch bei einem ganzen Spühlvorgang (ohne Stoptaste)!

Anzahl Teilnehmer: 222 Antworten:

Alle 187 vorangegangenen Antworten anzeigen

- 10
- 5
- 7
- 20
- 8
- 12
- 10
- 5
- 6 Liter
- 10
- 30l
- 5
- 5
- 10 L
- 8 l
- 10
- 2l
- 7 Liter
- 40
- 6
- 5
- 5L
- 10
- 10
- 3
- 5
- 10
- 8
- 6
- 15
- 20
- ca. 10 Liter
- 20
- 15 Liter
- 5

Allgemeine Frage zu neuartigen Sanitäsystemen

19. 19. Aus welchen Gründen sollte man sich mit neuartigen Sanitärsystemen auseinandersetzen? *

Anzahl Teilnehmer: 221

195 (88.2%): Umweltschutz

104 (47.1%): gesellschaftliche Verantwortung

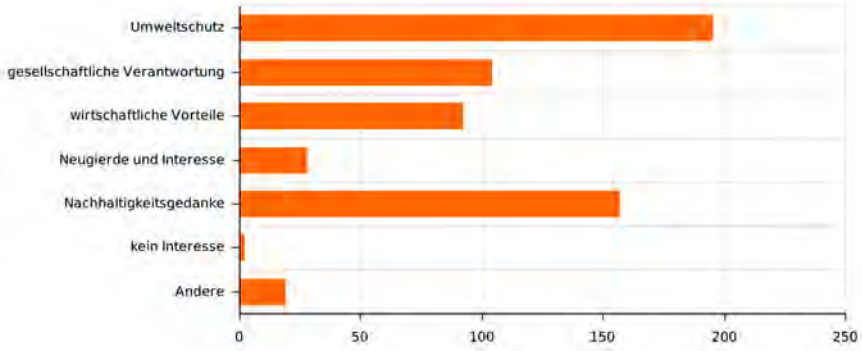
92 (41.6%): wirtschaftliche Vorteile

28 (12.7%): Neugierde und Interesse

157 (71.0%): Nachhaltigkeitsgedanke

2 (0.9%): kein Interesse

19 (8.6%): Andere



20. 20. Kennen Sie folgende Technik?

Regenwassernutzung für Toilettenspülung *

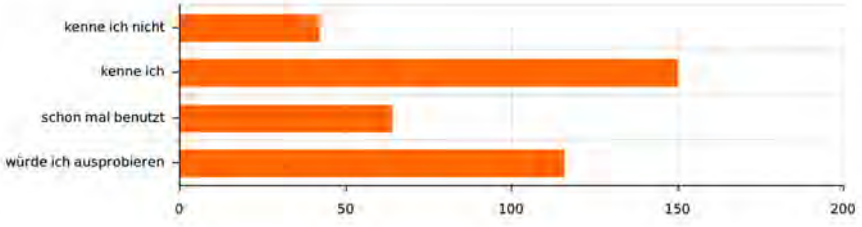
Anzahl Teilnehmer: 221

42 (19.0%): kenne ich nicht

150 (67.9%): kenne ich

64 (29.0%): schon mal benutzt

116 (52.5%): würde ich ausprobieren



21. 21. Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Anzahl Teilnehmer: 221

	sehr groß (1)		groß (2)		klein (3)		sehr klein (4)		gar keine (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
Sauberkeit	3x	1,36	14x	6,33	60x	27,15	61x	27,60	83x	37,56	3,94	1,01
Hygiene	5x	2,26	20x	9,05	65x	29,41	58x	26,24	73x	33,03	3,79	1,07
Geruch	4x	1,81	27x	12,22	71x	32,13	52x	23,53	67x	30,32	3,68	1,09
Handhabung/Bedienung	4x	1,81	10x	4,52	54x	24,43	58x	26,24	95x	42,99	4,04	1,01
Ästhetik und Design	1x	0,45	12x	5,43	48x	21,72	62x	28,05	98x	44,34	4,10	0,95
Installationsaufwand	11x	4,98	82x	37,10	62x	28,05	36x	16,29	30x	13,57	2,96	1,13
Praxistauglichkeit	9x	4,07	33x	14,93	73x	33,03	46x	20,81	60x	27,15	3,52	1,16
Bezahlbarkeit	10x	4,52	50x	22,62	71x	32,13	42x	19,00	48x	21,72	3,31	1,17

22. 22. Kennen Sie folgende Technik?

Grauwassernutzung (Waschwasser) für Toilettenspülung *

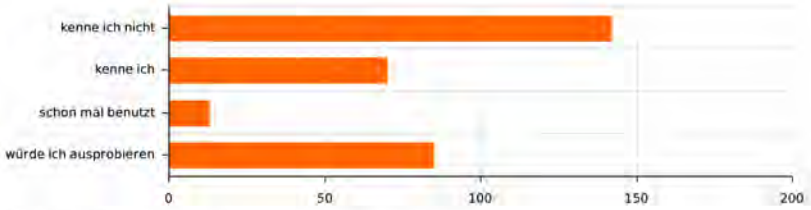
Anzahl Teilnehmer: 221

142 (64.3%): kenne ich nicht

70 (31.7%): kenne ich

13 (5.9%): schon mal benutzt

85 (38.5%): würde ich ausprobieren



23. 23. Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Anzahl Teilnehmer: 220

	sehr groß (1)		groß (2)		klein (3)		sehr klein (4)		gar keine (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
Sauberkeit	8x	3,64	49x	22,27	69x	31,36	48x	21,82	46x	20,91	3,34	1,15
Hygiene	11x	5,00	47x	21,36	76x	34,55	39x	17,73	47x	21,36	3,29	1,17
Geruch	10x	4,55	52x	23,64	78x	35,45	34x	15,45	46x	20,91	3,25	1,16
Handhabung/Bedienung	4x	1,82	15x	6,82	75x	34,09	46x	20,91	80x	36,36	3,83	1,06
Ästhetik und Design	5x	2,27	16x	7,27	78x	35,45	47x	21,36	74x	33,64	3,77	1,07
Installationsaufwand	13x	5,91	68x	30,91	86x	39,09	27x	12,27	26x	11,82	2,93	1,07
Praxistauglichkeit	14x	6,36	61x	27,73	82x	37,27	24x	10,91	39x	17,73	3,06	1,16
Bezahlbarkeit	13x	5,91	51x	23,18	81x	36,82	37x	16,82	38x	17,27	3,16	1,14

24. 24. Kennen Sie folgende Technik?

Trockentoiletten (wenig bis gar keine Wassernutzung) *

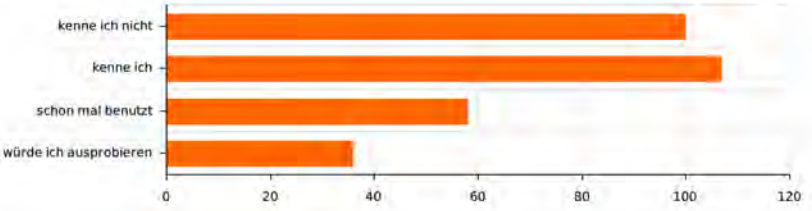
Anzahl Teilnehmer: 220

100 (45.5%): kenne ich nicht

107 (48.6%): kenne ich

58 (26.4%): schon mal benutzt

36 (16.4%): würde ich ausprobieren



25. 25. Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Anzahl Teilnehmer: 220

	sehr groß (1)		groß (2)		klein (3)		sehr klein (4)		gar keine (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
Sauberkeit	40x	18,18	93x	42,27	48x	21,82	21x	9,55	18x	8,18	2,47	1,14
Hygiene	46x	20,91	96x	43,64	39x	17,73	26x	11,82	13x	5,91	2,38	1,12
Geruch	68x	30,91	87x	39,55	37x	16,82	14x	6,36	14x	6,36	2,18	1,13
Handhabung/Bedienung	11x	5,00	37x	16,82	74x	33,64	47x	21,36	51x	23,18	3,41	1,16
Ästhetik und Design	25x	11,36	48x	21,82	60x	27,27	39x	17,73	48x	21,82	3,17	1,30
Installationsaufwand	14x	6,36	35x	15,91	77x	35,00	53x	24,09	41x	18,64	3,33	1,14
Praxistauglichkeit	40x	18,18	69x	31,36	62x	28,18	28x	12,73	21x	9,55	2,64	1,19
Bezahlbarkeit	13x	5,91	34x	15,45	80x	36,36	49x	22,27	44x	20,00	3,35	1,14

26. 26. Kennen Sie folgende Technik?

Trenntoiletten (seperate Erfassung von Urin und Fäzes) *

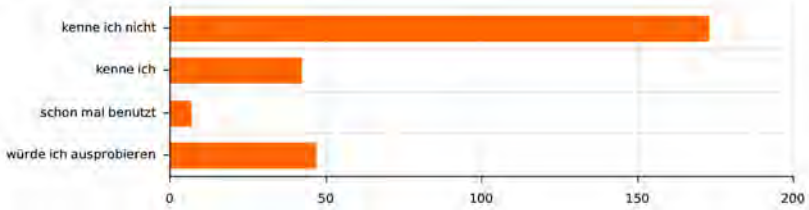
Anzahl Teilnehmer: 220

173 (78.6%): kenne ich nicht

42 (19.1%): kenne ich

7 (3.2%): schon mal benutzt

47 (21.4%): würde ich ausprobieren



27. 27. Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Anzahl Teilnehmer: 220

	sehr groß (1)		groß (2)		klein (3)		sehr klein (4)		gar keine (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
Sauberkeit	19x	8,64	43x	19,55	87x	39,55	36x	16,36	35x	15,91	3,11	1,16
Hygiene	19x	8,64	41x	18,64	78x	35,45	39x	17,73	43x	19,55	3,21	1,21
Geruch	18x	8,18	49x	22,27	84x	38,18	32x	14,55	37x	16,82	3,10	1,17
Handhabung/Bedienung	22x	10,00	54x	24,55	73x	33,18	31x	14,09	40x	18,18	3,06	1,23
Ästhetik und Design	17x	7,73	35x	15,91	77x	35,00	34x	15,45	57x	25,91	3,36	1,24
Installationsaufwand	47x	21,36	82x	37,27	49x	22,27	18x	8,18	24x	10,91	2,50	1,23
Praxistauglichkeit	43x	19,55	80x	36,36	57x	25,91	19x	8,64	21x	9,55	2,52	1,18
Bezahlbarkeit	36x	16,36	72x	32,73	68x	30,91	18x	8,18	26x	11,82	2,66	1,20

28. 28. Kennen Sie folgende Technik?

Vakuumtoiletten (Abführen der Fäkalien mittels Vakuumtechnik) *

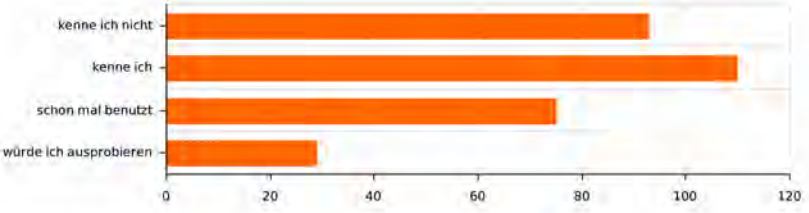
Anzahl Teilnehmer: 220

93 (42.3%): kenne ich nicht

110 (50.0%): kenne ich

75 (34.1%): schon mal benutzt

29 (13.2%): würde ich ausprobieren



29. 29. Wie groß sind Ihre Bedenken gegenüber dieser Technik hinsichtlich folgender Kriterien? *

Anzahl Teilnehmer: 220

	sehr groß (1)		groß (2)		klein (3)		sehr klein (4)		gar keine (5)			
	Σ	%	Σ	%	Σ	%	Σ	%	Σ	%	Ø	±
Sauberkeit	12x	5,45	50x	22,73	76x	34,55	41x	18,64	41x	18,64	3,22	1,15
Hygiene	14x	6,36	46x	20,91	81x	36,82	36x	16,36	43x	19,55	3,22	1,17
Geruch	13x	5,91	46x	20,91	76x	34,55	38x	17,27	47x	21,36	3,27	1,19
Handhabung/Bedienung	6x	2,73	33x	15,00	79x	35,91	52x	23,64	50x	22,73	3,49	1,08
Ästhetik und Design	7x	3,18	37x	16,82	78x	35,45	46x	20,91	52x	23,64	3,45	1,12
Installationsaufwand	42x	19,09	94x	42,73	48x	21,82	15x	6,82	21x	9,55	2,45	1,16
Praxistauglichkeit	21x	9,55	69x	31,36	65x	29,55	34x	15,45	31x	14,09	2,93	1,19
Bezahlbarkeit	44x	20,00	96x	43,64	46x	20,91	15x	6,82	19x	8,64	2,40	1,14

30. 30. Wie würden Sie die Produkte (Abwasser, Fäkalien, Papier etc.), die über die Toilette abgeführt werden, bezeichnen? *

Anzahl Teilnehmer: 220

131 (59.5%): Abfall

89 (40.5%): Ressource

31. 31. Würden Sie benutztes Toilettenpapier in Behältern sammeln, wenn das System es anbietet? *

Anzahl Teilnehmer: 220

61 (27.7%): ja

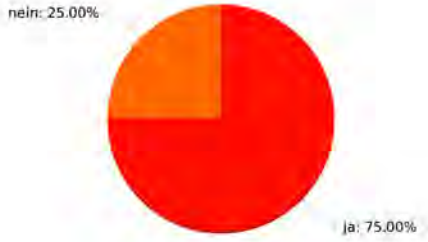
159 (72.3%): nein

32. 32. Könnten Sie sich vorstellen, dass menschlicher Urin in der Landwirtschaft als Dünger verwendet wird? *

Anzahl Teilnehmer: 220

165 (75.0%): ja

55 (25.0%): nein



Interaction points restroom & observation public toilets

notes on the development the interaction points and the development of a tool for an analyzing tool

The criteria:

Safety // cultural related
Safety is analysed on the aspect what kind public/ private place and if there is a light and / or a lock.

- abandoned place
- public place
- safe public place (there is observation by staff or an acquaintance)
- private place
- (Private place indoor...)

Intimacy // cultural related
How intimate is the toilet during the use of it and during the flush
- you are alone in a private place / public space / abandoned space
- you are alone in an enclosed space (private place / public space / abandoned space)
- you are alone but can hear / smell people that are doing the same (public space)
You are alone and someone else sees your urine / feces
- you are alone but the staff sees your urine / feces
You are surrounded by people of the same gender that do the same
- You are surrounded by people that do the same
- you are surrounded by people of the same gender that do something else
- you are surrounded by people that do something else

Hygiene
aspects related to health in direct terms, how easily can you get infected
- possible infection points
- does the human being come in contact with its own excreta
- is there a risk that the human being comes in contact with its own excreta
- does the human being come in contact with excreta from other human beings.

Health
aspects related to health in longer prospects
- visual feedback
- smell able feedback
- how 'healthy' is the position for your body: full squat position – half squat position – hovering low sit position – high sit position – lead backward sit position.

Economic
economical points can be measured on multiple levels, cleaning costs, maintenance costs, installation costs, service costs and life expand of the system...
- does the system provides jobs.. Profit... New resources >> complete system analyses

Efficiency
amount of flush material (water, electricity), is there a refill/charge component and amount of people that can use the toilet.
Flush: what kind of material, how much and how often
recharge: what kind of material, how much and how often

Dependency
System maintenance dependence on owner, government sewerage system, government collecting system, independent sewerage system, independent collecting services... etc.
- maintenance by private owner, by standard handyman or by specialist
- Cleaning by user, by private owner, by standard handyman or by specialist

Cleaning

- Special / standard or no Tools needed
- Material: no material – water – soap - antibacterial soap
- material that cleans the system as well, maintenances...
- Cleanable parts compared to used parts
- Time

Ergonomic
how ergonomic or user friendly is the system
User friendly (check ranking points...)

- Squat measurements standards

- Sitting measurements standards
- Grips
- Children friendly
- Elderly friendly
- Touch points
- Cognitive ergonomic /during the act...
- Visual feedback
- Smell able feedback
- Hearing: hear something else, hear nothing, hear yourself, hear the others
- Feeling

Sustainable // surrounding depended
- Material used in design
- Material used in cleaning material toilet
- Material used in cleaning material human being
- using natural sources

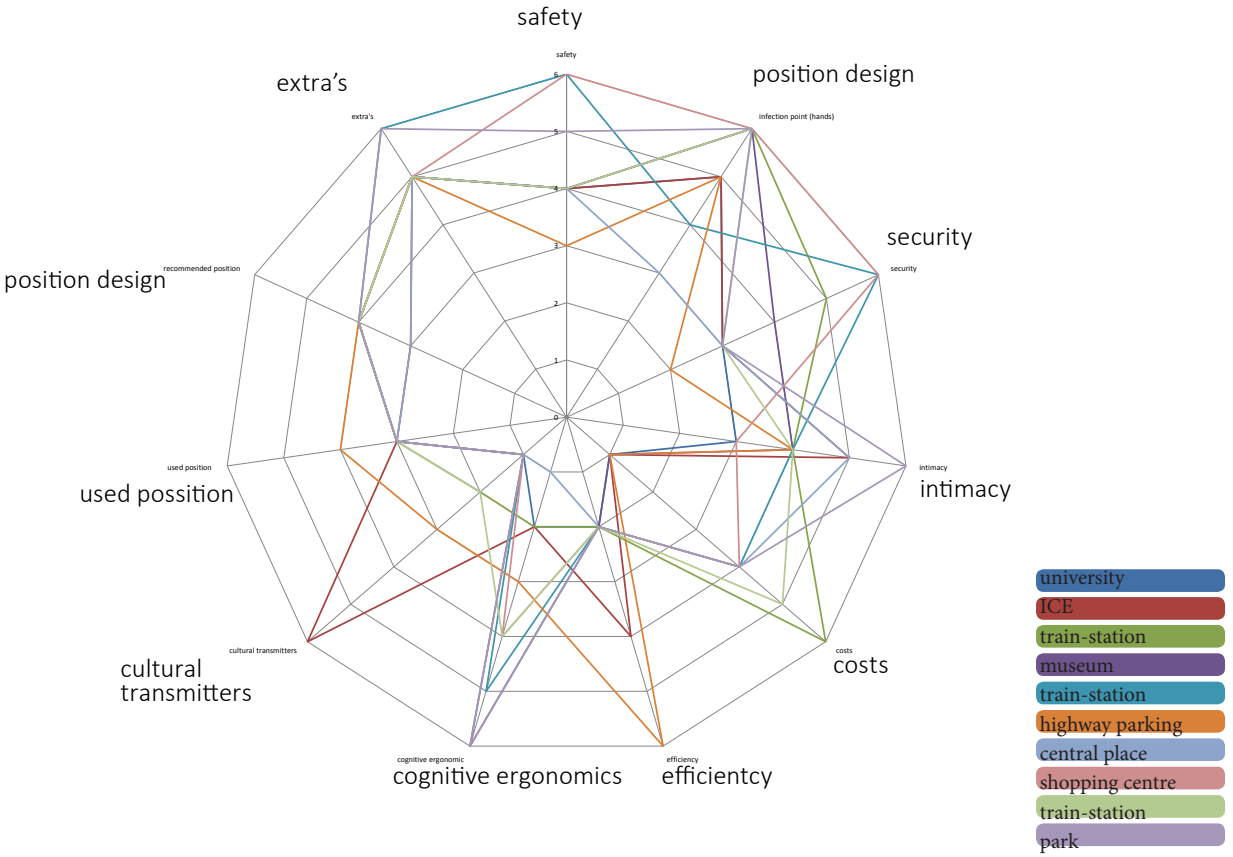
- Exhausting natural sources (water, trees...)
- closed system
- system energy cost

Aesthetic Interface // cultural related
- Is the object build for what it is used?
- Is the object designed
- Emotional sensitive design, does one care about this toilet.
- Design style: functional – blanco – luxe – etc...
- Material used

Cultural transmitters
What kind of decorative adjustments are in the facility

market research comparing web

try-out to compare several settings with one - another

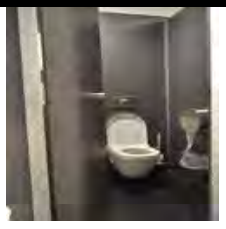


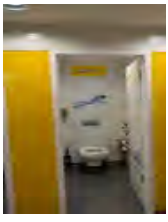
market research work data

part of the market recearch work data, how the material was collected

points	1	2	3
safety	sharp edges / unsafe design	to dark	glippery floor
infection point (hands)	tap / soap / towel / flush / seat / lock / doorhandle	flush / seat / lock / doorhandle	seat / lock / doorhandle
security	abandoned place	bad light / lock	crowded place
Intimacy	see & hear eachother	hear eachother	semi-walls
costs	> 1,00€	< 1,00€	> 0,50 cent
Efficiency	a lot of water	water	recycled water
Cognitive ergonomic	see tracks from formal visitors	see tracks on the seat	smell formal visitor
Cultural transmitters	clean design	own commercials	commercials
position	standing	squat on toilet seat	above seated
extra's	nothing	toiletseat	paper
name	**uni toilet**	**ICE toilet**	**rail & fresh WC**
type	indoor water toilet	vacuum toilet	indoor water toilet
location	Weimar	Germany	Duisburg
urban facility	University	ICE	trainstation
woman /man apart	yes	no	yes
special gehandicapt	yes	?	yes
space in M3	1,5	1	1,5
how many toilets	3	1	
safety	4	4	
infection point (hands)	2	2	
security	3	3	
intimacy	3	5	
costs	6	6	
efficiency	2	4	
cognitive ergonomic	2	2	
cultural transmitters	1	6	
used position	3	3	
recommended position	4	3	
extra's	5	5	

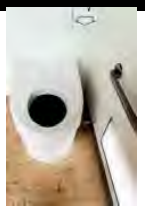
toilets





extra notes	extra notes	extra notes
	small	
	rvs > water looks (always?) yellow thus dirty..	expensive but looks che
	design as train	very expensive / no staf

	4	5	6
	normal	safety handles	helping staff
	lock / doorhandle	doorhandle	no infection points
	camera's	security gate / door	guarding
	private room / hear yourself	private room with sink	private room with sink + hear something else
	> 0,30 cent	own donation	free use
	vacuum	no water / dry toilet	seperation toilet
	hear other people using the toilet	hear yourself	hear nothing / something else
	cultural or traditional items	art or design items	specific theme
	seat	half squat position	full squat position
	brush	bin	storage space
	rijksmuseum	**trainstation toilet**	**dry toilet - france**
	indoor water toilet	outdoor water toilet	outdoor dry toilet
	amsterdam	netherlands	france
	museum	trainstation	highway parking
	yes	yes	yes
	yes	yes	yes
	1	1,5	7.5
4	20	20	2 + 3 Pissoirs
4	4	6	3
1	1	3	2
5	4	6	2
4	4	4	4
1	6	3	6
2	2	2	6
2	6	5	3
2	1	1	3
3	3	3	4
4	4	4	4
5	5	6	5



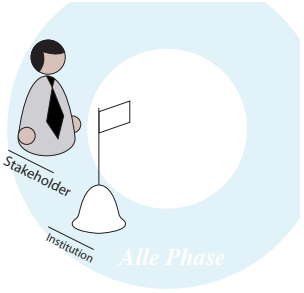
no pic

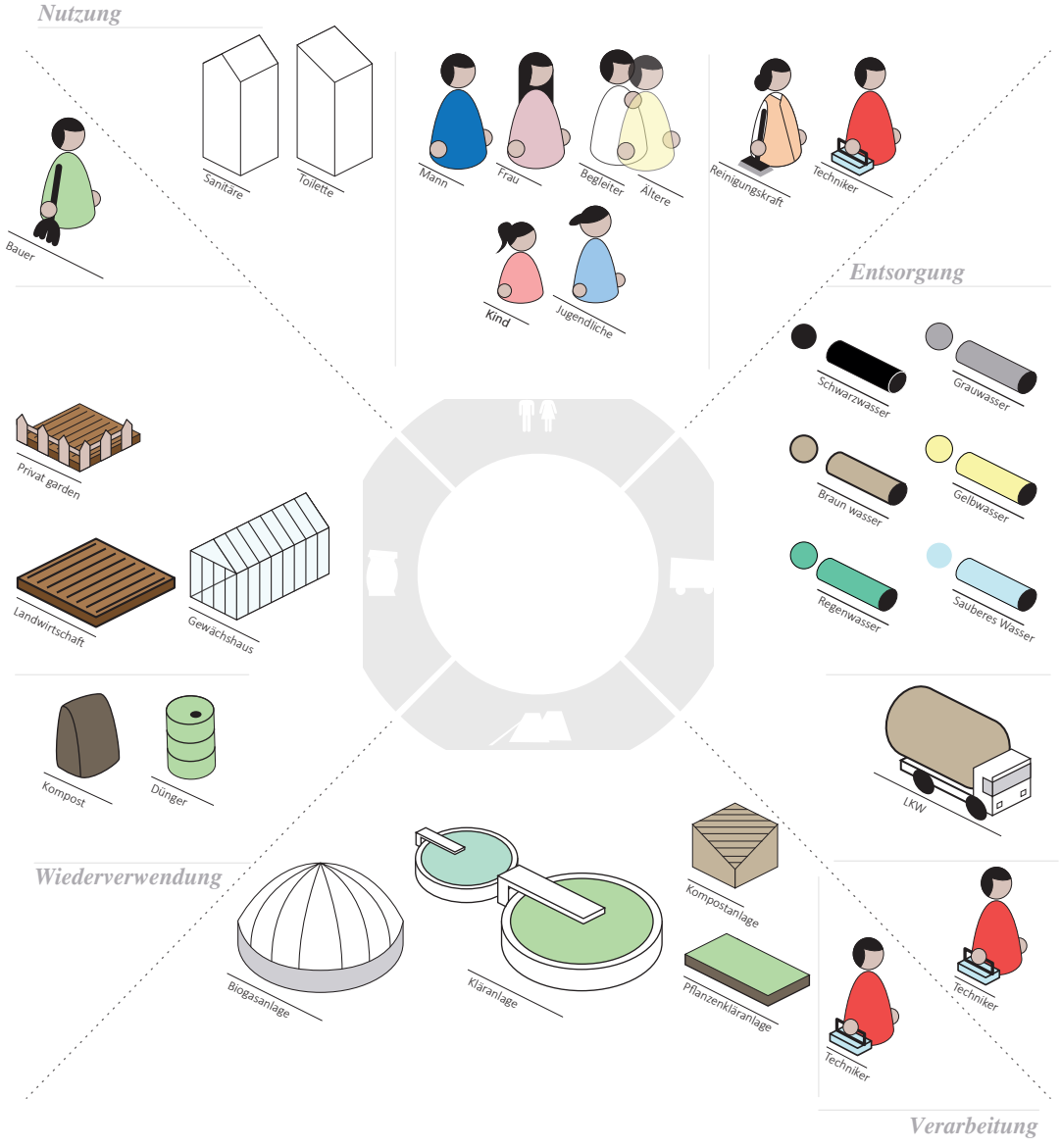
	extra notes	extra notes	extra notes
			special design
ap	inside / fancy museum > public?		Smells a lot
			the building looks like not finished
f	water tap hands	modern / clean / quality	

Legende

Sanitärsystemen

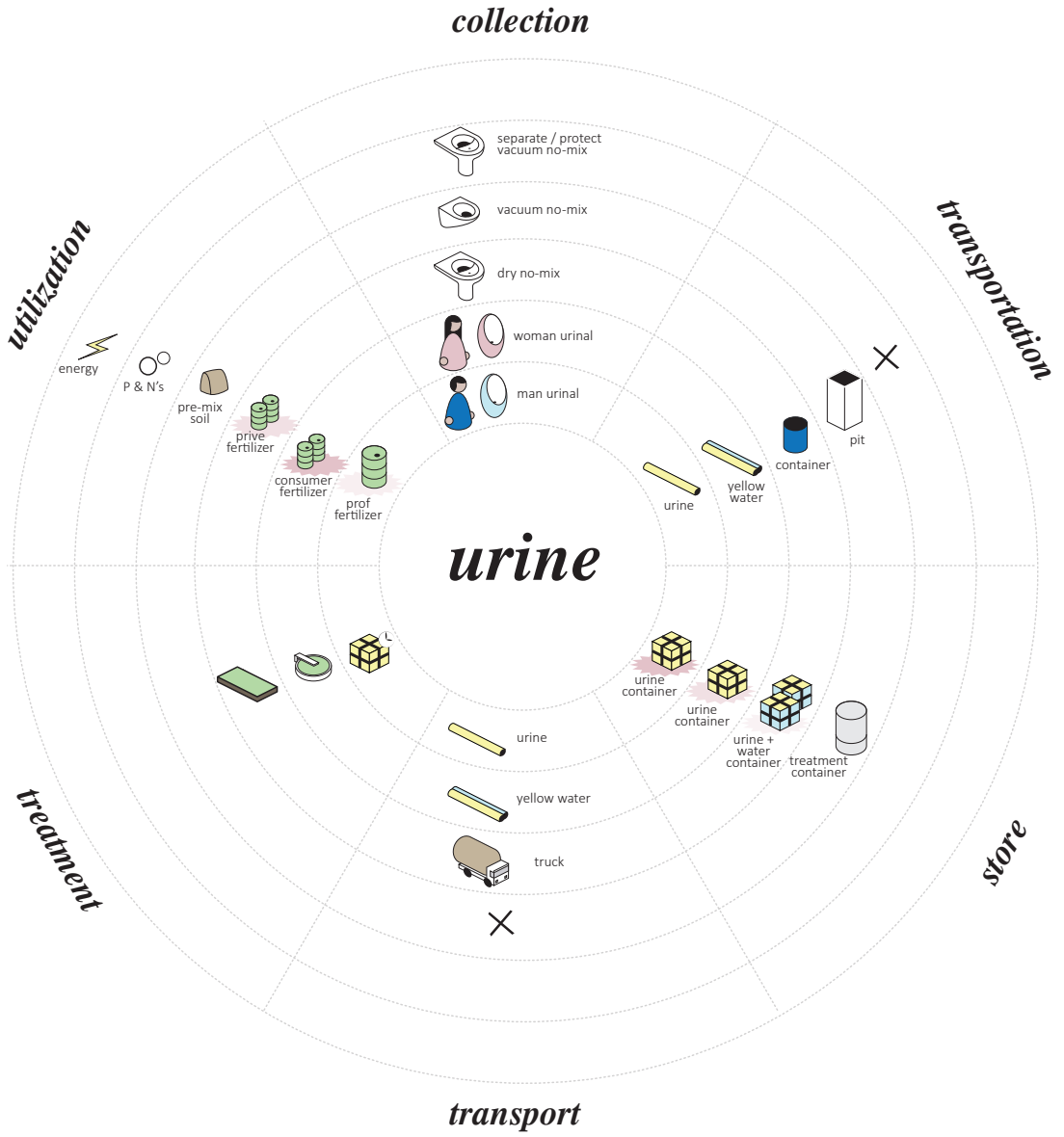
Übersicht der Teile pro Phase





Implementation table 1

tables that were used to discuss and define the 2 implementation steps for the campsite.

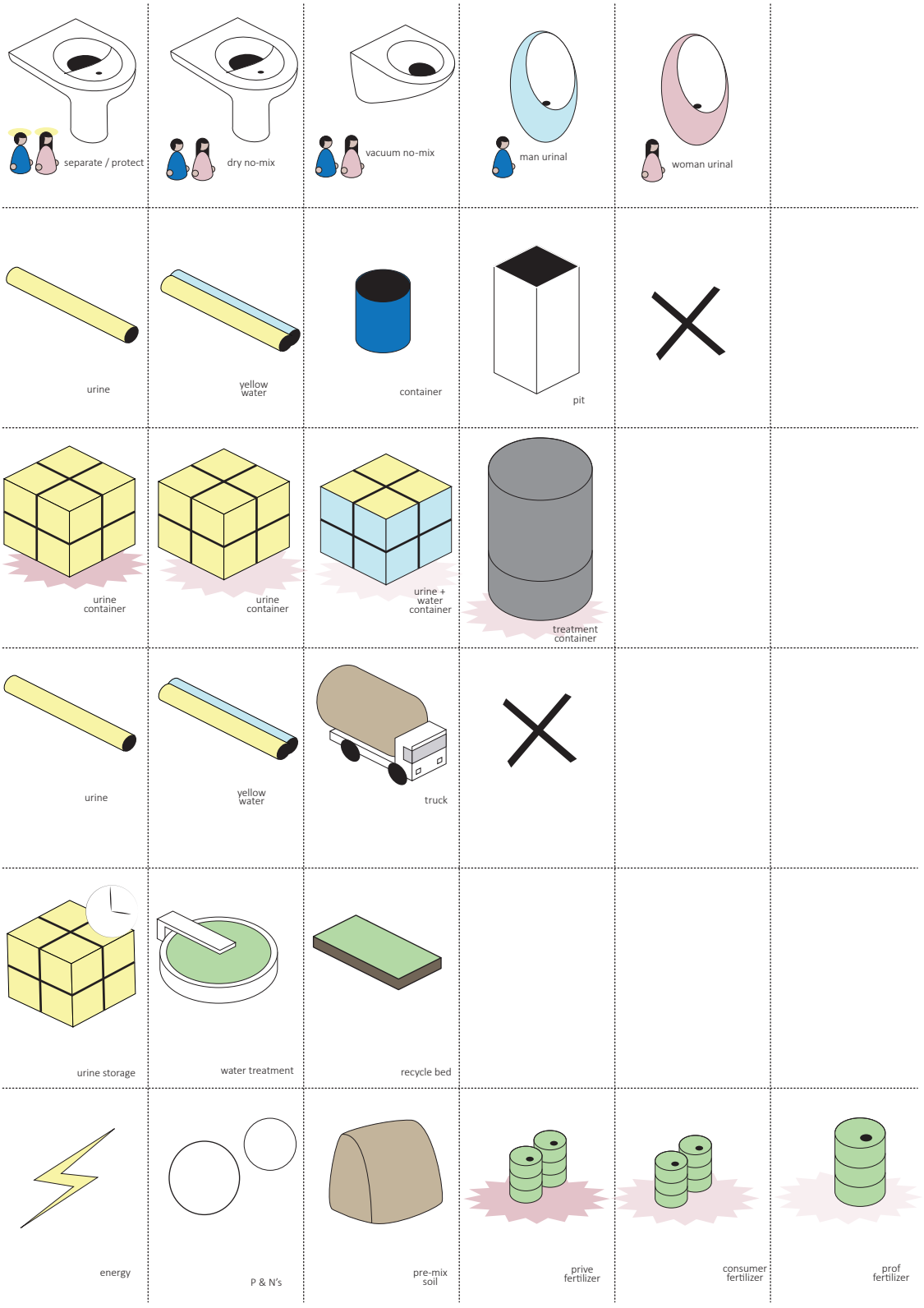


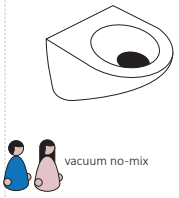
decision making table

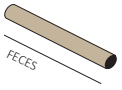
global *VISION*	*Create an experience*			*Awarness / Rethinking about the system's benefits*			*The use of no-mix toilet is standard*
	short term			***middle term***			***long term***
WHAT actions in our scenario	Women Urinals + Semi-dry system	Separate + collect urine and feces	Collect „dry" urine, the feces go through the existing treatments system	A working No-mix transportation + storage	A working transformation process of the urine on the campsite or in the area	Decentralised system for new constructions/ campingplaces	A fully closed ressources loop / Sustainable solution for all material flows

Implementation table 2

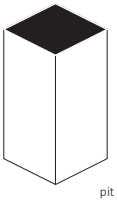
tables that were used to discuss and define the 2 implementation steps for the campsite.








container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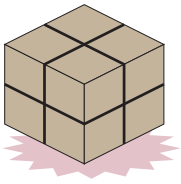
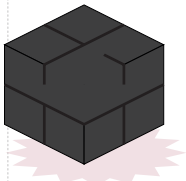
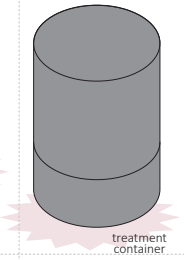
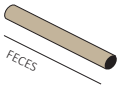
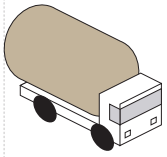

urine container


urine container



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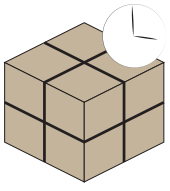
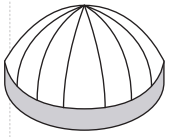
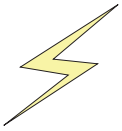
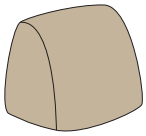
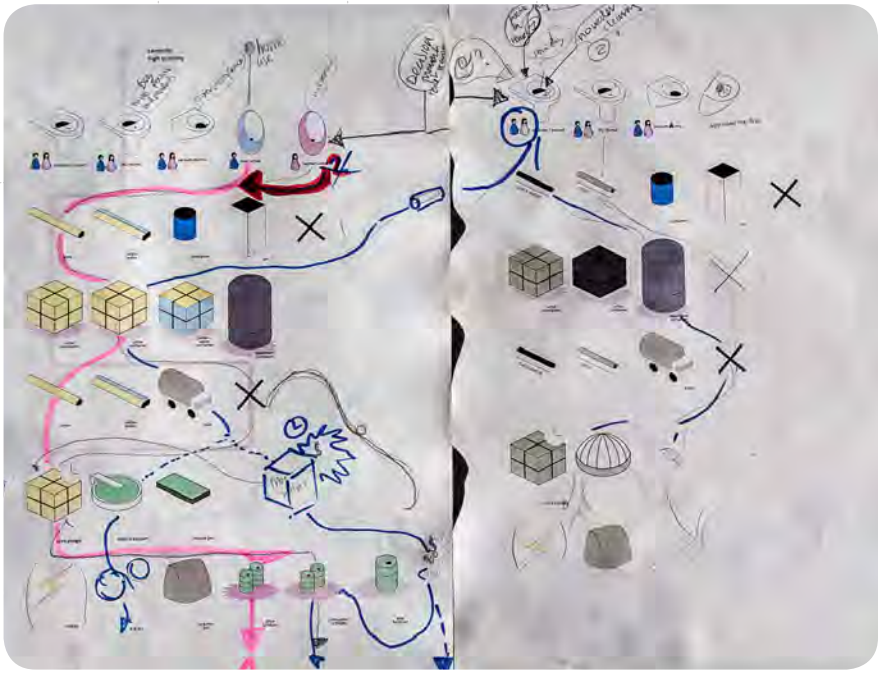

urine storage









Lexicon

This is the glosary of the ISaS project. The sources that are used in the lexicon can be found in the list of sources of the documentation.

Project terms

English Term	explanation	German term	source
project	finished after the deadline		87
program	not finished after the project but it is possible to be carried on by the stakeholders		87
Hardware tools	In ISaS perspective: methods to develop the concepts In sustainable sanitation perspective: are technical options to optimise your water and nutrient cycle. These are physical solutions that you can see and touch with your hands such as water filters, toilets, treatment systems or technologies to recycle water and nutrients. Usually, you will need a combination of different hardware and software tools to really make a sustainable impact		88
Software tools	"In ISaS perspective: methods to affect the teamwork, knowledge sharing and productivity. In sustainable sanitation perspective: instruments and set-ups with aim to change the behaviour and attitudes of different actors to optimise the sanitation and water management system. Software tools can also be implemented without combining them with hardware tools."		88

Sanitation terms

English Term	explanation	German term	source
WC	water closet	Wasserklosett	
No-mix toilet	The toilet bowl has two sections so that the urine can be separated collected and drained from the faeces and the flush water. Other terms for these toilets: - dividing toilets - (UDFT) The urine-diverting flush toilet - UST Urine-separating toilets	Trenn-Toilette	
Compost toilet	dry toilets that collect urine and faeces together and process them into compost Other terms for these toilets: - Biodegradable toilet system		
Dry no-mix toilet	dry composting toilets collect and transfer urine and faeces separating without the use of water	Trocken Trenntoilette	
Sustainable sanitation system	a more sustainable system then the standard sanitation system in Europe. This term in the ISaS documentation means sanitation systems especially for the No-mix toilets which drains the urine and faeces separately to treatment and waste water plant.		
sewage or sewer	An artificial, usually underground conduit for carrying off sewage or rainwater.	Abwasserkanal	97
Wastewater	Black water and collected rainwater	Abwasser	55
Domestic wastewater	Consist out of domestic black- and grey water (other term, domestic sewage)	Häusliches Schmutzwasser	
Black water	It combines all domestic wastewater with excreta (faeces & urine) and grey water	Schwarzwasser	
Yellow water	Water mixed with urine	Gelbwasser	
Braun water	Water mixed with faeces	Braunwasser	
Drinking water	Gereinigtes Wasser nach entsprechenden Richtlinien (z.B. Trinkwasserverordnung) mit Trinkwasserqualität (das Wasser kommt immer in so einer Qualität aus allen Wasserhähnen…ist unser fließend Wasser)	Trinkwasser	
Natural water	not treated water		
Composting piles	Here the organic matter is break down by microorganism.	Komposthaufen	
Greenhouse	a building, room, or area, usually chiefly of glass, in which the temperature is maintained within a desired range, used for cultivating tender plants or growing plants out of season.	Gewächshaus	98
Agriculture		Landwirtschaft	
Constructed wetland	A bed consisting of plants, growing on sand or gravel surface, wastewater is cleaned by microorganism	Pflanzenkläranlage	99
Vermi composting	The organic matter is break down by worms.	Wurmkompostierung	
Wastewater treatment plant (WWTP)	Plant cleans black water that comes there via the sewage system.	Kläranlage	

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Water purification plant	Surface and groundwater are treated in different steps to drinking water. A special quality has to fulfilled.		88
Nutrient loop / cycle	Nutrient (NPK) loop	Nährstoffkreislauf	
Waterless Urinal	Waterless urinals function without water. They have two important advantages compared to flush urinals: They save water and they allow the collection of undiluted urine, which is a valuable resource as fertiliser in agriculture. Synonyms: waterless urinals	Wasserloses Urinal	
Nutrients	are composed of proteins, fats, carbohydrates, vitamins or minerals. Often, nutrients refer also to the three elements nitrogen, phosphorus and potassium (NPK) since these are the main nutrients used for fertilisation in agriculture and the ones which needed to be eliminated from wastewater to prevent excessive amounts in water causing eutrophication .		88
Phosphorus	A chemical element (symbol P). Important nutrient for all organisms.		[100]
Phosphorus precipitation Phosphorus elimination	Process in wastewater treatment plants (WWTP) by which phosphorus is eliminated from the wastewater.		100

Biological terms

muscles, body parts and body activities

English Term	**explanation**	**German term**	**source**
the act of excreting (excretion)	to discharge (waste matter, such as urine, sweat, carbon dioxide, or faeces) from the body through the kidneys, skin, lungs, bowels, etc (the process)		89
excreta	excreted matter, as urine, feces, or sweat.		90
	Terms for 'going to the toilet'		95
urinating	(peeing) is the release of urine from the urinary bladder through the urethra to the urinary meatus outside of the body. (Physiologically, urination involves coordination between the central, autonomic, and somatic nervous systems. Brain centers that regulate urination include the pontine micturition center, periaqueductal gray, and the cerebral cortex)		32
defecating	(pooping) Defecation is the final act of digestion, by which organisms eliminates faeces via the anus.		91
faeces	solid, semi-solid, and/or liquid waste material from the digestive tract		91
urine	Filtered blood		30, 31
bladder	storing the urine		31
large intestine	*Producing and storaging the feaces*		*93, 94*
the detrusor urinae	*muscle that squeezes your bladder when it is full /muscle that you contract to control your bladder*		*92*
over-active bladder	*premature, sustained action of the detrusor urinae*		*92*
constipation	*faecal material hardens in one of the bowels (intestine) a condition of the bowels in which the faeces are dry and hardened and evacuation is difficult and infrequent.*		*91*
Involuntary action	*is one that occurs without volition or will (pee your pants) In infants, some elderly individuals, and those with neurological injury, urination may occur as an involuntary reflex*		*31*

ISaS presentation Summary

The ISaS Project is presented at the summary 2014 in cooperation with Holzapfel-konsorten, organised by the two Design students and Michel Riechmann of the master studies Environmental Engineering.


struvite


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