

REPORT

3D Geo-information for Disaster Management

Training school within the COST action TU0801 “Semantic enrichment of 3D city models for sustainable development” (www.semcity.eu)

5-9 October, 2009, Delft, Amsterdam, Arnhem

INTRODUCTION

The school was organised in response to the increased need for better, more elaborated and appropriate means for facing man-made and natural risks and reducing vulnerability of certain regions. As much of the problems are related to the search, integration, analysis and understanding of geo-information, this school aimed at investigating new ideas for dealing with geo-information. Special attention was given to semantics and semantic enrichment of 3D city models. As stated in the program of the school, the learning goals covered two challenging aspects of disaster management: 3D modelling and semantics.

The program was designed in such a way that the students can get maximum information on the different phases and characteristics of risk and disaster management, the roles and responsibilities of actors involved in risk and disaster management and existing and potential 3D applications for risk and disaster management. The exercises and the practical's were organised to stimulate the students to analyse the potential of current 3D GIS technology in support of decision making, to guide them in examination of the current bottlenecks in the use of 3D GIS technologies, to encourage them to introduce new 3D GIS technologies when appropriate and to challenge them to understand the domain semantics and analyze to which extent a semantic enrichment could overcome the current limitations and which semantics would be suitable to risk issues.

PROGRAM

The school offered lectures, exercises, a workshop (organised by E-semble www.e-semble.com/, visits to the Netherlands Institute for Safety, (www.nifv.nl/) and Geodan, www.geodan.nl. All the visited institutions are dealing with risk and emergency management. The tentative programme of the week is as follows:

- Risk and Emergency Management Basics (Delft, Monday, 5th):
- 3D Geo-information technology (Delft, Tuesday, 6th)
- GI technologies for Disaster Management in practice (Arnhem, Wednesday 7th)
- Interoperability and semantic enrichment (Delft, Thursday, 8th)
- Decision Support Systems (Amsterdam, Friday 9th)

Experienced lectures have shared their knowledge on risk and emergency management and 3D geo-information technology as follows Roland Billen (University of Liege, Belgium), Wietske Bijker (ITC, Netherlands), Partic Broijmans (Ministry of Defence, Netherlands), Matteo Cristani (University of Verona, Italy), Eduardo Dias (Free University Amsterdam, Netherlands), Laura Díaz (University Jaume I, Spain), Gilles Falquet (University of Geneva, Switzerland), Steven Fruijtier (Geodan, Netherlands), Tim Grant (Defence Academy, Netherlands), Michel Grothe (Geonovum, Netherlands) Thomas Kolbe (Germany), Peter van Oosterom (Delft University of Technology, Netherlands), Chris Phillips (Ordnance Survey, UK), Arda Riedijk (Free University Amsterdam, Netherlands), Henk Scholten (Free University Amsterdam, Netherlands), Sisi

Zlatanova (Delft University of Technology, Netherlands). Most of the international lectures (i.e. Billen, Cristani, Falquet and Kolbe) are members of the COST action.

The students were selected among 35-38 applicants. Most of the students were already working in the area of disaster management and wanted to learn more about 3D technologies and their use for managing disasters. Few of the students were already applying 3D technologies in emergency response. The selection procedure considered the experience of the students, their motivation to attend the school, the application filed as well as the country they are coming from. Since they were supposed to work in groups, it was considered important to get students from all over Europe to be able to cover the different organisational, technological and legal aspects. Among all the students 19 were granted a fellowship from the COST action. Another 7 attended the school on their own expenses. Two more students attended only selected days. There were 26 students from 15 countries (one from Korea). Prior coming to the Delft, the students have prepared short presentations about their research and collected information about a disaster management case (which was later used for the group assignments).

THE SCHOOL IN DETAIL

Monday

The school started in Delft. The students received on their arrival a folder with various materials and the book 'Geo-information for Disaster Management', (eds) Oosterom, Zlatanova & Fendel, 2005, ISBN 3-540-24988-5, Springer, Berlin, Heidelberg, New York, 1434 p.

The school was opened by Sisi Zlatanova (at 8:45), who presented the COST action, the goals of the school and the program. Immediately after that she gave the first lecture on the basics in risk management and emergency response, pointed out the differences and similarities between the phases and highlighted role of 3D geo-information. The second lecturer Tim Grant discussed the process of making decisions. He gave an inspiring lecture with many examples based on his huge experience in the military sector. He drew a clear line between the decision-making process and the systems to be developed for this purpose. At the end he demonstrated applications using 3D interfaces. After the lunch the last speaker for the day Matteo Cristani introduced semantics and discussed the problems in communicating different meanings between the actors in disaster management. He introduced ontology as a 'tool' to formally describe meanings and gave numerous examples of different meanings assigned to the term 'disaster'.

After the lecture period (at 15:45), the students have presented shortly their case studies and on the basis of these, we have formed 4 groups to work on flood, forest fire, earthquake and disaster within a built-up area (buildings). The groups had to develop a model (UML) representing the information needed for the specific disaster case. They had to agree on a common use case, to define the actors, to select the most critical data/information and create an UML schema. The students had worked very enthusiastically until 18:30.

The day has finished with a dinner at de Vlaanderen (<http://www.vlaanderen.nl/>). The students presented themselves and their research between the dishes (with a lot of humour and noise).

Tuesday

The second day was devoted to 3D geo-information technology.

Roland Billen started with 3D modelling and 3D relationships. He presented a large number of 3D topological structures and frameworks for detecting 3D relationships. He also pointed out some challenging issues in expressing relationships. The second block of lectures concentrated on data collection methods and applications and their applicability for different types of disasters. The lecturer Wietske Bijker illustrated the approaches with material from recent disasters in China, Indonesia, Pakistan. After the lunch, Chris Phillips (who is also involved in Map Action) discussed 3D advanced visualisation approaches, which are either in use or might be of help for response and aftermath phases of disaster management. His presentation provoked a discussion on the benefits of games (serious games) in emergencies.

The last block was devoted to a practicum, organised by E-Semble. The company develops 3D highly-interactive software for training of emergency responders at different levels. The students could 'play' with the software by designing their own incidents, investigating the situation, deciding on who is supposed to be involved and making decisions.

After the practicum (completed at 17:30) the students continued with their assignments from the previous day. Some of the groups kept discussing until 19:00.

Wednesday

The third day was organised in Arnhem at the Netherlands Institute for Safety (NIFV). The goal was to meet experts working in the field and to work with one of the Command and Control (C&C) systems currently available in the Netherlands. The students got together at the Delft central station at 7:30, where a coach was waiting for them. After the first half hour catching up on sleep, the students started discussing their assignments in groups. Some of them had structured their information and could start working on the UML models. The ultimate goal was to finish the model in the bus on the way back to Delft.

The lectures at NIFV started at 10:00 with a welcome speech by the director of the institute. After him Henk Scholten discussed the importance of spatial awareness, spatial thinking and new digital technologies. Laura Diaz presented her work on enabling web technologies for risk management and emergency response. She discussed also all the European initiatives (within GMES, INSPIRE, SEIS) in support of disaster management.

After the lunch the students could start their work with a C&C system. They were subdivided into several teams and had to resolve a dyke break in one of the lowlands (Flevoland) in the Netherlands. The C&C system had many GIS data (organised in different layers) and a simulation on how the water will flood the lowland for a period of four hours. The students had to find out who is in the treated area, whether there is need to evacuate (or wait), in which direction and how. All the information was available in the provided data they had to discover it and analyse it. The instructors of this exercise, playing the role of the mayor and the press, demanded reports every hour. The exercise was rounded by an evaluation and final discussions. Everyone found working almost in 'real-time' very exciting and admitted that they had felt the pressure of real responders and disaster managers.

About 19:30 all the students were back at Delft. Most of them decided to work during the dinner and after the dinner.

Thursday

This day focussed on interoperability issues, standards and semantic aspects.

In the first block of lectures Peter van Oosterom discussed which aspects of Spatial Information Infrastructures should be addressed to be able to cover the third dimension. He made an overview on the INSPIRE activities and discussed INSPIRE approach for harmonisation of data in detail. He has also presented some of the projects of TUDelft devoted to the third dimension (such as 3D topography and 3D cadastre). Gilles Falquet concentrated on semantic modelling and emphasized the importance of clear understanding of the entities, their names, attributes, relations with other entities and the invariant rules for a given domain. He discussed the difference between formal languages and demonstrated the power of descriptive logic with simple examples. The last lecture for the day (after the lunch) was devoted to 3D standards. Thomas Kolbe presented a detailed overview on 3D standards for visualisation (on the Web) and discussed the concepts and developments within CityGML.

After a short break, the practicum on ontology has started (15:45). The initial intention was to design ontology for one of the UML diagrams that students have created, but most of them look quite complex and not appropriate to demonstrate the use of ontology. A new simple UML diagram was designed, consisting of few users, their tasks and the types of disaster that they have to solve. This exercise was completed in Protégé as the whole group finally united around two laptops. The help of Gilles Falquet was critical for solving mistakes and wrong assumptions while creating the classes and relationships.

The students continued working until 19:30.

Friday

The last day was organised in Free University Amsterdam. The students could decide by themselves when and how to move to Amsterdam. The lectures started at 9:00 at the University. The first lecture was given by Michel Grothe, who presented the SDI activities within Netherlands with respect to providing data for disaster management. Peter Brooijsmans discussed the concept of 'net centric working', which is need for information sharing and situational awareness in emergency response. Eduardo Dias explained the EAGLE architecture as an example of net centric working. The EAGLE system won the Dutch award for best R&D development for emergency response for 2008. Arda Riedijk reported the evaluation of a large training with EAGLE in one of the 25 safety regions of Netherlands completed in March, 2008. The evaluation has clearly shown the added value of geo-information, but also has figured out various semantic problems. Finally Steven Fruijtier elaborated on sensor web and the integration of sensors and 3D and their use for emergency response.

After the lectures, the students presented their work on the assignments. Each group has prepared a presentation and each member of the group presented part of the work, he/she was working on. The presentations were surprisingly good, bearing in mind the short time they had to work and prepare.

The school was closed with awarding a Certificate of Attendance to the participants. After the 'graduation ceremony', the students were invited at Geodan for some demos and drinks.

CONCLUSIONS

The lectures and the discussions within the school have shown the importance of semantic and ontology for emergency response:

- Many users with different backgrounds and knowledge may get involved in managing emergencies, which requires mutual understanding while exchanging information
- The variety of data is large and may lead to misunderstanding and misinterpretation. In this respect ontology can help by providing a formal approach for integration of data.
- 3D city models are of interest but still insufficiently used. These models are still difficult to obtain and the semantics is very poor. Most of the 3D models are currently created only for visualisation.
- Context in which information is provided is of great importance. Knowing the context it is possible to select the most appropriate information and deliver it quick. Ontology can help by providing methods for creating rules and tools are available that complete the reasoning.

The work of the students on different cases studies provided also indications that 3D semantically enriched city models will be advantageous for emergency management as follows.

- Management of forest fire would benefit from 3D modeling of the smoke and the air pollution (especially when it is in the vicinity of cities) and enrichment of current 3D city models with air pollution models, based on in-situ sensor information.
- Flood management could be improved by considering indoor structures, underground construction (tunnels, shops) and enriching 3D city models with sensor information.
- Emergency management after earthquake could benefit from 3D models with semantic information about the structure and construction of the building (BIM were given as an example of a needed model for damage assessment and rescue of people)
- For emergency management in buildings 3D indoor models were pointed of a great importance, enrichment with information about facilities (pipes and data about people in buildings, evacuation plans, event situation, construction and material used in the building.

The very general impression is that the school was a great success. The goal of the school was achieved. We believe the students went back to their universities with more knowledge and new ideas on 3D geo-information technology, semantic modelling and systems for risk and disaster management.

The students were very active all the week (although at the end they admitted that they are exhausted). They were working with each other very well; it was a nice mixture of boys and girls from different countries. The students definitely wanted to keep in touch, some of them even planned to extend their work during the school in a publication. They hope we will keep them informed about the activities of the COST action.

The lecturers were also very well prepared and gave interesting high-quality lectures. The contact with the students was very good.

The lectures and the presentations of the students are available at http://www.gdmc.nl/zlatanova/downloads/COST_3D4DM.rar (about 164MB).

Some observations that can be useful for other activities within the COST action:

- We had almost every day one lecture after lunch, which made it about 6 lectures per day. This was too much for this group of students. They really preferred to have the whole afternoon for the assignments that had to prepare. It is good to keep in mind that in some situations is perhaps better to give more time self-study and assignments

- The lectures fitted finally quite well with each other, but this was a bit a coincidence. There were not that many overlaps or gaps. However it is good to synchronize better. Due to the very short preparation time, we could not collect the slides of the lecturers before the school. It is really recommendable to have an initial overview on the material that is going to be presented.
- Having the school at three different places finally appeared to be a very good decision. The students could experience different environments and prevented getting bored in one and the same room all 5 days.
- Written assignments and 'ready-to-use' software are always a better option although it may require more preparations from the local organizers. But a lot of time is saved during the exercises. For example the exercise in Arnhem (with prepared data) went smoother compared to practicum with E-Semble and Protégé.
- Some of the students were very enthusiastic about semantic modeling and proposed organizing a school on ontology only.
- Concerning the budget of the students. It is perhaps better to grant different fellowships. We have decided for 1000 euro each, but for some students this is too much.
- A more careful consideration is need for the budget for local organizers. It hardly fits in 3000 euro is something reasonable should be organized.

25th of October 2009
Sisi Zlatanova

Delft University of Technology
Delft, The Netherlands