

Assessment Report

ITC Research and Graduate Programme

Geo-information Science and Earth Observation

June 2010



ITC

UNIVERSITY OF TWENTE.

FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Assessment Report

ITC Research and Graduate Programme

Geo-information Science and Earth Observation

June 2010

Prof. Dr. R. Rummel (chair), Technische Universität München
Prof. Dr. C.W.A.M. Aarts, University of Twente
Prof. Dr. M.F.P. Bierkens, Utrecht University
Prof. Dr. A.K. Bregt, Wageningen University
Dr. R.M. Bhagat, Tea Research Association of India
X. Poshiwa, MSc (PhD student), Wageningen University

Preface

This assessment of the ITC Research and Graduate Programme marks an important milestone of ITC's development; it coincides with the integration of ITC in the University of Twente. On behalf of the members of the committee I want to express our thanks for the well prepared material, the open atmosphere and the good and intensive discussions with the professors, administrators, staff members and students. We saw a very dynamic institute with a very special and important mission.

We wish ITC continuing success and a bright future, now being part of the University of Twente.

München, 7. July 2010

Reiner Rummel

Table of Contents

Preface	iii
1. The Review Committee and the review procedures	1
1.1. Scope of the assessment	1
1.2. Composition of the Committee.....	1
1.3. Independence	1
1.4. Data provided to the Committee	2
1.5. Procedures followed by the Committee	2
2. Institute-wide assessment of ITC	3
2.1. Conclusions and recommendations.....	3
2.1.1. Mission	3
2.1.2. Implementing the merger with UT	3
2.1.3. Maintaining relationships with other Dutch universities.....	3
2.1.4. PhD programme.....	4
2.1.5. PhD students	4
2.1.6. Publishing strategies.....	4
2.1.7. Research funding and performance indicators	4
2.1.8. Research themes, leaders and departments	5
2.1.9. The whole is more than the sum of its parts	5
2.1.10. Technology and social science	5
2.1.11. Quality of graduate programme	6
2.2. Questions complementing the SEP terms of reference	7
2.3. Institute-level assessment Faculty ITC.....	8
3. Assessment per research theme	11
3.1. Biodiversity in Fragmenting Landscapes	12
3.2. Carbon Cycle and Climate	13
3.3. Disaster Management.....	14
3.4. Earth Systems Science	15
3.5. Food Security and Environmental Sustainability	16
3.6. Governance and Integrated Spatial Assessment	17
3.7. Informed Multilevel Governance for Urban Regions	18
3.8. Land Administration for Informed Governance	19
3.9. Managing Water Scarcity	20
3.10. Spatial Data Infrastructure Technology	21
3.11. Spatio-temporal Data Integration and Visualization.....	22
3.12. Stochastic Methods for Image Mining and Data Quality.....	23
3.13. Sustainable Urban Regional Dynamics	24
3.14. Utilization of Sensor Development for Efficient Topographic Mapping	25
3.15. Water Cycle and Climate.....	26
4. Appendices.....	27
4.1. Appendix A: Curricula vitae of the committee members.....	28
4.2. Appendix B: Final schedule of site visit meetings	31
4.3. Appendix C: Explanation of SEP scores and criteria	33
4.4. Appendix D: Acronyms	35

1. The Review Committee and the review procedures

1.1 Scope of the assessment

The Review Committee was asked to perform an assessment of the research and graduate programme of the Faculty of Geo-Information Science and Earth Observation (ITC) of the University of Twente (UT). The review covers the research within 15 research themes during the period 2006-2009. In accordance with the Standard Evaluation Protocol 2009-2015 for Public Research Organizations (SEP), the Committee's tasks were to assess the quality of the Institute and its 15 research themes on the basis of the information provided by the Institute and through interviews with the management and research leaders, and to advise how this quality might be improved.

Six additional questions were posed to the Committee:

1. How can ITC maintain a balance between its development oriented mission and excellence in research?
2. How can ITC strengthen its position on the Netherlands' academic stage?
3. How can ITC continue to strengthen its position in the N-S network?
How can ITC continue to expand the educational aspects of its research, in particular the integration of MSc and PhD research, in joint education and research (both within Europe and with developing (ODA) countries)?
4. What important trends does the Committee foresee in the coming five years that can have a bearing on the orientation of research at ITC?
This concerns trends in both science/methodology and society (attitude towards development). In some cases, such trends may be driven outside academia (e.g. Google Maps). How can ITC strive to (still) be the best in five years time?
5. How should ITC position itself with respect to graduate schools?
6. What pragmatic and strategic aspects can be the guiding principles in formulating a new research policy at ITC? What is the most promising position for ITC?

1.2 Composition of the Committee

The composition of the Committee is as follows:

- *Prof. Dr. R. Rummel* (chair), Technische Universität München
- *Prof. Dr. K. Aarts*, University of Twente
- *Prof. Dr. M. Bierkens*, Utrecht University
- *Prof. Dr. A.K. Bregt*, Wageningen University
- *Dr. R. Bhagat*, Tea Research Association of India
- *X. Poshiwa*, MSc (PhD student), Wageningen University

A short curriculum vitae of each of the committee members is included in Appendix A. Dr. P.M. van Dijk, Head Research ITC, is acting as secretary to the Committee.

1.3 Independence

All members of the Committee have signed a statement of independence, guaranteeing that they would assess the quality of the Institute's graduate and research programme in an unbiased and independent way. Any existing personal or professional relationships between committee members and the Institute under review have been reported and discussed. The Committee has concluded that there are no unacceptable relations or dependencies and that there is no specific risk in terms of bias or undue influence.

1.4 Data provided to the Committee

The Committee has received detailed documentation consisting of the following:

- A self-evaluation of the Institute and its 15 research themes, covering the years 2006 to 2009, according to the Standard Evaluation Protocol 2009-2015, with appendices.
- Academic Output 2006-2009 per research theme, per year and per researcher (on CD-ROM).
- Bibliometric analysis of the Faculty of Geo-Information Science and Earth Observation (ITC) 2004-2008, by W. Gerritsma, Wageningen UR Library, February 2010.

1.5 Procedures followed by the Committee

The Committee has proceeded in accordance with the Standard Evaluation Protocol 2009-2015. The meaning of the SEP scores is reiterated in Appendix B. The site visit took place from 26 to 28 April 2010 (see programme of the site visit in Appendix C). One interview (with Ir. B. Boer, acting head Marketing and Project Services) was added to the preliminary programme. An open call to all staff and PhD students with the option of additional interviews did not result in any expressions of interest, and hence did not lead to any extra sessions. One comment was received during the site visit to the effect that the Committee consisted entirely of male members.

The SEP scores are applied by the Committee strictly in accordance with the description given. The committee members observed a clear upward trend in terms of number of Ph.D. students, publication activity, and in particular, publications in ISI journals (as analysed in the bibliometric analysis, carried out by W. Gerritsma of Wageningen UR library). Therefore it has been regarded fair to base the assessment and grades primarily on the numbers for 2009. The number of fte's quoted at the top of the assessment sheet for each research theme includes the assigned time of all available staff (professor, UHD, UD) with a research task. The ISI/fte ratio for 2009 is taken as prime indicator for the assessment of the productivity (with cross-check to earlier years for consistency). The relative impact (RI) calculated for the years 2004-2008 is taken as prime indicator for quality, together with the overall impression and the number of top 10/1% cited papers. However it should be noted, that in general the committee's judgement is based on the overall impression taking into account all indicators of the self assessment report and the interviews. Societal relevance is a particularly important issue in the case of ITC. It is tried here to take into account the societal relevance of the individual themes as well as the relevance of actual research. Apart from the assessment of ITC itself, it was the task of the committee to assess ITC's 15 themes. Inevitably these 15 assessments can only reflect a general impression of the committee members, based on 15 rather short interviews and reports, the latter included in the self assessment document.

During the site visit, the Committee summarized its findings and formulated a first preliminary ranking. After the site visit, the Committee set out its findings for the 15 themes in an assessment template. The drafts, together with the institute-wide assessment (including the PhD programme), were circulated among all members for comment. The final ranking was discussed in a teleconference meeting. The text was finalized through e-mail exchanges. The final draft report was presented to the dean of ITC for factual correction and comments. The reaction of the dean of ITC was discussed by the Committee, and the final version of the report was approved by the Committee. The final report was presented to the rector magnificus of UT, and subsequently distributed.

2. Institute-wide assessment of ITC

2.1 Conclusions and recommendations

2.1.1 Mission

The previous research assessment of ITC took place in 2006¹. Since then, ITC has undergone a remarkable transition from a centre of international training and education with limited research activities to one where research is now of major importance, next to training and education. The research activity is of a high standard, in terms of both quality and quantity. ITC is well prepared to function as one of the faculties of UT.

ITC has its own distinctive mission, and this mission must be maintained and cultivated in the future too. Its mission is capacity building in developing countries and emerging economies. This is ITC's trademark and has led to remarkable success. A large number of experts from countries all over the world have received their education at ITC. These ITC alumni now occupy important and responsible positions in their countries. Contacts with these alumni are maintained and strengthened through post-academic training and joint development projects. At the same time, the network of alumni opens doors in these countries for experts from the Netherlands. An active alumni community exists, and former ITC students are proud of having been educated at this famous institution. A better and more sustainable approach to successful foreign policy is hardly imaginable. Against the background of global change, with a rapidly growing world population, mega cities, a shortage of clean water, limited and restricted access to land property and natural resources, as well as the additional pressing effects of climate change, the mission of ITC will only continue to gain in importance. From a foreign perspective, ITC is regarded with great admiration and most European countries would consider themselves fortunate to host such an institution.

Recommendation: Although ITC is now a faculty of UT and fully integrated into the Dutch research and education system, its distinctive mission should still be cultivated and expanded.

2.1.2 Implementing the merger with UT

The coming five years should be regarded as a period of transition from an independent institute to a regular, albeit special, faculty of UT. Two aspects make this a non-standard case: ITC's background, as discussed above, and the absence of an undergraduate programme. The latter is not a point of concern because ITC is very successful in attracting foreign graduate students with a high-quality undergraduate education. As regards the former, the ODA-earmarked subsidy has been confirmed until 2013, and a financial strategy and model have to be developed for the years following. The merger with UT is an important and positive step. Many mutual benefits could emerge and many opportunities lie ahead: UT with its research institutes and its high-level Twente Graduate School (TGS), ITC with its research and education profile, its fantastic international network, and its large number of international graduate and PhD students. Joint course programmes, PhD programmes and research projects can now be established.

Recommendations: ITC should prepare a tailored strategy for the time after 2013 in consultation with UT. A small high-level committee, with members from ITC and UT, should be set up to make an assessment and a strategic planning of joint opportunities (items: graduate school, status of PhD students, integration of graduate and PhD programmes, organization of joint research, etc.)

2.1.3 Maintaining relationships with other Dutch universities

In the past, ITC has established very successful and mutually beneficial cooperation with Wageningen University, Utrecht University, Delft University of Technology, and to a lesser extent with VU Amsterdam, with joint PhDs and the double appointment of ITC scholars. This cooperation can be regarded as an important part of ITC's national research network and also opens doors for internationally collaborative projects. In this period that started with the merger with the UT, this research network deserves careful attention because it is crucial to ITC's future role in the European research landscape, next to its new position as a UT faculty.

¹ T. Spit et al., 2006: Assessment report ITC Research and Graduate Programme Geo-information Science and Earth Observation, November 2006.

Recommendation: In view of ITC's research profile, the established cooperation with Dutch universities remains important and will continue to be so in the future. However, a new model has to be agreed. Within this context, it should also be fully transparent to the current generation of PhD students at which university they will earn their degree.

2.1.4 PhD programme

The PhD programme at ITC already meets the standards of a modern Dutch graduate school, with a progress monitoring programme, TSP forms, a travel and fieldwork budget for each student, a specific course programme (which also covers soft skills), publications in ISI journals during the PhD phase, and the possibility of earning the degree through a collection of publications instead of a classical dissertation.

Recommendations: ITC should for the foreseeable future maintain and further develop its PhD programme along current lines, like a quasi-independent graduate school. Or is there an option for it to turn into a – fully acknowledged – new graduate school at UT? Where appropriate and possible, research groups (themes) are encouraged to join the selective TGS of UT. It is also recommended that existing ties with graduate schools at other universities, as well as with nationwide research schools, be continued.

2.1.5 PhD students

Recently, the number of PhD students enrolled in the ITC programme has increased enormously. In just a few years, the total number has grown from 60 to the current 140. This is a great achievement and is the result of a good programme, relevant and attractive research themes, and a very good reputation. The key question now is how many PhD students can be adequately accommodated in this four-year programme. What is the proper ratio of staff to students, how many students can be supervised, what is the right number in terms of office and laboratory space and field equipment, and how many can be handled by the Bureau of Research Coordination (which is already working to its limit)? The full working load will not become clear until one or two years from now.

The number of drop-outs is below average and careful monitoring aims at early feedback. But early termination of a PhD programme is particularly painful for foreign students, so rigorous entrance control and selection is recommended.

Recommendation: A careful analysis is recommended to determine the appropriate number of PhD students, based on three criteria: (1) resources, (2) working load in terms of supervision, quality of research and conditions for the students, (3) feasibility of accommodating so many PhD students in a four-year programme.

2.1.6 Publishing strategies

Along with the rising number of PhD students, publication activity has also improved significantly, in terms of both quality and quantity. The recommendations of the 2006 assessment have been implemented and a large part of the publication activity meets modern quality measures (ISI journals, H-index, impact factors). This applies to the majority of themes and the majority of professors. It is a great achievement that quite often co-authors of publications are students (or former students) from developing countries. The publication culture of the permanent staff could be improved. It is unclear why there is often a distinct gap between staff and professors with regard to the familiar performance indicators for research. Is it due to a high teaching/training load, is it that their contribution to PhD projects is not adequately reflected in publications, or is there a lack of encouragement? High-impact publication activity is clearly in the interest of all staff members as far as career planning and national/international reputation are concerned.

Recommendation: Publication activity of permanent staff in high-standard international journals should be encouraged and facilitated.

2.1.7 Research funding and performance indicators

From now on, ITC, being a regular faculty of UT, can apply for funds from national research foundations, such as NWO. Although it will be a while before ITC is fully integrated in the Dutch research funding system, this will greatly enhance the visibility of ITC research in terms of its profile and quality inside the Netherlands. It will also improve the visibility of the strong international character and relevance of ITC research.

Until now, the research funding model of ITC has been strictly output-oriented. It is coupled with PhD projects and publication activity. This model stimulates research activity and internal competition. The acquisition of external research funds is not part of this funding model.

Recommendations: High-quality external funding (NWO, STW, EU, ESA, international) would also contribute to the reputation of ITC and its research groups, and it would improve flexibility. The acquisition of this type of funding should be actively encouraged. For example, postdocs could be introduced into the ITC research concept in order to introduce new know-how and ideas into the system. Reflection on the strategic role of external research funds and on the ways in which these can be acquired is recommended. It is also recommended that the acquisition of external research funding be stimulated by providing financial incentives.

2.1.8 Research themes, leaders and departments

Successful appointments of new professors in recent years have certainly contributed to the research performance of ITC. Appointments of professors are among the strategic key decisions of any research institution.

Following the recommendations of the 2006 assessment, ITC abandoned the idea of five spearheads and organized its research under 15 themes. The themes are grouped and attached to six departments. While organizational and budgetary decisions are negotiated with the departments, the research is organized primarily within the themes. From the discussions between theme representatives and the panel members, it emerged that the interpretation of the respective roles of the departments and the themes is not uniform. The average size of the research staff capacity in the 15 themes seems to be small – and in some cases it is definitely too small for a critical mass around the theme. Small-sized research groups are as a rule at a disadvantage when it comes to attracting external funding and postdocs. Therefore, while maintaining their focus, the number and size of themes should be critically re-assessed.

Recommendation: It is our advice that clear roles and responsibilities of department, department head and theme leaders be agreed. The chosen structure must also be compatible with the UT structure. A rotating scheme of department heads may add to the flexibility of the structure and may strengthen the mutual understanding of the role of the departments. The division of ITC research over 15 themes should be critically reconsidered from the perspective of the critical mass necessary for making a research group work – some themes stand to benefit from merging with other themes.

2.1.9 The whole is more than the sum of its parts

On average, the research quality is very high – in some themes even very high at international level. A few themes are relatively new but demonstrate a positive trend, whereas a few others are small and are experiencing some difficulty in maintaining the general pace.

Cooperation between scientists of the various themes is quite intensive and there is mutual support. Nevertheless, the current model of research funding stimulates competition inside ITC and on national and international levels. However, there seems to be more emphasis on the success of the individual research themes rather than on the success of ITC and its mission as a whole. To a large extent, this is normal and acceptable. However, it may hamper the strategic position of ITC. ITC can bring some unique features and strengths to the national and international research landscape. It is one of the few institutions that can combine remote sensing, geo-informatics, geo-visualization and geostatistics. ITC combines remote sensing and geo-information systems with a whole suite of applications. In climate change research, emphasis is generally on modelling; there is an obvious and much disputed "lack of measured evidence". ITC combines field observation and airborne and spaceborne observational techniques with applications, and it has established a worldwide network of contact points and specialists. It could therefore serve as a strategic partner for organizations such as GEO and ESA, and actively contribute to IPCC-type assessments.

Recommendation: Next to the successful research within themes, the unique and strategic role of ITC research as a whole should be strengthened.

2.1.10 Technology and social science

ITC is one of very few institutions that try to establish through research the connection between natural sciences & engineering and social sciences. This is especially and most visibly the case

within the themes coordinated by the ITC Department of Urban and Regional Planning and Geo-information Management (PGM), and it is important for the sustainability of the ITC mission in its partner countries. The heads of the groups are newly appointed and seem to be capable of leading this segment of research to success.

Recommendation: Efforts to build bridges between natural and engineering sciences, on the one hand, and social sciences, on the other, should be actively encouraged by the ITC management, as such efforts do not emerge automatically.

2.1.11 Quality of graduate programme

The quality of the PhD programme at ITC was judged to match very closely the very good to excellent performance indicated by the research programme. The Committee was impressed by the well defined and well structured programme; the very effective training, with links with national and international research training programmes; the very high quality of the theses produced; the strong commitment to exposing PhD students to the international scientific community; and the enthusiasm and commitment of the PhD students. The recent PhD theses made available to the Committee for inspection were all highly impressive and of very high quality. The high quality of the ITC PhD programme is clearly demonstrated by the success rate for PhD students, which must be seen as being at a high level. About 83% of the PhD students enrolled at ITC come from many countries outside Europe, with a greater number of ITC alumni in very influential positions in their home countries – a clear reflection of the strength of the PhD programme and its organization. The objective of achieving high international visibility is undoubtedly being met.

The Committee had a very useful and positive discussion with a group of six PhD students from different departments and at different stages in the PhD trajectory. The Committee was impressed by their enthusiasm and motivation, which in turn reflected well on the quality of PhD training. The overwhelming impression is that the facilities are good, the interface between the MSc and PhD programmes works well, the course programme is appropriate but could even be enlarged, and the publication scheme is a positive challenge. The students are proud of being ITC PhD students and pointed out that existing links with other universities, such as Wageningen, Utrecht, Delft and Amsterdam, should continue to be maintained. They asked for more transparency concerning the student budget. The Committee recommends strict implementation of the research progress monitoring form (RFP), as well as the training and supervision plan (TSP), to avert their fears. The students also recommended a safer financial model with partner institutions for “sandwich students”, for example bank guarantees before the beginning of the project.

Recommendation: The panel saw a well organized PhD programme, with enthusiastic students. RPF and TSP procedures should be applied more strictly.

2.2 Questions complementing the SEP terms of reference

The research Review Committee was asked to comment on six specific questions, in addition to the SEP terms of reference. Almost all of these questions have been addressed implicitly in the conclusions and recommendations. Here they are summarized. The comments should and can only be seen as an initial attempt to address some of the strategic issues concerning the future of ITC. It is recommended that the same questions be discussed with the members of the Scientific Council.

1. How can ITC maintain a balance between its development-oriented mission and excellence in research?

The development-oriented mission is the trademark of ITC. ITC's success is founded on its mission and this mission is also the main characteristic that distinguishes it from other research institutions. ITC combines remote sensing and geographical information for various fields of applications relevant to ODA countries. This will continue to be a highly relevant research field in the foreseeable future. Mission and focus are the best recipe for maintaining and strengthening ITC's research profile. In addition, ITC should continue to invest in attracting the brightest students from ODA countries.

2. How can ITC strengthen its position on the Netherlands' academic stage?

Integration into UT will automatically strengthen ITC's position in Netherlands academia. So far ITC has been a welcome partner for a number of Dutch universities by bringing in complementary expertise and by delivering PhD students. In the future, it will also be a competitor for funds. Visibility will certainly increase if NWO funds are acquired. ITC has the potential to become a national centre of excellence in the field of remote sensing, geographical information and selected fields of application (e.g. biodiversity, water cycle, disaster management and geo-exploration).

3. How can ITC continue to strengthen its position in the N-S network?

How can ITC continue to expand educational aspects of its research, in particular the integration of MSc and PhD research, in joint education and research (both within Europe and with ODA countries)?

ITC could strengthen its strategic position by emphasizing its characteristic research profile combined with its international network of partners. It could play a prominent role for institutions such as ESA, GE and EIT. International partnerships should be selected carefully on the basis of a strategic model. As far as the educational dimension is concerned, a goal could be a topical graduate school (with or without European partners), again focusing on its mission.

4. What important trends does the Committee foresee in the coming five years that can have a bearing on the orientation of research at ITC?

This concerns trends in both science/methodology and in society (attitude towards development). In some cases, such trends may be driven outside academia (e.g. Google Maps). How can ITC strive to (still) be the best in five years' time?

The greatest challenge of the coming five years is the smooth integration into UT and the cultivation of the potential of this integration, while simultaneously finding a new basis for partnership with Wageningen, Delft and Utrecht. Academic and research trends are very difficult to predict.

5. How should ITC position itself with respect to graduate schools?

ITC should for the foreseeable future maintain and further develop its PhD programme along current lines, like a quasi-independent graduate school. Where appropriate and possible, research groups (themes) should be encouraged to join the selective Twente Graduate School of the University. It is also recommended that existing ties with graduate schools at other universities, as well as with nationwide research schools, be continued.

6. What pragmatic and strategic aspects can be the guiding principles in formulating a new research policy at ITC? What is the most promising position for ITC?

The research profile, organization and performance are fine and should not be changed. However, more emphasis on common strategic goals involving multiple research themes would help to strengthen ITC's national and international position.

2.3 Institute-level assessment Faculty ITC

Research and graduate programme:	Geo-information Science and Earth Observation	
Rector/Dean:	Prof. Dr. Ir. T. Veldkamp	
Research staff ² (2009):	28.34 fte	
140 PhD ³ /staff ² (2009):	4.9	
124 ISI publications ⁴ /staff ² (2009):	4.4	
Total number of ISI pub. ⁵ (2004-2008):	336	
Relative impact ISI pub. ⁵ (2004-2008):	1.37	
Number of top 10% ISI pub. ⁵ (2004-2008):	54	
Number of top 1% ISI pub. ⁵ (2004-2008):	3	
Assessment:	Quality:	4
	Productivity:	4
	Societal relevance:	4
	Vitality and feasibility:	4

Short description

ITC has a distinctive mission, namely education and research contributing to capacity building in developing countries and emerging economies in the domain of geo-information science and earth observation. This is ITC's trademark and has led to remarkable success. Close on 20,000 experts from countries all over the world have received their education at ITC since 1950, including 167 doctorates since 1990. A better and more sustainable approach to successful foreign policy is hardly imaginable. Research at ITC is currently carried out under 15 research themes, each headed by a full professor (in three cases an associate professor as interim leader). The 15 research themes are the units of evaluation in this review.

Quality

The research activity is of a high standard in terms of both quality and quantity. ITC is well prepared to function as one of the faculties of UT. The field of research is highly relevant to its mission. Internationally, ITC is one of the few institutions that link remote sensing, field experiment and geographical information systems with various fields of scientific application. ITC succeeds in guiding a large number of students from ODA countries through a well focused four-year PhD programme to the award of their degree. Students are strongly encouraged to publish their work in ISI journals, and this is visible in the output figures.

- Academic reputation
Since the previous research assessment in 2006, ITC has undergone a remarkable transition – from a centre of international training and education with limited research activities to one where research is now of major importance, next to training and education.
- Quality of the PhD training
The PhD programme at ITC already meets the standards of a modern Dutch graduate school, with a progress monitoring programme, TSP forms, a travel and field work budget for each student, a specific course programme (which also covers soft skills), publications in ISI journals during the PhD phase, and the possibility of earning the degree by a collection of publications instead of a classical dissertation.
- Financial resources
The ODA-earmarked subsidy is confirmed until 2013, and a financial strategy and model have to be developed for the years following. The merger with UT is an important and positive step. Many mutual benefits could emerge and many opportunities lie ahead. *Table 2-1* gives a brief overview of the funding situation in the past years.

² Total tenured and non-tenured research staff expressed in fte for 2009 (Table 1-3 in self-evaluation report)

³ PhD enrolment in 2009 (Table 1-3 in self-evaluation report)

⁴ ISI publications in 2009 (Table 1-10 in self-evaluation report)

⁵ Based on W. Gerritsma (2010)

ITC	2006		2007		2008		2009	
	fte	%	fte	%	fte	%	fte	%
Funding:								
Direct funding	-- ⁶	--	25.93	87.01%	26.56	73.96%	30.06	80.5%
Contract research	7.34	100%	3.87	12.99%	9.35	26.04%	7.28	19.5%
Total funding	7.34	100%	29.8	100%	35.91	100%	37.34	100%
Expenditure:	K€	%	K€	%	K€	%	K€	%
Personnel costs only	532	100%	2,161	100%	2,603	100%	2,707	100%

Table 2-1 Research funding and expenditure of the entire ITC

- Human resources
The academic staff encompasses a wide variety of scientific backgrounds, and has a highly international orientation: 25 nationalities are employed, making up 20% of all staff (i.e. approximately 50% of scientific staff; 2009 figures). Table 2-2 shows there has been a healthy increase in non-tenured staff (now approximately 25% of research fte, excluding PhD students) and PhD bursaries over the past years.

ITC	2006	2007	2008	2009	Increase*
Tenured staff (professor, UHD, UD) in fte	20.7	18.37	21.74	21.48	15%
Non-tenured staff (researcher, postdoc) in fte	-- ⁶	2.48	3.57	6.86	64%
PhD students (number only)	74	98	124	140	30%
Total research staff	94.7	118.85	149.31	168.34	29%
Support staff in fte	2.2	2.54	2.48	3.05	17%
Total staff	96.9	121.39	151.79	171.39	29%

Table 2-2 Staff at institute level in research fte (* = increase in % from 2007 to 2009)

- Research facilities
The research facilities in terms of data acquisition, (fieldwork) equipment and general conditions are very good. The Geoscience Laboratory fulfils an important role in providing analytical equipment, in particular state-of-art spectrometry.
- Organization and internal processes
In hosting a wide variety of application domains and attempting to facilitate cross-disciplinary research while at the same time bridging technical and social science, ITC is performing very well in terms of organization and internal processes. This is not an easy task, and obviously there are ways to improve. The Committee noted two main points of attention: the size of the research themes and their relation to the departments, and the balancing and facilitating of the graduate programme, which has been growing rapidly in recent years.
- Leadership
Successful appointments of new professors in recent years have certainly contributed to the research performance of ITC. On average the quality of the research is very high – in some themes even very high at an international level. A few themes started quite recently, or are headed by a new leader, but demonstrate a positive trend. A few other themes are small and are experiencing some difficulty in maintaining the general pace.

The new management of ITC, and ITC's position as a special faculty of UT, have paved the way for strategic decisions concerning the future. Now with a level playing field, ITC has the potential to become even more successful and can play a role in academia at home and abroad on equal terms.

- National and international positioning
From now on, ITC, being a special faculty of UT, can apply for funds from national research foundations, such as NWO. It will be a while before ITC is fully integrated in the Dutch research funding system but this will greatly enhance the visibility of ITC research in terms of its profile and quality inside the Netherlands. It will also improve the visibility of the strong

⁶ Figures for 2006 are not available because of the transition from five spearheads to 15 research themes at that time.

international character and relevance of ITC research. From a foreign perspective, ITC is regarded with great admiration and most European countries would consider themselves fortunate to host such an institution.

Productivity

There is a clear overall tendency towards increased publication activity in high-impact journals and there is a steep increase in the number of PhD students. ITC maintains a large number of joint activities with several Dutch universities and with a large and very valuable network of international partners.

Table 2-3 shows some bibliometric indicators for the years 2004-2008 based on ISI publications in Web of Science (WoS) for the entire Institute. The data come from the bibliometric analysis by Gerritsma, 2010 (available on the CD-ROM, with appendices of the self-evaluation report). Data for the research themes are mentioned in the individual assessments. No firm conclusion can be drawn from the calculated bibliometric parameters for groups with less than ten ISI publications. Publication activity has improved significantly in terms of both quality and quantity since the last evaluation in 2006. A large part of the publication activity satisfies modern quality measures (ISI journals, H-index, impact factors). This applies to most themes and most professors. The publication culture of the other permanent staff could be improved. It is unclear why there is often a distinct gap between staff and professors with regard to the familiar performance indicators for research. High-impact publication activity is in the interest of all staff members as far as career planning and national/international reputation are concerned.

Year	N	C	Wavg	CPP	CI	RI	T10	T1
2004-2008	336	2055	1693.72	6.12	1.21	1.37	54	3

Table 2-3 An overview of bibliometric indicators for ITC 2004-2008 (Gerritsma, 2010)

Relevance

Capacity building in developing countries and emerging economies is ITC's trademark and has led to remarkable success. This distinctive mission is more relevant than ever. It must also be maintained and cultivated in the future. The scientific basis is solid and has developed dynamically over the past years, in pace with technological advances. A large number of experts from countries all over the world have received their education at ITC. These ITC alumni now occupy important and responsible positions in their countries. Contacts with these alumni are maintained and strengthened through post-academic training and joint development projects. At the same time, the alumni network opens doors in these countries for experts from the Netherlands. An active community of alumni exists, and former ITC students are proud of having been educated at this famous institution. Through the alumni community, as well as by other means of (popular) dissemination, ITC is at the forefront of implementing geo-ICT solutions in its target countries. This success is also illustrated by the relatively high percentage of co-authors from developing countries in ISI publications (39% for ITC as a whole). A better and more sustainable approach to successful foreign policy is hardly imaginable. Against the background of global change, with a rapidly growing world population, mega cities, a shortage of clean water, and limited and restricted access to land property and natural resources, as well as the additional pressing effects of climate change, the mission of ITC will continue to gain in importance. From a foreign perspective, ITC is regarded with great admiration. The Netherlands should consider itself fortunate to have founded and to host an institute with such a profile and of such quality.

Vitality and feasibility

The coming five years should be regarded as a period of transition from an independent institute to a regular, albeit special, faculty of UT. The merger with UT is an important and positive step. Many mutual benefits could emerge and many opportunities lie ahead for both UT and ITC. For further elaboration on the perceived strengths and weaknesses, see section 2.1, Conclusions and recommendations.

3. Assessment per research theme

The Committee assessed the following 15 research themes of ITC:

Section:	Research theme:	Quality	Productivity	Societal Relevance	Vitality & Feasibility
3.1	Biodiversity in Fragmenting Landscapes	4	5	4	4
3.2	Carbon Cycle and Climate	3	2	3	2
3.3	Disaster Management	4	3	5	4
3.4	Earth Systems Science	4	3	4	4
3.5	Food Security and Environmental Sustainability	3	3	4	4
3.6	Governance and Integrated Spatial Assessment	3	4	4	3
3.7	Informed Multilevel Governance for Urban Regions	3	3	3	3
3.8	Land Administration for Informed Governance	3	3	4	4
3.9	Managing Water Scarcity	3	4	4	3
3.10	Spatial Data Infrastructure Technology	3	3	4	2
3.11	Spatio-temporal Data Integration and Visualization	4	4	4	3
3.12	Stochastic Methods for Image Mining and Data Quality	4	5	4	3
3.13	Sustainable Urban Regional Dynamics	3	3	3	3
3.14	Utilization of Sensor Development for Efficient Topographic Mapping	4	4	4	3
3.15	Water Cycle and Climate	4	4	4	5

A detailed assessment per research theme is given in the next sections of this report.

3.1 Biodiversity in Fragmenting Landscapes

Theme leader:	<i>Prof. Dr. A.K. Skidmore</i>	
Research staff ² (2009):	3.23 fte	
21 PhD ³ /staff ² (2009):	6.5	
23 ISI publications ⁴ /staff ² (2009):	7.1	
Number of ISI publications ⁵ (2004-2008):	64	
Relative impact ISI pub. ⁵ (2004-2008):	1.40	
Number of top 10% ISI pub. ⁵ (2004-2008):	11	
Number of top 1% ISI pub. ⁵ (2004-2008):	1	
Assessment:	Quality:	4
	Productivity:	5
	Societal relevance:	4
	Vitality and feasibility:	4

Short description

The research within this theme is operational and applied to societal issues. The main focus on herpetological species (amphibians and reptiles) has been extended to encompass birds and mammals as well. The scientific field has expanded from flat 2D modelling of flyways of migratory birds to include weather conditions at different altitudes. The research area of interest has increased to cover not only the Mediterranean, the original focus, but also the Western Palaearctic (including Northern Africa, the Middle East, Northern Europe and extending to Central Asia), as well as countries in other continents. Areas of research include the risk of birdflu, determining the conditions of stopover by migratory birds (using hyperspectral imagery), the behaviour of birds in relation to weather conditions, and the impact of wind farms on collision victims. Research topics in other continents within this theme include the impact of pollution on sea grass and coral reefs in Indonesia and the conservation of the Giant Panda and the Golden Takin in China.

Quality

Publications are excellent to good, and on average "very good". The output makes a valuable contribution in the international field and the research is internationally visible (particularly in the developing countries) through its publication in international journals. The theme leader is visible in his field of research and has ongoing cooperation across disciplines. The research work seems highly impressive and has great potential as far as its application is concerned.

Productivity

Productivity is excellent. It makes a significant contribution in the field of research on a global scale. The number of PhD graduations during the review period is the highest of all research themes.

Societal relevance

Its relevance is very high in its current area of research, particularly in the developing countries. Its relevance will continue to grow, making it increasingly relevant to developing countries. This theme has the highest proportion of co-authors from developing countries in ISI publications (67%).

Vitality and feasibility

The programme is viable and is expected to expand in future. Given the relevance of the theme within the current and future contexts, this theme is highly viable and will continue to be so in the future too, because it attempts to address highly relevant issues.

Conclusions and recommendations

This is one of the best performing themes at ITC and has an overall rating of very good to excellent within the current context. One point of concern, however, is that it is not well visible in Dutch academia. Efforts must be made to make it more visible. Inter-theme collaboration is good, but duplication of work must be avoided. The theme is well positioned and is important to the mission of ITC. However, expertise should be sought within ITC in order to work across themes to a greater extent. The leadership is highly capable in the theme. Core researchers should have completed their PhD in order to secure research time.

For footnotes see section 2.3, page 11. The same parameters are used for all research themes.

3.2 Carbon Cycle and Climate

Theme leader:	Dr. Y.A. Hussin (interim)	
Research staff (2009):	2.70 fte ⁸	
1 PhD/staff (2009):	0.4	
2 ISI publications/staff (2009):	0.7	
Number of ISI publications (2004-2008):	1	
Relative impact ISI pub. (2004-2008):	1.39	
Number of top 10% ISI pub. (2004-2008):	0	
Assessment:	Quality:	3
	Productivity:	2
	Societal relevance:	3
	Vitality and feasibility:	2

Short description

Relatively speaking, a very small group. Within the carbon cycle, forestry in a broader sense forms the principal area of research, as regards both emissions (sources) and sequestration (sinks). The theme deals with the known knowledge gaps, while trying to build on existing expertise within ITC. Research also needs to include the development of cost-effective biomass monitoring systems for afforestation, reforestation, deforestation and forest degradation.

Quality

Although the quality of published papers adds to knowledge enhancement, at best it is only of average level.

Productivity

Productivity is satisfactory, but a quantum leap is needed to catch up with the relevance of the theme. With few publications, visible productivity is missing.

Societal relevance

Work is highly relevant in the present context and can potentially make a valuable contribution in the international arena.

Vitality and feasibility

Viability is still questionable – not because of the work but because of the extremely small size of the group and the absence of leadership (the professor retired in 2009).

Conclusions and recommendations

The climate change research seems to be in its infancy and rather limited. It is hardly visible and lags behind in the global context. The group is small and may shrink further, although the theme is highly relevant in the present context and cannot be left out. Possibilities for strengthening this theme include a possible merger with a similar group, and strong leadership is definitely required. The theme itself is important, but needs strengthening by the ITC management.

⁸ The 2.70 fte for 2009 includes 2.41 temporary allocation for a large project. Without this extra allocation, the PhD/staff ratio would have been 3.5 and the ISI publications/staff ratio 6.9.

3.3 Disaster Management

Theme leader:	<i>Prof. Dr. V.G. Jetten</i>	
Research staff (2009):	3.13 fte	
18 PhD/staff (2009):	5.8	
13 ISI publications/staff (2009):	4.2	
Number of ISI publications (2004-2008):	38	
Relative impact ISI pub. (2004-2008):	1.38	
Number of top 10% ISI pub. (2004-2008):	8	
Assessment:	Quality:	4
	Productivity:	3
	Societal relevance:	5
	Vitality and feasibility:	4

Short description

The theme stands out through its clear research vision, focusing on all aspects of managing disasters, providing both the necessary information following a disaster and pre-disaster analysis of single hazards and risks of multiple hazards. There are three logical subthemes – (1) natural hazard analysis, (2) multiple risk analysis and (3) spatial information for disaster management – which will put the theme/group in a strategic position to act as an important partner for governmental and non-governmental organizations dealing with the entire spectrum of prevention, awareness, and the effects of natural disasters. Since the arrival of the Prof. Jetten, the theme has grown in modelling capability, particularly regarding slow disasters. There is a strong link with the ESS theme through subtheme 3. The theme has grown in terms of numbers of ISI publications and PhD students, and is expected to grow further in the near future.

Quality

The theme shows a relatively large number of papers in the top 10 most cited papers in its field and good relative impact, and has a research leader with a relatively high H-index in this field.

Productivity

There is good productivity of publications and a healthy number of projects. Given the number of research fte, there is room for an increased number of publications.

Societal relevance

The theme is highly relevant to the mission of ITC and the project portfolio shows that the research is deemed important by both the EU and many developing countries. A strategic alliance exists with the United Nations University in the field of disaster geo-information. The percentage of co-authors from developing countries in ISI publications within this theme is higher than the ITC average.

Vitality and feasibility

Prospects for further growth of scientific impact and societal importance are very good. A breakthrough to excellence depends on the publication strategy (see recommendations).

Conclusions and recommendations

This is a very good group dealing with important lines of research and has further potential for growth. Many of the research projects show a local focus. While this is desired from a capacity building perspective, restricting research to local applications limits the scientific impact and the chances with NWO. However, combining the large number of local cases into a global perspective of multiple risks, including large-scale future projections, is an avenue that will generate high-impact publications and eventually research projects. Working together with large-scale modelling groups (such as those at Utrecht University) would be helpful in achieving this.

3.4 Earth Systems Science

Theme leader:	<i>Prof. Dr. F.D. van der Meer</i>	
Research staff (2009):	3.34 fte	
11 PhD/staff (2009):	3.3	
13 ISI publications/staff (2009):	3.9	
Number of ISI publications (2004-2008):	53	
Relative impact ISI pub. (2004-2008):	1.12	
Number of top 10% ISI pub. (2004-2008):	4	
Assessment:	Quality:	4
	Productivity:	3
	Societal relevance:	4
	Vitality and feasibility:	4

Short description

This theme relates to understanding solid Earth processes near the subsurface in terms of resources, geo-environmental engineering and tectonics. Two main subthemes are hyperspectral remote sensing for rock and soil properties, and GIS predictive modelling. Both are applied to exploration and increasingly to environmental applications.

Quality

The topics are well defined and focus on relevant applications, for example the extraction of soil/mineral properties from high-resolution spectral data. The resulting work published in articles, dissertations and books is of high quality.

Productivity

The publication activity is above average. The attraction of external funding, also from industry, is good. The number of PhD students is high, and the number of graduations during the period of review is one of the highest. Some alumni find employment in industry.

Societal relevance

The research is of relevance to understanding geo-processes and has important applications in (environmental) engineering and exploration.

Vitality and feasibility

The research theme has a forward look to emerging trends and new opportunities; the activities are driven by new technology and sensor systems.

Conclusions and recommendations

The focus is on the use of hyperspectral remote sensing, primarily airborne and in the future also space-based, for the purpose of surface and subsurface analysis. A second activity focuses on GIS predictive modelling. Both are strong research activities with high relevance to exploration and engineering. The quality of the research is high, the fields are rather narrow. Connections exist and can be further exploited, with hyperspectral remote sensing for vegetation and water applications, and predictive modelling and seismicity for natural hazards. In this group, with a relatively young staff, there is a clear vision about the research objectives and high competence in doing this type of research. There is a high demand for graduates in this field, again in exploration and engineering. The contact with industry is valuable and should be invested in. The group has an adequate critical mass. It is well organized, with regular meetings with staff and PhD students. Postdocs would help to introduce complementary ideas and new expertise into the group. Accommodating students with own research ideas in the research activities of this theme should be seen as a challenge typical for ITC students in all fields. In summary, a narrow field, high relevance and quality, and a good, well organized research group. The name ESS is confusing as it is too broad, and a title more appropriate to the content should be discussed.

3.5 Food Security and Environmental Sustainability

Theme leader:	<i>Prof. Dr. Ir. E.M.A. Smaling</i>	
Research staff (2009):	0.8 fte	
8 PhD/staff (2009):	10	
3 ISI publications/staff (2009):	3.8	
Number of ISI publications (2004-2008):	15	
Relative impact ISI pub. (2004-2008):	0.93	
Number of top 10% ISI pub. (2004-2008):	1	
Assessment:	Quality:	3
	Productivity:	3
	Societal relevance:	4
	Vitality and feasibility:	4

Short description

The research programme addresses the agricultural production system and food security, but against the backdrop of the degrading natural vegetation cover. It attempts to treat agriculture as a major land use that competes with other land uses for the same land. Considerable attention is paid to the rapidly expanding soybean and oil palm plantations. This programme has two subthemes. One addresses the improved use of geo-information and earth observation techniques in observing and predicting crop performance, while matching it with soil and climatic conditions. The other addresses the trade-off between agriculture and other land uses, thus studying the competing claims on natural resources that lead to conflict areas between game parks, rangelands and croplands. Forest and savanna degradation due to agriculture expansion are also key to this theme.

Quality

The quality of research is good, with many publications in ISI journals. The research is internationally competitive and has made a significant contribution to this specific field. The projects in which this theme is involved are highly impressive, particularly in the developing world.

Productivity

Productivity is good, with a good number of publications in ISI journals.

Societal relevance

The theme is highly relevant in the present context, as food security and environmental sustainability are both at centre stage in the developing countries. The relevance will also continue to grow in the future. The research being conducted within this theme is highly relevant to both ITC and society. The percentage of co-authors from developing countries in ISI publications within this theme is higher than the ITC average.

Vitality and feasibility

The theme is highly viable and is going to stay, being a major concern in developing countries. It is also very important for the mission of ITC, but the current set-up is rather small.

Conclusions and recommendations

A very broad theme, with a provocative title, it has immense relevance. However, with the limited staff capacity and to avoid distractions, definite choices have to be made. The theme has strong leadership and the theme leader has a very clear vision of the research direction. The theme holds much promise for the future, with food security and environmental sustainability being in focus and emerging strongly. The leadership seems quite aware of this and is quite capable of taking up any challenges that emerge. The theme has a clearly identified focus on soybean and oil palm or tea and is highly applied, with a clear societal impact. A point of concern could be the decision support systems being developed. As these can often lead to erroneous outcomes, extreme care needs to be exercised. Although the theme may seem a bit isolated, some areas (e.g. optimization of crop yields) are well suited to the ITC mission. However, much depends on how ITC adds value to food science and agronomy in the future. There are immense opportunities for consultancy but limited staff capacity may often lead to limited time. This theme will continue to attract attention worldwide and needs more integration within ITC (through the ITC management). The focus of the theme is clearly identified, but is limited by the size of the staff capacity, which needs strengthening given the great importance of the theme.

3.6 Governance and Integrated Spatial Assessment

Theme leader:	<i>Prof. Dr. A. van der Veen</i>	
Research staff (2009):	1.89 fte	
7 PhD/staff (2009):	3.7	
9 ISI publications/staff (2009):	4.8	
Number of ISI publications (2004-2008):	9	
Relative impact ISI pub. (2004-2008):	0.84	
Number of top 10% ISI pub. (2004-2008):	0	
Assessment:	Quality:	3
	Productivity:	4
	Societal relevance:	4
	Vitality and feasibility:	3

Short description

The theme aims at setting up integrated projects between the social and technical sciences within ITC in order to facilitate societal decision-making. Its focus is explicitly on interdisciplinary research. The theme is involved in a variety of research projects and involves researchers from a variety of disciplinary backgrounds. It only started in 2007 and is the youngest research theme within ITC.

Quality

This theme has the ambition to organize interdisciplinary research at ITC, and has thereby set itself an important and difficult task. Its publications are in respected international journals, even though the theme leader emphasized the inherent difficulties in finding outlets for interdisciplinary research. The theme leader is visible in his (interdisciplinary) field and has often cooperated with researchers from a variety of backgrounds. The array of research projects in which this theme is involved is impressive.

Productivity

Productivity within this theme is very good, even though the relative impact of the journal outlets is not very high and publications in the real top-tier journals are still lacking (see also remarks under *Quality*).

Societal relevance

The research conducted within this theme is highly relevant for the outside world and ITC alike. Together with the other themes anchored in the PGM department, it attempts to bridge the traditional divide between technology and society. This type of research is increasingly gaining scientific and social recognition, and has a great future ahead.

Vitality and feasibility

The researchers come from divergent backgrounds, which is not automatically conducive to strong cooperative work. The theme leader has highlighted the dilemma for individual researchers from disciplinary backgrounds who are dealing with an inherently interdisciplinary research theme, and has indicated that the researchers need to strike a balance here. Despite these handicaps associated with the theme choice, the theme will continue to be very important for the profile of ITC.

Conclusions and recommendations

This theme, though coping with the double-headed problem of interdisciplinary research and beta-gamma collaboration, does a very good job in fulfilling the ITC mission. With proper guidance from both the theme leader and the research management of ITC, the theme has a bright future. It is important not to lose focus by becoming too broad, and to build a larger core group of committed researchers. Furthermore, the theme is, together with the other PGM-hosted themes, particularly well positioned for the future development of ITC-UT research collaboration – in this case also as a result of the personal ties of the theme leader with UT (IGS institute). Core researchers should have completed their PhD in order to secure research time.

3.7 Informed Multilevel Governance for Urban Regions

Theme leader:	<i>Prof. Dr. Ing. P.Y. Georgiadou</i>	
Research staff (2009):	1.02 fte	
4 PhD/staff (2009):	3.9	
5 ISI publications/staff (2009):	4.9	
Number of ISI publications (2004-2008):	8	
Relative impact ISI pub. (2004-2008):	0.92	
Number of top 10% ISI pub. (2004-2008):	0	
Assessment:	Quality:	3
	Productivity:	3
	Societal relevance:	3
	Vitality and feasibility:	3

Short description

The theme aims at analytically understanding how the governing and the governed interpret, strategically control, access, share, produce and use geo-information and geo-ICT for policy- and decision-making in empirical, multilevel contexts. Research addresses the public governance implications of developments in geo-ICT and geo-information. Its methodological approach is explanatory and qualitative – one might perhaps say “thick”, in contrast with the “thin” explanations and descriptions preferred in quantitative work. The theme is relatively new; the theme leader was appointed professor in mid-2008.

Quality

The theme leader has a very clear and convincing vision of the direction the research should take. This theme has produced some good contributions in visible journals, but the quality of the publication outlets can be further increased (higher-impact journals, top journals in the field, and consequently higher H-indices). The Committee is aware that cross-disciplinary work faces some specific hurdles, but encourages the researchers within this theme to take up the challenge. The work within this theme is important for ITC and for the outside world.

Productivity

The number of ISI publications is at a good level. Some of these publications were (co-)authored by retired staff; therefore upholding a stream of publications requires specific attention. Publication cultures differ across different fields of the technical and social sciences, but it seems desirable and possible to aim for more article publications, with a larger proportion of these publications in highly-rated ISI journals.

Societal relevance

The research conducted within this theme is highly relevant for ITC and for society. Together with the other themes anchored in the PGM department, it attempts to bridge the traditional divide between technology and society. This type of research is increasingly gaining scientific and social recognition, and has a great future ahead. This theme specifically is in a very good position to enhance cooperation with various other research themes at ITC, because of its core aim of studying the governance impact of geo-information and geo-ICT.

Vitality and feasibility

The theme in its present composition is relatively new and relatively small. The number of graduate students appears to be relatively small, and the theme leader has mentioned that a theme like this faces some difficulties in attracting good graduate students. The theme is, however, very important to the mission of ITC, and will undoubtedly grow in importance and size as it matures.

Conclusions and recommendations

The theme, though facing the complications of beta-gamma collaboration, has a mission and clear goals. It is also very important to the mission of ITC. It should aim at an increased research mass (graduate students, PhD candidates). Furthermore, it is, together with the other PGM-hosted themes, particularly well positioned for the future development of ITC-UT (IGS) research collaboration. Core researchers should have completed their PhD in order to secure research time.

3.8 Land Administration for Informed Governance

Theme leader:	<i>Prof. Dr. J.A. Zevenbergen</i>	
Research staff (2009):	0.92 fte	
4 PhD/staff (2009):	4.3	
2 ISI publications/staff (2009):	2.2	
Number of ISI publications (2004-2008):	8	
Relative impact ISI pub. (2004-2008):	1.26	
Number of top 10% ISI pub. (2004-2008):	1	
Assessment:	Quality:	3
	Productivity:	3
	Societal relevance:	4
	Vitality and feasibility:	4

Short description

This research theme focuses on how to improve land administration systems for poverty reduction and growth. This is done by developing knowledge on (1) institutional environments of land administration and their relationships, (2) concepts, models and methods to make land administration systems work, and (3) methodologies to support land administration systems in their general and specific contexts. The theme is highly relevant to the mission of ITC and the research can significantly contribute to improving land administration systems worldwide. In the last years, there have been no PhD graduations within this theme but that is set to change as four PhD students are currently active. With the recent appointment of Prof. Zevenbergen (mid-2008 part-time and since 2010 full-time), it is expected that the theme will grow in size and scientific output.

Quality

Although limited in quantity, the scientific output is of good quality, with relative impact being a bit above the world average. One paper produced is in the top ten most cited papers in the field.

Productivity

Productivity in terms of publications is good but there is certainly room for improvement. Nor has past performance in terms of PhD theses been that impressive.

Societal relevance

The research is highly relevant for the land administration field. The theme is also able to attract external funding and, given the topic, more external funding can be expected in the future.

Vitality and feasibility

Prospects for further development of the theme in terms of scientific quality and output are very good. The presented strategy is clear and realistic.

Conclusions and recommendations

Land administration is an important research theme for ITC, with a very healthy future. To create more critical mass, it is recommended that more funding be attracted for research. Given the theme, this is expected to be highly possible. It is also recommended that the research should focus on conceptual and methodological issues. The suggestion made by the theme leader to develop an assessment framework for land administration is a very good one. The scientific and the societal impact of such a research direction is expected to be high.

3.9 Managing Water Scarcity

Theme leader:	<i>Dr. Ir. M.W. Lubzcynski (interim)</i>	
Research staff (2009):	1.39 fte	
9 PhD/staff (2009):	6.5	
6 ISI publications/staff (2009):	4.3	
Number of ISI publications (2004-2008):	25	
Relative impact ISI pub. (2004-2008):	1.26	
Number of top 10% ISI pub. (2004-2008):	3	
Assessment:	Quality:	3
	Productivity:	4
	Societal relevance:	4
	Vitality and feasibility:	3

Short description

This theme touches upon important issues that are at the heart of the mission of ITC. Water scarcity is already affecting two billion people worldwide and is expected to increase with population growth and climate change. The theme is popular with students and is productive. However, the range of issues and the existence of two clusters of subthemes are too broad given the limited staffing and should be focused. The cluster dealing with modelling and observing groundwater recharge has a good focus, dealing with research that is rather fundamental and in a definite niche that will yield many new insights. The second cluster on river basin management is middle of the road and does not stand out. The experimental facilities in the various countries to monitor groundwater recharge are impressive. The professor retired in 2008.

Quality

Average quality is good, based on a cluster of activities rated very good and satisfactory.

Productivity

Productivity is very good, based on relative impact, number of projects and the number of PhD students enrolled.

Societal relevance

The theme itself as well as the research within the theme are highly relevant in light of the mission of ITC. The percentage of co-authors from developing countries in ISI publications within this theme is higher than the ITC average.

Vitality and feasibility

With increased focus and a full professor leading the theme, viability could be higher.

Conclusions and recommendations

This is an important theme for the mission of ITC and should be reinforced. This should be done by focusing the second cluster on water scarcity management (the first could then focus on mechanisms of groundwater recharge), with specific attention to groundwater/surface water management and the use of earth observation tools in this context. There is an opportunity for close cooperation with the Twente Water Centre. The lack of a professor in this area is an omission that requires reconsideration, given that a professor of water quality has not yet been appointed.

3.10 Spatial Data Infrastructure Technology

Theme leader:	<i>Dr. Ir. R.A. de By</i> (interim)	
Research staff (2009):	0.5 fte	
5 PhD/staff (2009):	10	
0 ISI publications/staff (2009):	0	
Number of ISI publications (2004-2008):	10	
Relative impact ISI pub. (2004-2008):	1.58	
Number of top 10% ISI pub. (2004-2008):	3	
Assessment:	Quality:	3
	Productivity:	3
	Societal relevance:	4
	Vitality and feasibility:	2

Short description

This research theme focuses on the development of theory, methods and tools to design, realize and maintain technical components of spatial data infrastructure (SDI). Special attention is paid to the possibilities of exploiting SDI in developing economies, for instance by embedding geo-information in daily practices. The overall objective is to develop theory and tools to improve this exploitation in emerging markets by, among other things, aiming at well-understood functional needs of SDI end-users. This theme has been operating under an interim leader ever since its inception.

Quality

The research within this theme, although limited in size, is competitive at the national level and makes a valuable contribution in the international field. The number of top 10% publications is relatively large and the overall impact of the publications is above the ITC average.

Productivity

The productivity of the theme in terms of research publications is rather limited.

Societal relevance

This research theme is important to the mission of ITC. In particular the design and the development of innovative technology for emerging markets is an interesting niche for this theme.

Vitality and feasibility

Viability is low: the lack of a full professor over the years has seriously hampered the healthy scientific development of this theme.

Conclusions and recommendations

This theme, although limited in size and productivity, is highly relevant for the ITC mission. The current group lacks leadership and is too small to be viable in the long run. It is recommended that a new professor be appointed for this theme (possible name: chair "geo"-informatics). A possible link between this chair and the UT informatics department needs to be considered in order to create critical mass.

3.11 Spatio-temporal Data Integration and Visualization

Theme leader:	<i>Prof. Dr. M.-J. Kraak</i>	
Research staff (2009):	1.39 fte	
7 PhD/staff (2009):	5.0	
7 ISI publications/staff (2009):	5	
Number of ISI publications (2004-2008):	16	
Relative impact ISI pub. (2004-2008):	1.37	
Number of top 10% ISI pub. (2004-2008):	3	
Number of top 1% ISI pub. (2004-2008):	1	
Assessment:	Quality:	4
	Productivity:	4
	Societal relevance:	4
	Vitality and feasibility:	3

Short description

This research theme focuses on methods and techniques of integrating data from different sources and dimensions (2D, 3D, time). The data are offered via a variety of map representations in multifunctional visual (online) environments that allow exploration and data analysis. To justify the solutions produced, usability research is an integral part of the theme's activities. During the assessment period six PhD students graduated, one of the highest numbers of all ITC themes. One of the leading international textbooks on cartography has been written by the theme leader.

Quality

Research carried out within this theme is nationally leading and has a clear impact at international level. The average impact of the publications is the ITC average. One publication belongs to the top 1% most cited papers in this field.

Productivity

The productivity of the theme is very good in terms of publications per fte. A substantial number of PhDs have graduated within this theme.

Societal relevance

The research performed is highly relevant for the development of the geo-information science discipline.

Vitality and feasibility

The prospects for this theme are good, but it is not easy to attract external research funds for visualization research.

Conclusions and recommendations

This is a very good theme, with a clear profile. However, funding for cartography research is under pressure both nationally and internationally. The strategy of the group to extend the research focus to geovisual analytics is highly appreciated. It also offers more possibilities to attract funding together with the more application-oriented disciplines inside or outside ITC. It is recommended that the second research line "multi-resolution data integration" be reconsidered. Maybe with a clear research focus on geovisual analytics the theme has the possibility for further growth to excellence.

3.12 Stochastic Methods for Image Mining and Data Quality

Theme leader:	Prof. Dr. Ir. A. Stein	
Research staff (2009):	1.26 fte	
7 PhD/staff (2009):	5.6	
12 ISI publications/staff (2009):	9.5	
Number of ISI publications (2004-2008):	39	
Relative impact ISI pub. (2004-2008):	0.95	
Number of top 10% ISI pub. (2004-2008):	4	
Number of top 1% ISI pub. (2004-2008):	1	
Assessment:	Quality:	4
	Productivity:	5
	Societal relevance:	4
	Vitality and feasibility:	3

Short description

All ITC research deals with geographical processes. All measured data and models exhibit uncertainties in space and time. This theme deals with stochastic modelling, analysis and classification of spatio-temporal processes, with data quality and information extraction as its main tracks. The basic domains are spatial statistics, the processing of remote sensing scenes and uncertainties in geographical information systems.

Quality

The work of the group is innovative and has great impact on the quality of PhD research at ITC. The quality is certainly very high.

Productivity

Productivity is high in terms of support and supervision of PhD research. The publication record is excellent. The impact could probably be increased by selecting higher-impact journals.

Societal relevance

The relevance of the subjects within this theme is very high. Data quality and quality analysis are often overlooked and should receive much more attention. Purely mathematical research may, however, be less attractive for funding.

Vitality and feasibility

The group is continuously moving towards new and relevant fields. The plan is to do more research on "fuzziness" and "machine learning" and to merge this with probabilistic methods. Here a more strategic line could be followed in cooperation with the other themes to achieve a good compromise between an own genuine line of research and the support of other themes.

Conclusions and recommendations

One could regard this theme as the mathematical/statistical conscience of ITC. Therefore cooperations are many, and part of the work is in the service of other themes. The group is loosely organized but it seems to work in a focused way. The emphasis is on the application of stochastic analysis. Application is also the main interest of the students and staff. Therefore publications are primarily in journals dealing with applications and not so much in the pure mathematical/stochastic literature. On the other hand, inside ITC this theme belongs to methodology rather than application. The publication activity is high and of very good quality; the impact could be higher. The field is attractive to PhD students. The group size is sufficient and the number of PhD students is relatively high.

Data quality in geographical analysis is often said to be very important but little is really done to work on a comprehensive approach. Therefore this theme is very important and to some extent unique. ITC can offer a closed chain from remote sensing via geo-information and visualization to geostatistics. Maybe this asset could be more emphasized.

3.13 Sustainable Urban Regional Dynamics

Theme leader:	<i>Prof. Dr. Ir. M.F.A.M. van Maarseveen</i>	
Research staff (2009):	1.67 fte	
14 PhD/staff (2009):	8.4	
5 ISI publications/staff (2009):	3.0	
Number of ISI publications (2004-2008):	4	
Relative impact ISI pub. (2004-2008):	2	
Number of top 10% ISI pub. (2004-2008):	1	
Assessment:	Quality:	3
	Productivity:	3
	Societal relevance:	3
	Vitality and feasibility:	3

Short description

This theme aims at investigating and enhancing sustainable urban regional development of large groups of LDC cities and their functional urban regions. Sustainability is central. Empirically, the focus is on sub-Saharan African and Latin American urban regions facing hypergrowth, and on Latin American and South/Southeast Asian regions facing fast economic growth. The theme started relatively recently, with the appointment of the theme leader in 2008.

Quality

The theme leader has a clear vision of the research within this theme, as well as its future development. The relative impact of the publications is high, and these publications include one top 10% outlet. The H-index of the researchers, however, is rather low, which implies that the theme research is not yet making its mark on the field.

Productivity

Productivity is good, and can be further increased in terms of ISI journal contributions given the input of research fte's, which is larger than in the other two themes hosted by the PGM department.

Societal relevance

The research conducted within this theme is highly relevant for ITC and for society. Together with the other themes anchored in the PGM department, it attempts to bridge the traditional divide between technology and society. The theme research is in particular very relevant for issues of sustainable government in the developing world.

Vitality and feasibility

The theme in its present composition is relatively new. It is very important to the mission of ITC and has existing ties with research at UT (currently particularly with the CTIT research institute), which will prove very valuable for the future development of the theme. The theme leader has a clear and convincing vision of the future development of the research. The pull on research fte's for capacity building is seen as a threat to the further development of the research. The management should facilitate and ascertain that a balance is found between problem-driven research and capacity building as research valorization.

Conclusions and recommendations

The goals of the theme are clear and are important to the ITC mission. The research being conducted is highly relevant; leadership appears promising. Research productivity can be further increased.

3.14 Utilization of Sensor Development for Efficient Topographic Mapping

Theme leader:	<i>Prof. Dr. Ir. M.G. Vosselman</i>	
Research staff (2009):	1.24 fte	
7 PhD/staff (2009):	5.6	
7 ISI publications/staff (2009):	5.6	
Number of ISI publications (2004-2008):	9	
Relative impact ISI pub. (2004-2008):	2.73	
Number of top 10% ISI pub. (2004-2008):	2	
Assessment:	Quality:	4
	Productivity:	4
	Societal relevance:	4
	Vitality and feasibility:	3

Short description

The theme deals with sensor development in the field of imaging, topographic mapping and automated information extraction, as well as sensor and data fusion. These topics are the core business of ITC and rest on a long and very successful tradition.

Quality

This research theme produces a very high standard of work. It has a high reputation inside the international photogrammetry/remote sensing research community. The research deals with the most advanced topics of photogrammetry.

Productivity

The publication record is very good, with an upward trend. The intention is to shift publication activity more and more to ISI journals. The ISI papers that have been published are of a high standard, and have a very high relative impact.

Societal relevance

The theme is one of the traditional core subjects of ITC, the (automated) collection of metric geo-information. It will gain in relevance in the future. More and more geographical information is being requested to support decision processes. The information has to be available, up to date, complete, understandable, and in (almost) real time for planning, disaster management, traffic management, process monitoring and other applications.

Vitality and feasibility

The group performs innovative research by employing modern high-end technology and methodology. The theme leader has high expectations of the possibility of NWO applications, also in combination with other themes. While there are good cooperative links within the Netherlands and Europe, joint projects with partners inside ITC could be intensified.

Conclusions and recommendations

The professor has been at ITC since 2004. He is very active in acquiring external projects and in increasing the publication activity and quality within his theme. There are connections with CTIT, the informatics institute at UT. NWO funding is possible in the future and attempts will be made to secure this. This core research lies more in a fundamental and conceptual direction than in the applied direction. Reportedly, it is not easy in this field of research to attract high-quality staff to ITC.

3.15 Water Cycle and Climate

Theme leader:	<i>Prof. Dr. Z. Su and Prof. Dr. Ing. W. Verhoef</i>	
Research staff (2009):	3.86 fte	
17 PhD/staff (2009):	4.4	
25 ISI publications/staff (2009):	6.5	
Number of ISI publications (2004-2008):	52	
Relative impact ISI pub. (2004-2008):	1.87	
Number of top 10% ISI pub. (2004-2008):	15	
Assessment:	Quality:	4
	Productivity:	4
	Societal relevance:	4
	Vitality and feasibility:	5

Short description

The research programme shows a clear focus, with five subthemes: aquatic ecohydrology, climate change, land ecohydrology, surface hydrology and terrestrial water storage. The theme – and in particular its two team leaders – has built up a world leading reputation in the monitoring of the water cycle and the energy cycle, especially with regard to the fluxes between land and atmosphere and radiative transfer modelling. Within the theme, a number of earth observation facilities (with two sites in the Netherlands and sites on the Tibetan plateau and in Africa) are maintained that play a key role in fundamental research and teaching on land-atmosphere processes. This more experimental profile has lately been extended through modelling work: coupled energy, water and carbon-exchange modelling, land surface modelling, mesoscale atmospheric modelling, and large-eddy simulation.

Quality

The research is internationally competitive in the field of terrestrial water cycle monitoring, with above average relative impact, papers in good-impact journals, and a significant number of top 10% cited papers in the field.

Productivity

Productivity in terms of number of papers, number of papers per fte and PhD students is high.

Societal relevance

The focus of the research is on understanding hydroclimatic systems, a topic highly relevant to predicting both climate change and its effects on the water system. The percentage of co-authors from developing countries in ISI publications within this theme is higher than the ITC average.

Vitality and feasibility

The prospects for this theme are excellent, especially if, in view of the consequences of global change and climate change, modelling and observations are both pursued.

Conclusions and recommendations

This is a very good research theme, with a bright future for further growth to excellence. Acceptance in the climate community is needed and will be enhanced by publishing more in atmospheric journals. It is highly recommended that the atmospheric modelling efforts be institutionalized by hiring an atmospheric modeller. Contacts with ESA and GEO are highly appreciated, and should be employed for the benefit of ITC as a whole.

4. Appendices

Appendix A: Curricula vitae of the committee members

Appendix B: Final schedule of site visit meetings

Appendix C: Explanation of SEP scores and criteria

Appendix D: Acronyms

4.1 Appendix A: Curricula vitae of the committee members

Prof. Dr. R. Rummel (chair)

Professor of Satellite Geodesy, Technische Universität München
Chairman of the GOCE Mission Advisory Group
München, Germany

Reiner Rummel studied geodesy at Technische Universität München from 1966 to 1970 and then did his PhD in Darmstadt. From 1974 to 1976, he was a postdoc at the Department of Geodetic Science, Ohio State University, Columbus, Ohio. Afterwards he carried out research at the German Geodetic Research Institute and at the Geodetic Commission of the Bavarian Academy of Sciences and Humanities, both in Munich. In 1980 he became professor of physical geodesy at Delft University of Technology. In 1993 he moved to back to his alma mater, Technische Universität München, as professor and head of the Institute of Physical and Astronomical Geodesy. His field of research is physical geodesy with a focus on the determination of the Earth's gravitational field by satellite gradiometry. Prof. Rummel is heavily involved in the ESA satellite mission GOCE, which was launched in spring 2009. He is currently coordinating the GOCE High-level Processing Facility (HPF), which is a joint project between ten institutes from seven European countries.

Prof. Dr. C.W.A.M. Aarts

Professor of Political Science,
Scientific Director Institute for Innovation and Governance Studies (IGS)
University of Twente
Enschede, The Netherlands

Kees Aarts (1959) is professor of political science at the School of Management and Governance. He is also scientific director of the Institute for Innovation and Governance Studies (IGS), one of the research institutes of the University of Twente. He obtained his MA degree in political science, in particular research methods and techniques, from the University of Amsterdam, and his doctorate from the University of Twente. His research focuses on democracy, elections and electoral behaviour in the Netherlands and from an international comparative perspective. Another field of interest is the construction of data infrastructures for the social sciences. He is presently co-editor of *Acta Politica* and is on the editorial boards of *Electoral Studies* and *Methodological Innovations On Line*. Prof. Aarts is the national coordinator for the Netherlands of the European Social Survey, and is involved in various other international survey projects. He is a member of the Scientific Advisory Council of Data Archiving and Networking Services.

Prof. Dr. M.F.P. Bierkens

Professor of Earth Surface Hydrology
Faculty of Geographical Sciences
Utrecht University
The Netherlands

Marc Bierkens (1965) holds the chair in geographical hydrology at the Department of Physical Geography at Utrecht University and currently acts as chairman of the department. He received his MSc in hydrology from Wageningen University in 1990, a PhD in physical geography from Utrecht University in 1994, and became professor of hydrology at Utrecht University in 2002. He is also partly employed by TNO/Deltares. Between 1994 and 2002 he worked as a senior scientist and team leader at Alterra Research institute in Wageningen. His fields of expertise are groundwater hydrology, stochastic hydrology, hydrological regionalization, upscaling theory and geostatistics. Recently initiated work includes integrated modelling of soil-water-vegetation dynamics, data assimilation methods for operational water management, and global-scale hydrological modelling in relation to climate. He is a member of the European Geosciences Union, the American Geophysical Union and the International Association of Hydrological Sciences, and an associate of Water Resources Research and Geoderma. He co-organized the IAHS ModelCARE conference in 2005 in the Netherlands. Prof. Bierkens has (co-) authored about 120 publications, 55 of which have appeared in international peer-reviewed journals. He is principal author of the book *Upscaling and Downscaling Methods for Environmental Research* (2002), co-author of the book *Sampling for Natural Resource Monitoring* (2006), and editor of the book *Climate and the Hydrological Cycle* (2008).

Prof. Dr. A.K. Bregt,

Professor of Geo-information Science
Wageningen University
Wageningen, The Netherlands

Arnold Bregt (1959) has a doctor's (1992) degree from Wageningen University. The subject of his PhD thesis was "Spatial data handling in soil science". From 1983 until 1989 he was head of the Department of Applied Information Science and Statistics at the Netherlands Soil Survey Institute in Wageningen. From 1989 until 1998 he was head of the Department of GIS, Quantitative Methods and Information Science at the Winand Staring Centre in Wageningen. During this period he was leader of a DLO research programme on GIS. In 1998 he became half-time professor in geo-information science at Wageningen University, with a full-time position following in 2002. In 2001 he was appointed guest professor at the Huazhong University in Wuhan, China. Through his work he has been involved in international projects, consulting missions, and lecturing in countries such as China, Indonesia, Kenya, Philippines, Vietnam, Cameroon and Japan. In the period 1993-1994 he was a visiting scientist for about a year at the National Institute for Agro-Environmental Sciences in Tsukuba, Japan. He is (co-)author of around 250 publications on spatial statistics in soil science, spatial data uncertainty, spatial-temporal modelling, spatial data infrastructures and the application of geo-information science in the natural resources domain. He has given various presentations at national and international meetings and symposia (on average seven to eight a year). His current research interests are spatial data infrastructures, spatial data quality, and land use modelling. In recent years he has been, and still is, heavily involved in a number of projects and activities concerning the development of spatial data infrastructures (SDIs). He was one of the initiators and project leaders of the Dutch clearinghouse for geo-information. Within Europe Prof. Bregt has been involved in a number of working groups related to SDI developments. He was also one of the initiators of the research programme Space for Geo-Information, which was granted a subsidy of 20 million euro in 2003. He was chairman of the CEN TC/287, the technical committee concerned with European standardization of geo-information.

Dr. R.M. Bhagat,

Research & Development Co-ordinator
Tea Research Association of India
Jorhat – 785 008, Assam, India

Rajiv Bhagat (1958) holds a PhD degree (1983) in soil physics from H.P. Agricultural University, Palampur, H.P., India, on the subject soil hydraulic properties and their use in water withdrawal patterns by crop roots. He was a junior associate (1985-1988) of the International Centre for Theoretical Physics, Trieste, Italy. He was associate professor from 1991 to 1993 at H.P. Agricultural University in India and project scientist at the International Rice Research Institute (IRRI), Manila, Philippines, from 1994 to 1996. At IRRI he led the project on agro-hydrology and tillage interactions in wet seeded rice. In 1999 he became professor of soil science at H.P. Agricultural University, Palampur, India. During this period he was leader of GOI-funded projects on modelling cereal yields in variable water and nutrient supply conditions. He also led START, the Washington/UNEP-APN Japan project on global change in northwestern India and inventoried glaciers and glacial lakes of Himachal Himalaya in the Hindu Kush Himalayan region. He was also a leader of the joint ICIMOD-Nepal/HPAU projects on defining agro-ecological zones, soil/crop suitability in H.P., and water resources mapping. He took over as director of the Centre for Geo-informatics Research and Training in 2004. He supervised nine national and international projects on climate change, environmental impact assessment, water resources and flash flood monitoring, developing decision support systems for hill agricultural systems, and modelling environmental persistence of pesticides and agro-chemicals. He took over as research and development co-ordinator at the Tea Research Association of India in Assam in 2007 and is currently coordinating R&D activities and the various outreach activities of one of the largest and oldest tea research institutes in the world: the Tocklai Tea Research Institute. Dr. Bhagat has more than 130 publications to his credit on subjects ranging from soil science, agronomy, GIS and remote sensing to simulation modelling. He is a member of various national and international scientific decision-making bodies, including environmental and climate change working groups, and actively participates in meetings, seminars and symposia (at least ten a year).

X. Poshiwa, MSc (PhD student)
Resource Ecology Group
Wageningen University
Wageningen, The Netherlands

Xavier Poshiwa is a PhD student with the Resource Ecology Group, Wageningen University. He graduated in 1997 with a BSc in agriculture from the University of Zimbabwe. He received his MSc in animal science from the same university in 2000. The very same year, he started his research career at Grasslands Research Station in Zimbabwe as a rangeland ecologist. He has taken part in collaborative research programmes involving other countries: "Tropical forage and ley legume technology for sustainable grazing and cropping systems in Southern Africa", funded by ACIAR (2000 to 2005); and "Symbionts in Agro forestry systems: What are the long term impacts of inoculation on the growth of *Calliandra calothyrsus* and its intercrops?", funded by the EU (2001 to 2006), where he was the principal investigator for the project. In 2007 he joined the Resource Ecology Group, Wageningen University, through the INREF project "Competing claims on natural resources: overcoming mismatches in resource use through multi-scale perspectives". This study analyses competing claims for land, and identifies alternative arrangements for wildlife management and livestock farming in Zimbabwe, in close relation with the local stakeholders. The project aims at designing sustainable resource distribution and accessibility systems with adequate opportunities for diverse livestock farming and wildlife use in the southeastern Lowveld of Zimbabwe. Xavier Poshiwa is in the writing phase of his PhD.

4.2 Appendix B: Final schedule of site visit meetings

Programme for site visit to ITC, Enschede, 26-28 April 2010

Monday 26th April

- 09:00 Welcome by the rector of ITC, Prof. T. Veldkamp
Background of the evaluation
- 09:30 Committee meeting
(ITC boardroom 1-163 booked three full days exclusively for the Committee)
- 10:30 General overview of ITC research
Dr. P. van Dijk, Head Research
- 11:30 Meeting research theme leaders per department:
Department of Earth Systems Science
Prof. F. van der Meer (chair), ESS
Prof. V. Jetten, DMAN
- 12:30 Lunch in ITC restaurant
- 14:00 Meeting research theme leaders per department:
Departments of Earth Observation Science and Geo-Information Processing
Prof. A. Stein (chair EOS), DAQUAL
Prof. G. Vosselman, TOPMAP
Prof. M.-J. Kraak (chair GIP), STDIV
Dr. R. de By, SDIT
- 15:00 Meeting research theme leaders per department:
Department of Natural Resources
Prof. A. Skidmore (chair), BIOFRAG
Dr. Y. Hussin, C-CYCLE
Prof. E. Smaling, FSES
- 16:00 Meeting research theme leaders per department:
Department of Water Resources
Prof. B. Su (chair), WCC
Dr. M. Lubczynski, MWS
Prof. W. Verhoef, WCC
- 17:00 Wrap-up by Committee
- 19:00 Committee dinner Eden Dish hotel

Tuesday 27th April

- 09:00 Committee meeting
- 09:30 Meeting research theme leaders per department:
Urban and Regional Planning and Geo-information Management
Prof. M. van Maarseveen (chair), SURD
Prof. A. van der Veen, GISA
Prof. J. Zevenbergen, LA
Prof. Y. Georgiadou, MUG
- 10:30 Meeting on the link between Education and Research
Ir. F. Paats (Head Education)
Dr. P. van Dijk (Head Research)
Dr. M. Weir (Coordinator MSc blocks 3 and 4)
- 11:30 Meeting with PhD students
Mila Luleva (Bulgaria)
Juan Francisco Sanchez Moreno (Colombia)
Sukhad Keshkamat (India)
Alain Frances (France)
Aidin Niamir (Iran)
Ma Xiaogang (China)
- 12:30 Lunch in ITC restaurant
- 13:30 Guided tour of ITC laboratory facilities (Drs. B. de Smeth, Head Geoscience Lab.)

Tuesday 27th April (continued):

- 14:00 Financial matters
 - Dr. P. van Dijk (Head Research)
 - Mrs. E. Leurink (Managing Director)
 - Mrs. E. Velthuis (Controller)
 - Ing. R. Brinkman (Management Information Officer)

- 14:30 Meeting with Bureau Research Coordination staff
 - Dr. P. van Dijk (Head Research)
 - Mrs. L. Colenbrander (secretary Graduate Programme)
 - Mrs. R. Spaan (financial administration)

- 15:00 Wrap-up and report writing by Committee
- 19:00 Committee dinner Eden Dish hotel
 - Together with ITC staff: Heads of Department, Head Research (8)

Wednesday 28th April

- 09:00 Committee meeting
- 09:30 Meeting with the former rector of ITC, Prof. M. Molenaar
- 10:00 Meeting with Ir. B. Boer, acting Head Project Services Bureau
- 11:00 Call for additional discussions from staff and graduate students (via secretary)
 - No use is made of this opportunity
- 11:00 Report preparation
- 12:30 Lunch
- 13:30 Report preparation
- 15:30 Briefing with ITC management on main conclusions
- 16:00 Presentation of main conclusions in ITC Auditorium to all staff and students
- 16:30 Drinks in the Annex

4.3 Appendix C: Explanation of SEP scores and criteria

Standard Evaluation Protocol scores:

5. Excellent

Research is world leading. Researchers are working at the forefront of their field internationally and their research has an important and substantial impact in the field.

4. Very good

Research is internationally competitive and makes a significant contribution to the field. Research is considered nationally leading.

3. Good

Work is competitive at the national level and makes a valuable contribution in the international field. Research is considered internationally visible.

2. Satisfactory

Work adds to our understanding and is solid but not exciting. Research is nationally visible.

1. Unsatisfactory

Work is neither solid nor exciting, flawed in the scientific and/or technical approach, repetitions of other work, etc.

Standard Evaluation Protocol criteria:

Criterion 1: Quality

Quality refers to the level of the research conducted by the researchers of an institute and its groups or programmes compared with accepted (international) standards in that field. As a rule, quality is measured by judging the international academic reputation, the position and the output of the unit to be evaluated. When judging research quality, sub-criteria are:

- Quality and scientific relevance of the research
- Leadership of the institute and the individual leadership of the principal investigators, including research policy and research management
- The academic reputation of the researchers
- Organizational aspects of the institute and of the research programmes, such as the human and financial resources
- PhD training in the institute or within research programmes.

Criterion 2: Productivity

Productivity regards the relationship between input and output. Output should always be judged in relation to the mission and resources of the institute. When looking at productivity in terms of publications of scientific articles and the like, a verdict is usually cast in comparison with international standards of a quantitative nature. However, this is often not possible when looking at other forms of output (e.g. health protocols, designs, policy reports). Since many institutes will have variegated output and scientific activities, evaluators are asked to also include other forms of (qualitative) information in their assessment.

- At the level of the institute, the judgment regards the policy measures to raise the output to the best and most relevant level possible.
- At the level of the research group or programme, both the output directed toward the scientific community and the output for wider audiences are to be judged. Quantitative and qualitative measurements may be used.

Criterion 3: Societal relevance

This criterion covers the social, economic and cultural relevance of the research. Thus, it concerns a great variety of subjects that are both scientifically and socially relevant (global warming, sustainable energy, inequality, governance, migration and integration, quality of life, water, religion, cultural identity, language problems, etc.). In principle, all research activities can be (or become) relevant for these subjects, though this might be more obvious in some cases than in others. When assessing research activities in terms of societal relevance, evaluators are asked to consider one or more of the following three aspects. The three are not mutually exclusive and are meant as indicative guidelines. The institute specifies in its self-evaluation report on which aspect(s) it would like to be evaluated.

- *Societal quality of the work.* This aspect refers primarily to the policy and efforts of the institute and/or research groups to interact in a productive way with stakeholders in society who are interested in input from scientific research. It may also refer to the contribution of research to important issues and debates in society.
- *Societal impact of the work.* This aspect refers to how research affects specific stakeholders or specific procedures in society (e.g. protocols, laws and regulations, curricula). This can be measured, for example, via charting behavioural changes of actors or institutions.
- *Valorisation of the work.* This aspect refers to the activities aimed at making research results available and suitable for application in products, processes and services. This includes activities regarding the availability of results and the interaction with public and private organizations, as well as direct contributions such as commercial or non-profit use of research results and expertise.

At the level of the institute, this criterion is assessed by reviewing the policy measures aimed at enhancing societal relevance, and the societal orientation of researchers and their activities. This includes the institute's policy for making the results of research available to other than academic users (knowledge transfer). At the level of the research group or programme, this criterion can be assessed by reviewing the various kinds of output and activities through impact indicators or more qualitative measurements.

Criterion 4: Vitality and feasibility

This dual criterion regards the institute's ability to react adequately to important changes in the environment. It refers to both internal (personnel, research practice) and external (developments in the field, in society) dynamics of the group. In the self-evaluation, this can best be assessed through a SWOT analysis.

- At institute level, the ability of the institute to react adequately to important changes may be shown by the process of establishing research themes, personnel policy, subject choices, concentration of research lines, etc.
- At the level of the group or programme, for example, it may be shown by the way in which projects are professionally managed. This regards an assessment of policy decisions as well as an assessment of project management, including cost-benefit analysis.

4.4 Appendix D: Acronyms

ESA	European Space Agency
ESA (in ITC)	Department of Earth Systems Analysis
EIT	European Institute of Innovation and Technology
fte	Full-time equivalent (staff capacity)
GEO	Group on Earth Observations
ITC	Faculty of Geo-Information Science and Earth Observation, University of Twente Also: International Institute for Geo-Information Science and Earth Observation
NWO	The Netherlands Organisation for Scientific Research
ODA	List of recipient countries of Official Development Assistance (ODA) from OECD
RPF	Research Progress monitoring Form
STW	Technology Foundation STW
TGS	Twente Graduate School
TSP	Training and Supervision Plan
UT	University of Twente