

Geoinformation as a Key Technology for Urban and Wastewater Planning Semi Central Waste Treatment in Hanoi

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SUMMARY

Many rapidly growing cities face the issue that infrastructures and public services (energy, water supply and disposal, etc.) are unable to keep pace with the rapid urbanization, often caused by immigration. This frequently results in provision shortages of energy as well as water. Vietnam is currently experiencing an economic boom accompanied by growing social and economic inequalities and rapid urbanization. In Hanoi, as in other urban and rural areas of Vietnam, the situation is characterized by a high demand for wastewater treatment plants, serving only a small fraction of the accumulating wastewater. The existing structures of waste- and sanitary management should be included in the planning aspects.

The main objective of the co-operative project is the development of a semi centralized solution, combining both the upgrading of existing supply and disposal structures, as well as the construction of adapted and integrated supply and disposal systems in new settlement areas in Hanoi. This means specifically to equip new settlement areas with an integrated system of treatment capacities for different wastewater fractions as well as for organic waste. Geoinformation is one of the main key tools to assist the Urban planning and the facility design of the semi central disposal centre. The use of GIS can ease the prediction of the waste accumulation.

The main challenges are the collection and processing of heterogeneous data into a consistent database model. Primary and secondary data acquisition has been combined to get the foundation for further analyses. The dimension of the surface catchment area and the quantity of waste and wastewater are calculated. In addition to the support of Hanoi's municipal development the Geoinformation system is used for the planning of a transport concept for the wastewater and organic waste treated in the semi central centre.

The joint research project of the Technische Universität (TU) Darmstadt and Hanoi University of Civil Engineering (HUCE) develops tools and methods for the calculation of a semi central disposal centre. The international cooperation facilitates the efficient exchange of experience and findings.

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1. HANOI SITUATION

Urbanisation is one of the main phenomenons of the change in lifestyle in this period and it is a challenge for the development of new infrastructures around the world. The permanent As many other cities in Asia, Hanoi is a fast growing city. Through this growth many new problems have appeared and have a large impact on the existing concepts from the past. One of the main problems in Hanoi is the Water supply and treatment of wastewater. The wastewater treatment is a combination of septic tanks and untreated sewer pipes. The concept of a septic tank is to collect the wastewater from the toilet. The sludge will sink down and the remaining water runs into the channels and finally untreated to the river. If the septic tank is full, it will be evacuated and the sludge will be transported to the central treatment plant. A standard septic tank contains around 5m³ and for multi-storey buildings up to 200m³. The quality of the septic tanks in conjunction with the marginal control of clearance the septic tanks cause a serious impact on the ground water. While the city is growing the newly developed areas increase the malfunction of this treatment system.



Figure 1 Suction vehicle

In addition the waste accumulation generates another problem. Usually the waste will be collected every day and carried to the dump side. Unfortunately the waste separation and reuse of waste is still at the initial phase. The lack in the system causes uncontrolled places with waste in the city.

The waste from the restaurants mainly organic waste is collected by individuals and used for feeding their animals.

2. SEMICENTRAL APPROACH

The fast growth of cities generates a new demand for flexible acclimatization for the supply of water and electricity and the treatment of waste and waste water. The increased sensibility for environmental protection, recycling and climate change necessitate new solutions for the waste treatment. The semicentral approach is an answer, by combining the treatment of waste

and waste water at the same time close to their provenance. In addition to the previous project¹ the system has to adapt the combination of new developments and existing structures. The location of the *Semicentralized supply and Treatment Centre* (STC) next to the district reduces the quantity of transport capacities. The new solution of a combined treatment of organic waste, wastewater and sludge maximise the energy efficiency through an optimized biogas production and the STC could run in a self sufficient status. The modularized semicentral system is large enough to support a quarter or district and can be extended in a flexible way as the demand by the district is growing.

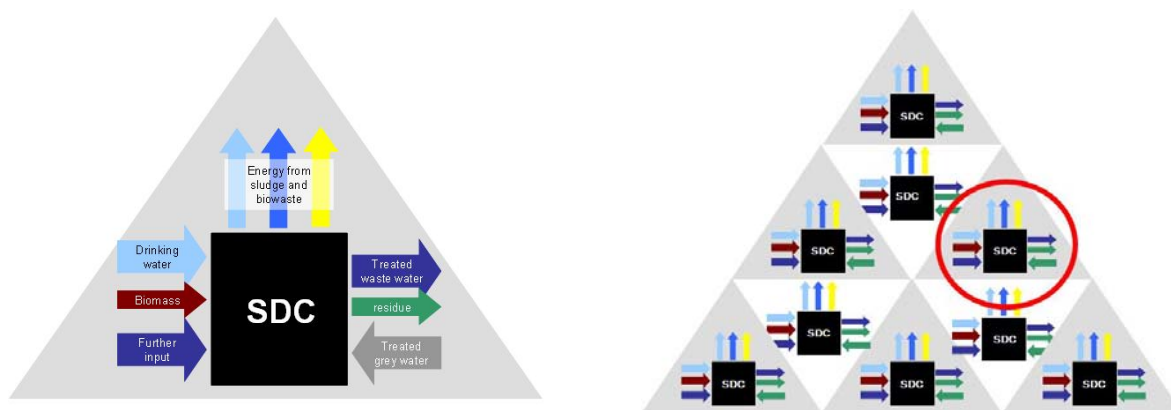


Figure 2 Concept Semicentralized supply and Treatment Centre (S. Schramm)

The STC generates, apart from treated waste water, amicrobic fertilizer and stabilized waste. Therefore the residues for disposal will be minimized.

The Project is a cooperation between the Technische Universität Darmstadt (TU-Darmstadt) and the Hanoi University of Civil Engineering (HUCE) Faculty of Environmental Engineering. In Darmstadt the Departments of Wastewater Technology, Environmental and Spatial Planning and Landmanagement participate on the project. The industrial partner “Passavant Roediger Anlagenbau” supports the Project with their experience and the supply of two experimental plants.

3. GEOINFORMATION

3.1 Database design

For the cooperation between the project partners it is essential to have a good data basis. With data from more than 50 different sources it is required to design an adequate foundation for the further analysis. Apart from the data it is important to have good documentation. So the Metadata have to be considered as well. The database design has to start with the modelling of the existing structure. The database model includes the existing water supply and sewage

infrastructure and reflects the relation between this infrastructure and the existing and planned buildings. In addition to the building situation the markets as one of the sources for organic waste has to be included in the design as well. The model was adjusted with the existing situation identified in the field work so that the model can be used as a foundation for the data collection. The description of the model in UML generates a structure what can easily be transferred and adjusted for other situations.

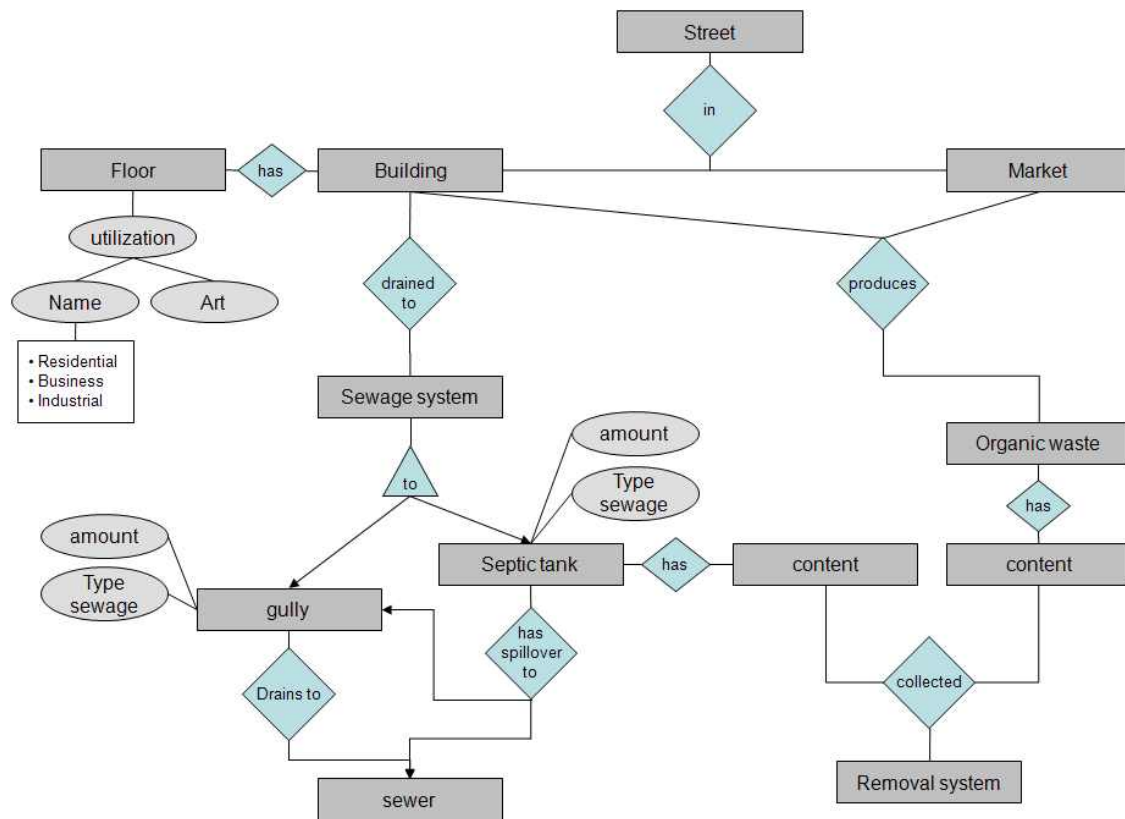


Figure 3 Datamodell (Ch. Hickel)

3.2 Secondary data acquisition

The data basis in Hanoi is ambivalent situation. Several dataset exists but the documentation of this data is incomplete. Because of these gaps not all available data could be used for further analysis. This data are used to generate the origin for the data collection in the investigation area.



Figure 4 Core team, data capture

3.3 Primary data collection

The main campaign for the data collection was done in March/April 2009 with staff and students from TU-Darmstadt and HUCE. The work focused on the defined investigation area in Cau Giay district. This area is a conglomerate of different buildings and combines old and new constructions. The area contains public and private buildings, from standard houses up to high-rises. It reflects the main building types in Hanoi. The first goal of the data collection was to collect detailed information about the waste accumulation and wastewater in the households. From interviews with individual house owners detailed information could be generated. The second goal was to confirm and improve the information on markets and restaurants as an additional source for organic waste. One market has been surveyed and through interviews of stall holders the data about waste accumulation could be improved.

The project includes the use of modern methods and equipments for the data acquisition. After several tests the decision focused on two mobile devices. The Trimble GeoXH (2005 Series) contains a GPS- Receiver and is based on the operation system Windows mobile 5.0. The second device is a Topcon GMS-2Pro which combines the signal of GPS and GLONASS satellite systems. Both systems support the ArcPad. The Topcon device was shipped with a special edition including extensions for the easy use of ArcPad and the control of the satellite receiver while the GeoXH uses the standard ArcPad. The combined use of GPS/GLONASS in the GMS-Pro2 increases the coverage inside the narrow roads and the survey could cover a larger area. Therefore in the existing situation of Hanoi the use of the TOPCON device was more efficient. One of the project goals is also to identify the advantages and disadvantages of using mobile devices. The third mobile device is a Mettenmeier X6 “Colibri” rugged tablet PC. Size and weight are the main disadvantages of this device while the full PC CPU-power enables several operations which can’t be done on Windows mobile based systems. Compared with the smaller devices from Trimble and Topcon the “Colibri” is very heavy and without carrying strap it



is not comfortable during the work. Therefore the “Colibri” device will be used in the next steps of analysis in the project.

By using mobile GIS most of the data could be captured directly with the spatial relation on ground. Based on the skill with mobile devices the use of mobile GIS was, for all participants, an easy way to collect information in a short period of time. Especially the locations of the restaurants including information about size and food could be captured. The structure of Hanoi does not allow the use of GPS in every street. In this case the spatial relation was captured manually based on the detailed aerial photo in the mobile GIS.



Figure 5 Existing land use situation investigation area Cau Giay (Ch. Hickel)

3.4 GIS supports Urban Planning

The database is the foundation for the analysis. The use of visual presentations based on geodata facilitates enables the control over several different scenarios. The flexibility of GIS to give several data a spatial relation is a powerful tool to include heterogeneous information in the planning.

One of the information for the dimensions of the STC is the relation of organic waste, wastewater and septic sludge. Depending on the size of the STC the calculation for the districts can change. For this analysis information about houses, waste water, water supply, land use, streets, septic tanks, transport systems, administrative districts and so on are necessary. All this information has strong impact on the design and shape of the patch for the STC. The patch for septic tank and organic waste might not match exactly. The target is to identify the optimal relation between Dimensions of the STC, patch and transportation system. The complexity in combining new and old structures can be modelled including the existing infrastructure.



Figure 6 Planned road network, investigation area (Ch. Hickel)

One of the targets in the project is to generate a complete concept around the STC. This includes an optimized transportation system for the area. Because of the existing traffic problems the transport of waste to the dump side is slow and ineffective. The central dump side is, for most districts, too far away from the main districts of the city. Depending on the street and building structure the concept should include the access to all septic tanks and control emptying. During the field survey one of the main complaints was the smell of waste and septic sludge in the roads. Only a controlled emptying and reducing of the overflow of septic tanks into the rain drainage system will reduce this problem.

The next step is to generate an application module to assist the concept design. The module should support the calculations of the patches (waste, waste water, septic sludge) and should include the design for a transportation system. The application module is flexible and can be used to analyse similar situations in other districts of the city. Therefore the adjustments should be minimized.

4. CONCLUSIONS

The semicentral system will be an answer to some of the problems of fast growing cities, where the traffic is close to a collapse and long distance transportation of goods becomes ineffective. The direct improvement of the districts by optimizing the waste management in combination with the probably necessary reforms in the administration might be a first step

for a new solution in waste and wastewater treatment in urban areas. The next steps have to be to check the new concepts along with the HUCE and other Vietnamese partners to identify the limitations of the concept. The project should prove the possibilities of the semicentral concept as a solution for the urban areas. The application module should become a standard tool for the planning of a SDC to minimize the planning effort. Environment protection is one of the main challenges in these days. The semicentral concept could play an essential part in waste treatment in urban areas.



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Links:

Project homepage: <http://www.semizentral.de>

BIOGRAPHICAL NOTES

Graduated in Surveying and Geoinformation at the Technische Universität Darmstadt (TU-Darmstadt), Germany, Mr. Hickel worked from 2004 - 2008 as a Project-Engineer to develop a Spatial Data Infrastructure for the Federal Capital Territory Abuja in Nigeria. Since September 2008 he works as scientific assistant with Professor Dr.-Ing. H. J. Linke at the Geodetic Institute, Department for Landmanagement, TU-Darmstadt.

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