Interview with Prof. Peter van Oosterom, Head of the Section o Delft University of Technology

Impact on Literature and Society

The Geo Database Management Center (GDMC) at the Department of Geodesy, Delft University of Technology, was officially opened on 15th November 2000. The GDMC is the research and development centre of the Section of GIS Technology. The centre aims at contributing to the fields of modelling, storage, querying, analysis, presentation and distribution of geo-information. The centre wishes to co-operate with the GIS industry. At present, Oracle, Sun Microsystems, Computer Associates (CA) and Professional GEO Systems participate in the centre. The official opening of the GDMC provided reason to interview it's founder and head, Prof. Peter van Oosterom, who since January 2000 has had charge of the Section of GIS Technology. He was previously employed by TNO and the Netherlands Cadastre.

By Mathias Lemmens, Editor of GIM International

Prof.dr.ir. Peter van Oosterom (37) has a background in ICT. Although since completing his studies in Informatics at the Delft University of Technology he has been continually employed in practice, he has remained primarily a researcher. Whilst in practice he carried out and completed his Ph.D. dissertation. The foundation of the GDMC was a natural result of his work at the Netherlands Cadastre. At present, his research group consists of thirteen members. Being an ambitious researcher whose anxiety that he might lose touch with actual problems motivates him personally to conduct research, he admits that he is still not used to managing a group of this size. He considers teaching a group of students to be a big challenge.

The interview took place in Prof. van Oosterom's working room, on 19th January 2001

You have now been working for slightly over one year at the Delft University of Technology. What are the most striking differences you have met with when changing coordinates from a practically- orientated scene to the academic one?

I have never been a manager. When working in practice, I have always been a researcher. At the university one has more freedom to do the research one really wants to do and which one considers important for the development of one's own discipline. Of course, one's interests should be more or less in line with what the others in the group are doing; there must be some coherence. However, there is not so much pressure that the results of the research should be instantaneously applicable. The time-horizon at a university is farther ahead. One gets the time to investigate problems deeply; one is not expecting directly applicable results. Of course, scientists are complaining, that the freedom for research is getting less and less because research has become a commodity. Nevertheless, there is really more freedom than when working in practice. When I look at my research subjects now there is not so much difference with the work I did at TNO and the Nether-

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lands Cadastre. However, because I have to manage a group I do have less time, compared to the past, to do actual research. Okay, one may say that as a professor you just need to manage the research, but I am afraid that if I don't carry out research myself I will lose contact with the actual problems.

What are the main topics on your present research agenda?

We are now very busy with our first geo-DBMS management system (DBMS) projects and I would like to invite your readers to have a good look at our research topics. Besides research on the geo-DBMS itself, we are doing research on network access to geo-information because in the networked society more and more data will be exchanged. A third important topic, one which is growing increasingly in importance and with which I know that you too are specifically concerned, is the quality of geo-information. Because of the increasing merging of geo-data stemming from different sources, the meaning of data must be well-understood by the user and/or the system otherwise you get misinterpretations and misunderstandings. The fourth and last topic, which is currently rather dormant, is dynamic spatial processes.

In the past, GIS has been particularly concerned with 2D aspects of the world. However, the world is inherently 3D and 3D modelling is growing rapidly in importance, in particular because human beings are using space increasingly intensively. With what type of research do you contribute to this dimensional expansion?

Several of our staff members are involved in 3D. Long before my appointment, the group was already engaged in the development of a 3D Virtual Reality (VR) system. The aim of this research has been to connect the storage and query capability of a GIS system with the strengths of a Virtual Reality system. This was important research. To the best of my knowledge this system, called Karma - you published an article about it last year in GIM International - was the first which fused the GIS with the VR environment. A VR system is able to visualise the 3D world whilst one is able to navigate through the scene. However, Karma is more than a VR system. It enables extraction via the scene of information from the underlying DBMS, while one can also interact with the scene. For example, a building may be added to the scene or modified. One can operate world-wide with the system over the Internet. That is the importance of a good architecture.

Another project in this area is Ubicom. This is a co-operative research effort involving several faculties of the Delft University of Technology. Its goal is to develop an augmented reality system. This means that onto the actual reality in which you are standing, additional features are projected with the use of special equipment which fuses, in front of your eyes, reality with a virtual reality. These features may be planned objects, like buildings, or features which are not otherwise visible, like objects in the ground, e.g. pipelines and cables. Textual information may also be projected over the actual reality.

What type of applications do you have in mind with the Ubicom project?

A really big application is the tourist market. Imagine you are in a city and you wear this equipment – even at the present time it is quite handy. It presents information to you, in the same field of view as you are looking at the actual scene, concerning the architecture of a building, or some historical information about the site upon which you are walking. The information is provided to the tourist interactively; he is the person in charge. A second application is to inform politicians and the general public in an insightful way about the consequences of intended urban changes and infrastructures. I see it as the ultimate tool for the presentation of a plan and its alternatives. In this way, politicians can responsibly take important decisions. It may also be very useful during the design stage. With some additional tools, like using a finger as mouse, the designer can grasp a building and move it to another location. Technically, this is quite difficult to realise. In order to avoid anybody getting seasick you need accurate positioning, orientation and fast rendering of the superimposed features and object; at least thirty

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Banners on the façade of the building of the Department of Geodesy, Delft University of Technology, on the occasion of the Opening of the GDMC

to forty times for the left and right image, because it is stereo. This really presents a technological challenge at the present moment. It therefore requires a co-operation between several faculties: Computer Science, Information Theory and Geodesy We all work together on this project. Perhaps the most important application I see is in facility management. When one considers the damage maintainers of utility services bring to bear when digging holes and grooves, it would be a real improvement could the invisible be made visible. Augmented reality makes possible projection of underground cables and pipelines over the actual scene.

Research in this area requires more than a pencil, paper and a computer

I sometimes call the cadastre the mother of geomatics. All over the world, cadastres reduce the world to 2D surfaces before representing it in the DBMS. In the context of the increasingly intensive and multifunctional use of space, do you see the cadastre developing in the direction of 3D representation of space?

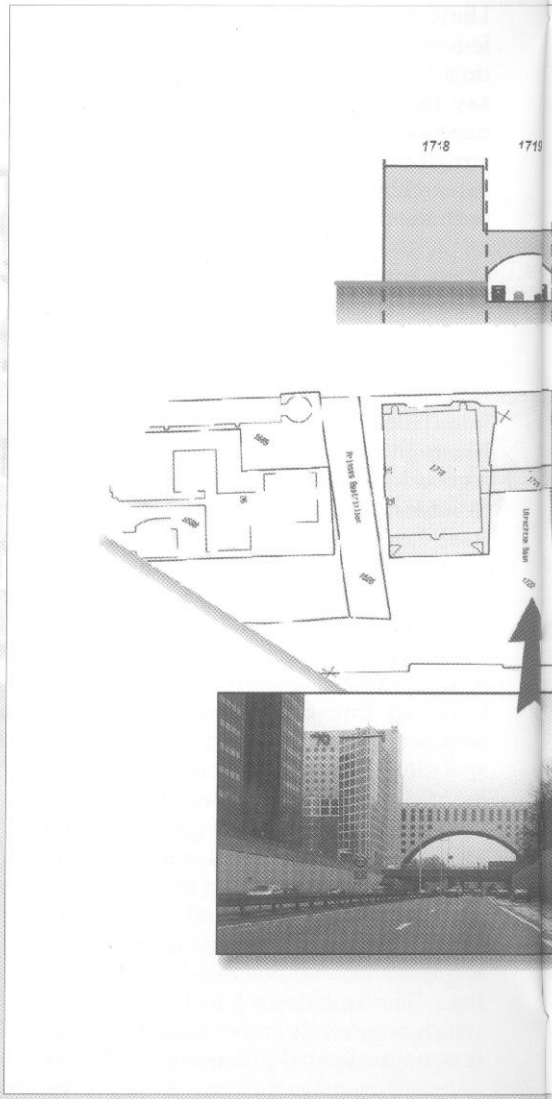
Indeed, when I was employed by the Netherlands Cadastre I noticed that the juridical relationships of people to space are often more complex than can be represented by a 2D representation. This solution adopted to represent the 3D world is an administrative one; markers on descriptive text paper documents are used to indicate that something special is going on with a particular parcel. This may suffice so long as it seldom occurs but when it becomes a regular occurrence more sustainable solutions should be adopted. A better solution, therefore, would be to resolve the situation not administratively but spatially. Clear ownership information might thus be assigned to 3D objects. So instead of having a projected 2D object associated with complex administrative ownership and other rights, space is divided up into real 3D objects with clear one-to-one ownership relationships. From a technological view-point, this is a huge challenge. Difficult questions have to be addressed, such as how to collect 3D information, how to represent the third dimension and whether use should be made of the actual absolute coordinates in a geodetic reference system or instead the height be represented relative to a horizontal surface plane. Also, which geometric primitives should be used, e.g. planes, cylinders or spheres. Besides the technological realisation, any change from a 2D to a 3D cadastre would also have a huge legal impact. One of my researchers is working on the technological aspects of 3D cadastres. This research should ultimately result in a Ph.D. dissertation.

I can imaging that the establishment of a 3D cadastre involves many and complicated measurement activities. Would the establishment of a 3D cadastre result in the revival of the surveying profession, in the sense that we would need more and more surveyors?

3D data collection is hard work. It takes a lot of effort to achieve 3D object representations with the same accuracy as we are presently used to with 2D cadastres. It is probably too expensive to establish country-wide 3D coverage and, in my opinion, this is not at all necessary. It is only necessary for densely-populated areas. One should consequently be very selective in choosing where a 2D solution suffices and where a 3D solution is needed. Ultimately, one will have areas with 2D representations and other areas with 3D representations. At the boundary of these, one will be faced with the problem of how to connect the 2D with the 3D world. This is in some sense comparable with the present scale problems between maps, for example where urban areas and rural areas meet each other. However, one should recognise that scale is a representation issue. When stored in a DBMS it does not mean so much anymore.

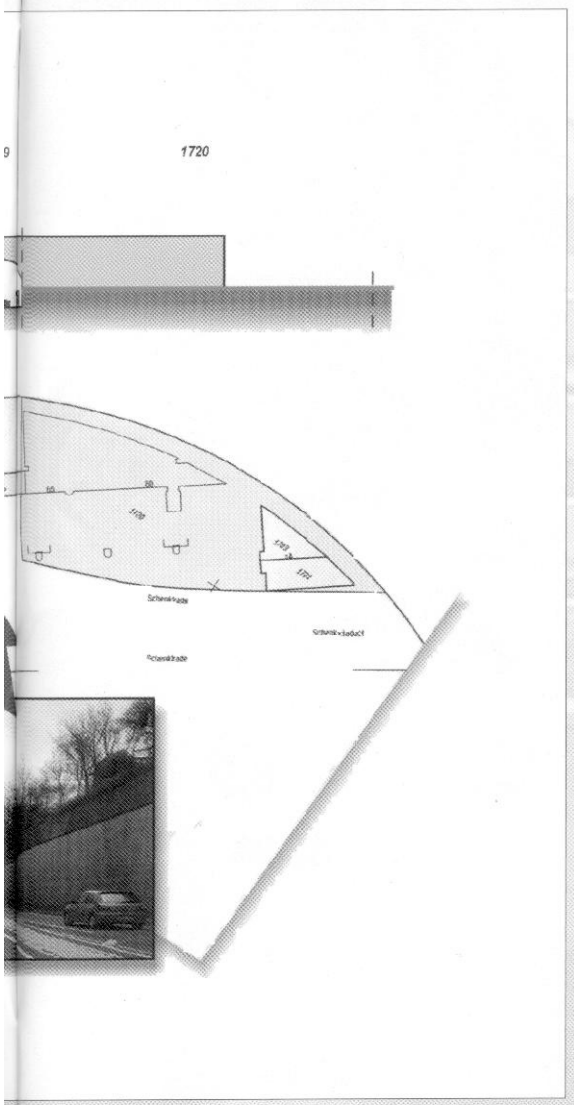
Why did you establish the GDMC in order to realise your research goals? Is it not possible to fulfil one's research ambitions without such a Centre?

Our group is named GIS Technology. Technology is a very difficult area to work in from a university perspective. The reason for establishing this centre is that research in this area requires more than a pencil, paper and a computer. Concepts, software, implementations and hardware have to undergo development. We are operating in an area of technology in which the players are large companies, software developers and vendors like ESRI, Informix, MapInfo, Oracle, Computer Associates, IBM, Bentley, and Autodesk. These com-



Cadastral systems represent the world in 2D. A better solution would be to use real 3D objects to which clear ownership information might be assigned. From a technological point of view this represents a huge challenge

panies are all investing a lot in R&D. So that one of the main questions which confronted us was: what can we, as a relatively small group of scientists, add to the field of GIS technology? We have bright people who have good ideas and these good ideas should be connected to solving real problems. These ideas should be capable of implementation and should advance the current software one step further. We need also to avoid the situation in which we ourselves create too many things from scratch, especially those things which take many years of hard labour in terms of development and which once completed would be out-of-date due to industry having solved the same problems already. We cannot do everything by ourselves. Therefore it appeared important to establish an open centre within which we could carry out fundamental research in close co-operation with the Industry. That is why we have chosen for an open approach.



You mentioned a number of firms. With which firms are you actually co-operating at this very moment and what is the reason behind your choice of these specific firms?

There is a certain logic in the choice of firms which are our partners. Because my personal research background is in spatial databases it is my strong belief that the heart of any GI Technology is the spatial DBMS. Key to any DBMS is that data should be stored in a well-ordered manner. In terms of IT, the concept of a DBMS was developed for this purpose. The same is true for spatial applications. However, when looking five or ten years back, the average GIS vendor did not then store spatial information in the DBMS. The research in which I was involved with my previous employers, was trying to bring spatial data into the DBMS so that it could be managed together with other data and be accessible to many users. So that it was quite natural that when we were looking for partnerships we focused on spatial DBMS developers. These partners are Oracle and Computer Associates. We chose Oracle because this is a worldwide player which takes many initiatives in the field and which had also thorough experience. Of course, software needs hardware to run on. Oracle carries out its software R&D on SUN platforms. Computer Associates, with their DBMS Ingris and Jasmine, also suggested using this platform. So, to arrive at optimal symbioses, it was quite natural then to begin a partnership with SUN Microsystems. A second, equally important, reason is that SUN is very involved in Java developments and applications. So that in the perspective of our ambitions with respect to research on access to geo-information via the Internet this appears a good choice. Of course, partnerships have to come from two sides and we are lucky that the partners mentioned were willing to co-operate with us.

Is the list of participating companies extendable in the near future?

Yes, in principle it is. For example, after having made agreements with Oracle and Computer Associates, we came in contact with Informix. We now have their DBMS on our server. However, the partnership with them will be less close, at least this year, than with the two other database vendors. This is because with a small research group one has to limit oneself; one can't manage all the existing software systems. They are all notoriously complex. Nevertheless, I have to admit that it is difficult thus to limit oneself because researchers are very curious about new developments in their field.

You have a plethora of ideas and ambitions. Where do you want to be within five years; where is your horizon?

From a scientific point of view I would like the group to have had some impact on the scientific and non-scientific literature. However, this should not be the main goal. The main goal is that our concepts and ideas have effects on society. I hope that what we do and are going to do will be visible within five years. Of course, it takes time before one's ideas and concepts are implemented in everyday work processes. That sums up the research aspect of my time horizon. In the field of education, we are presently in the process of redesigning our curriculum. One of the major reasons to do so is because of the Bachelors-Masters structure of university education

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which has been accepted by many European countries. Of course, GIS Technology will represent profound components of the new curriculum. What worries me the most is the small number of students streaming in yearly at the Department of Geodesy. One of the major starting points for revision has been to make the curriculum more attractive to high school students.

What might be the reason for the small number of students? Is this specific to the study of geodesy or is it a more general problem affecting all technical universities?

In my opinion, it is because high school students, their parents and their teachers do not know what geodesy is. I am really a hundred per cent convinced that were high school students, young people of sixteen to seventeen years old, familiar with the contents of this study and what type of jobs they could step in after completion, than we would have at least one hundred students run in each year. Now this number is ten. That is far too few.
Technology has reached a level at which people no longer value it because they are so used to it and do not realise what was needed to get here. From our point of view, this means that technology is clearly undervalued. Nevertheless, I am not too pessimistic because when the time comes that there are too few technicians their value will steadily increase - it is a matter of supply and demand - and doing a technical study course will become increasingly positively weighted.

Talking about students, you come from practice where you were primarily a researcher. After a year in this department how do you feel about the new role of being, besides a researcher, also a teacher?

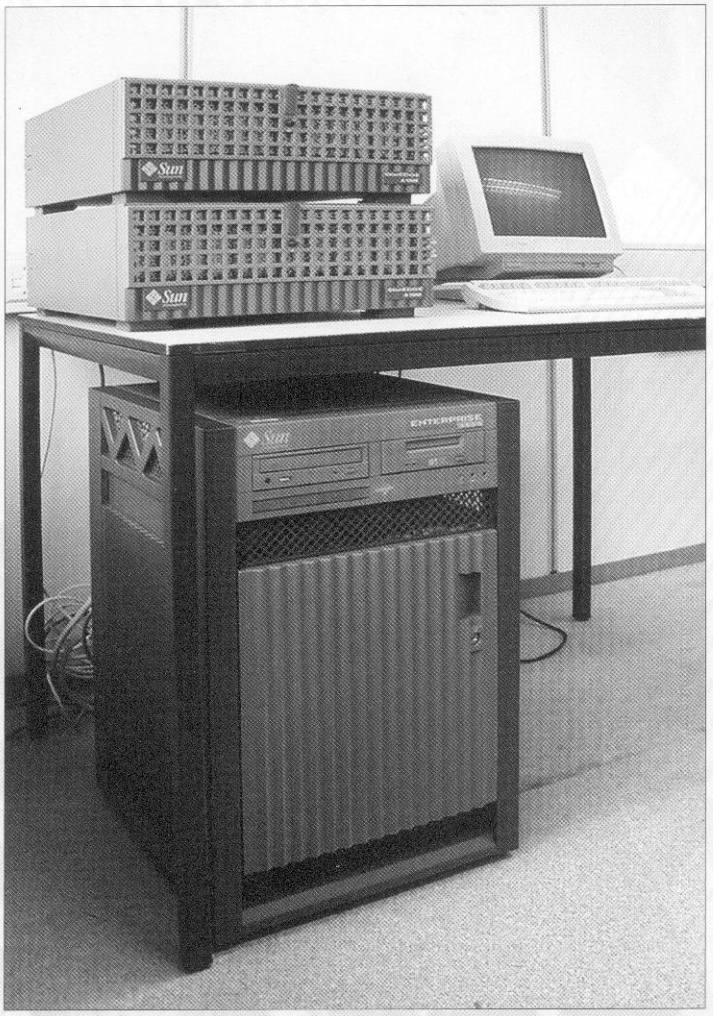
A big challenge! I have never been involved in education before so I still have to find out whether I can teach at all. To prove that I can do it is for me a personal challenge. Should I arrive at the impression that I cannot do it, I will find myself in a difficult situation because as a professor you are supposed not only to do research but also to play your part in the education system. At present, I cannot give a good indication of how well I will teach because my course starts in spring this year. I still have to experience it....

The everyday use of geo-information will steadily grow. Does this mean that in primary and secondary education there should be more emphasis on teaching the ins and outs of digital geo-information?

We are entering the information society. In the information world, not only is geo-data important as geo-information but also as an interface to other data. I see a very important role here for geo-information as an organising principle in terms of information because human beings are used to space; they live in space. I think ICT can't do without geo-information.
The image of geo-information or geography should therefore be rethought. For example, when I went to high school one could choose from a wide variety of course-combinations for final exams. Some of these combinations were called fun-packages because they were rather simple to do; little mathematics, no physics. Part of such a fun-package was geography. Although in the meantime our educational system has changed, this still says something about the image geography has. It is not given proper value.

Approaching the end of our interview, maybe there is still a subject upon which you would like to comment? If so, please feel free to do so.

The research group in our department of Geodesy, headed by Prof. Peter Teunissen, is very strong in positioning. We should try to combine the strengths of this group with those of our own to work in the direction of Mobile GIS, also called location-based services. If there is one centre in the Netherlands where research on Mobile GIS could be successful than it is in our Department. This is because Mobile GIS has three main ingredients: wireless communication, positioning and geo-data and geo-processing. Considerable knowledge concerning two of these three components, positioning and GI technology, is present in this department and substantial knowledge regarding the third one, telecommunication, is available in another department of this same university of technology. No other university in the Netherlands can claim to have these resources in-house. So it is my opinion that, because we do have the basic disciplines in-house, we should proceed in this direction.◆



The SUN E3500 used as hardware platform for the GDMC

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