INAUGURAL LECTURE
23 APRIL 2010

FROM WHITE ELEPHANTS TO SPACE ELEPHANTS

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LECTURE GIVEN TO MARK THE ASSUMPTION OF THE POSITION OF

RECTOR / DEAN AND PROFESSOR OF SPATIAL ENVIRONMENTAL QUALITY

AT THE FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION (ITC) OF THE UNIVERSITY OF TWENTE ON FRIDAY, 23 APRIL 2010

BY

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MR RECTOR MAGNIFICUS, LADIES AND GENTLEMEN,

I will open my inaugural lecture with a topical example that illustrates how modern society is relying more and more on geodata and how, despite all the achievements of the last decades, many issues in current geospatial data supply and use still remain unresolved.

We all witnessed the decision to stop all air traffic in northern Europe. On 14 April 2010, an Icelandic volcano, the Eyjafjallajökul, erupted and spewed a large amount of ash into the atmosphere, which was subsequently blown over northern Europe. Apparently the ash cloud was clearly visible on the Meteosat image (www.metoffice.gov.uk) and this information led to the decision to close northern European airspace.

If we take a closer look at the ash distribution map (voted “map of the day” by the magazine Business Insider (http://www.businessinsider.com/map-ash-cloud-europe-2010-4)), it becomes unclear where the ash actually is (figure 1). The pinpointed ash cloud displays colours that are also visible above Greenland and areas of Finland that were known to be unaffected by ash at that moment. Without a scale, legend or units, the map is a nice image to make a point but not a true map. Nevertheless, it was this type of geo-information that led to the decision to halt air traffic – a decision that trapped many people, including myself and other colleagues, in faraway places. Many of those affected tried to access relevant timely information about what was happening. On the World Wide Web, they could track aeroplane movements and the closing of airports, but there was no information about the ash cloud. Fellow travellers of mine were looking at Google Earth because they expected to see it there! The same day several different, usually very simple, hand-sketched maps appeared in the media, all of which showed different patterns and conveyed different messages. Suddenly it became clear that, although there were several maps of ash distribution patterns, no one knew exactly how much ash was where or how it
behaved in time. The information on the 4D behaviour, x-y coordinates and altitude (z) in time (t) was very limited. To project possible future pathways of ash distribution, meteorologists were arm-waving on television and simulation models were made. These model simulations (www.dmi.dk/dmi/) looked very convincing – like the Meteosat images – but again no one knew how realistic the produced animations were (figure 2). This uncertainty prompted a discussion on how real the ash cloud actually was, and suddenly the geo-information provided was considered insufficiently reliable to serve as a basis for deciding when
to reopen European airspace. In the end, it was old-fashioned experimentation driven by commercial interests that persuaded governments to allow air traffic again.

ITC has been dealing with such geo-information issues for 60 years now. Originally the focus was on making maps based on aerial photographs but later, as satellite and computer technology developed, remote sensing and geo-information science became more important. ITC has always operated within the context of international development cooperation, helping countries to map and analyse their re-
sources and problems and at the same time educating local people to perform these tasks in the future. With the changes in technology (indicated by ITC’s different names), the level of capacity building has risen to PhD level, and within this context the merger with the University of Twente is a logical step in a long-term process.

This inaugural lecture will address the question: How future-proof is the Faculty ITC? I will discuss its strengths and weaknesses, as well as the opportunities and threats facing the Faculty. This SWOT analysis is based on an assessment I have made within the Faculty during the last few months, and I will sketch future strategy options with reference to elephant stories.

Why elephants? ITC is a longstanding member of the International Society for Photogrammetry and Remote Sensing (ISPRS). The main mission of ISPRS is “the development of international cooperation for the advancement of photogrammetry and remote sensing and their applications to contribute to the well-being of humanity and sustainability of the environment”. This mission has a strong similarity with the mission of ITC. It came to my attention that in 2004 ISPRS founded an ad hoc knowledge transfer committee called the White Elephant Club. It was founded on the occasion of Prof. Armin Gruen’s 60th birthday, which was celebrated at the Yildiz Hisar Club, Istanbul, Turkey, during the XXth ISPRS Congress. It consists of active and formerly active senior ISPRS officers and other recognized persons with close relations with ISPRS. One of my predecessors, Prof. Klaas Jan Beek, is a member of the White Elephant Club. But why choose the name “White Elephant”? Probably not because products or services that have not sold well despite the large amounts of money spent on their development are known as white elephants. An example here is the Dutch billion euro investment in the Betuwe Lijn, a railway hardly ever used. Nor is the American white elephant metaphor for worthless possessions or gifts that are redistributed at white elephant parties very inspiring. But
the elephant as a symbol of knowledge transfer triggered my attention and I decided to use elephants to illustrate my analysis of the Faculty ITC.

Back to the SWOT analysis. One of the main strengths of ITC is that it has a large critical research and education mass covering the full spectrum of geo-information science, from sensor through analysis to dissemination and use. “Full spectrum” does not automatically imply that there is good collaboration and communication. The different versions of oriental stories about a number of blind men examining an elephant (http://en.wikipedia.org/wiki/Blind_men_and_an_elephant) are well known. Each man can feel a part of the elephant but believes that it is the whole of the elephant. In reality, however, each has touched only a part of the animal and no one can feel the whole – just as no one can know the whole truth about a matter. Nevertheless, together they get closer to the whole picture (figure 3). To avoid becoming a group of “blind men”, ITC has to organize itself more as a research chain (Bouma et al., 2007) or, according to more modern insights, a learning circle (Giller et al., 2008), and thus make the whole greater than the sum of the individual components. In this respect, collaboration and good communication are essential to the future of ITC.

ITC should also clearly use and present the whole range of tools and domains within the Faculty as one overall domain to solve real-world problems. The potential limitation of a purely method- or tool-based focus is that, rather than approaching issues by means of a problem
analysis, the tendency is to start looking for an application for a tool. The phrase “when you have a new hammer, everything starts to look like a nail” illustrates the pitfall of a disproportionate tool or method orientation. The different domains at ITC should all have relevance in developing countries. These active research and teaching domains are urban planning, land administration, disaster management, land and water governance, water management, earth sciences, environmental management and biodiversity, and food security. Do we have development-related research questions (elephants) concerning these issues? It turns out that we can find illustrative elephants for every domain – ranging from crop-raiding elephants that threaten food security, water-managing elephants, and elephant biodiversity in people’s backyards, to urban elephants roaming the streets of Asia. We even have elephant governance, with elephant-repellent crops and disaster management
focusing on elephants who actively remove tourists from their habitat. Elephant land administration leads to well defined and clearly marked elephant corridors (figure 4).

Finally, beautiful geo-scientific elephants can even be recognized in volcanic and sedimentary rocks. These geo-elephants nicely illustrate how our brains are hardwired to recognize patterns – elephants in this case. The longer you look at these geo-elephants, the less elephant-like they become (figure 5).

This brings me to the second strength of ITC: instant access to on-site research problems for global development. Our students, alumni and partners give us direct access to actual development problems in their countries, a unique portal for relevant problem-oriented research. Our elephant domain examples clearly illustrate this strength.

Of course ITC also has weaknesses. The first identified weakness is the tension felt between the capacity building mission and the need to strive for excellence in fundamental research. This is a commonly observed weakness in universities where the education burden is not distributed equally among the staff and faculties. The challenge to strive for excellence in both research and education is especially felt within the context of tenure track procedures. I will come back to this point later in my analysis.

Figure 5: Elephants in geo-science
A second perceived weakness is the observation that ITC is not clearly visible in Dutch academia. A typical illustration is the current concept report by the Royal Netherlands Academy of Arts and Sciences (KNAW), Agenda 2020: ITC is not even mentioned in the Earth Sciences Netherlands education and research agenda, despite the fact that we have several earth science departments and are in the Dutch top ten of R&D institutes. ITC is unique but feels like an elephant in a herd of Frisian cows. We stand out but not in a way that counts with our Dutch colleagues (figure 6). ITC needs to address this by taking more initiatives within the context of KNAW and the Netherlands Organisation for Scientific Research (NWO).

There are of course many opportunities. The use and awareness of Geo-ICT in society is clearly growing, as I have demonstrated using the volcanic ash cloud example. A second opportunity is that ITC has the established experience and knowledge to contribute to the international development agenda. The domain elephants I have discussed illustrate this point. ITC can offer many examples of how it has significantly contributed to global development issues.

Finally we come to the threats. As expected given current societal developments, our funding insecurity is recognized as a main threat. I will return to the funding sensitivity of ITC later in my analysis. Another identified threat is the fact that Geo-ICT is not always recognized as knowledge that is relevant to solving global development problems. On the one hand, we do see more applications of Geo-ICT in developed countries owing to GPS technology applications in computer, organizer and mobile phone technologies. On the other hand, although there
are similar opportunities in less developed countries, they are not rec-
ognized by policy makers as pertinent to the development of these less
developed countries.

To understand the sensitivities and uncertainties that ITC is currently
facing, I have made a sensitivity analysis of ITC as a system. This was
done using fuzzy cognitive mapping (FCM), a methodology common-
ly used in participatory scenario development with stakeholders (Kok,
2009). A cognitive map is the graphical representation of a system. Its
components are represented as boxes and the relationships as arrows
(Kosko, 1986). In this particular case, the resulting map is a personal
cognitive interpretation of the ITC system. The fuzziness relates to the
fact that the strengths of the relationships are not really known but are
graded relative to each other on a scale of zero to one.

To illustrate how FCM works, a hypothetical system is presented where
two boxes (C0 and C2) with an initial value of 1 both feed into another
box (C1). The values in the boxes and the arrow values have no units.
The box values show relative value changes. The relationships indicate
that the content of C0 feeds its value 1 completely into C1, C2 feeds
only half (0.5) of its initial value (1) into C1, leading to a constant value of
box C1 of 1.5, while C0 and C2 remain at their initial value of 1 (figure 7).

When we add a small (0.1) negative feedback from C1 back into box
C0, we observe that, if we let these boxes iterate in a spreadsheet, the
values of boxes C0 and C1 gradually and infinitely decrease, while box
C2 remains stable at its initial value of 1 (figure 8).

When we add a similar feedback from C1 into C2, the value of this box
also demonstrates a gradual decrease. The additional feedback will also
affect the values in the other two boxes, leading to different final values
than before. When we add a self-enforcing property to box C1 (feeding
itself), we get a highly dynamic fluctuation of all box values. We ob-
serve an oscillating perpetuating behaviour of the box values (figure 9).
Figure 7: Fuzzy cognitive mapping (FCM) based on research of Kasper Kok (2008): a hypothetical example

Figure 8: Fuzzy cognitive mapping (FCM): a hypothetical example

Figure 9: Fuzzy cognitive mapping (FCM): a hypothetical example
Now that I have demonstrated how FCM can be used to give a semi-quantitative indication of system dynamics, it is time to introduce my cognitive view of the ITC system based on working at the Faculty for four months. Given the ITC mission, we have as main output the number of well trained students for less developed countries. These countries are often referred to as Official Development Assistance (ODA) countries. The main input is basic funding for ODA education activities by the Ministry of Education and Science. As additional means, we have external funding from external funding agencies such as the EU Erasmus Mundus. As extra faculty goals, we have education and research quality. All values are visible in the following system description (figure 10).

The number of students is positively affected by our basic funding, external funding and education quality (figure 11).

Conversely, the more students ITC has, the less funding remains, causing a negative feedback. Education quality suffers from a large number of students. Basic funding does have a positive effect on external funding because most external funding requires additional basic co-funding. This in turn causes a negative feedback from external funding on the basic funding.

This principle is a common threat in many projects with co-financing obligations. If a faculty obtains too many such projects, it could go bankrupt because it cannot fulfil its financial obligations. Basic funding does help to improve the education quality, and education quality has a positive effect on our external funding by attracting additional students. There are two self-enforcing boxes: funding (assumed to be constant in this analysis) and the number of students. I do not mean students whose children also study at ITC – although this has already happened. It represents the alumni network, which plays a role in attracting new students. If we let these four boxes iterate, we get an output with a highly oscillating character, indicating how these boxes
Figure 10: The ITC capacity building system

Figure 11: Unstable interactions between funding, education quality and student numbers. Unstable system but number of students could increase. Student housing capacity (not incorporated) sets current limit

interact. With the FCM settings, we can see that potentially the maximum number of students could even increase, provided that good management keeps the system at the high output level. Within this context, good management is surfing the waves of the unstable ITC system. In reality, the number of students cannot be significantly increased because student housing (not included in the system description) is a limiting factor. To demonstrate some of the system sensitivities, I switch off the self-enforcing property of the alumni network. Immediately we see a decrease in the number of students, thus demonstrating the importance of ITC’s alumni network (figure 12).
If we assume that education quality has no effect, we can also observe a negative effect on the number of students, but this effect is less pronounced than that of the alumni network (figure 13).

Now let us experiment with less basic funding. If we reduce the funding by 20% while retaining all other settings according to the original FCM, we can see a slow decrease in the number of students. The tipping point of basic funding reduction is around 10% (figure 14).

The negative effect of a reduction in external funding is even more pronounced than the negative effect of a reduction in basic funding. This is because external funding acts as a kind of multiplier for the Faculty, suggesting that it is important to continue attracting external funding provided we have enough basic funding to co-finance it (figure 15).

A more positive scenario with a stable continuation of basic funding and an increase in external funding and education quality suggests that significant growth is possible in the assumed simple system (figure 16).

The next step is to include research quality in the system description (figure 17).

Research quality is considered to stimulate external funding and will raise education quality somewhat. However, if we have more students, research quality will suffer because the staff will have less time left for research. If we link research quality into our ITC FCM with default settings, we see an increase in the number of students (figure 18).

So according to the FCM, there is no real tension between our capacity development mission and the need for high scientific quality. I am not saying that tension is not felt, but at faculty level it is not visible. I personally think that this should not be a problem, but we have to make sure that the education burden is well distributed among departments.
Figure 12: Discounting our alumni network: this indicates that the network is highly relevant for our future

Figure 13: When education quality does not attract students: this indicates that education quality is highly relevant

Figure 14: A 20% decrease in basic funding: less funding means less students!
and staff. In summary, the unstable ITC system, as cognitively modelled by the five interacting boxes, is a highly interlinked and unstable system that, given current funding and trends in research and education quality, has the potential to grow. I consider it to have sufficient resilience to cope with significant budget cuts should they happen.

In terms of our future in education, we clearly have to continue to increase our reputation and visibility as a centre of excellence in capacity building in ODA countries and in our research field. We have to maintain our efforts to increase the quality of both our research and education. Finally, we have to consider strengthening the alumni factor by

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**Figure 15:** A 20% decrease in external funding: less external funding means even less students!

**Figure 16:** If quality and external funding increase and basic funding remains stable, the organization still has growth potential.
exploring BSc options with our Joint Education Programme partners and in the Netherlands. A Dutch BSc will certainly help to make us visible in Dutch academia. A BSc has been a proven strategy in most universities to guarantee a steady pool of students that in turn guarantees a sufficiently large high-quality inflow in MSc programs.

We need adaptive management to keep us on track and to keep us surfing the waves. But to cope with long-term change, we have to face the challenge of avoiding the trap of reorganization and restructuring. According to James Balasco (1992), we have to teach the ITC elephant to dance as a way of developing long-term strategies and solutions.

Figure 17: Including research quality

Figure 18: Effect of including research: research quality can help to attract students!
in our changing society (figure 19). I am convinced that ITC has this adaptive capacity.

But what is ITC’s long-term goal? ITC has always been an application-oriented organization directed at finding solutions to strengthen civil society in addressing issues of local, national and global dimensions. But what are these issues? Is there an elephant in the room we need to address? This is an English idiom for an obvious truth that is being ignored or goes unaddressed. The idiomatic expression also applies to an obvious problem no one wants to discuss, an inconvenient truth. We all associate an inconvenient truth with Al Gore’s plea for addressing global warming, a quest that earned him the Nobel Prize. In my view, the real elephant in the room for the last 40 years has been global development. Unchecked population growth and undirected development globally have led to unsustainable settings: people living in the wrong places and causing many unintended but nonetheless real problems for our living environment, including climate change. In the Netherlands, for example, the issue is not that sea levels are rising (this has been the case for the last 14,000 years) but the fact that people insist on living in areas below or near sea level.

Global development, like sustainable development, is a typical example of what is called a “wicked problem”. Wicked problems have the following characteristics: they are not clearly formulated and it is never clear when they are solved. The perceived solution depends on how the problem is framed, and vice versa. An example is Escher’s Whirlpools (1957), where different people will recognize different fishes swimming in different directions (figure 20).
Because normative aspects drive the problem framing and the perceived solution, every problem is considered to be unique. The problem constraints and the resources needed to solve it change over time. To summarize, wicked problems are problems that cannot be resolved in a neat clean way, as is commonly done in physics and engineering sciences. There is some literature about how to deal with these problems (Beinecke, 2009 Navarro et al., 2008). From my own experience in a large programme concerning transition towards more sustainable agriculture in the Netherlands Trans Forum, and based on innovation literature (Norton, 2005), there are at least three possible ways of dealing with wicked problems: experimentation, multiscalar approaches and place sensitivity.

Since there is no single pathway possible to the solution, the only way forward is by executing experiments that will reveal whether any proposed solution or approach will improve the current situation. There is never a true or false solution. The influence of different spatial and temporal scales introduces a lot of value-driven assumptions related to the problem. Different levels of scale must be addressed simultaneously when handling the problem. A hotspot of deforestation is scale-sensitive depending on your data source and way of data handling. In the presented example (Kok & Veldkamp, 2001) of changes in pastures in Central America, Costa Rica and the Zona Atlantica in Costa Rica, hotspots of change appear and disappear depending on the resolution and extent of the data used. There are already many examples of how hotspots of change appear and disappear depending on the level of aggregation and the extent of the area surveyed. A major cause of disagreement on problem definition and potential solutions can be found in the local attributes that are attached by the various stakeholders to
the challenge. A typical NIMBY (not in my backyard) attitude has hampered many national and global solutions to certain issues. The typical Dutch compromise approach (polder model) does not work when life and death issues are perceived to be at stake.

What can ITC contribute from its education and research perspective? ITC has proven knowledge and expertise in spatial and temporal system dynamics. We know not only how to collect, integrate and analyse data but also how to visualize and translate these data in a meaningful way. ITC has some experience in integrating such data in a stakeholder environment. Integrated modelling could be used more than has so far been the case. Furthermore, ITC has a multicultural legacy that will be essential in making a real contribution to global development. To illustrate this cultural dimension, I will use the zebra as an example.

If you are in East Africa and ask local people to describe the punda milia (striped donkey in Kiswahili), they will tell you that it is a black donkey with white stripes. The average Dutch citizen will tell you that a zebra is white and has black stripes. This is a simple example of how cultural identity and background affect the framing of a simple thing like a zebra (figure 21). Imagine what this can mean when framing global development questions!

Now let us go back to the image of elephants as used by the White Elephant Club. Elephants have very positive intercultural connotations. They are strong, are associated with wisdom, and even have religious dimensions. Who doesn’t want to be associated with an elephant? Well, perhaps the one exception is the pink elephant: you would certainly have no wish to see, or be seen as, one.

I will now take this a step further. The artist Dali first painted celestial space elephants in his 1946 painting The Temptation of St Anthony. I consider this positive post-war painting to be an inspiration for our
Faculty. I have already shown it – during my New Year speech in January this year (figure 22).

In my view, a space elephant should have the following properties. It should have a global multiscale perspective; it should be able to accommodate the multiple dimensions of wicked problems; it should be dynamic and adaptive; it should be anchored in the mainstream developments in science and society; it should be multicultural; and it should be able to ... dance. Above all, a space elephant should be inspiring and able to mobilize change and innovation. The nice thing to do is to project all these properties onto Dali’s picture of a space elephant. The elephant’s size and prospect of long life allow it to be mul-
tiscalar; the multiple joints represent the multiple dimensions of the wicked problem of global development; while its size also represents the critical mass required to address these issues. The elephant figures represent all the positive aspects of elephants. You can use your own imagination to conjure up what styles of dance are possible when you have at least two additional joints in your legs. The elephant’s trunk represents sensitive and adaptive behaviour, while its back can carry many students keen to learn the tricks of the trade. The trunk may also symbolize the way of thinking outside the box – a requirement of a real space elephant.

ITC can consider itself to be a space elephant well equipped to contribute to solving the wicked problem of global development. ITC provides “space for global development”. Only a space elephant can comprehend the multiple dimensions of global development. We as scientists
have to become space elephants. But curiosity-driven or blue skies re-
search is always required to advance our research field. In this respect,
it is important to mention the notion of serendipity. Without being able
to recognize the unexpected, we will be unable to advance science and
education.

After using and abusing so many elephants, I have come to the end of
my inaugural lecture and it is time for thanks and acknowledgements.
I thank my family for their ongoing support and love. I would like to
thank both the Executive Board of the University of Twente and the ITC
Foundation for their confidence in my abilities and for trusting me to
lead the new Faculty of ITC in its transition process from independent
institute to university faculty. I thank my colleagues here and in my pro-
fessional network for the fruitful and enjoyable collaboration and many
stimulating scientific discussions. I thank all ITC members: you togeth-
er have created something unique, let’s continue to fulfil our mission.
Finally, I thank the students for their interest in our science and their
eagerness to learn. Without you the Faculty of ITC would not exist.

Mr Rector, *ik heb gezegd* and I thank you all for your attention.
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