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Cleaner and better transport in cities

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# Implementation status report on bicycle theft prevention system

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# 1. Introduction

From 2008 to 2012 StudentENmobilititeit and the City of Gent receive funding from the European Commission with the CIVITAS-ELAN project for a measure which addresses the problem of bicycle thefts in Gent, especially rental bikes of StudentEnMobilititeit and MaxMobiel. This will be done by:

- Installing a theft prevention system in rental bikes; with hand computers to locate stolen or displaced bikes,
- Developing a unique physical form (frame) for rental bicycles,
- Installing secured sheds for rental bikes,
- Using “lokfiets”.

This will lead to:

- Supporting the use of quality bikes in the city centre, especially by students, and
- Increasing the numbers of visitors to the city centre using the bike.

The aim of this report is to provide an overview about the current status of the implementation of the CIVITAS-ELAN measure 8.9-GEN IT-based bicycle theft prevention.

## 2. The Non-Profit Organisation StudentENmobilititeit

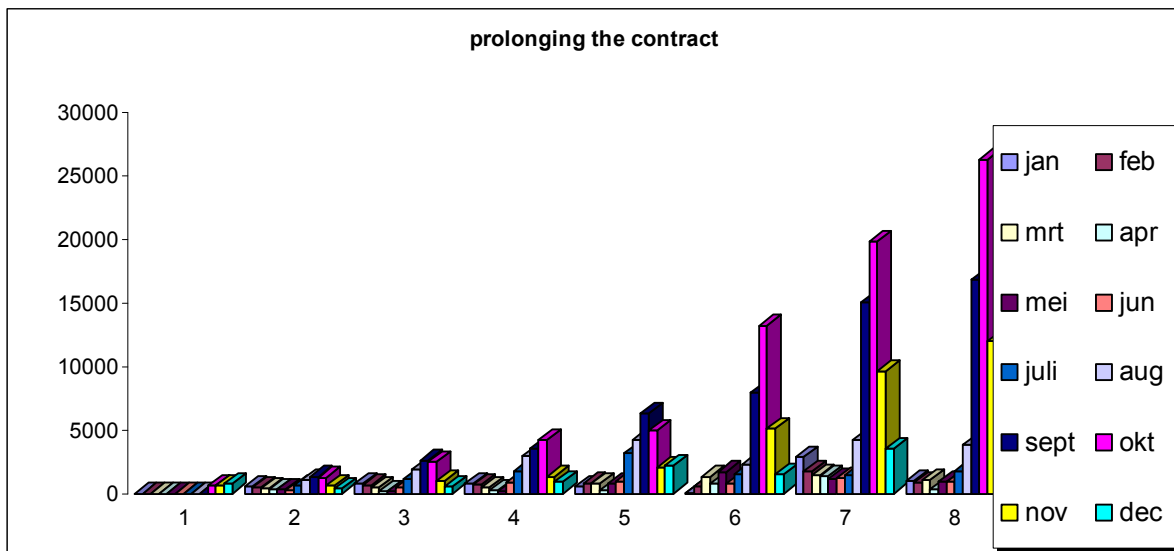
The non-profit organisation “StudentENmobilititeit” is an initiative of the City of Gent, the University of Gent and the Gent Schools of Higher Education. In co-operation with another non-profit organisation, Ateljee, StudentENmobilititeit offers a very big number of rental bicycles for students at all the institutions mentioned above. The main aim of StudentENmobilititeit is to provide cheap bicycles for students to be able to travel within Gent in a sustainable way.

The partners are responsible for the co-ordination, the administrative management and the logistic support. Next to the bicycle rental, the three schools run a bicycle repair shed where students can get technical advice regarding the repair of their bicycle for free.

One of the key objectives of the measure 8.9-GEN IT-based bicycle theft prevention is to offer a solid bicycle, enhancing the safety while riding the bicycle. On the other hand, the measure tackles the problem of bicycle theft. Research has shown that students are the main victim of bike theft but are also the main delinquents. StudentENmobilititeit is trying to break the vicious circle by offering students reasonably priced rental bicycles which at the same time offer the maximum possible security against theft.

StudentENmobilititeit is a rapidly growing organisation. Starting with 200 bikes in 2002, the organisation has by now more than 5.000 bikes. The goal is to have 6.000 rental bicycles in 2012. In terms of rental bicycles to student StudentENmobilititeit is probably the largest rental organisation in Europe.

Below is a chart which shows the evolution of the number of bicycle rental contracts that students have prolonged between 2002-2009. The chart shows the revenue, not the number of contracts. But they can easily be deducted from the chart. In 2009 for example the revenue was 30,000 euros in February. One contract costs 40 euros. This implies the prolongation of 750 contracts (30.000/40).



(1 = 2002/ 8= 2009)

### 3. The unique bicycle, implementation of chips and the use of handhelds

#### 3.1. History unique bicycle frame

One of the basic objectives of StudentENmobilität is to reduce the number of bicycle thefts, specifically the number of students' bicycles that are being stolen.

Also if students' rental bicycles are equipped with the best locks, if the locks are not used properly or not used at all, it makes no sense to invest in the locks. After almost 10 years, StudentENmobilität knows how students behave and has made big efforts adapt to their way of using the bikes.

Since most of the bikes were stolen because students didn't use the bicycle locks or didn't use the locks in a proper way, StudentENmobilität focuses on deterrent effects on the one hand and the recovery of stolen bicycles on the other:

##### 3.1.1. Deterrent Effect

Within the CIVITAS-ELAN measure 8.9-GEN all bicycles from StudentENmobilität are engraved with a specific logo and number. It is assumed that this unique bicycle (frame) will considerably lower the number of stolen rental bikes. It is expected that if someone tries to sell a stolen rental bike which has a unique frame the potential buyer will become suspicious as the specific logo and number of the bicycle is very obvious.

##### 3.1.2. The Recovery of Stolen Bicycles

The other issue being addressed in the measure is the recovery of stolen bikes for which the unique frame also plays a key role. As the specific logo and number of the rental bikes are quite visible, StudentENmobilität expects that more stolen bicycles will be reported based on social control of people who spot one of StudentENmobilität's bicycles, also if they have been changed by adding other parts, different colour, etc.). This way it is being ensured that more stolen StudentENmobilität bicycles can be identified and collected.

In an ideal world envisaged by StudentENmobilität, all bikes would have a large indelible bicycle number and all the data of these bicycles would be stored in a central database. This would certainly help that through social control and by patrols all stolen bikes would eventually find its owner again. StudentENmobilität's vision is going even further: each citizen could have a bicycle (with a national

registry number or name engraved or stamped out of the frame so that it's not erasable and recognizable from a distance) that you can link on the spot to its owner. While many cities' rental bicycle providers are already engraving the national number on their bikes it usually is so small that it can easily be removed.

It might be an idea for a completely new bike market to be able to just order a personalised bike. Another possibility would be to copy the number of the car's license plate to the bicycle which would mean that no additional national registry would have to be set up. The picture below shows an example of a design bicycle with the name of the bicycle stamped into the frame.



Figure 1: Example of a design bicycle with name stamp

While this vision might be the ultimate objective for the future, StudentENmobiliteit wanted to at least show how it could be. At the start of the CIVITAS-ELAN project the idea was to introduce such a system for Gent (as a pilot project). However, not all the players on the field have a similar vision or were convinced of such a system. Nevertheless, StudentENmobiliteit wanted to give a solid start to a fully integrated system by implementing an ambitious programme on theft prevention and detection of stolen bikes.

### **3.2. The unique bicycle (frame)**

Right after the start of the CIVITAS-ELAN project StudentENmobiliteit introduced with success a unique rental bicycle(frame). The frame is produced solely for the use by StudentENmobiliteit.

In a first step, the bicycle frames are being painted with a special and easily recognisable colour in the factory. In a second step StudentENmobiliteit engraves a unique frame number into the bicycle which cannot be removed without irreparably damaging the frame.

#### **→ what makes the bicycle frame so special**

While some major manufacturers in the Netherlands are having a similar frame, StudentENmobiliteit's frame has a few unique elements:

- The down tube on which the number and logo is engraved is rectangular instead of round and has a greater wall thickness than usually. In this way, the strength of the frame is not affected by the engraving of the number and logo.

- The engraving of the number and logo is unique. Similar personal bikes have a number that is stamped out of a plate.
- The bike rack is welded on the frame.
- The frame is equipped with reflective stickers.



Figure 2: Unique rental bike from StudentENmobilititeit



Figure 3: For comparison: Personal bike from the BATAVUS factory in Holland

### → The engraving machine

Usually this type of machinery is used in the furniture and advertising industry. StudentENmobilititeit adapted one of these engraving machines to use them on bicycles. By using a few simple templates, the engraving goes smoothly.

StudentENmobilititeit ordered a special milling head from the U.S.. This milling head is provided with a spring so that the cutter follows the surface perfectly, even if the surface is not perfectly flat.



Figure 4: Engraving machine by CNC

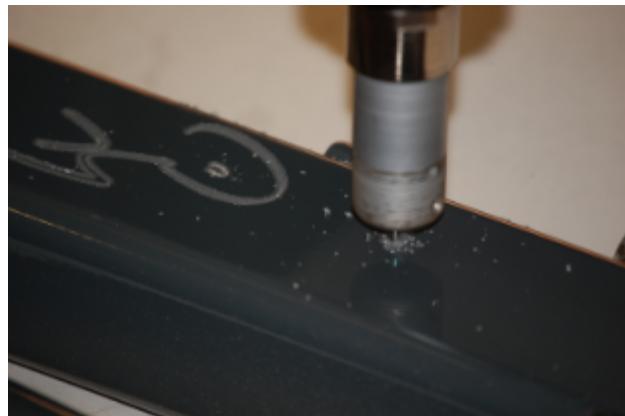


Figure 5: Engraving the logo

For the moment we have 1,700 bicycles in patrimonium that have been engraved with a logo and number and 300 bicycles that have been engraved with a logo (for the staff of the University of Gent).

### **3.3. Future plans**

The next step after the end of the CIVITAS-ELAN project is to take the unique bicycle one step further. StudentENmobilititeit's frame still looks quite similar to other frames used by major bicycle manufacturers. If it proves to be possible StudentENmobilititeit wants to create a frame which is totally different compared to the existing frames that are available today.

Here is an example of what StudentENmobilititeit has in mind.





Figure 6: Future vision of an individual bike frame

The benefits of such a frame would be:

- Recognisability (one frame/ one organisation).
- One frame that fits for all students.
- Because it is a small frame, the wheels are also smaller, which implies the luggage rack to be much lower. Therefore students cannot transport other students by bike, which happens a lot nowadays and is rather dangerous.
- small, so you can put the bicycle inside
- small, so more bikes can be stored in the same room

At the end of the CIVITAS-ELAN project StudentENmobilititeit will analyse whether students would be interested in using such a bike. Although StudentENmobilititeit is convinced of the benefits, they first want to hear the opinion from their customers (students). Perhaps, it will already be possible to present the vision of an “ultimate” rental bike at the end of the CIVITAS-ELAN project.

### **3.4. The Implementation of Chips in bicycle**

The objective is to complement the unique ‘indelible’ bicycle frame number with a second mechanism which allows StudentENmobilititeit to identify the user and the bicycle.

In a first phase StudentENmobilititeit conducted a market research to identify a system which could be developed. The best option which StudentENmobilititeit found on the market is a bike lock with an embedded chip. While these locks are also the standard locks used on StudentENmobilititeit’s bikes, the locks are not being provided with a chip in Belgium due to privacy regulations. Although it is not possible to produce these locks in Belgium it is nevertheless possible to buy these in another country and use them in Belgium. Since StudentENmobilititeit has good contacts with manufacturers it was possible to get the lock with an embedded chip for quite a good price.

Since early 2010, all of StudentENmobilititeit’s new/ unique bikes are equipped with a “tag protector chip”. Currently, StudentENmobilititeit is working on a software link so that the chips can be read when a bicycle that appears to be stolen is spotted on public domain. Even if the unique number would be fully removed the bicycle can still be traced by the chip.

The pictures below show a lock that has been broken by StudentENmobilititeit to verify where the chip is located in the lock. StudentENmobilititeit even had to break two locks to really find the chip – in the first lock the chip simply has not been successfully located.

Idem as the engraved bicycles with logo and number, there are 2,000 bicycles with a chip for the moment. The location of the chip in the lock is secret information. We use the same type of lock on all the bicycles, thieves do not remove these locks but just cut a small part from the lock so the lock stays on the bicycle even when the bicycle is stolen.



Figure 7: the lock is forced open to show the chip



Figure 8: The chip = the small blue tube

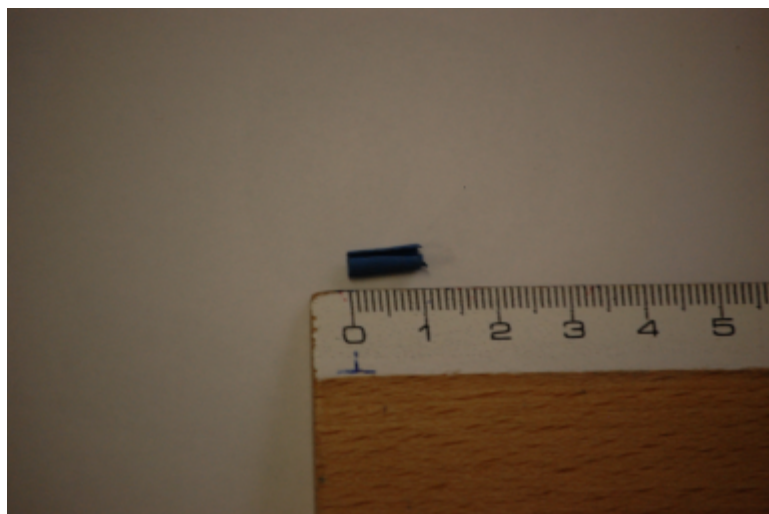


Figure 9: The chip is really that small

StudentENmobliliteit believes that in the nearby future it will be possible to trace all its bicycles with GPS/ GPRS at any point in time

### **3.5 The Use of Handheld Computers and Development of Necessary Software**

According to the work plan of the measures it is foreseen that it will be possible to check on the spot whether registered bikes are stolen or not by means of a handheld computer. The choice to purchase a specific type of handheld computers has been taken just recently. It was foreseen to take this decision earlier but responsible for the purchase of the handheld computers was DIGIPOLIS who joined ELAN only recently as a new partner. Also, it was necessary to conduct a thorough market analysis in order to select appropriate and efficient equipment.

At the time of writing this report the process of ordering the devices is about to be started. Additionally, the necessary software will be developed so that the operations on public domain can be made and all the data can be collected correctly via the handheld computers. As DIGIPOLIS decided that the initial developer of our software system also has to develop the necessary software for the handhelds the delays will be huge (end of 2011)

It is also being examined to what extent a reader module can be installed on the handheld computers so that the chips that are installed in the new rental bikes can be read through the handheld computers.

Because the chips have a specific coding mechanism (other than barcodes) additional research is necessary.

StudentENmobliliteit is very that it was possible to choose a high performance hand-held computer which offers a multitude of applications.



Figure 10: Handheld computer to be used in measure 8.9-GEN

## **4. Guarded bicycle sheds**

StudentENmobliliteit recently succeeded to reach an agreement with universities and schools in Gent to provide guarded bicycle parking facilities on their sites. The guarded bicycle sheds have three major objectives:

- To give students the opportunity to leave their bikes during the summer holiday in a guarded shed, so that they find their bicycle in September in the same place as they left it in June.
- Rental bikes that are not brought back at the end of the school year can be collected in a few guarded sheds which makes control more efficient.
- The guarded bicycle sheds can be used during the rest of the year by students that go to school.

The guarded parking facilities are provided throughout the city so there is always a parking nearby for the students. The first locations are known. In some further universities and schools internal procedures are in the process of being completed as regards a decision of where sheds can be built. Build-

ing will start in the months of May and June 2011. StudentENmobliliteit will provide the first sheds in autumn 2011. About 600 places will be available.

## 5. Theft promotion

Despite all efforts taken in the last years, too many bikes are still being stolen each year. StudentENmobliliteit will therefore communicate even more with the students and raise its efforts further. Besides all the efforts which have already been listed (see above), StudentENmobliliteit conducts a number of extra initiatives:

- A beer mat (example: „make sure you still have your bike after this pint, lock your bicycle thoroughly“) and other cards/ posters will be created and distributed to local merchants.
- A scoreboard will be put up at StudentENmobliliteit’s central location which will display the number of stolen and recovered bicycles since 1 January of the current year. Many students still think that the rental bikes cannot be stolen, the reality is different.
- More information about issues related to theft will be included on the new StudentENmobliliteit website (from August 2010 on). There will also be a direct link to the website „police on web“. In case of theft students can report the loss or theft via this link.
- StudentENmobliliteit will talk to students on the spot if the bicycle is not properly closed and students who do their best to lock their bike safely will be rewarded.

## 6. The lokfiets

In the measure StudentENmobliliteit is developing a so-called ‘lokfiets’ (which might be translated into English as “lure bicycle”), a bicycle that is equipped with a ‘track jack’ system. The bottom line is that StudentENmobliliteit hopes this bicycle will be stolen, so the thief can be traced. StudentENmobliliteit places a tracking system in a way it cannot be identified by eye sight. The ‘lokfiets’ will be placed on public terrain, and will be provided with a lock. When the bike will be stolen, StudentENmobliliteit gets a signal through the tracking system that the bike is in motion (read stolen). StudentENmobliliteit will then notify the police and through the tracking system the location of the bicycle/ offender will also be given to the police.

By means of the ‘lokfiets’ StudentENmobliliteit also hopes to get a better view on the profile of bicycle thieves. Currently, StudentENmobliliteit does not know whether the thieves are mainly students who “borrow” a bike, to what extent organised gangs steal bikes on demand or whether second-hand merchandisers are involved. StudentENmobliliteit assumes that the identification of thieves will lead to a better approach to theft prevention.

Next to the ‘lokfiets’ the tracking device will also be installed in stolen rental bikes that have been located. Nowadays, stolen rental bikes that have been found are simply picked up and brought back to StudentENmobliliteit’s central rental location. While the bike is back in StudentENmobliliteit’s possession the costs that often occur to repair stolen bikes have to be covered entirely by StudentENmobliliteit as the current user/ thief cannot be identified. The objective is to tap the stolen bike with the tracking device. As soon as the stolen bike is in motion StudentENmobliliteit will receive a message and the police can be contacted so that the thief can be red-handed. When the user/ thief has been identified, StudentENmobliliteit can recover the costs (repair costs, transport, etc.).

This project had a good start because different companies showed interest to develop such a product. However development is often related to investments and when the investment stops, the development stops. As a result, the number of potential suppliers drops fast.

After some research, StudentENmobliliteit found a Dutch company that developed a similar system to trace children when they report a problem. After having conducted some tests, StudentENmobliliteit is convinced that this system is not sufficient. However, StudentENmobliliteit found out that a complete system to trace bicycles was developed by the bicycle theft centre in the Netherlands. StudentENmobliliteit realised that this bicycle theft centre has the same objectives.

After a first thorough analysis the system developed by the Dutch bicycle theft centre looks quite promising. DIGIPOLIS has recently been involved in this project and is already in contact with the bicycle theft centre to discuss technical details. Currently, DIGIPOLIS is checking the IT needs concerning the Dutch system.

The testing of the system starts in March 2011. From the moment StudentENmobilititeit is convinced of the system, they have to convince the police to use the system as well and to work together with StudentENmobilititeit on this matter. StudentEmobilititeit hopes to start implementing the system in summer 2011.

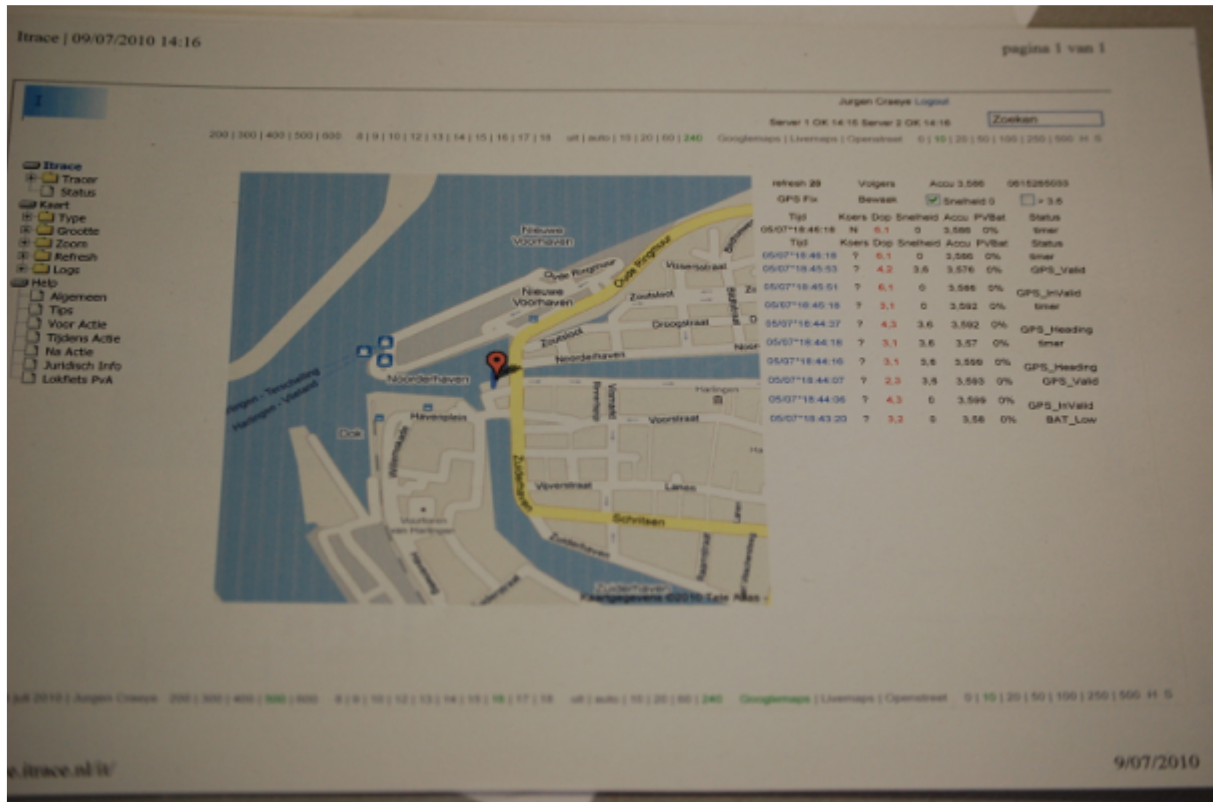


Figure 11: map shows where the bicycles are, how long they have been parked there and the cycled distance between the last stop.



Figure 12: Receiver and antenna from the tracking device Mambo II / supplier Falcom



Figure 13: Tracking device Mambo II which will be put on the lokfiets

The Mambo II tracking device is an advanced personal tracker that integrates a quad band GSM/ GPRS phone for two-way communication and a 20 channel low-power GPS receiver for positioning. At first glance, Mambo II looks like a conventional mobile phone. The Mambo II features many functions which have been designed specifically for the use by logistics providers, cab companies, security and fire services, the police or technical emergency services.

Mambo II can be used as a mobile phone with the standard features (voice calls, SMS) through a simple menu-guided operation. This small robust device can be carried along in a pocket or fixed in a vehicle. It is a mobile all-rounder both for commercial and private users. Mambo II also supports a series of functions for GPS navigation and tracking via SMS, CSD and GPRS/ TCP. The all-rounders' true strength lies in the multitude of its configuration options: Rolling GPS display, geo-fencing capability with alarm and an ultra-precise movement detector are just some of the Mambo II's core functions.

Mambo II integrates up to five communication options, including GSM and TCP, system-wide IEEE 802.15.4 for communication with a keyfob, Bluetooth for hands free communication, and ANT+ for heart rate monitoring. This first-of-its-kind solution with sophisticated software offers system integrators and developers the possibility to develop their own cost-efficient and flexible solution.

## 7. Compact bicycle shed

Another objective of measure 8.9-GEN is to install secured sheds for rental bikes. There are many bicycle sheds on the market, e.g. rather compact ones as the figure below shows.



Figure 14: Example of a compact bicycle shed

In the original work plan it was not foreseen to design/ develop a compact bicycle shed. However, StudentENmobilität noticed that compact bicycle sheds currently available on the market are quite expensive: up to 5.000 Euro for one single bicycle shed that can store five bicycles. This price even is without the annual maintenance and repairs. Moreover, StudentENmobilität found out that, even without considering the high price, most of the sheds are not even practical.

StudentENmobilität is convinced that such sheds could be built much cheaper. Moreover, the existing compact sheds are placed in one piece so that the replacement of only one component is not possible or difficult and expensive. The storage of such modules takes also a lot of space. Therefore, StudentENmobilität decided to build an alternative shed.

The advantages of compact bicycle sheds are:

- ultimate protection against vandalism and bicycle theft,
- bicycle owners are known, so no or less neglected bicycles,
- perfect solution for neighbourhoods with small houses.

If StudentENmobilität succeeds to develop a competitive model, the compact bicycle shed can be patented and other cities can use this model. StudentENmobilität wants to at least:

- in terms of design to distinguish themselves from current suppliers,
- in terms of price, decrease the price by 50%,
- in terms of use and maintenance develop a more practical box than the ones currently available on the market.

It is envisaged that the new design will also be a nod to the new city logo.