

Research Programme 2009 - 2014

OTB Research Institute for Housing,
Urban and Mobility Studies



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OTB Research Institute for Housing,
Urban and Mobility Studies
Delft University of Technology
Jaffalaan 9, 2628 BX Delft, The Netherlands
Postbus 5030, 2600 GA Delft, The Netherlands
Telefoon +31 (0)15 278 30 05
Fax +31 (0)15 278 44 22
E-mail mailbox@otb.tudelft.nl
www.otb.tudelft.nl

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1 Introduction

The OTB Research Institute for Housing, Urban and Mobility Studies is an interfaculty research institute of the faculties of Architecture, Technology Policy and Management, and Civil Engineering and Geosciences. As an Interfaculty Research Institute it has an independent status within Delft University of Technology, it falls directly under the responsibility of the management board of the university (CvB) and functions as an autonomous unit within Delft University of Technology.

The three deans of the constituent faculties form the board of OTB. They advise the OTB-management and the CvB. The institute is formally unable to establish its own professorships. All the OTB chairs are in its three constituent faculties or are partly outside Delft.

Mission and Research Area

The OTB's research covers the areas of housing, urban, mobility and geo-studies. The research activities deal with the built environment, and refer to aspects of the technological sciences, the policy and management sciences, the behavioural sciences, spatial disciplines and the application of information and communications technology. This research profile is directly connected to the mission of the institute to conduct strategic research on the built environment in which both a fundamental understanding and application of results are central objectives. More specifically, research on the built environment is focused on the design and use of system innovations. The interplay between technical components and societal issues forms a key element of the research.

The main objective of OTB is to perform strategic research in the areas of housing studies, urban studies, mobility studies and geo-information studies. This type of research, which can be described as 'use inspired basic research', is positioned between fundamental and applied research, see figure 1.

Figure 1 Quadrant model of scientific research*

Research is inspired by:		Considerations of use?	
		No	Yes
Quest for fundamental understanding?	Yes	Pure basic research (Bohr)	Use-inspired basic research (Pasteur)
	No		Pure applied research (Edison)

*) Stokes, D.E. (1997), Pasteur's Quadrant. Basic Science and Technological Innovation, Washington D.C.: Brookings Institution.

It is directly related to the mission of Delft University of Technology, which is '...to contribute significantly to well-considered solutions for urgent societal problems, both nationally and internationally.' This means that the input for the research at OTB Research Institute for Housing, Urban and Mobility Studies

Delft University often comes directly from societal problems (for an elaboration see the Research Programmes in the subsequent chapters), and the application of the results is also an important objective of the research. This does not imply, of course, that researchers at OTB do not conduct fundamental and applied research. Often they are the start (fundamental orientation) or the result (applied orientation) of strategic research. So, besides a fundamental orientation aimed at understanding, design, innovation and evaluation are also part of the research activities at OTB. Since use-inspired basic research looks at both fundamental understanding as well as considerations of use, the output of use-inspired basic research is broader than in the case of pure fundamental research. Valorisation in the form of, for instance, professional publications and publications aimed at the general public forms an essential part of use-inspired basic research.

The research activities of OTB have an international as well as a national scope, are often multi-disciplinary, and involve the technical sciences, the policy and management sciences, the behavioural sciences, the spatial disciplines and the application of information and communications technology. Sustainable urban development is the focus of the institute's research portfolio, which is oriented at both scientific progress and identifying and solving future societal problems, and which consists of seven research programmes:

- I. Housing Systems, which aims at examining and explaining the manner in which housing systems can be characterized, how they change over time, and whether they are and will continue to be sustainable in terms of affordability, quality of individual units, and quality of the residential environment;
- II. Housing Quality, which focuses on the physical quality of dwellings and which studies how to improve the physical quality of houses in four research areas: technical knowledge on health and sustainability of dwellings, innovation of building and maintenance processes, management of housing providers, and policy instruments and enforcement procedures aimed at improving housing quality;
- III. Urban and Regional Development, which deals with the interrelationships between the ever growing complexity of urban systems and the extent to which the development of these systems can be influenced through policies and governance;
- IV. Neighbourhood Change and Housing, which is concerned with the ways in which residential neighbourhoods are ordered, organized and lived as everyday realities in a changing urban world;
- V. Transport Studies, that focuses on investigating the sustainability performance of particular intermodal (freight) and integrated (passenger) transport systems/networks;
- VI. Governance of Geoinformation and Land Development, which focuses on research in land law, the administrative, legal and organizational aspects of geo-information, and the institutions, such as organizations, processes, legal rules and (financial) instruments, that are (or may be) used in the spatial development of both urban and rural areas;
- VII. GIS Technology, which concentrates on developing and providing geo-information technology and knowledge for crisis management and spatial information infrastructure.

Management

The management structure of the institute in 2009 is depicted in figure 2. There has been a scientific director, Peter Boelhouwer since 1 September 2003, who formally has both managerial and scientific responsibilities for the institute. In addition, Willem Korthals Altes has been a director of the institute since 15 October 2003. Both

directors and the administrator and the head of the Department of Methodology and Informatics form the management team of the institute. This team meets every three weeks. The coordination team, which meets every three weeks, consists of the coordinators of each research section and the management team. The research sections are presented in figure 2.

The *Management style* could be characterised as informal, content-based, stimulating, quality assurance, entrepreneurial (fund raising, development of new topics). The emphasis is on ‘coaching leadership’, whereby each researcher bears a certain personal responsibility and is accountable for his or her activities and output. The management style is also result-driven. For *Motivation*, the R&O cycle plays an important role, not only as an assessment but also for the development of careers. Through a series of annual assessment interviews, certain performance targets (formulated as ‘SMART’ objectives) are agreed upon with each member of staff and form the basis for the next assessment. Other important tools are human resource management and talent scouting. The daily management is quite business orientated and differs a lot from the common management style in University groups. Everybody at OTB uses a management tool which registers all different activities using a specific code. This is not seen as an annoying procedure but as a worthwhile tool to conduct all activities efficiently and effectively.

In the *Research* process, project groups are formed on a regular basis, often between sections. Other research activities in which collaboration takes place include workshops within the institute, but also with colleagues of constituent faculties, NETHUR (Stadsdag), TRAIL (annual international conference), international research conferences, joint articles etc. OTB also takes advantage of referee comments. The scientific research of OTB is peer reviewed regularly, either in the form of a midterm review or as part of a VSNU-NWO-KNAW research assessment, which may take place in the context of a research assessment of one of the constituent faculties, TRAIL, or NETHUR.

The decision-making procedures, management style, means of motivation, communication and control and processes of improvement and innovation are sketched in more detail in the following. Figure 2 depicts the management structure of OTB.

The OTB *Board* is made up of the three deans of the constituent faculties. The board meets 4 times a year. The board advises the *directorate and the CvB* and advises on matters of strategic management. The *scientific director* has scientific and managerial responsibilities, takes decisions, usually in the form of joint decisions of the management team and/or the coordination team, which meets once every three weeks.

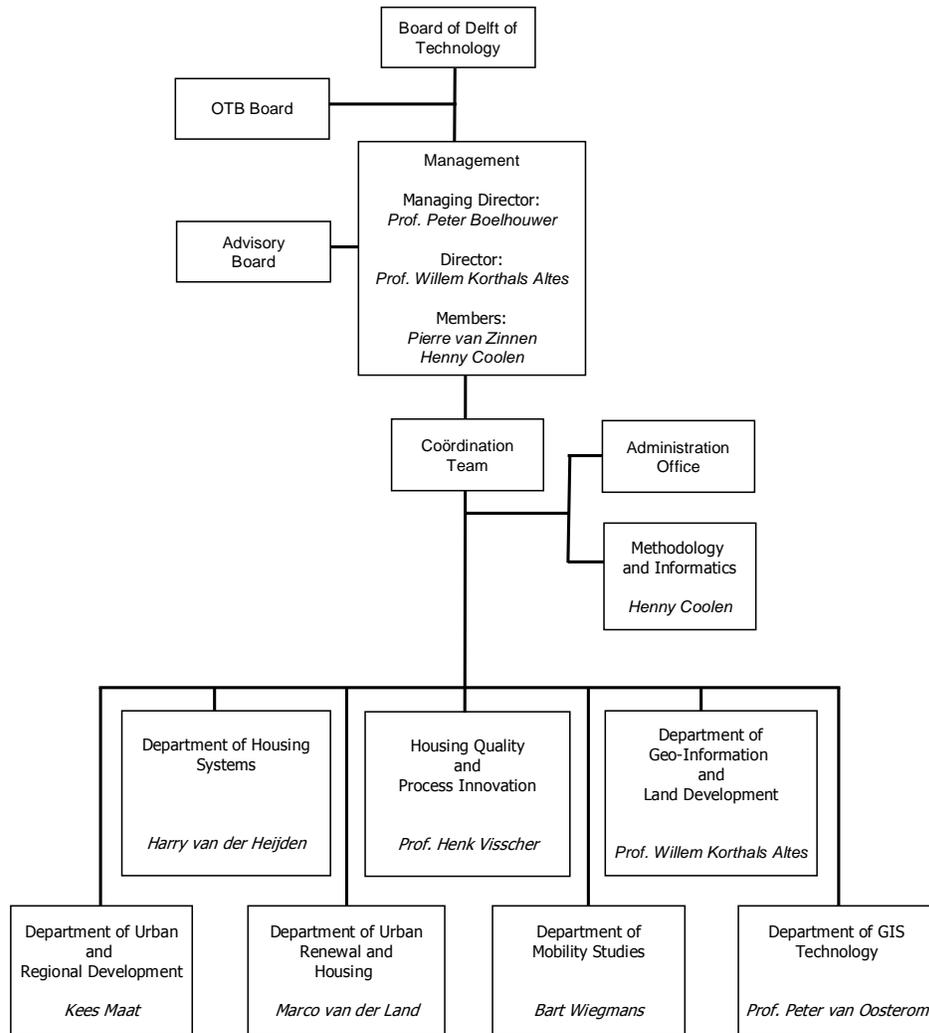
The *management team* is the policymaking heart of the institute where most of the institute’s policy is prepared and meets once every three weeks. The management team also prepares the meetings of the coordination team.

The *coordination team* is the body where de facto decisions are taken about new research initiatives, about human resource management, about finance, about collaboration, and in general, about priorities.

Each *coordinator* leads a *research section* where the day-to-day management takes place. There is budgetary independence of the sections: both internally and externally. The TUD financial allocation system has a direct financial impact on the research output. A certain competition between sections is promoted. Management information is crucial. The content of the research is the prime concern of the *theme group* headed by a *theme leader*. Research programmes are directed by a *programme leader*.

Once a year the *programme council* (Programmaraad) meets, consisting of both external researchers and practitioners, who advise the OTB directorate at programme level.

Figure 2 Management structure OTB, ultimo 2009



Research programmes, Research themes, programme and theme leaders

The research activities of the institute are organised into seven research programmes, congruent with the research sections. In some cases, the coordinator is not in charge of the research programme but acts as a manager of the research group.

In this document the following seven research programmes are presented:

- Housing Systems (programme leaders: Prof. Peter Boelhouwer and Dr Marja Elsinga).
- Housing Quality (programme leaders: Prof. Henk Visscher and Dr Vincent Gruis).
- Urban and Regional Development (programme leader Prof. Wil Zonneveld).
- Neighbourhood Change and Housing (programme leader: André Ouwehand).
- Transport Studies (programme leader: Prof. Milan Janic).

- Governance of Geoinformation and Land Development (programme leader: Prof. Willem Korthals Altes).
- GIS technology (programme leader: Prof. Peter van Oosterom).

The research is organised into a number of themes within the seven programmes. Table 1 gives a complete overview of the research groups and these theme groups. The OTB Research Institute and the Faculty of Architecture cooperate in the Housing Quality research programme.

Table 1 Research programmes, research themes and theme-leaders

Research programme	Research theme	Theme leader
Housing Systems Programme leaders: Peter Boelhouwer, Marja Elsinga	Housing Institutions and Governance	Marja Elsinga
	Housing Preferences and Choice	Harry Boumeester
	Housing Prices and Supply	Harry van der Heijden
Housing Quality Programme leaders: Henk Visscher, Vincent Gruis	Sustainable and Healthy Housing	Laure Itard, Anke van Hal
	Housing Management	Vincent Gruis, Nico Nieboer
	Policy Instruments and Enforcement Procedures	Frits Meijer, Henk Visscher
	Innovation of Building and Maintenance Processes	Ad Straub, Anke van Hal
Urban and Regional Development Programme leader: Wil Zonneveld	Spatial Development	Kees Maat
	Spatial Governance	Dominic Stead
Neighbourhood Change and Housing Programme leader: André Ouwehand	Neighbourhood Stratification	Reinout Kleinhans
	Neighbourhoods as Changing Social Sites	Marco van der Land
	Neighbourhoods as Sites of Governance	André Ouwehand
Transport Studies Programme leader: Milan Janic	Sustainability of Freight and Passenger Transport Systems	Milan Janic
Governance of Geoinformation and Land Development Programme leader: Willem Korthals Altes	Land Development	Willem Korthals Altes
	Geo-information Studies	Jaap Zevenbergen
	Land Tenure and Property Rights	Hendrik Ploeger
GIS technology Programme leader: Peter van Oosterom	Crisis management	Sisi Zlatanova
	Spatial Information Infrastructure	Peter van Oosterom

The collaboration between the different research programmes is represented in table 2, which indicates for each of the programmes in the rows with which of the other programmes, mentioned in the columns, it collaborates on a frequent basis.

Table 2 Frequent collaboration between research programmes

	Housing Systems	Housing Quality	Urban and Regional Development	Neighbourhood Change and Housing	Transport Studies	Governance of Geoinformation and Land Development	GIS Technology
Housing Systems	-	X		X		X	
Housing Quality	X	-		X		X	
Urban and Regional Development			-		X	X	X
Neighbourhood Change and Housing	X	X		-		X	X
Transport Studies			X		-		X
Governance of Geoinformation and Land Development	X	X	X	X		-	X
GIS Technology			X	X	X	X	-

Research Strategy and Policy

Since the establishment of OTB in 1985 several assessments of the institute's research by international review committees have taken place. Several of these review committees recognized that the institute considered it to be a challenge to develop a profile of fundamental research and to position its research in an advanced and international research setting, but they also noticed that this had not yet materialized. This has led the OTB to putting more effort into establishing an environment in which internationally oriented basic research can flourish.

This was recognized by the VSNU-NWO-KNAW International Evaluation Committee that evaluated the research of OTB in 2003 over the period 1997-2002. The Committee concluded that OTB had made substantial progress over the last 6 years towards reaching its goals to move from short-term contract research to internationally significant fundamental research, without losing sight of the important role that OTB has to play in public and private sector housing and built environment policy in the Netherlands. The review committee scored each of the research programmes according to the criteria of the Standard Evaluation Protocol and remarked about these scores: 'Our general view of OTB is that on the 5 point scale used in 1997 and again for this current review, the Institute scores 4 which is "...very good with some research of international standing." This was the score in 1997 and there is the obvious reaction that in terms of this scoring, OTB is no different from then. This shows that the numbers simply do not reveal the progress that has been made and must be treated as indicative only.'

In 2007 the research of OTB over the period 2003-2006 was reviewed by an international review committee as part of the assessment of Urban and Regional Research in the Netherlands (Nethur Research School). This committee recognized that the strategy of the institute had developed since the last review in 2003 partly based on the recommendations of that review committee. In the spectrum of ‘fundamental research, strategic/basic research, applied research and consultancy research’, the focus of the institute has shifted to more fundamental and more basic research, with less applied research. The review committee was of the opinion “... that OTB has achieved many of the goals it set itself since the last review. It responded positively to a majority of the recommendations.” [that the previous review committee had made]. The scores of six of the seven research programmes are depicted in table 3; the programme Geo-Information and Land Development was not reviewed by the committee, because the committee did not feel qualified to review this programme.

Table 3 VSNU-NWO-KNAW International Evaluation 2007 of the OTB research programmes 2003 – 2006

	Housing Systems	Sustainable Housing Transformations	Urban Studies	Intermodal and Urban Freight Transport	GIS technology	Urban Renewal and Housing
Quality	4.3	3.4	3.8	4.0	4.6	4.0
Quantity	3.9	3.9	4.2	4.2	3.2	3.7
Relevance	4.5	3.8	3.3	3.9	4.6	4.1
Viability	4.4	3.4	3.1	3.2	4.6	4.4
Total	17.1	14.5	14.4	15.3	17.0	16.2

The 2007 review committee also came up with several recommendations both at the level of the institute and at the level of the individual research programmes. Many of these recommendations have been taken into account during the process of developing the OTB Research Programme 2009-2014 that is presented in this document. This process started with a meeting of the programme leaders, theme leaders and the management team in the fall of 2008 in which the results of the review were discussed and evaluated, and in which each of the proposals for the new research programmes were extensively discussed. The main recommendations of the review committee concern internal and external collaboration. The committee concluded that there is only limited co-operation between the seven programmes within OTB. It recommends that the institute should aim to encourage more cross-fertilization and interconnection between the programmes. Researchers in the institute could benefit more from each others experiences and expertise. Although internal collaboration between research themes and programmes has been an ongoing concern of the institute since the previous research programme, which is acknowledged by the review committee, it nevertheless notices that OTB has still a way to go. During the discussions with the programme and theme leaders this aspect received quite some attention and they became fully aware of the importance of this point. In the description of each of the research programmes a section is dedicated to, among other things, internal collaboration and whenever possible collaboration between themes and programmes will be actively sought.

As far as external collaboration is concerned the review committee points specifically to collaboration within NETHUR of PhD students and senior researchers. Although

there will definitely be situations in which collaboration within NETHUR could be improved, it is emphasized here that NETHUR covers only part of the research domain of OTB. For instance, researchers of the Transport Studies programme already co-operate successfully in TRAIL for a long time, researchers of the Governance of Geoinformation and Land Development programme collaborate with the research school Ius Commune, researchers of the SHT-programme participate in the research school SENSE, and the GIS technology programme co-operates with the ITC in Enschede. Moreover, when the review committee acknowledges that OTB has achieved many of the goals it set itself, goals which were to a large extent focused on fundamentalisation and internationalization of the research, it should be realized that this is at least partly due to external collaboration, both nationally and internationally, in research projects and in research networks. The institute intends to continue and whenever possible intensify its, apparently successful, strategies and policies with respect to external collaboration. The current collaboration between the different programmes has been presented in table 2.

Resources and Funding

OTB is a hybrid organisation in the sense that it combines research that is directly funded with contract research. The aim of the institute is to maintain a largely balanced – 60:40/40:60 – relationship between directly funded and contract based activities.

The achievement of many of the goals that OTB had set itself for the period 2003-2008 was partly facilitated by the institute's participation in two long-term research programmes. The participation in various BSIK programmes, awarded by the Ministry of Economic Affairs, is a good example of how the institute's research was embedded in long-term objectives and strategies. Another important and significant boost to the scientific and academic status of OTB came with the founding of the Delft Centre for Sustainable Urban Areas (SUA) of Delft University of Technology. Its activities were coordinated by OTB. Six of the seven OTB research programmes were conducted within the SUA. The exception, Sustainable and Reliable Freight (& passenger) Transport Systems/Networks, falls under the TU centre for next Generation Infrastructures (NGI). The University's Executive Board made additional financial resources available to these centres for the period 2003-2009.

These long-term research programmes have now ended and have only partly been replaced by others. Combined with the financial position of Delft University of Technology, which may result in a substantial reduction of the institute's direct funding, this might imply a return to more relatively short term contracts. In order to avoid that this will lead to the drying up of the stream of PhD students, which was started with the long-term programmes in 2003, the OTB has decided to appoint every year one new PhD student to every research programme during the period 2009-2014 (and one per two years for the research programme on Transport Studies). The OTB will also try to acquire new long-term research projects such as EU-projects and NWO-projects.

2 Housing Systems

2.1 Introduction

a. Mission and research area

The objectives of the Housing Systems research programme are to examine and explain the manner in which housing systems function, thereby contributing to the development of theory, and to play an influential part in the social debate on housing.

b. Relationship with previous programme

The Housing Systems research programme studies housing systems in different countries and the way they change over time. The focus of the group is on the general shift away from government intervention toward more of a market orientation in recent decades. But recently, not least because of the credit crunch and economic recession, this government withdrawal has been debated. There is a need for a new description of the role of government in housing markets. We analyse developments in the market and also study the governance of housing and the outcomes of housing systems.

We analyse different parts of the housing system in three theme groups. The first group is Housing Institutions and Governance, which compares the role of institutions in systems from a theoretical point of view, in different countries, and analyses governance over time. The second group, Housing Preferences and Choice, studies the demand side of the market and focuses on how housing preferences can be measured and explained. The third group, Housing Prices and Supply, studies the supply side of the market and develops housing market models and monitoring systems. There used to be four groups, but for reasons of overlap with other groups and critical mass we reduced the number to three.

The programme for the period 2009-2014 builds on the previous programme for the period 2003-2008. Many projects will continue, and many contract partners will be the same, but new goals have been formulated and new partners have been approached. Consequently, the programme will continue to work toward the goals established by the previous programme while developing new goals which are in line with the recommendations of the assessment committee.

c. Scientific relevance

The programme is based on the question of how housing systems can be characterised, how they change over time, and whether they are sustainable, i.e. whether they will continue to produce the desired results (affordability, quality of individual units and quality of the residential environment) in the long term. In other words, it must address not only the needs of today, but also those of future generations. To what extent can the housing system ensure that adequate housing results are and will continue to be achieved?

Figure 1 The housing system model

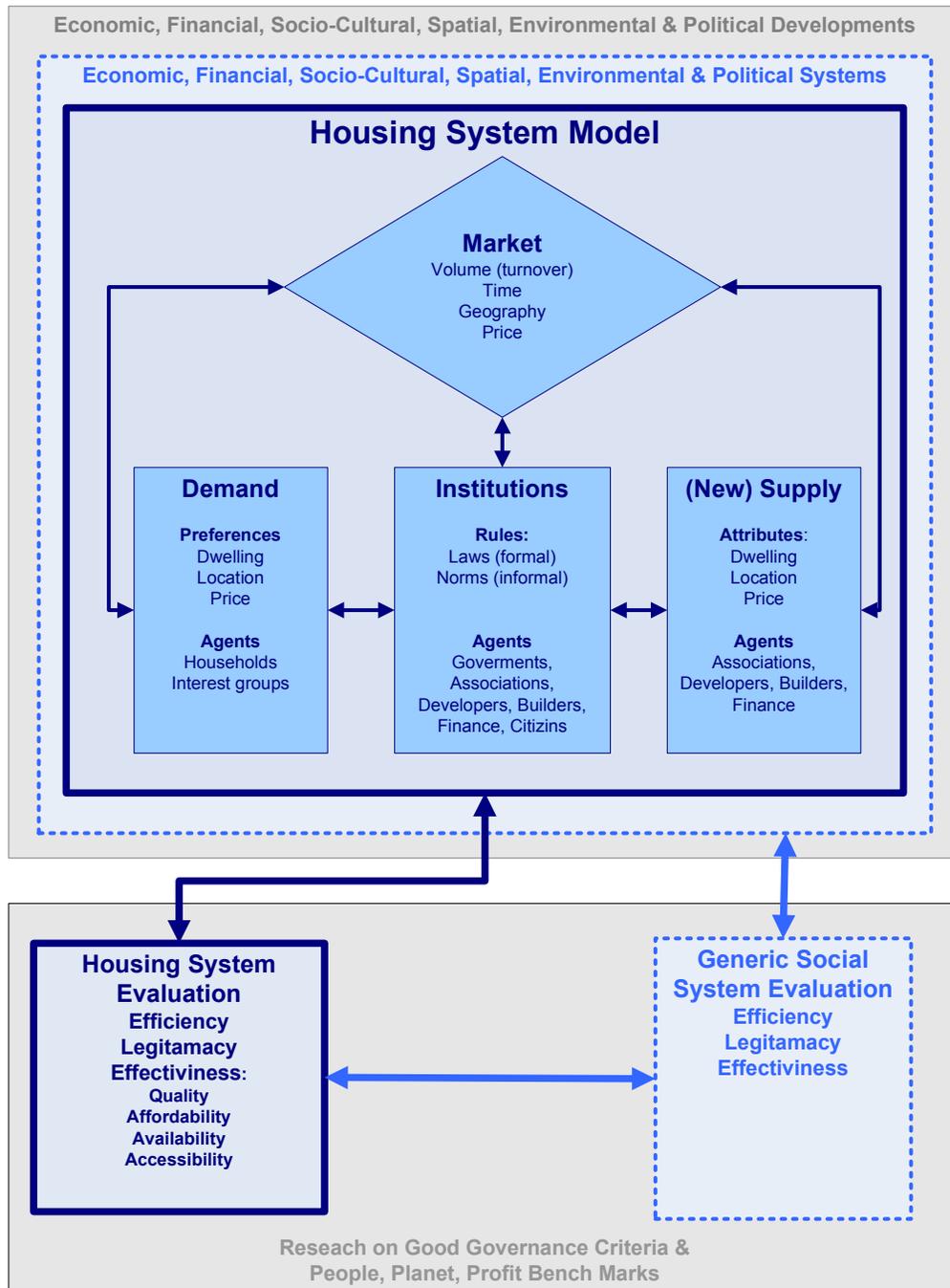


Figure 1 shows our perspective on the housing system. Our definition of systems is derived from Bekebrede and Mayer (2006). A system is composed of organised parts that interact in time and space. While the subparts of the system seem to be manageable or under control, the system as a whole may display complex behaviour. A system is more than the sum of different parts; in the case of housing systems we focus on the composition of the system and on different outcomes.

A housing system consists of different agents, which are described in Figure 1. On the demand side, households are the key agents. On the supply side, agents producing houses and housing services, such as building companies, project developers, commercial and social landlords, are the key agents. Finally, institutions such as housing

policy, forms of public-private partnerships and the values and norms of households play an important role in the housing market, where demand, supply and institutions meet, and where the outcomes of the system are the consequent result.

In our analyses and evaluations of housing systems or parts of housing systems we use the UN's ideas of good governance, which imply effectiveness and efficiency but also address issues of equity and inclusiveness. In terms of the outcomes of the housing system we focus on affordability, quality, availability and accessibility. Since the housing system is part of a broader societal system, housing outcomes have an impact on broader outcomes such as economic growth, social equity and household welfare. Housing production is an important economic factor contributing to economic growth. The extent to which housing demands are met contributes to the well-being of households. And housing regulations, such as allowances and laws, contribute to redistributing income and wealth and are therefore part of societal welfare arrangements.

Three theme groups comprise the programme, each of which focuses on certain aspects of the housing system as outlined in Figure 1.

1. Housing Institutions and Governance

This group focuses on the institutions that constitute the housing system and the governance of this system. By studying differences between countries and developments over time, insight into the working of housing systems is gained, particularly into the interplay between housing and welfare. The theoretical approach is drawn largely from welfare theories (sociology and economy) and governance theories (policy sciences).

Group members: Elsinga (theme leader), Boelhouwer, Van Bortel, Haffner, Van der Heijden, Hoekstra, Lawson, Mulder (Architecture), Lennartz, Oxley, Ronald, Tous-saint.

2. Housing Preferences and Choice

The work of this group centres on the demand for housing services and housing units and is concerned with identifying, quantifying and explaining consumer preferences and choices. Both qualitative and quantitative methods are used to determine preferences and the desire or propensity to relocate. The disciplines of psychology and geography are important to this group.

Group members: Boumeester (theme leader), Boelhouwer, Coolen, Dol, Elsinga, Goetgeluk, Hoekstra, Jansen, Mariën and Meesters.

3. Housing Prices and Supply

This theme group focuses on the functioning of the housing market and in particular on house prices and housing production. Neoclassic theory is a point of departure for the housing market models that are being developed. However, this theory is also subject to discussion since its theoretical preconditions are not always met in practice in the housing market. This group aims to unravel the functioning of the housing market by reflecting on existing models and refining the different monitoring systems that measure the functioning of the housing market in practice.

Group members: Van der Heijden (theme leader), Boelhouwer, Boumeester, Dol, Elsinga, Neuteboom, Oxley and De Vries.

d. Societal relevance

Since the 1970s, housing has undergone a process of deregulation in many western European countries. Governments chose to take a lesser role in housing, for both ideological and economic reasons. The market has had an increasing influence. In many countries, we see a shift from supply-side subsidies, intended to promote housing production and improvement, to housing allowances for the most vulnerable social groups. Government interventions addressing affordability are restricted to the most vulnerable social groups, and appear to have become an instrument of social policy. In the Netherlands in particular, the government's withdrawal has led to the social rental sector becoming fully independent, although by law it retains the social objectives of housing provision. This reshaping of social housing is not unique to the Netherlands. In many other countries serious reconsiderations of social housing are taking place.

Moreover, markets may not always produce what the government would prefer. In particular, the credit crunch and its global effects which have led to recession in many countries enforced a reconsideration of the role of the government in both financial markets and housing systems. Housing systems are strongly interconnected to financial markets and therefore housing systems have suffered from the credit crunch: housing production decreased considerably, housing preference has changed and care for the most vulnerable households in the housing market is under pressure. The question of what housing systems should look like and how housing systems can lead to desirable social outcomes is will be a pressing issue in 2009 and subsequent years.

Changes in the housing system and the new roles of government, providers and consumers in the housing market raise a number of new questions. What are current consumer preferences, how can they be measured and how flexible are they? Why does the residential construction market not produce what consumers and government would like? And how do changes affect the role of individual organisations and households? What is the role of social housing associations likely to be in the future, and to what extent is home ownership considered to be a bedrock form of pension?

The purpose of the programme is to chart the housing system, to gain a deeper understanding of that system, informed by different theoretical perspectives and methods, and to explain why there are differences between countries. The programme also seeks to explain why changes to the system itself will have consequences, both expected and unexpected, for the housing market. Various theories are tested and various methods applied. Further to the overall OTB mission, the Housing Systems group also wishes to make a tangible contribution to the resolution of social and societal debates and problems in the field of housing. It will therefore make deliberate efforts to translate the knowledge gained into usable reports and recommendations, and to identify the social issues facing the various partners.

e. Synergy between fundamental and applied research

The programme leaders ensure that contract research contributes to the research programme as a whole. This enables the group to contribute to the aims of the research programme by means of the contracts it must acquire in order to secure funding for the Institute. It acquires such contracts by presenting its research to the wider field and by demonstrating that the research group is indeed a leading repository of expertise in its specialist area. The available expertise is actively brought to the attention of potential contract research clients. Contract research requests are considered selectively, with those most appropriate to the overall research programme enjoying pref-

erential treatment. The group has substantial experience in executing contract research for different levels of government as well as for corporations and nonprofits.

f. Internal and external collaboration

There is a relationship between the Housing Institutions and Governance theme group and the research group Urban Renewal and Housing. Both groups are concerned with matters of housing governance. Moreover, they share the same theoretical approach: the governance network theory. Both theme groups will work on dissertations and theses involving desk study and field research, and on the further development of network theory. The two groups will continue to inform each other of their progress, and will attend each other's group meetings where appropriate.

There is also close cooperation between the Housing Preferences group and the group considering Social and Spatial Integration in the residential environment (part of the Urban Renewal and Housing programme). Both groups conduct research into the perceived quality of housing units and neighbourhoods, where perceptions rely heavily on underlying value systems.

Similarly, there is a relationship between the House Price and Supply group and the Geo-Information and Land Development research programme, whose relationship centres around research into the functioning of the land market. Where the Geo-Information and Land Development programme looks specifically at questions of government intervention and its consequences, the House (and House Building) market group will use the knowledge it gains to identify consequences in terms of housing production.

Moreover, the group on housing preferences cooperates with the Faculty of Technology, Policy and Management, the Faculty of Architecture and the Faculty of Industrial Design Engineering to refine the instruments used to measure consumers' preferences.

The Housing Systems group collaborates with different universities in other countries. There are official ties with the Centre for Comparative Housing Research of De Montfort University in Leicester, the Australian Housing and Urban Research Institute, the Rural Institute in Seoul, Reading University, the University of Glasgow, Uppsala University and the University of York. We also collaborate in several activities with the Centre for Urban and Regional Studies (CURS) at the University of Birmingham. We exchange knowledge, provide facilities for visiting researchers and explore possibilities for joint projects with these universities. The group participates with Belgian universities in the Flemish Knowledge Centre for Spatial Planning and Housing. This centre is led by the University of Leuven and executes scientific as well as policy-relevant research.

g. Relations with education

The research group strives to strengthen the relationship between its activities and the educational courses of the faculties of Architecture and Technology Policy and Management. The aim is to integrate the knowledge of housing systems in the relevant courses conducted by these faculties. A number of researchers are involved in, and are partly responsible for, the courses offered by the Faculty of Architecture (Boelhouwer, Coolen and Goetgeluk). In addition, Goetgeluk and Elsinga contribute to the 'Land: Use and Development' components of the relevant TPM courses.

The intention is to reinforce the relationship with the Faculty of Architecture's courses by allowing students to participate in the research group's programme. Based on its goals, the research group is formulating a number of proposals for graduation projects, to be put forward to the students of the Real Estate and Housing faculty.

The curriculum will then devote greater attention to the relevant topics. In addition the research group is planning to develop a postgraduate part-time course on Housing and Urban regeneration. We will do this in close collaboration with the English Chartered Institute of Housing (CIH), other Dutch research groups and partners in the Dutch housing sector. With this course we want to strengthen the links and create synergy between our academic research, applied contract research and education.

h. Researchers and other personnel

The research group comprises a mix of junior, experienced and senior researchers. This makes it possible to commence and complete doctoral projects while conducting other strategic and applied research. We strive towards maintaining a creative balance in our research staff in terms of expertise and seniority. We will especially focus on attracting promising junior researcher. The group covers a broad range of disciplines within the field as a whole: economics, sociology, governance and spatial disciplines.

Table 1 Staff of the research programme and research themes

	Themegroup		
	Housing In- stitutions and Govern- ance	Housing Preferences and Choice	Housing Prices and Supply
Prof. P.J. Boelhouwer	X	X	X
G. van Bortel	X		
Dr H.J.F.M. Boumeester		X*	X
Dr H.C.C.H. Coolen		X	
K. Dol	X		X
Dr M.G. Elsinga	X*	X	X
Dr R.W. Goetgeluk		X	
Dr M.E.A. Haffner	X		
H.M.H. van der Heijden	X		X*
J.S.C.M. Hoekstra	X	X	
Dr S.J.T. Jansen		X	
C. Lamain			X
Dr J. Lawson	X		
C. Lennartz	X		
G. Mariën		X	X
Dr J. Meesters		X	
A. Mulder	X		
Dr M. Oxley	X		X
Dr R. Ronald	X		
G. van Steen	X		
J. Toussaint	X		
P. de Vries			X

*) Theme leader

i. Resources, funding and facilities

Research carried out as part of the programme will have various sources of funding, including the NWO, research funds and regular primary funding flows, EU resources and, to a considerable extent, contract research income.

2.2 Ambitions for the period 2009-2014

Scientific goals

During the coming period, the group will concentrate on increasing its academic and scientific contributions. More details on these ambitions and the three theme groups within the program are described below.

1. More emphasis on strategic and fundamental research

Wherever possible, the research group will seek to appoint postgraduate researchers working on a doctoral thesis. The PhD students are professionally supported and supervised to pave the way toward achieving their doctorate. In the coming years we intend to appoint one PhD student each year.

2. Influence the international scientific debate

The research group will continue to participate in the international scientific and academic forum. It will do so by increasing the number of international publications, by increasing its representation on the editorial boards of international journals devoted to housing studies, and by improving its exposure in theoretical and methodological respect by producing books and articles on these topics.

3. International cooperation

The research group is making efforts to intensify international cooperation, by participating in different comparative projects for the European Commission. The OTB Research Institute's contribution to the Flemish Knowledge Centre for Sustainable Housing Policy is a good example of long-term bilateral cooperation. The production of articles and books in co-authorship with international researchers is another means by which this aim is currently being, and will continue to be achieved.

The group also regards its active participation in the European Network for Housing Research (ENHR) as important. Boelhouwer is chairman of the ENHR's coordination committee, while members of the research group chair several of the working groups active in the ENHR context. The goal for this period is to strengthen ties with Australia, Canada and the US.

Social and societal goals

Real-life practice constitutes an important source of inspiration for the research conducted within the Housing Systems programme. The provision of new perspectives to support social debate, the production of recommendations and the development of instruments are not only important motivators but also a source of income. Moreover, the process of translating current academic insights into practical recommendations is a challenging one, as is the desire to have a thorough knowledge of practice contribute to the development of theory. During the coming period, our ambition is to strengthen this mutual interaction.

1. Relevance of research to social discussion

The research group strives to play a part in the Dutch housing debate and, wherever possible, to introduce academic and scientific knowledge to the discussion. To do so, it conducts sound, relevant research, and ensures that the results are published in reports and professional journals.

2. Participation in the Dutch housing debate

The research group is always eager to accept invitations to make presentations, to answer questions from the professional and popular media, and to take part in various

discussion forums. Its members sit on the editorial boards of various professional journals.

2.3 Description of research programme and research themes

Housing Institutions and Governance (HIG)

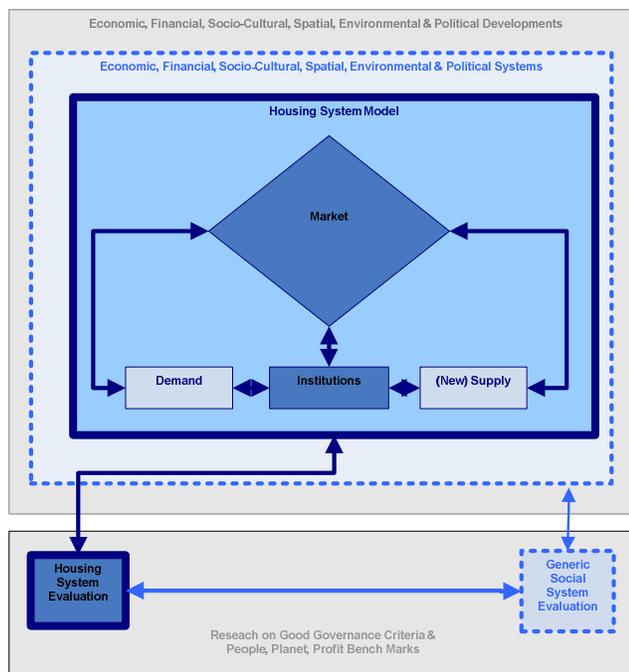
Introduction

This group centres around the institutions that constitute housing systems, the way housing systems are governed and the outcomes of housing systems. Figure 2 shows the focus of this group, on housing institutions and how housing institutions influence the market and the outcomes of the housing system. The group works closely together with the group on Housing Preferences and Housing Choice, in particular where housing tenure and housing affordability are concerned. On the issue of housing provision and housing affordability the group has joint projects with group on Housing Price and Housing Supply.

Currently housing systems are being reconsidered and debated in academia and in politics. The credit crunch and economic recession affecting many countries put pressure on the functioning of housing systems. Housing demand decreased, house prices are decreasing, housing production is dropping and there new questions in academic and social debates about the way decent housing for the most vulnerable households should be or could be organised. The Housing Institutions and Governance group wants to contribute to these debates by a thorough analysis of housing institutions and housing governance. Good knowledge of housing systems and their outcomes is crucial to understanding systems and contributing to theory but also to reconsidering and reshaping housing systems in practice.

The research projects in this group are mainly comparative. We compare housing systems or parts of housing systems between two or more countries and the way these have evolved since the early 1990's. Comparing housing systems contributes to better understanding, to theory building and to societal debate on solutions for current housing problems.

Figure 2 The focus of HIG



The research results so far are mainly derived from European countries, with many similarities observed: housing systems are confronted by the withdrawal of governments and a more competitive financial market. But many differences can also be observed: different tenure structures, differences in government involvement in housing, and differences in the interconnectedness of

the housing system with the financial system. Countries with typically higher percentages of homeowners are more dependent on financial markets and seem to be harder hit by the credit crunch. The different regulations, the different housing tenures and different ways of governing social housing create different logics for actors in the systems and lead to different outcomes. Social housing, for example, has very different meanings which need to be understood to analyze the housing system. Not understanding can lead to what Kemeny calls the 'Romeo error'. Also, home ownership has different meanings in different countries (Ruonavaara, 1993; Mandic and Clapham, 1996; Toussaint et al., 2007). These different meanings easily result in misunderstandings and misinterpretations of housing systems.

The Housing Institutions and Governance group focuses on understanding different housing institutions and how they work within the system. By 'institutions' we are guided by Keogh and D'Arcy: 'In the most general sense, institutions are the rules, norms and regulations by which a society functions. They impart certainty and stability to social interaction, but they also change and develop over time as circumstances and experience dictate. Since institutions are created by human society, they are a reflection of the power and interests within that society.' (Keogh and D'Arcy, 1999 in Oxley, 2004). We follow Williams (1998) in his classifications of three types of institutions:

- formal institutions: laws and regulations
- institutional arrangements between partners
- informal institutions: values and norms

Governance (see Figure 1) is another keyword in the name of this group. We use governance as a verb and mean the process of decision-making and implementation or non-implementation given the range of formal and informal institutions and institutional arrangements.

The issue central to this group is the role of housing and the housing system on welfare and welfare regimes. Should housing be considered to be a wobbly pillar or as a cornerstone of welfare? A wobbly pillar called social housing, that develops into a safety net for the housing market? Or a cornerstone called home ownership: housing as a way to build equity that serves as a pension and safety net—in other words, a private welfare arrangement often called asset-based welfare (Malpass, 2008; Harloe, 1995; Kemeny, 1995; Groves et al., 2007).

The group will continue to contribute to the ongoing debate on convergence and divergence of housing systems from a social scientific perspective (Donnison 1967; Donnison and Ungerson, 1982; Harloe, 1995; Kemeny, 1992, 1995; Kemeny and Lowe, 1998; Boelhouwer & Van der Heijden, 1992; Boelhouwer et al., 2000; Heijden, 2002; Hoekstra, 2003). Two PhD projects will be finished in this research period (Harry van der Heijden and Joris Hoekstra) and will contribute to this debate on housing systems.

Moreover, the group intends to contribute to societal debate on the institution's changes and their impact on housing governance and housing outcomes. We will focus on three research lines:

1. Social housing: welfare or market?
2. Home ownership and welfare strategies
3. Welfare through the housing market: instruments of affordability

The priority research lines

Social rental housing: welfare or market?

Social housing is between housing policy and welfare policy, between market and government, and is therefore the topic of theoretical and societal debate. The withdrawal of the government and the reorganisation of the welfare state impact heavily on the position and role of social housing. It is hard to capture these developments with existing theories. In his theory of the dynamics of rental systems, Kemeny (1995; 2005) uses the degree of competition between nonprofit housing and for-profit housing and comes to a distinction between (integrated) unitary and dual rental systems. In an integrated unitary rental market nonprofit rental housing can compete with for-profit rental housing effectively without the need for invasive regulation or being given either special protection or special responsibilities. In a dual rental market there is no competition between nonprofit rental housing and for-profit rental housing. We thoroughly studied Kemeny's concept of a unitary model from an economic perspective and concluded that such a model, without governmental governance, is vulnerable and it might either go bankrupt or stop delivering housing to the most vulnerable groups (Van der Heijden et al., 2008). We are, however, fascinated by three key features in theories on social housing: competition, governance and nonprofit organisations.

We have previously explored competition and social housing and developed a framework for analyzing competition and social housing (Oxley et al., 2008; Haffner et al., 2009). A PhD project will concentrate on competition between social housing and market housing in theory and in practice in England and in the Netherlands (Christian Lennartz).

The relation between housing associations and governments is changing and is a topic of debate in different countries (Boelhouwer, 2002; Scanlon & Whitehead, 2007). Due to the shift from government to market the position of social housing has changed, governance has also changed and is still changing. We intend to continue studying the relation between housing associations and government at the local level, using a network approach (Bortel & Elsinga, 2007; Haffner & Elsinga, 2008). We explored different strands in network approaches and applied the approach in practice. This resulted in new research questions, in particular, how do local networks work over time and to what extent are they influenced by the broader national housing context? This resulted in a PhD project on the functioning of local networks in urban renewal over time in England and the Netherlands (Gerard van Bortel).

Finally, the issue of nonprofits and how they can operate in between the government and the market is our research interest. In continental Europe nonprofits often have roots in the corporatist tradition and in different countries there are different arrangements with governments. These arrangements are under pressure since governments are deregulating and privatising. Who legitimises nonprofits and under which conditions are they financially viable are our key questions (Swartz et al., 2008; Elsinga et al., 2008). We will continue to study the European as well as the American literature on nonprofits, in particular the studies of the Johns Hopkins Center for Civil Society. We will explore the extent to which this literature and empirical evidence can contribute to theory and to Dutch and European practice.

Home ownership and welfare strategies

Home ownership is steadily growing in Europe: more and more people own their homes and are building equity with the house (Groves et al., 2007; Doling et al., 2006; Elsinga et al., 2007; Haffner, 2008). Kemeny (1992) distinguishes home owning and cost rental societies and Ronald (2008) further elaborates on this concept of home owning societies and more particularly on home ownership ideologies.

Housing is an important asset and for many households it is the largest investment they make in their lives. Over the past 25 years, more and more Europeans have become homeowners. They have often taken out a mortgage and while repaying they build up housing equity. The differences in numbers of mortgages taken out and borrowers' behaviour in different European countries are thoroughly described and analysed in a recently finished thesis (Neuteboom, 2008). By repaying the mortgage, households build equity; in many countries household equity grew even more as a result of rising house prices. In sum, household housing wealth has increased substantially (Horsewood & Neuteboom 2006)

At the same time, there is a tendency toward increasing income insecurity for EU citizens (O'Malley, 2004). In order to survive economically while facing globalisation and ageing populations, welfare expenditures have diminished. Generally, benefits have gone down and households cannot count on the government to the extent they once did. Instead, they must be self-reflective, make decisions about private safety net strategies and take responsibility to prevent getting into financial difficulties. It has been suggested that in this context housing equity represents a more important role in households' financial safety nets (Kemeny, 1992; Groves et al. 2007).

The group took part in a European project that studied the impact of these developments and focused on the security and insecurity of homeownership. The results show that housing equity is regarded as a nest egg and more and more households look to housing equity as a kind of additional pension. Households anticipate lower housing expenses in old age and will consider downsizing or moving to a rental dwelling to free up equity. Among many households there appears to be cautiousness and hesitancy, even disgust, at the idea of freeing equity by remortgaging (Jones et al., 2007). Nevertheless, mortgage equity withdrawal is regarded as a promising option for the future, at least by policymakers and lenders. The results of this study are part of a PhD project that explores the concept of 'housing asset based welfare' (Janneke Toussaint). Housing equity and ageing societies is the subject of a follow-up EU project titled 'Demographic Changes and Housing Wealth' (DEMHOW). Housing equity, and in particular withdrawing equity with different equity-withdrawal mortgages, can be a way to reduce the costs associated with an ageing population. The DEMHOW project describes the developments in mortgage markets and pension systems and explores their roles in financial planning by interviewing households in eight countries in different cohorts. A number of researchers from this group take an active role in this project.

In some countries, however, the home ownership rate is decreasing. It is harder for young people to become homeowners, and they do so at an older age than their parents did (Ronald & Dol, 2008). Young people have fewer opportunities to build equity, at the same time that job security as well as welfare arrangements have been reduced. A post-doc project will shed some light on generational effects and in particular on the position of would-be first-time buyers on home ownership in the UK, Japan and the Netherlands (Richard Ronald).

Welfare through the housing market: instruments of affordability

'What is affordable housing and how can it be achieved?' has been a key research question since the inception of the research group. In past years we have elaborated different definitions of affordability (Haffner & Heylen, 2008; Winters et al. 2004). Moreover we used the concept of 'user cost' to enable an adequate comparison of the costs for homeowners and tenants (Elsinga & Conijn, 2001) and reflected on the concept of tenure neutrality (Haffner, 2003). We have elaborated further on these policy basics used to achieve affordable and accessible housing by exploring welfare econom-

ics (Barr, 1998) and theories on nonprofit housing (Handy, 1997; Glaeser & Shleifer, 1998). The central question is: What exactly is the aim of policy, and what is the best way to achieve the aim? We endeavour to develop a theoretical framework to evaluate different instruments in housing policies that are intended to safeguard the affordability and accessibility of housing while also taking the risks of home ownership in particular into account.

There have been many policies to provide affordable housing. Some policies were aimed at housing for all, others were targeted at the most vulnerable households. As a result of government withdrawal in many countries there has been a push to reduce financial involvement and to target housing subsidies to those most in need. This went hand-in-hand with a shift from supply-side subsidies to housing allowances (Kemp, 2007). Moreover, these housing allowance schemes have been changing over time, trying to address the drawbacks of the systems, like the poverty trap and overconsumption (Haffner & Boelhouwer, 2006; Turner & Elsinga, 2005). Housing allowances appear to be more cost-efficient than brick and mortar subsidies but they do not encourage housing production. Different governments are concerned about the production of housing and they are particularly interested in efficient ways to produce affordable housing. There may be a return to a supply strategy as described by Lawson & Milligan (2007). Alternative strategies that combine affordability with a production incentive are being developed in different countries. We also explored the role and effect of government mortgage guarantees on the affordability and accessibility of home ownership (Elsinga et al., 2004). In the next period the group will contribute to this search for alternative affordability strategies and evaluate different alternatives.

A first alternative, already applied in different countries in different ways, is the land subsidy, of which Section 106 in Britain is a clear and elaborated example (Oxley, 2008). In other countries, such as Belgium and the Netherlands, there is interest in such strategies and an interest in research to get a clear picture of the effects of such strategies.

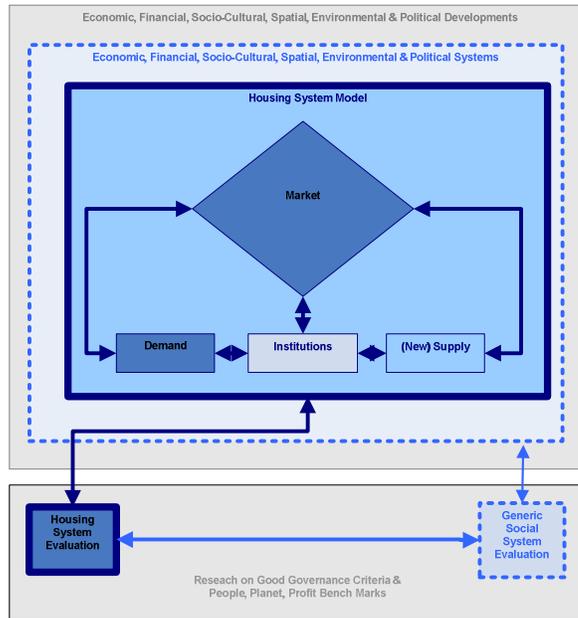
A second alternative is so-called intermediate housing tenures, which are tenures in between renting and owner occupation. There are different types of low cost and low risk home ownership. Some of these can be considered as temporarily subsidised home ownership, while others appear to involve a different tenure in the long run as well: a social home ownership sector (Yates & Whitehead, 2006; Elsinga, 2005, Gruis et al., 2005). We will further elaborate on this topic and contribute to the understanding of different types of intermediate housing and their impact.

A third strand of alternatives is private funding for social rental dwellings. Different countries have different approaches to attempts to relieve the financial burden of social housing and to attract private funding for social housing (Haffner et al., 2009). This can be enabled in different contexts, and nonprofit organisations and government guarantees can play a role here. We are exploring the developments in different countries (Lawson, 2009, Elsinga et al., 2004) and gaining insights that can be useful in the practice of changing housing systems.

Housing Preferences and Choice (HPC)

Introduction

Figure 3 The focus of HPC



The theme group Housing Preferences and Choice (hereafter referred to as HPC) concentrates on the dark and medium blue parts of the Housing Systems Conceptual Framework. HPC aims to describe, analyze, model and forecast latent and effective demand. Demand is defined by its volume, composition, value-preference structures and value-choice structure.

To restrict the domain of HPC we apply a commonly used housing model conceptualisation (Hooimeijer & Linde 1988, Goetgeluk 1997, Oskamp 1997). The conceptualisation starts with the definition of housing.

According to Hooimeijer (2007) a house is a multidimensional object. It's a care centre (safety: eating, sleeping and so on); an activity centre (expression: work, family life, friends, leisure); a geographic node in a 'care network' (neighbours, friends, family); a geographic node in an activity network (work, schools and so on) and a means of investment. A house must be an expression of value for money at a specific time and at a specific geographical location (Mulder 1993). Value for money implies that the quality of the house - expressed as people's valuation of its attributes (care centre/node, activity centre/node), which must match people's (social) value structures and activity patterns, which are related to the various careers (study, work, family, housing) at a specific time in space - must be affordable in the short and long run.

People permanently define preference structures that are related to the various stages in their lives. The number of housing choices, whether to stay or move, is limited since it involves a high level of risk and is costly (transaction costs). It is risky since the choice will have effects on the course of their lives, as path dependency studies show. Individual housing choice not only depends on housing market supply, but also affects this supply. A characteristic of the housing market is that supply is generated for the most part by people moving house. This can also be referred to as 'filtering supply'. At this point HPC meets the research work of the theme group House Prices and Housing Supply. The extent to which supply is made available and is reoccupied by various categories of households also depends on government policy, regulation and institutions, the parts of the housing system that are under study by the Housing Institutions and Governance group.

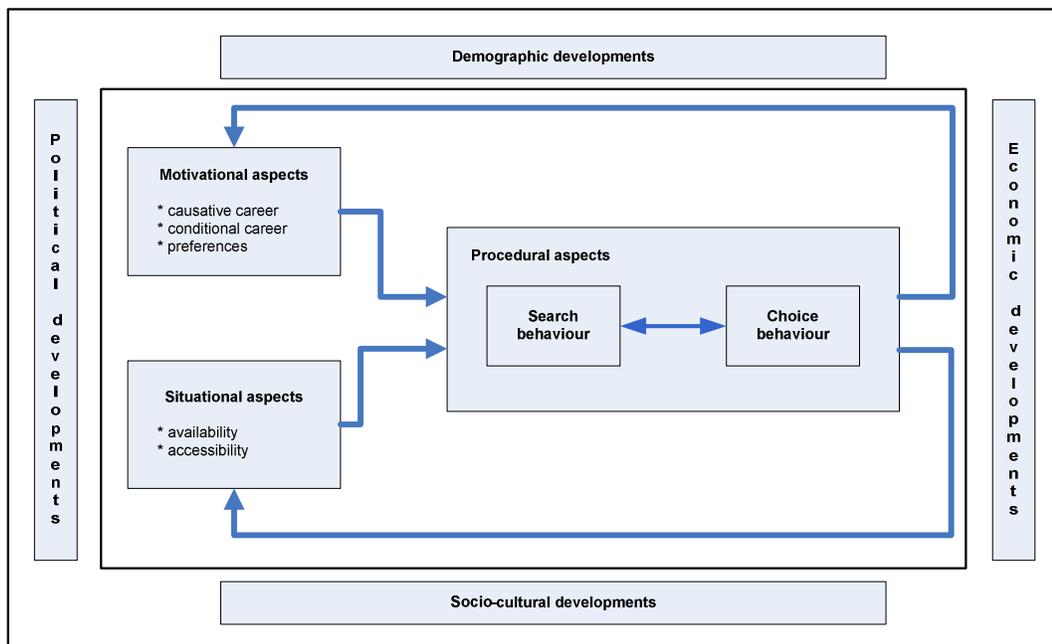
At the individual or household level, supply must be linked to the preferences of the household. The housing consumer will learn how the housing market enables or con-

strains the housing search. These opportunities and constraints can occur at both the micro and the macro level. The degree of the constraint depends on the urgency of the move. It is safe to say that after a period of search, people will often exhibit actual behaviour (revealed preferences) that differs from their original plans (stated preferences).

Theoretical framework

As Priemus stated in 1969: 'Dwelling can be considered to be a continuous attempt to match the actual housing situation with the aspiration image – which is determined by the comparison of present practical possibilities – and the continuous attempt to harmonise the aspirational image with the subjective ideal image, which is the result of the consideration of the present theoretical possibilities' (Priemus 1969, p 14). This definition implies that housing behaviour 1) develops through certain processes (e.g. housing preferences develop throughout people's lives), 2) is goal-oriented (people anticipate changing circumstances) and 3) can be regarded as situational (e.g. dwellings need to be available and accessible at a certain time and location). These three aspects of consumer behaviour in the housing market are represented in Figure 4 (Goetgeluk, 1997).

Figure 4 Motivational, procedural and situational aspects of consumers' behavior on the housing market

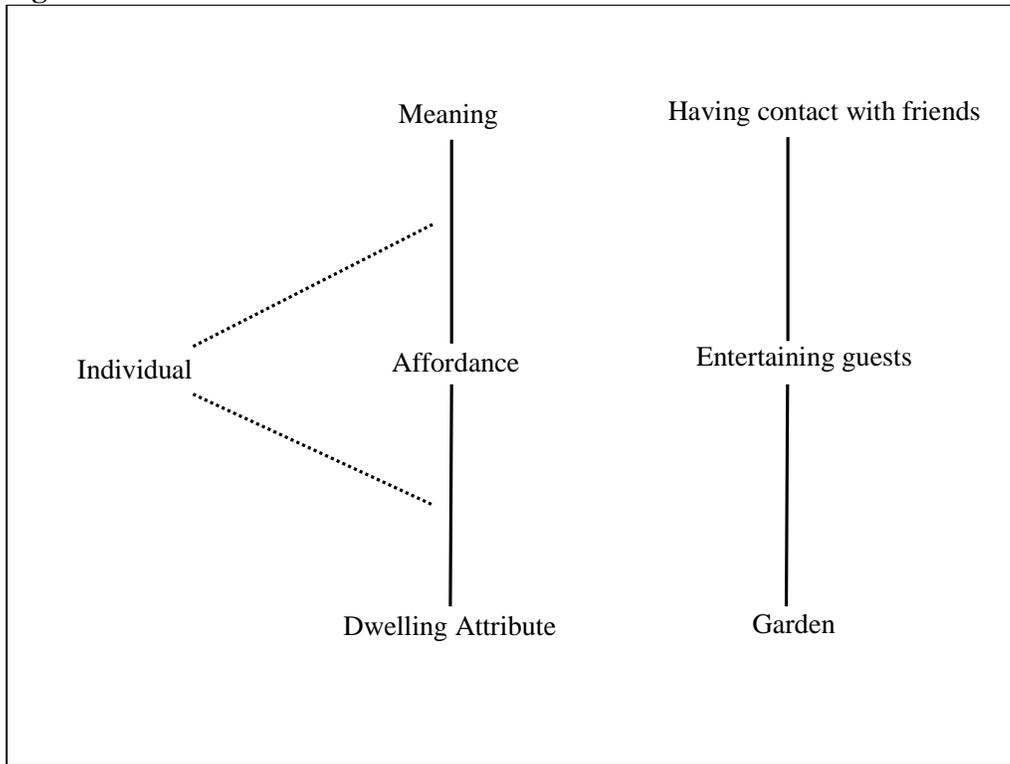


Source: Goetgeluk, 1997 (adapted)

Initially the motivational aspects of housing behaviour were based on the career/life cycle theory as previously used in a Dutch context (Priemus, 1984; Hooimeijer & Linde, 1988; Mulder, 1993; Clark et al., 1994; Goetgeluk, 1997 and Boumeester, 2004). Demographic changes (household composition, age) or changes in labour market position (other job, income change) can lead to adaptation of the aspiration image and consequently lead to moving. The consumer needs to gear the different careers (housing, study, work and life cycle) to one another by defining the requirements of the dwelling and the residential environments (Baanders, 1995). Nevertheless, households seeking housing with identical motives and the same indi-

vidual resources can have different housing preferences. This is why, in the previous period, the group focused its activities to a large extent on broadening the conceptualisation of motivational aspects. Since objectives and values play an important part in people's behaviour and preferences (Rokeach, 1973; Bettman, 1979) a conceptual and methodological framework has been developed that relates these objectives and values to housing preferences (Coolen, 2006; 2008). This conceptual framework rests on three pillars: means-end theory (Gutman, 1982; Reynolds and Gutman, 1988), the conceptualisation of the meaning of the built environment as developed by Rapoport (1988; 1990), and on the theory of affordances (Gibson, 1986). The framework is presented in Figure 5, and it shows the interrelations between the individual, affordances, meanings, and dwelling features.

Figure 5 Individual motivational framework



Dwelling features have many and diverse potential functions. These functions may be activities, but can also be psychosocial functions and values. Whenever a function is assigned to a feature a relationship arises between the feature and the function, which is called an affordance (c.f. Chemero, 2003). This relationship originates from the individual assigning the function, and it is relative to the individual in the sense that the relationship between a function and a feature may be possible for some individuals but not for others. The lower dotted line in Figure 5 indicates this relativity of the individual-environment relationship. So the term affordance is reserved here for the direct relation between a feature and a function that is assigned to it by an individual, whatever the nature of that function may be. In this sense, affordances may be considered to be basic meanings (cf. Chemero, 2003).

Given an affordance, the function, which is one of the relata in the affordance relation, may have meaning for the individual. This may be the case for activities, but other functions may also have meaning for the individuals who assign the functions. For instance, the activity of entertaining family and friends, afforded by the garden,

may have such meanings as being together with the family or having contact with friends (see Figure 5). These meanings, which are represented in Figure 5 by the link between affordance and meaning, are also relative to the individual. The chain 'dwelling feature – affordance – meaning' is called a meaning structure.

The relativity of the individual-environment relationship, which has so far been illustrated in terms of abilities or attitudes, is also relevant in another sense, in terms of socio-demographic variables: income, age and household composition, for instance. These variables condition individual-environment relations in the sense that they determine to a certain extent whether potential affordances may become actual affordances. For instance, a certain dwelling may potentially afford all the affordances one is looking for, but these affordances may not materialise because one cannot afford the dwelling financially. Or, a certain dwelling might afford a separate room for every family member for some families but not to others, due to the size of the household.

The individual motivational framework in Figure 5 has been applied to dwelling features in several studies by Coolen (2008) and to the affordance category of daily activities in the dwelling and residential environment by Meesters (2009).

Priority research lines

Since the individual motivational framework has only been partly integrated in career/life cycle theory one of the challenges for the coming years is a further integration of both approaches. The group continues to use this motivational framework and wants to relate it more systematically to career/life cycle variables to see the ways in which these variables affect meaning structures. Our aim is to obtain more insight into the complex relation between meaning and actual or intended behaviour with regard to housing. Following this line of reasoning, another of the group's goals is to broaden the motivational framework by trying to relate it to actual or intended behaviour. The most widely used theory of behaviour is the Theory of Planned Behavior (Ajzen, 1991). According to this theory, behaviour is guided by three types of considerations. The first type, attitude, concerns beliefs about the perceived consequences of the intended behaviour (behavioural beliefs). The perceived likelihood of the positive and negative consequences of the behaviour are combined with the evaluation of these consequences to form the attitude. The second consideration, subjective norm, is based on normative beliefs that reflect a person's perception of what referent individuals or groups think that he or she should do, combined with the person's motivation to comply with these referents. The third consideration, the perceived behavioural control, reflects the person's perceived ease or difficulty of performing the behaviour considering the potential barriers and opportunities. It entails beliefs about the presence of factors that may facilitate or impede the behaviour, combined with the perceived possibilities of having control over these factors (control beliefs). According to the Theory of Planned Behavior, attitude, subjective norm and perceived behavioural control work together to form the behavioural intention to perform the specific action. The intention may result in actually performing the behaviour but this is dependent upon actual behavioural control. The person must have a sufficient degree of actual control over the behaviour in order to be able to act.

One of the group's special interests is meanings. Variables such as meanings, preferences, values, personality traits, demographic variables and so on are considered to be 'background factors' in the Theory of Planned Behavior (<http://people.umass.edu/aizen/faq.html>). They are assumed to influence intentions and behaviour indirectly by affecting behavioural, normative, and/or control beliefs. That is, the components of the Theory of Planned Behavior are assumed to mediate the effects of background factors on intentions and actions.

However, research has shown that not all background factors act entirely through these components and that some may have a direct effect on intention and behaviour. The theory acknowledges this and indicates that it is possible to examine the way in which a given background factor influences behaviour by tracing its effects via the more proximal antecedents of the behaviour (that is, attitude, subjective norm and perceived behavioural control). There is no objection to including additional predictors for intention and behaviour as long as they are relevant, behaviour-specific and can act as a causal factor. It would be interesting for the group to combine meanings with the other components of the Theory of Planned Behavior in order to explore their direct and indirect impact on (intended) behaviour.

Although the individual has been the point of departure for investigating the meaning of housing preference and choice, another of the group's interests concerns the impact of socio-cultural developments on housing preferences, intentions and behaviour. Aspects of these socio-cultural developments are also known as lifestyle variables.

In recent years, the development and use of lifestyle typologies in housing research has grown tremendously. However, lifestyle is a complicated construct with many problems attached to it. For example, there is no consensus in the research field about what is meant by lifestyle, nor about the factors through which lifestyle is expressed and through which it can be measured (e.g., in activities or in values). Despite these problems, however, lifestyle typologies receive widespread attention in the domain of housing. Therefore, it is important that the group devote some of its time to exploring this research field. Specifically, it is important to determine which types of lifestyle typologies are applied in practice and to determine their methodological properties (reliability, validity, and so on) as well as their usefulness for developing new dwellings, restructuring existing ones or allocating dwellings. In cases when existing lifestyle typologies do not fully comply to scientific demands, this research could even result in a proposal to revise an existing lifestyle typology or to develop a completely new one on the basis of thorough scientific research.

The overall objective of the research of the HPC group is to arrive at more reliable, more valid measurements of housing preferences and their relationship to actual housing market behaviour. Especially in this period in which attention to a more quantitative housing demand is undergoing a significant shift toward attention to a more qualitative housing demand, valid measurement instruments are necessary. At the same time, knowledge of the mutual exchangeability of preferred features of the dwelling and the environment is of growing interest. In the coming years we will elaborate further on well-tested and well-known approaches and on new approaches to measuring housing preferences, by using traditional surveys, Decision Plan Nets, a Means-End approach, the Multi-Attribute Utility Theory and the Conjoint Measurement Technique.

Housing preference can be defined as the operational goal of an intended move. At the beginning of the search process, housing preference is often not properly linked to a household's actual prospects on the housing market. However, the discrepancy between preference and reality diminishes during the search. Processing the collected information can lead to a continuing search for a dwelling, the cancellation of the intended move, or to the acceptance of a new dwelling. In the last case, substitution can occur (Goetgeluk, 1997; Oskamp, 1997). Until now, little attention in the housing literature has been paid to the search process used by consumers looking for housing. To improve our understanding of the relation between preference and behaviour,

more insight into the search process is needed. The search process can be split up into search behaviour and choice behaviour (Bettman, 1979).

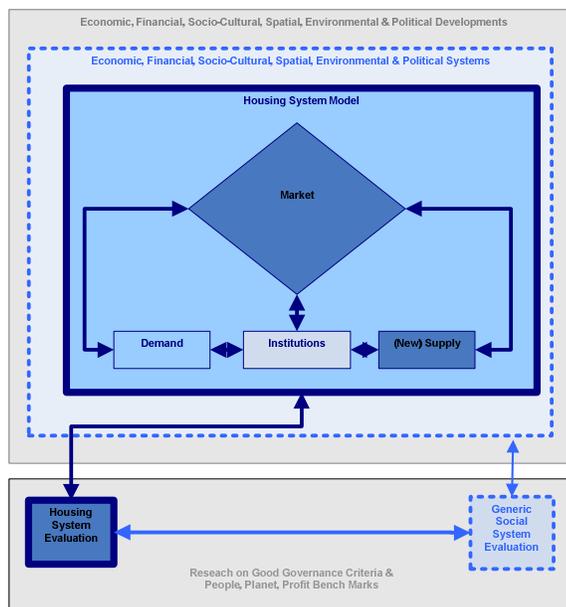
During the past ten years, technological advances have made the housing market more transparent. Information about available housing, newly built houses, housing finance and housing allocation, for example, has increased enormously both in volume and quality. As a result, the search and choice behaviour of housing consumers has become increasingly complex. In the coming years we shall try to answer the question of whether increased information sources have also enlarged the search area of people looking for a new dwelling.

HPC closely relates its research to the international literature and uses various theoretical approaches. The empirical foundation is based mostly on national research data. However, the behaviour, and possibly also the preferences, of housing consumers is also determined by situational aspects and by the demographical, economic, socio-cultural and political context in which people live (see also Figure 4). That is why HPC will strive to place its research findings in a comparative international context. Furthermore, situational aspects can also differ strongly among regions within the Netherlands (Goetgeluk, 1997; Boumeester, 2004). Consequently, HPC will also test and compare consumer behaviour among various national regions.

House Prices and housing Supply (HPS)

Introduction

Figure 6 The Focus of HPS



Understanding how the housing and the house-building markets function and what factors influence house prices and housing production is central to the work of the House Prices and Housing Supply Theme Group. The main focus of the theme group is house prices, housing supply and the relation between the two. General economic, financial, spatial and political factors play an important role here, but there is also a clear relationship with the specific institutional and policy framework on which the supply and price of housing is based. Changes in housing preferences are also studied,

primarily by examining the choices that households make within the housing market and the consequences of these choices on the balance between supply and demand.

In recent years the research group has developed several models that explain the price and production of housing, mainly in the Dutch context. From a theoretical point of view, neo-classical economic theory has provided an important frame of reference for the work of the group. This theory assumes the operation of an efficient market that

brings together the balance of housing supply and demand with changes in house prices and production. Much of the model-based research into the changes in prices in the housing market is based on this theory (Chen, 1998; Weston, 2002; de Vries en Boelhouwer, 2005).

According to neo-classical economic theory, economic efficiency can only be achieved if a number of standard conditions are met (Barr, 1998; Boelhouwer, 2003). However, the housing market in many countries does not fulfil these standard conditions in a number of ways. Some of these discrepancies are inherent to the housing market (immovability of properties, inelasticity in supply), while others are linked to government actions (Priemus, 1978; Boelhouwer, 2003). The consequences of these discrepancies are that neither the housing market nor the house-building market behave as expected from neo-classical economic theory. For example, an increase in the price of existing properties on the market either has no effect on, or leads to a very slight increase in, the production of houses for sale (Boelhouwer, 2003; Koning et al, 2006; Vermeulen and Rouwendal, 2007). Examination of the predictions and conclusions of neo-classical economy and challenging these predictions and conclusions is part of the work of the research group. It is therefore important to examine both the changes in how the housing and house-building markets function and the role played by the different actors.

Since the end of the 1980s supply subsidies have been phased out, leading to a decrease in the government's ability to influence the housing market. This has also led to changes in the market. The government can still exert indirect influences on the housing and house-building markets, through spatial planning and building regulations for example. It is, however, mostly local authorities and the private sector who are jointly responsible for housing production. Furthermore, the goals of the local authorities can, to a greater or lesser extent, differ from those of the private sector. In order to be able to analyse the way in which this playing field affects housing production we have chosen to use a network approach (De Bruijn & Ten Heuvelhof, 1999; Klijn 1996; Koppenjan & Klijn, 2004). Networks arise when the different parties involved are dependent on each other in order for development to take place. The parties that make up a network can differ greatly in terms of their goals and organisation. Particular regulations exist within a network and the decision-making process can also be influenced by the regulations of other networks at other levels. Both the regulations and the other features of a network are also susceptible to change. The network approach enables the features of networks to be examined and the decision-making process to be analysed (Haffner et al, 2008). Utilising the knowledge gained from the network approach in the decision-making process involved in housing production at a local level enables the regulations employed by the different parties involved in the process to be identified.

Priority research lines

Understanding changes in house prices and housing production

Economically oriented research has focused mostly on accounting for changes in house prices. Boelhouwer and De Vries developed a price model in the second half of the 1990s that has been applied in many situations (Boelhouwer and de Vries, 2000; Boelhouwer et al, 2004; de Vries and Boelhouwer, 2004, 2009). The price model was used to gain insight into the effect of changes in the current fiscal approach to house-ownership (de Vries and Boelhouwer, 2007a). Studies have also appeared where relationships have been made between the quality of a property, the economic climate and the price of a property (de Vries and Boelhouwer, 2007b), income and the price of a

property (de Vries and Boelhouwer, 2004, 2009) and housing production and house prices at a low geographic level (de Vries and Boelhouwer, 2005). In the near future an international comparative study on England and the Netherlands will be completed looking at the effect on prices of the quantity of houses currently on the market as well as the effect of new supply. The hypothesis is that there is a positive relation between changes in house prices and the total number of transactions.

Mass valuation of housing has also been an important research topic of the theme group in recent years (Jansen et al., 2008; Kauko, 2008; de Vries et al., 2008). This research will be continued in cooperation with Kadaster Netherlands and the Dutch Statistical Office. These research projects form the basis of Paul de Vries' doctorate.

Research examining housing production is less developed (DiPasquale, 1999; Weston, 2002; Vermeulen and Rouwendal, 2007) and mostly focuses on the American market. De Vries and Boelhouwer have however modelled the production of houses for sale in the Netherlands. In this model the production of private housing is a function of household income, the mortgage interest rate and the rental price. The accuracy of this model has diminished greatly since the middle of the 1990s (Vries, P. de & Louw, E., 2003; van der Heijden et al., 2004). This indicates that changes occurred in the factors that influence the housing production process during the 1990s. Identifying and modelling these factors is the challenge for the theme group in the future. A start has already been made with the project 'The economic climate and the housing and house-building markets' (Neuteboom and van der Heijden, 2005). The goal of this project was to analyse the historical developments in the housing and house-building markets in terms of both changes in supply and demand in the short and long term. In the long term there is evidence of an increasing demand for quality, whereas in the short term on the demand side affordability plays an important role. The model was inspired by DiPasquale and Wheaton's (1994) model, a dynamic balance model in which the dynamics of the housing market are central. The model describes the process of trying to achieve balance, even though the balance is continually shifting due to changes in the exogenous variables. To improve and maintain the applicability of the model it is important to be able to apply the changes in the specific circumstances within which the Dutch housing and house-building markets operate to the choices that the actors in the housing market make. This is discussed further in the next research theme.

How the housing market and the house-building market operate

As stated above, the housing and house-building markets do not meet all the conditions of an economically efficient market. In order to understand the actual workings of the housing market it is important to look in detail at how the housing and house-building markets operate. What is the exact influence that economic and demographic changes have on the balance between supply and demand and the resulting price changes in the housing market, and how does the house-building market react? How is the housing market and housing production affected by changes in the policy framework within which they operate? And how do the different authorities, private sector actors and housing consumers react to changes in the housing market?

The foundations for future work have been laid in an initial analysis of how the housing and house-building markets operate (van der Heijden et al., 2004), which focuses on changes in government policy, the relation between the economic climate, house prices and housing production, the relation between the market for existing and new private housing and the changes in supply and demand in the housing market. A comparative study has also been carried out, focusing on the operation of the house-building market and the office-building market (de Vries and Louw, 2007). The in-

crease in prices and changes in the price/quality of new houses to rent and to sell has also been examined (Van de Heijden et al., 2005).

These studies demonstrated that the relationship between changes in supply and demand in the Dutch housing market and housing production is not straightforward. This is true as much for the housing market, where the balance between supply and demand can be seen in the changes in house prices, as for the rental market, where 'waiting time' works as a proxy for the balance of supply and demand. In terms of the housing market, it appears that consumers experience the price/quality balance of new properties in relation to those of existing properties as playing an important role in the sale of new properties.

In the future, we want to understand more about what brings about the price/quality relation for new properties as well as monitoring changes in the price and price/quality relation of existing and new properties. Because spatial policy, land policy and land prices are important factors with respect to housing production will cooperate with the Geo-Information and Land Development research programme.

Three research themes will have a central place in the work of the theme group in the coming years. The first theme concerns the relation between building for consumers already on the housing ladder and the long-standing shortage of housing in the Netherlands. Housing production for those moving up the housing ladder implies providing homes for households already in the housing market. In this case, the production of housing (and tackling housing shortages) is dependent on the economic climate and the extent to which the new properties meet the needs and preferences of these households. The availability of properties for first-time buyers and households with a low income is therefore dependent on the extent to which households already on the ladder are prepared to move to better and more expensive properties. This theme, which encompasses the availability and affordability of properties, will be explored together with the Housing Institutions and Governance theme group.

An associated second theme concerns Dutch urban policy and the consequences that it has on house building. In recent years the emphasis has been on building houses within the urban environment, which has led to an increase in the proportion of apartments built. However, diverse market information systems have shown that selling the relatively large number of new apartments coming onto the market has been difficult. The question then is how urban development can be combined with the building of properties that meet the consumers' preferences. This theme will be investigated together with the Housing Preferences and Choice theme group.

Finally, we will focus on the strategic decisions that underlie the behaviour of the actors involved in the house-building market, based on what is known about the institutional framework of the house-building market and the roles of the actors involved. This relates to the work of Healey (1991,1992) and Healey and Barrett (1990), who focused on developing a "descriptive institutional model of the development process which takes account of the complexity of the events and agencies involved in the process and the diversity of forms the process may take" (Healey, 1991). In developing the Dutch model, the output of the house-building market is considered to be the result of the interaction between the institutional framework of the house-building market, the strategic decisions of the actors involved in the house-building market and the supply and demand relations in the housing market as a consequence of economic and demographic developments. In developing the model, case studies and interviews will provide information concerning the considerations and decisions confronting actors (local authorities, project developers, building companies and housing corporations) within the prevailing institutional framework. This approach will also involve economic and demographic indicators and output details of the housing and house-

building market. The network approach will be used to analyse the decision-making process for housing production at the local level. The results of these analyses will be used to determine the general regulations that apply to the various parties involved in house building. A dissertation will be written on this subject. The results of this project may lead to an improvement of the accuracy of the existing models used to explain the price and production of housing.

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3 Housing Quality

3.1 Introduction

a. Mission

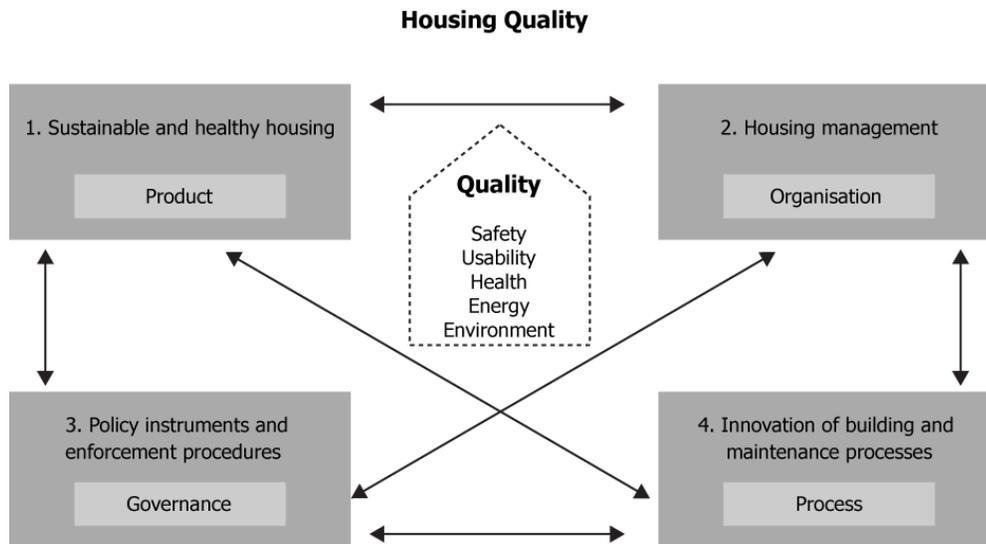
The mission of the new Housing Quality (HQ) research programme is to study how to improve the physical quality of houses from four perspectives: technical knowledge on the health and sustainability of dwellings; innovation of building and maintenance processes; management of housing providers; and policy instruments and enforcement procedures aimed at improving housing quality.

The programme is a joint endeavour of the OTB Research Institute and the Faculty of Architecture and is led by Professor H.J. Visscher and Associate Professor V.H. Gruis.

b. Relationship to the previous programme

The study of Housing as an academic discipline has a 30-year tradition within the Faculty of Architecture and over 20 years within the OTB Research Institute for Housing, Urban and Mobility Studies. The HQ programme is the successor to the Sustainable Housing Transformation (SHT) programme, which ran from 1999 to 2008. The SHT programme was also a joint endeavour of the OTB Research Institute (in the Department of Sustainable Housing Quality) and the Faculty of Architecture (as a sub-programme of the Housing research programme). The SHT programme consisted of three theme groups: Sustainable and Healthy Housing; Housing Portfolio Policy and Technical Management; and Building Regulations and Quality Assurance. During the period 2003-2008 the SHT programme leaders were Dr Henk Visscher and Prof. André Thomsen (Faculty of Architecture), at the time there was no chair within the OTB Research Institute to lead the programme. In 2007, a new chair structure was established at the Faculty of Architecture. Since then, four new Housing chairs have been established. The research area encompassed by the previous SHT programme is now covered by three of these chairs: Housing Quality and Process Innovation, Sustainable Housing Transformation and Housing Management. In 2009, the current HQ programme was defined, covering roughly the same areas of research as the SHT programme, but explicitly highlighting the research objectives of the participating chairs. The new HQ programme consists of four research themes (see Figure 1), providing a better structure for and division of the academic disciplines and the corresponding projects across the themes.

Figure 1 Four dimensions of housing quality



c. Scientific relevance

The academic discipline of Housing is described as the study of the way in which society meets the accommodation needs of households. The mission of the academic discipline of Housing within the wider field of architecture is to contribute to the realisation of a sustainable housing stock by the development and dissemination of knowledge in this field. Various questions have been posed in connection with the task of improving housing quality. Firstly, in relation to the product, what constitutes sustainable housing stock and how can the sustainability of the existing housing stock be improved? Secondly, in relation to the process, how can the actors involved in the housing market contribute to the realisation of sustainable housing, and how can the process of transformation of the existing housing stock be improved, for example, by adequate organisation, cooperation and policy instruments?

The central focus of the Housing Quality programme is the physical quality¹ of dwellings and the processes that can increase the quality of housing in terms of safety, comfort, health, energy saving, environmental and socioeconomic sustainability. This covers the whole range of physical-quality dimensions that are considered to be essential in order to meet individual and public demand. In most countries, these subjects are also covered by public building regulations for newly built dwellings. The programme also covers the quality demands of the occupants, owners and developers of dwellings. The development phase of new dwellings, and the use, maintenance and refurbishment phases of existing dwellings, all fall within the scope of the HQ programme. The societal need for reductions in energy use and CO₂ emissions have increased enormously in recent years. Consequently, the need for reductions of CO₂

¹ The term 'quality' in the research programme is to be interpreted as 'measurable performance'. We use the international standard ISO 8402 which defines quality as 'the set of characteristics of an entity that give that entity the ability to satisfy expressed and implicit needs'. This relates to definitions from quality assurance literature such as 'Fitness for use' (Juran and Gryna, 1988) and 'Conformance to requirements' (Crosby, 1979). We also study how people use their houses and related technical equipment and services so we are able to improve the design and basic quality specifications, but we do not study housing preferences as defined in the framework of housing systems as the mapping out of the motives, goals and values that underlie households' residential environment preferences.

emissions caused by the residential sector has become a dominant factor in the definition of housing quality.

The programme consists of four research themes all of which have their own perspectives. Each theme is based in one major academic discipline with which it approaches the field of Housing Quality (see Figure 1).

1. Sustainable and Healthy Housing (Product) – Theme leaders, Dr L. Itard (OTB) and Professor J.D.M. van Hal (Architecture)
2. Housing Management (Organisation) – Theme leaders, Associate Professor V. Gruis (Architecture) and N.E.T. Nieboer (OTB)
3. Policy Instruments and Enforcement Procedures (Governance) – Theme leaders, Dr F.M. Meijer (OTB) and Professor H.J. Visscher (OTB and Architecture)
4. Innovation of Building and Maintenance Processes (Process) – Theme leaders, Dr A. Straub (OTB) and Professor J.D.M. van Hal (Architecture)

1. Sustainable and Healthy Housing

Energy savings in the built environment have a high priority on political and scientific agendas. Cost savings, security of supply and the reduction of CO₂ emissions are the main reasons for saving energy. Energy can be saved by reducing operational energy use in heating, cooling and electrical appliances by different means. While, energy use in itself is not an environmental problem, it can contribute to a number of environmental problems, such as global warming, smog, toxicity or depletion of resources. Previous research has shown that:

- Energy use is not linearly related to environmental impacts (Kohler & Lützkendorf, 2002; Klunder & Van Nunen, 2003; Itard & Klunder, 2007). Switching from gas to electricity supply for example, can cause strong increases in the environmental burden (Itard, 2007).
- In conventional dwellings the energy embodied in materials and construction is equivalent to 10-15 years of operational energy (Tucker & Treloar, 1994; Peuportier, 2001). In low-energy houses, such as passive houses, it may amount to more than 50 years of operational energy (Itard, 2009). Finding ways to analyse and reduce the energy embodied in construction and renovation, materials and processes, as well as the related environmental effects will therefore be important in the future.
- Health and human toxicity are now widely recognised as environmental effects (Hofstetter, 1998; Muller-Wenk, 2004; Meijer et al., 2005a & 2005b), but there is still little known about the relationship between building materials, occupancy, indoor air quality and health. Because people spend on average 90 percent of their lives indoors, it is an urgent priority to develop a better scientific understanding of these relationships and to develop methods to better include health in environmental impact assessment.
- Household characteristics and occupant behaviour are widely admitted by experts to greatly influence final energy use (by a factor of 2 to 6) and also the quality of indoor air. Until now there have been only limited attempts to quantify and understand these influences (Lutzenhizer, 1993; Jeeninga, 2001; Bourgeois et al., 2005), but there is an urgent need to develop knowledge and methods in this field.

Research in the theme of Sustainable and Healthy Housing is directly related to international developments in the fields of environmental and health assessment. It focuses on developing or improving methods from these disciplines for the use in specific and complex cases of buildings and their occupants. Obtaining data and develop-

ping a framework that allows an understanding and quantification of these influences is a major scientific challenge in our group. The framework is based on the methodology of Life Cycle Assessment (LCA) in combination with the fate-exposure-effect-damage model used in environmental and health sciences. The central question of the Sustainable and Healthy Housing theme group is: *Which methods can be used and developed to determine the environmental and health impact of dwellings and how can this impact be reduced to an acceptable level?*

2. *Housing Management*

Due to deregulation and privatisation policies within the housing sector, the possibility of stimulating quality and sustainability in the housing stock through government regulation is limited. As a result of these policies, non-profit and commercial housing organisations have become much more independent and are now major actors in determining and organising strategies to achieve the adequate management and transformation of the housing stock and related services. These organisations are now looking for ways to reshape themselves into social entrepreneurs to cope with their new role, positioned between State, market and society. As key actors in improving the socioeconomic and environmental performance of housing, the housing providers must adapt their approach to the organisation and management of their housing portfolios. The Housing Quality research programme aims to develop theories and empirical knowledge of innovative approaches by employing, testing and adapting general theories from policy, management and organisational studies within the specific area of sustainable housing transformation and management. The development of these theories will not only contribute to the scientific development of the discipline of housing, but will also be used to test and develop the underlying theories. The focus of this theme group is on the management strategies of professional housing organisations. The main question for the Housing Management theme group is: *How do or can housing organisations adapt themselves and their portfolios to the changes in demand for housing and related services?*

3. *Policy Instruments and Enforcement Procedures*

The governance dimension of housing quality is the point of departure for this theme group. The aim of Policy Instruments and Enforcement Procedures is to study building regulations and enforcement procedures that define and guarantee a minimum level of quality for residential buildings. With this theme, specific attention is paid to the definitions, procedures, tasks and responsibilities of public and private parties that guarantee good quality. It addresses public as well as private quality policy instruments, standards and certification schemes. The central question for this theme group is: *How do we define and ensure a minimum quality for dwellings?*

National building regulatory systems are increasingly becoming the centre of attention in policy evaluation as well as in academic research. In almost every EU country, building regulations and their enforcement are being discussed in and outside parliament. Two examples are: in England a discussion about the ‘The Future of Building Control’ is presently underway, while in the Netherlands a special parliamentary commission has recently published, at the request of the minister responsible, a report about fundamental changes in the building regulatory system. The questions raised and the answers sought are fundamental and match the main research questions of the theme group. This growing attention is also reflected within the academic community.

4. Innovation of building and maintenance processes

The fourth theme focuses on innovation in building and maintenance processes. Many studies show that traditional building and maintenance processes do not always meet contemporary needs with respect to quality and that they entail high failure and transaction costs (Ang et al., 2004; arTB, 2002; Egan, 1998; Hughes et al., 2006; USP Marketing Consultancy, 2007). Although much has been achieved, further innovation within building and maintenance processes and related forms of cooperation are necessary. The need for higher energy performance and the integration of sustainability in an overall quality approach demands process innovations. Furthermore, the diffusion of these innovations, which contribute to the sustainable quality of the housing stock, should be stimulated. The central question of this theme group is: *What process innovations are needed and can be developed to stimulate integrated, up-to-date and high-quality housing?*

The theme group consists of three sub-themes, addressing the following questions:

- How can building and maintenance processes be improved through cooperation in the building and maintenance chain?
- How can the diffusion of process innovations be improved?
- How can the technical management processes of housing associations contribute to housing quality?

Connection between the theme groups

There are strong links between these four dimensions. Most of the research projects are multidisciplinary in nature. All of the projects have a strong technological basis and combine this with other areas of academic research, such as business, management, policy and other social sciences. Many projects are related to more than one of the four dimensions.

The research programme is strongly multidisciplinary. An optimal use of technical solutions that support occupants' needs and at the same time cause minimal burden to the environment requires research which combines technical and social sciences. Our research, as part of the Delft University of Technology, supports the University's mission to create solutions to societal problems. Therefore most of the projects have a fundamental as well as an applied character, a combination we call strategic research. Each of the four theme groups in the HQ programme has its own domain in terms of the research topics, relevant frameworks and international platforms (see details in Section 3). All four theme groups concentrate on academic fields that are being rapidly developed internationally. This can be seen by the number of new academic journals and the increase in the impact of these journals in these academic fields. In addition, national and European budgets for scientific research are paying much attention to the development of fundamental knowledge about energy and the environment, as well as the processes and policies required for the implementation of new approaches in society.

d. Societal relevance

Within the broad spectrum of technical, organisational, governance and process issues related to the physical quality of housing, we needed to choose subjects which provided a focus for our long-term research projects. These choices were based on a combination of scientific questions derived from previous projects or that emerged from international debates, and questions that arise from societal problems. There are a series of societal issues that have an impact on our research domain.

Energy, climate change and environmental issues

Climate change is one of the major global challenges of our time. It has, and in the coming decades will continue to have, a dramatic impact on how we think about the physical quality of housing in all its dimensions: technique, management, governance and processes. More than ever, it has recently become clear that the need for a dramatic reduction of CO₂ emissions will have a major impact on the direction taken with respect to newly built houses as well as existing housing stock.

Several reviews conclude that the risks and costs of ‘doing nothing’ are so high, at both the national and international levels, that this cannot be regarded as a serious option. Action is necessary in the short term in order to avert potentially serious consequences in the longer term. The recent report of the UN Intergovernmental Panel on Climate Change (IPCC) underscores the need for urgent action, and emphasises that an effective response to climate change is technically and financially feasible. Over 190 countries – such as the US and Japan, but also including developing countries such as China, India and Brazil – ratified the UNFCCC (United Nations Framework Convention on Climate Change, Rio de Janeiro, 1992). This convention is one of the driving forces behind national climate policies. The main objective of the convention is to stabilise atmospheric concentrations of greenhouse gases at a level where the climate system no longer suffers from any dangerous interference due to human activities. According to article 2 of the Convention, this level must be attained rapidly enough to allow ecosystems to adapt in a natural way, food production to continue unharmed and economies to develop in a sustainable manner. The Kyoto Protocol (1997) represented an important first step in combating climate change. The Kyoto Protocol stipulates that between 2008 and 2012 the most developed countries must reduce emissions of greenhouse gases such as CO₂ by an average of more than 5 percent compared to 1990 levels. Ideas of sustainable construction and living have been further reinforced by Al Gore’s *An Inconvenient Truth* and books such as *Cradle to Cradle* and *Natural Capitalism*, which have provided visions that have influenced global and regional thinking. As a result, local and national authorities are increasingly putting environmental issues high on their agendas. More regional authorities are showing very high levels of ambition with respect to ecological and climate protection. Municipalities, housing associations, architects, technical consultants and universities all over the world are searching for new concepts to decrease the environmental burden of construction activities, using such methods as design for reconfiguration, design for disassembly and IFD.

Europe

The building stock in the European Union accounts for about 40 percent of total EU energy consumption (EC, 2003). In recent years, this energy consumption, both in relative as well as absolute numbers, has increased dramatically due to the growing numbers of households and consequently the increased need for power for appliances, room heating and hot tap water. Energy saving in the built environment has been rated so highly by the European Union that it has opted for a communal approach. In 2000, the European Committee adopted an action plan in line with this to improve energy efficiency, stating that the use of energy in the Union should be reduced by one percent annually until 2010. This was the precursor to the slogan ‘20% in 2020’.

Ambitions of the Dutch Government

Energy saving and the use of sustainable energy have extremely high priority in the Netherlands. This is not only due to concerns about climate change but also due to the increasing financial cost of fossil fuel resources, such that in the future, especially for low-income earners, the cost of energy will almost certainly become a disproportionate element of living expenses. In the domain of CO₂ reduction, which is closely connected with the use of fossil fuel resources, the government has set very ambitious targets, with CO₂ emission required to be reduced by 30 percent of the current rate by 2020. Assuming that the use of energy will increase by 20 percent during this period, with no intervention this would mean that in twelve years time we must rely on only roughly half the fossil fuel resources used at present. For a large part the building sector will have to fulfil the assignment to create greater efficiency, because other sectors, such as agriculture and industry, have taken comparatively larger steps in the past, and it is not likely that transportation can be drastically reformed in the short term. Because of the growing differences between the energy use of new buildings and existing buildings it is obvious that the focus will be on existing buildings.

Problems in the building industry

The cost of failures in the Dutch building industry amounts to more than 10 percent of turnover (USP Marketing Consultancy, 2007). Total investment costs (including maintenance) in homes were 46 billion Euros in 2007, which means annual wastage of 4.6 billion Euros in this part of the building industry. The Vereniging Eigen Huis, a consumer organisation for homeowners, carries out final inspections on many new homes, and in 2005 reported that construction companies were gradually improving their standards. The average number of defects in more than 1,400 homes examined at new build housing areas was 17.5 per home. However, some homes had as many as 71 defects. In recent years there have been many problems with construction safety. In many cases, the faults are not due to a lack of technical knowledge but to carelessness in the building process. There are also many problems with aspects of building physics, as revealed in a study of 78 housing projects by the VROM Inspectorate (Kuindersma et al., 2007). The researchers observed acute health risks, reduced living comfort and, above all, poor energy performance. New homes must comply with the EPC (Energy Performance Coefficient), an important policy instrument for achieving CO₂ reduction targets. The study showed that 25 percent of the EPC calculations associated with building permits were incorrect. The performance of new homes built was also studied, and found to be unsatisfactory in 47 percent of homes. In order to comply with EPC regulations, a system whereby heat is recovered from the ventilation system (balanced ventilation) is often installed. In the past few years, this system has been installed in approximately 400,000 homes. Problems with the system in the Vathorst area of Amersfoort have featured regularly in the news (Duijm et al., 2007). An analysis of the problems has shown that they are not necessarily due to the ventilation system itself, but that poor-quality management throughout the construction chain can lead to an accumulation of faults.

The need for higher performance with respect to energy and other quality issues in dwellings, in combination with all the evidence of the poor performance of the building industry, demand innovations across all aspects of housing quality, as addressed in the HQ programme.

Developments within housing organisations

Social housing across Europe has been subject to several political, economic, cultural and demographic developments. In the past decades, housing policies in many Euro-

pean countries, as part of wider neoliberal policies, have been characterised by a shift away from government control towards a reinforcement of market principles (e.g. Boelhouwer, 1997, 1999; Priemus et al., 1999; Priemus and Dieleman, 2002). For many social housing providers, these developments have meant greater freedom and responsibility in undertaking social activities at the local level, but also the challenge of achieving their social objectives with fewer public resources (e.g. Gruis and Nieboer, 2004). Furthermore, one response to these neoliberal policies has been an increased emphasis on local democratisation and public accountability within the provision of social housing services (e.g. Mullins, 2006). The provision of social housing services is also influenced by internal market regulations and policies at the EU level (e.g. Priemus et al., 1993; Chapman and Murie, 1996; Doling, 2006). This is most evident in the procurement standards for contracting public housing developments; however, EU market regulations could also have an impact on national housing policies and the structure of social housing provision (e.g. Gruis and Priemus, 2008). In addition to developments in housing policy, a number of cultural and societal changes are likely to have an impact on the evolution of social housing providers. The contextual developments have had several effects on the organisational strategies of social housing providers. Considered as more or less general trends, we recognise an increasing application of business principles to social housing management, as well as a broadening of the services provided by social housing organisations. The implementation of business principles has taken place in two different forms, which can but do not necessarily have to coincide. One form is the increasing application of business-like approaches to promote efficiency and upward accountability, that is, performance management. Within this approach, business principles are implemented to manage operations without actually changing the traditional social and other objectives of the organisation (e.g. Clapham & Satsangi, 1992; Kemp, 1995; Symon & Walker, 1995; Walker, 1994, 2000; Gruis et al., 2004; Koopman et al., 2008). Another application of business principles within social-housing management is an increased market orientation within the business strategy itself. Business principles are thereby introduced into the way social-housing providers approach the market, leading to a much more active attitude towards the market and profit-making opportunities. This may result in social housing providers taking on a much broader view of the housing market, including entering the more commercial (higher rent and owner occupied) segments of the housing market (e.g. Gruis and Nieboer, 2004, 2007; Walker, 2000; Brandsen et al., 2006). Thus, the changing role of housing providers coincides with new organisational strategies and approaches to improving housing quality, as addressed in the Housing Quality programme.

e. Synergy between fundamental and applied research

As mentioned above, the field of research in HQ is strongly determined by societal problems. Most of the fundamental research projects also aim to generate knowledge that can be utilised in the practice of building and managing dwellings. In this way, the synergy between fundamental and applied research can often be observed within projects, but there are also more fundamental research projects that will contribute to daily practice only in the long run (e.g. PhDs). Within the projects that lie much closer to daily practice, we explore, test or experiment with newly derived insights developed from fundamental research. The combination and synergy between these two types of research is also reinforced by the sources of funding. The need for funding (see also subsection 1.i. below) from governmental bodies, market parties and, if available, subsidy schemes, and the strong partnership with many parties in the field has led to initiatives to formulate new research programmes based on a combination

of fundamental and applied research. These are the Housing Quality 2020 and the MOVE programmes.

Housing Quality 2020

In the Housing Quality 2020: Knowledge development for the energy transition of the housing stock (HQ 2020) programme, we combine a series of ten PhD projects which have been recently commenced, or are planned to commence shortly, with questions derived from the recent policy agendas of the Dutch government, housing associations and other societal and professional organisations. In addition to the long-term academic projects, the programme will also contain a series of practice-oriented, more short-term projects. We took this proposal to the stakeholders to explore possibilities for co-funding and the development of specific projects that address the questions and knowledge requirement of these parties (see also 1.f). We also explored subsidy opportunities that might be available from Delft University of Technology (Delft Research Initiatives for the Environment and Energy), from new governmental subsidy programmes or EU projects. The aim of HQ 2020 is to develop practical knowledge underpinned by fundamental research. It is designed facilitate the large-scale upgrading of the energy performance of the housing stock. An improvement in integral environmental performance, a healthy indoor climate and good levels of living comfort are essential preconditions. Innovations in policy, management and government procedure, as well as the roles of housing organisations and other stakeholders are required for this transition.

MOVE

During the 1990s, Dutch housing associations underwent a transformation from task-oriented, government-driven organisations to independent, market-oriented organisations with public objectives. The term ‘social entrepreneurship’ was introduced to identify the way in which housing associations should operate in their new role, positioned between State, market and society. Because the transformation of housing associations into independent organisations has taken place fairly recently (particularly in comparison to their long tradition as semi-governmental organisations), they are still looking for ways to reshape themselves into social entrepreneurs. The MOVE programme (*Maatschappelijk Ondernemerschap en Voorraadbeleid van woningcorporaties*) has been established to fund scientific research into the development of social entrepreneurship in housing management and to facilitate the transfer of knowledge between science and housing associations through the organisation of master classes for participating housing associations.

f. Internal and external collaboration

The chairs in Housing at the Delft University of Technology

The HQ programme combines the research of three chairs in the Housing research programme, which is based in the Faculty of Architecture. These chairs are in Housing Quality and Process Innovation, Chair: Prof. Henk Visscher, which is a full-time chair within OTB, research also being entirely carried out within OTB; Sustainable Housing Transformation, Chair: Prof. Anke van Hal, which is a part-time chair in the Faculty of Architecture; and Housing Management, Chair: Associate Prof. Vincent Gruis. The latter two chairs operate mainly within the Faculty of Architecture but are also involved in the supervision of PhD and other forms of research carried out at OTB.

There are close links to other Housing chair groups and their research programmes within OTB and the Faculty of Architecture. These are Housing Systems, Chair:

Prof. Peter Boelhouwer, a chair shared between OTB and the Faculty of Architecture, with its research programme being carried out within OTB; and the Urban Renewal chair, created in 2009 for the Neighbourhood Change and Housing research programme. Furthermore there are incidental cooperative projects with other OTB groups such as GIST.

Other relationships within Delft University of Technology

In addition to being part of the Housing research programme, the HQ programme has close links with other chairs within the Faculty of Architecture. There are strong collaborations with Climate Design in the Department of Building Technology. Projects are also conducted in cooperation with the Faculty's Real Estate, Design and Construction Management programme (Prof. Hans de Jonge, Prof. Hans Wamelink and Prof. Friso de Zeeuw). Furthermore, Henk Visscher and Frits Meijer cooperate on projects with Prof. Monika Chao and Fred Hobma from the chair group in Building Law within the Faculty. Several projects are conducted in cooperation with chairs outside the Faculty of Architecture: the Faculty of Industrial Design (Prof. Han Brezet), the Faculty of Technology, Policy and Management (Dr E. van Bueren), the Nyenrode Business University Center for Sustainability (Sustainable Building & Development) and the University of Wageningen (Prof. Louise Vet). Furthermore, we have established some cooperative activities with the Construction Processes research group from the Faculty of Civil Engineering and Technical Geosciences (TU Delft), chaired by Prof. Hennes de Ridder and we also have a relationship with the Safety Policies group, chaired by Prof. Ben Ale of the Faculty of Technology, Policy and Management (TU Delft).

Dutch institutions

The Sustainable and Healthy Housing theme group has close ties with the Department of Materials Science at Eindhoven University. In addition, Professor Nico Hendriks (Eindhoven) is active as the co-supervisor of the dissertation by Inge Blom, and an academic publication has been written in collaboration with the University of Wageningen (Urban Environment Group). There is also an ongoing research project together with the Radboud University of Nijmegen on high-efficiency photovoltaic cells. The group is also active in a Dutch initiative concerning the coordination of LCA software in the Netherlands, together with IVAM (affiliated to the University of Amsterdam). Apart from these projects, we also work with numerous other organisations, usually in connection with applied research. For example, we collaborate with ECN (Energy Centrum Nederland) and TNO (The Netherlands Organisation for Applied Scientific Research) in the project Building Future. Other organisations and companies include the Ministry of VROM, the SBR, SenterNovem, the Institute for Construction Law, the Aedes Federation of Housing Associations, Woonbond, SKW Certification, SVn, NEN, SEV, Cartesius, PeGo, Meer met Minder, as well as consultancy firms and contractors. Some of the academic staff within the programme are affiliated with the Netherlands Graduate School for Housing and Urban Research (Nethur). Recently we have also become affiliated with the Research School for Socioeconomic and Natural Sciences of the Environment (SENSE).

International organisations

Important international platforms relevant to the HQ programme include the International Council for Building Research Studies and Documentation (CIB) and the European Network of Housing Research (ENHR). Almost all of our researchers are members of one or more working groups within these organisations, and regularly take part in international conferences or working-group activities.

Sustainable and Healthy Housing

Members of the theme group are involved in several international networks. Arjen Meijer is actively involved in SETAC (The Society of Environmental Toxicology and Chemistry) in the Indoor Exposure Models working group within the UNEP/SETAC Life Cycle Initiative programme. Laure Itard is involved in IBPSA-NVL, the Dutch/Flemish section of the International Building Performance Simulation association and is a member of ASHREA. Laure Itard and Inge Blom are members of the CIB working group, W115 Construction Materials Stewardship.

Housing Management

At the annual conference of the European Network for Housing Research (ENHR), Vincent Gruis and Nico Nieboer coordinate the ENHR working group, Housing Regeneration and Maintenance and also organise workshops on housing management policy. Furthermore, there is close cooperation with CECODHAS (the European lobby organisation for social housing providers), the University of Birmingham (Prof. David Mullins) and the University of Calgary (Prof. Sasha Tsenkova).

Policy Instruments and Enforcement Procedures

Henk Visscher and Frits Meijer are members of the CIB working group, W113 Law and Dispute Resolution. They are also members of the ENHR working group, Legal Aspects of Housing. These affiliations have led to close contacts with various international parties and have given rise to two internationally oriented books. In our international comparative research, we are able to call upon a network of contact persons. Of particular importance is the Consortium of European Building Control. Contact has also been established with the Queensland University of Technology in Australia.

Innovation of Building and Maintenance Processes

Ad Straub is a scientific member of the CIB working group, W070 Facilities Management and Maintenance. Straub also participates in the CIB working group, W092 Procurement Systems, and the ENHR working group, Housing Regeneration and Maintenance. Prof. Anke van Hal cooperates with a number of universities including Chalmers University in Sweden (Prof. Michael Eden), Waseda University Tokyo and Roma III.

g. Relationship with teaching

In addition to members of the chair groups, Sustainable Housing Transformation and Housing Management, the Department of Sustainable Housing Quality at OTB has a long tradition in teaching activities within the Faculty of Architecture, through contributions to educational tasks in Real Estate and Housing. Ad Straub and Evert Hasselaar are regular contributors to the MSc programme in RE&H. Henk Visscher is coordinator of a third-year Bachelor's module in the SIRO domain of the Faculty of Technology, Policy and Management (TPM). Laure Itard, Evert Hasselaar, Ad Straub and Henk Visscher teach the courses in this programme. Henk Visscher lectures in Building Law in the Department of Building Technology's Master's programme. Laure Itard has worked on the development of a new Minor in Sustainable and Healthy Indoor Environment proposed as a cooperation between the Department of Building Technology in the Faculty of Architecture and the Faculty of Mechanical Engineering. Laure Itard also coordinates two Master's courses, the Sustainable Built Environment in the Faculty of Technology, Policy and Management and Indoor

Climate Fundamentals in the Faculty of Mechanical Engineering. Evert Hasselaar coordinates the Urban Restructuring Master's course in the Faculty of Technology, Policy and Management. Henk Heeger and Ad Straub regularly organise courses for professionals on housing portfolio management and technical management. Furthermore, we often organise national conferences for combined audiences of academics and professionals.

h. Researchers and other personnel

As of January 2009 the group consists of 30 people, of which one-third is senior tenured staff and the remainder PhDs and postdoctoral guests. It is our policy to finish two or three PhD dissertations per year, and to start two or three new PhD projects. See Table 1.

i. Resources, funding and facilities

The availability of funding for pure fundamental research (from the University) is uncertain and will probably be limited to some 30-40 percent of the total budget required for human resources. It is our policy to obtain another 30 percent from subsidies and the final 30-40 percent from the Dutch market. Sources for subsidies may be: funding for scientific research (NWO, STW), funding from Dutch government departments involved in major societal and policy issues (such as climate change) and EU programmes.

Table 1 Staff of the research programme and research themes

	Institution		Theme group			
	OTB Research Institute	Faculty of Architecture	Sustainable and Healthy Housing	Housing Management	Policies, Regulations and Enforcement	Innovation of Building and Maintenance Processes
K.P.M. Aalbers		X				X
M.M.F. Ammerlaan	X		X			
M. Bedir	X		X			
I.S. Blom	X		X			
Dr J. Costa Branco Pedro	X				X	
D.K. Czischke		X		X		
S.S. van Dam		X	X			
R. Dankert	X			X		
M.P. Femenias		X				X
C.L. van der Flier		X				X
Dr V.H. Gruis		X		X*		
O. Guerra Santin	X		X		X	
Dr E. ter Haar		X				X
Prof. J.D.M. van Hal		X	X*			X*
Dr E. Hasselaar	X		X			X
Dr H.P. Heeger	X			X		
M.M.A.E. Heemskerk		X		X		
M.J. Koopman	X			X		
R.J. Kroese	X					X
R.S. van der Kuij		X		X		
Dr L.C.M. Itard	X		X*			
Dr A. Meijer	X		X			
Dr F.M. Meijer	X				X*	
E. Mlecnik	X		X			X
A. Mulder		X		X		
L.C. Murphy	X				X	
N.E.T. Nieboer	X			X*		
Dr C.J. van Oel		X	X			
A.J. van Overmeeren		X		X		
F. Riccardo		X				X
F.C. Sanders		X				X
C.A.M. Snepvangers	X		X			
Dr A. Straub	X			X		X*
M. Tambach	X				X	
Prof. A.F. Thomsen	X					X
Prof. H.J. Visscher	X				X*	
S. Zijlstra		X		X		
Total	21	16	12	12	6	13

*) Theme leader

3.2 Ambitions for 2009-2014

In recent years, the programme has made significant progress in shifting its research activities and output from applied to strategic research. For the coming period, the objective will be to increase the focus on strategic research, although we will continue to attach great importance to the societal relevance of our research questions. This strategy will be followed mostly in the context of research projects which are partly financed by societal stakeholders. In addition, we will attempt to extend our international network and initiate or participate in international research projects relevant to our themes. Most projects will take the form of doctoral research, resulting in dissertations and international academic publications. Our senior researchers aim to publish at least once a year in a recognised academic journal. Our applied research activities will be selected on the basis of their potential contribution to our scientific mission and will therefore focus on the evaluation of innovative practices.

In the period 2009-2014 we intend to achieve:

- approximately twelve completed doctoral dissertations
- increased production and quality of articles in internationally refereed journals
- editorship and guest editorship of special issues of international journals
- a more active and leading role in international platforms such as the working groups of the Council for Research and Innovation in Building and Construction (CIB) and the European Network of Housing Research (EHNR)

3.3 Description of research programme and research themes

Sustainable and Healthy Housing

Theme leaders: Dr L. Itard and Prof. J.D.M. van Hal

Introduction

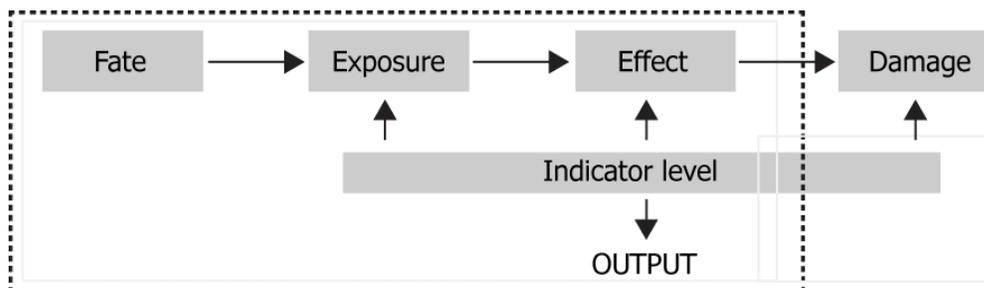
In the previous period, the Sustainable and Healthy Housing theme group moved from a combination of various technical and policy-oriented research towards research focusing entirely on the health-related and environmental quality of dwellings. A choice was made to focus research activities more on technical aspects, which was of great importance for the integration of the group into Delft University of Technology. Special efforts were put into the integration of basic and applied research and into the development of more basic research. Attention was devoted to the multidisciplinary character of the research and new projects were defined in order to strengthen these aspects while avoiding the dangers of fragmentation which were identified in the former period. A first step was to recognise that environmental assessment and health assessment share the same scientific frameworks and methods and that basic and applied research in these fields is urgently needed. New projects were started as a result of participation in the BSIK subsidy programme and housing association interest in financing research through Corpoevenista. The size of the theme group may grow considerably in the present period. From 2006 to 2008 much effort was put into the development of a clear focus and framework for our research.

The central research question of the Sustainable and Healthy Housing group is: *Which methods can be used and developed to determine the environmental and health impacts of dwellings and how can this impact be reduced to an acceptable level?*

Scientific framework

The research field of Sustainable and Healthy Housing is multidisciplinary in nature and entails the use of frameworks from the environmental sciences, health sciences and behavioural sciences in relation to building construction and building services engineering sciences. Our scientific framework is based on the approach used in environmental and health impact assessment (Hofstetter, 1998; Muller-Wenk, 2004; Meijer et al., 2005a & 2005b), that is, impact-pathway analysis, from fate to exposure, effect and damage (Figure 2). Fate defines the characteristics of a source of pollutant (e.g. dimension, behaviour). Exposure describes the extent to which human beings, animals, plants and ecosystems in general are exposed to this source. The exposure to the source causes health or environmental effects (e.g. respiratory problems, cancer, acidification or global warming), and finally, these effects may cause damage to humans, animals, plants and ecosystems (e.g. illness, death). Indicators of environmental or health burdens may be found at the level of exposure, effect or damage. Specific research about the relationship between effect and damage is not carried out in our group because it is a specialist domain in environmental or health science.

Figure 2 Environmental and health impact assessment



The research domains of the group fall within the dotted line

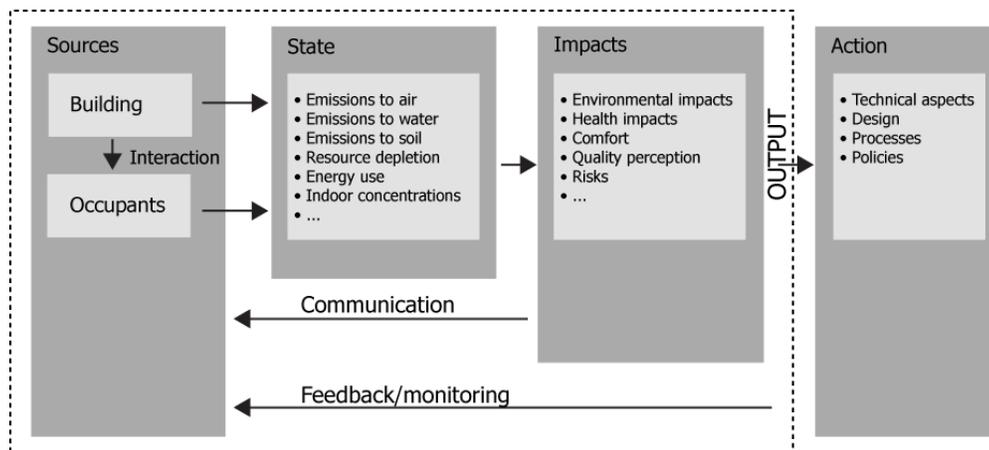
The same kinds of pressure-state-response models are also used in policy analysis. We apply this assessment scheme to building and housing-related issues (see Figure 3). In the physical system, boundaries are defined by the building and its occupants. Although the sources of environmental or health burden determining fate and exposure may not be related to the building and its occupants, we study the resulting fate in these buildings. For example, outdoor pollution arising from traffic has its source outside the building but affects the occupants inside and, as such, is studied. By using existing or developing new fate-exposure-effect models we can calculate the state of the system (building + occupants) in terms of emissions to different ecosystem compartments (e.g. air, soil, water), indoor pollutant concentration, energy use or other kinds of indicators such as resource depletion. Finally, using existing effect-damage models we can calculate the environmental and health impacts. These studies result in recommendations for possible actions (policies, regulations, technical norms and management) to decrease the environmental and health burden (feedback and monitoring loop). We do not carry out specific research on these aspects, but limit ourselves to the production of knowledge to be used by other groups in the HQ programme. However, we are specifically concerned with knowledge transfer to specific actors in the building industry (such as housing associations) (see communication line in Figure 3).

We consider the building from the point of view of Life Cycle Assessment (LCA), which means we consider all phases, from the manufacture of building components to demolition, with an emphasis on the use phase. Specific attention is paid to the in-

teractions between building and occupants (see Figures 3 and 4) and their effect on the system's state. At present very little is known about these aspects (Lutzenhizer, 1993; Jeeninga, 2001; Bourgeois et al., 2005).

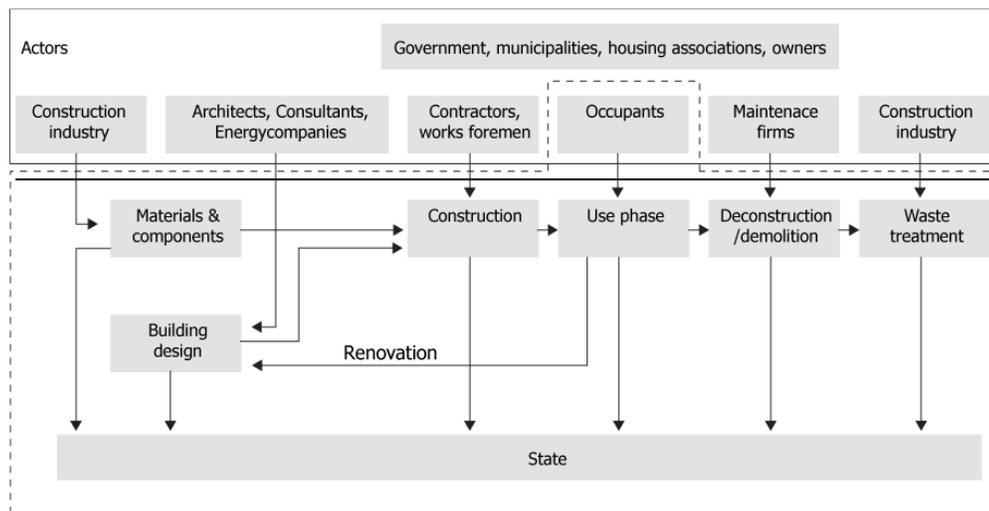
Most of our research is based on empirical data collection using existing databases, technical measurements, surveys, interviews and diaries. The latter three are methods adopted from the social sciences. For this type of research we use the support and facilities of the Department of Methodology and Informatics of OTB. Because the use of these methods in relation to technical studies has not been very common up to now, there is a need to refine their application to this field.

Figure 3 Framework and boundaries of research



The research domains of the group lie within the dotted line

Figure 4 Framework for building process and actors



The research domains of the group lie within the dotted line

Problem definition and research questions

Three facets of sustainable housing construction and maintenance are considered: the environmental quality of dwellings, the health quality of dwellings and the effect of occupant behaviour on this quality. The central research question is:

Which methods can be used and developed to determine the environmental and health impacts of dwellings and how can this impact be reduced to an acceptable level?

The social relevance of this research question is evident: buildings and building activities are responsible for a large part of the global environmental burden through material and energy use. In the Netherlands, more than 30 percent of the total final energy use comes from the building sector. Sustainability is now considered a very important component of building practice, but is mainly restricted to energy-saving measures and applications relevant to new buildings. Other sustainability aspects such as regional and local pollution of air, water and soil, and associated impacts on health have little influence on policies, norms or design guidelines. Until now, the environmental quality of the building stock has been addressed in only a very limited way (Tucker & Treloar, 1994; Peupartier, 2001; Kohler & Lützkendorf, 2002; Klunder & Van Nunen, 2003; Itard & Klunder, 2007; Itard, 2007). Improvement of the environmental quality of the existing stock is essential to achieve a large improvement at the national and international levels (Meijer & Itard, 2008).

In addition to their high social relevance, our research questions are also based on scientific needs in the area described in the framework. Usually, a particular research question will be addressed through a combination of basic research (scientific relevance) and contract research (social relevance) that facilitates data collection. The research questions usually concern the relationships between the different blocks defined in Figures 1, 2 and 3. The main research lines are:

1. Energy use is not linearly related to environmental impacts. Switching from gas supply to electricity supply, for example, can cause a strong increase in the environmental burden. What robust sustainable concepts are there with respect to future buildings?
2. In conventional dwellings the energy embodied in materials and construction amounts to 10-15 years of operational energy. In low-energy houses such as passive houses, it may amount to more than 50 years of operational energy. In which ways can the energy essential for construction, maintenance, renovation, materials and processes, and the related environmental effects be analysed and reduced?
3. Health problems and human toxicity are now widely recognised as environmental effects, but there is still little known about the relationship between building materials, occupancy, indoor air quality and health. How can we develop a better scientific understanding of these relationships and how can we develop methods to better include health issues in environmental impact assessment?
4. Household characteristics and occupant behaviour are widely admitted by experts to greatly influence final energy use and also the quality of indoor air. What methods can be developed to measure this influence and which factors can predict this influence?

Future research

The research themes defined above will be continued during the coming years in order to collect enough data to further develop theories and models, especially concerned with understanding the effects of occupant behaviour and household characteristics on energy use and indoor air quality. In particular, the monitoring of occupant behaviour in relation to technical aspects of buildings will be continued. In the future, models of behavioural aspects will be included in building simulation models for energy, environment, comfort and indoor air quality. Research on suitable models

(e.g. dynamic holistic, causal or fuzzy models) will be an issue for which collaboration with other universities will be required.

Data collection in the field of LCA studies will remain important as it is essential to have validated LCA data at our disposal. We also expect the research on the incorporation of indoor climate models into LCA models to continue. In this area, research on behavioural patterns of indoor pollutants and their relation to air movement is needed to better understand the dynamic behaviour of systems. How to cope with the dynamic aspects of health, behaviour and energy demand is expected to become a major theme. Research on indicators of health (Daly, Qaly), and the quality of the environment (impact categories, exergy) will be needed as well as further research on the interdependence of and causal relationships between physical characteristics, behavioural patterns and social, environmental and health states. We also expect to carry out further research at a scale which exceeds the neighbourhood level, because this could offer new, more efficient solutions for energy saving and some health-related problems. Finally, we are considering extending our research in the direction of the issue of better housing concepts.

Housing Management

Theme leaders: Dr V. Gruis and N.E.T Nieboer

The theme of housing management focuses on developing and disseminating knowledge concerning the changing organisational strategies, especially those related to the physical investment by housing providers, in relation to the contextual developments described above (see Section 1d). The general research approach within housing management is as follows:

- General theories are adapted to specific theories for analysis of organisational strategies in the housing sector.
- These theories are used to evaluate organisational strategies, focusing in particular on frontrunners among housing organisations.
- The confrontation between theory and innovative practices is used to generate new theoretical insights (theory testing) as well as recommendations for general policy and practice within the housing sector.

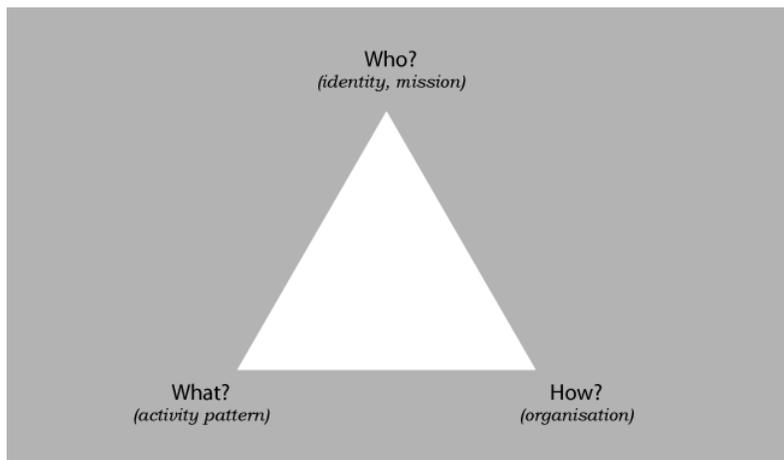
Within the organisational strategy of housing providers, we focus in particular on strategies for the management of the housing portfolio and related services. The housing portfolio is, of course, the main asset of housing providers. As for the social housing sector, recent studies (e.g. Gruis and Nieboer, 2004; Gruis et al., 2009) indicate that housing portfolio management is still in an early stage of development, despite initial expectations of rapid policy development as a consequence of reduced government support. Although (particularly in the Netherlands, Australia and the UK), some studies have focused on transferring approaches from business planning to housing portfolio management, these planning approaches are not often applied in practice. Furthermore, a number of studies, including research by Nieboer (2009, forthcoming), point out that traditional business planning methods do not fit well with practice. In line with criticism by Mintzberg (1995) and Peters and Waterman (1982) among others, these 'blueprint' methods were found to be inadequate (or at least insufficient) in relation to strategic management, and there are several reasons why they could prove to be even harder to apply in the area of real estate management by social housing providers (e.g. Gruis, 2006). One of the reasons is that, unlike commercial companies, non-profit organisations such as social housing providers, have to deal not only with profit or profit maximisation, but with a range of other dissimilar objectives related to, for example, welfare, liveability and environmental conservation. Following Whittington (2001), we argue that this plurality of objectives

leads to a different strategy process, in which not one but several strategies compete. Applied to housing management by social housing organisations, this means that investment is the result of several, sometimes conflicting interests and complex processes. Due to the focus on the commercialisation of the social housing sector, however, this approach has rarely been examined in recent research on organisational behaviour in this sector. Although there is a growing body of literature about strategy development in the non-profit sector (e.g. Bryson, 2004; Allison and Kaye, 2005; Mouwen, 2006), this literature does not deal specifically with the housing sector. Therefore, additional research is necessary to adapt the latest theories on organisation and management to effective approaches to housing portfolio management.

The key and binding element within the available Housing Management research is the ‘strategic position’ that housing providers occupy between State, market and society. Its strategic aspect lies in it being the link between the contextual developments and changes within the housing organisations, expressing and influencing (see Figure 5):

- ‘who’ the organisation is and aspires to be: what identity and mission do social housing providers have (the strategic position in terms of stated objectives)?
- ‘what’ the organisation does: what kind of activities do the social housing providers undertake (the strategic position in terms of revealed actions)?
- ‘how’ the organisation makes itself ‘fit for use’: how are the social housing providers organised to perform their activities?

Figure 5 Key aspects of a housing organisation’s strategic position

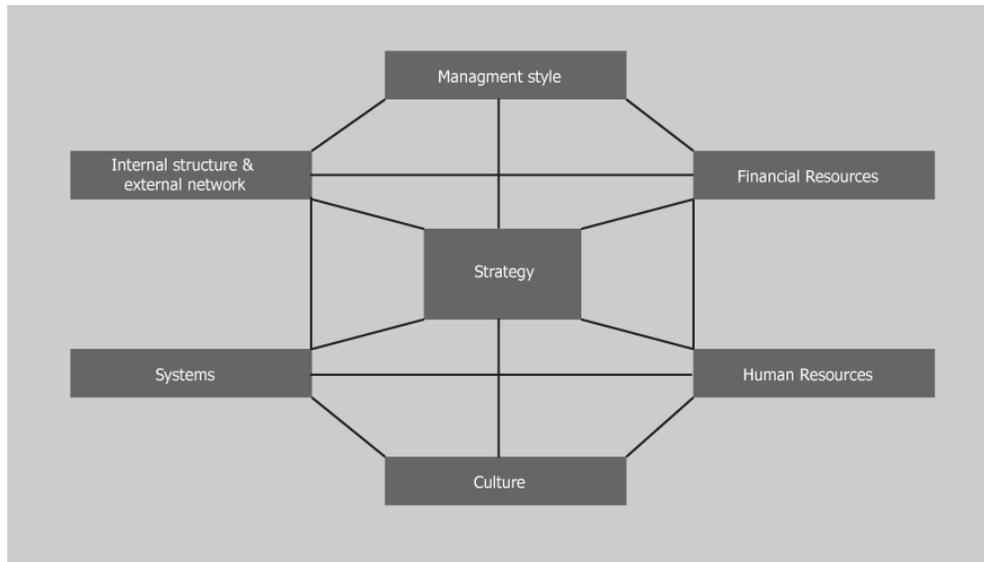


An analytical model based on McKinsey’s so-called 7s model (see Peters and Waterman 1980, 1984) and Wijnen’s (1994) adapted model is employed to describe the organisation of the social housing providers. Wijnen distinguishes the following interrelated dimensions of an organisation: strategy, structure, employees, culture, systems and management style (see Figure 6). In addition to the elements of Wijnen’s model, we also look at the financing of the activities and pay particular attention to the position of the housing organisations within their local network. As stated above, one of the main scientific ambitions will be to integrate organisational theory with network theory to develop an effective approach for social housing entrepreneurs. Key literature has been selected as a primary basis for an analysis of the individual organisational aspects:

- Strategy: Mintzberg et al., 1992; Mintzberg, 1994; Miles & Snow, 1978; Johnson & Scholes, 1999

- Structure: Mintzberg, 1992
- Human resources: Snoeks & Dreimüller, 2006
- Culture: Dreimüller, 2008; Cameron & Quinn, 2006
- Systems (Management): De Caluwé & Vermaak, 2006
- Management style: Quinn et al., 1996
- Financial resources: Gruis, 2000
- Networks: Kickert et al., 1999; Koppenjan and Klijn, 2004

Figure 6 Organisational dimensions



Based on Wijnen, 1994; Waterman et al., 1980

Expected results

In addition to achieving the general scientific and societal objectives mentioned above, the Housing Management theme group aims to achieve the following:

- Identification and evaluation of existing and innovative approaches to the management of housing portfolios and related services, resulting in tested approaches that can be used to improve the quality of housing in relation to changing demand.
- Classification and evaluation of different organisational strategies among housing associations, split into general organisational strategies and specific strategies for project development, neighbourhood-based management, urban development, cooperation with actors working in related fields of public interest, cooperation with actors working in other segments of the real estate market, governance and tenant empowerment. In other words, knowledge that can be used within the housing association sector to support strategy development.
- Insight into housing providers' missions and drivers that can be used for purposes of housing policies targeted at housing quality and the governance of housing organisations.

Policy instruments and enforcement procedures

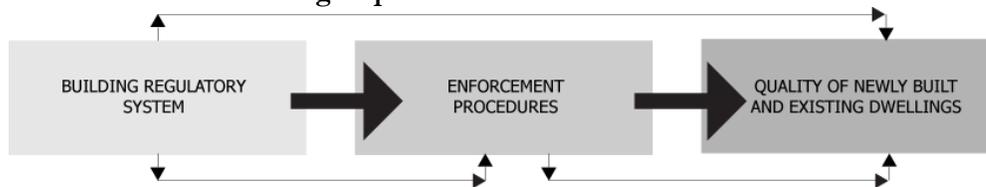
Theme leaders: Dr F.M. Meijer and Prof. H.J. Visser

The focus within this theme group is on regulatory, financial and communicative instruments that guarantee the physical quality of housing. Governments have introduced legislation governing the quality of the built environment for many years. The original reason for doing so was, and remains, the protection of public health and safety. Most countries have increasingly developed regulations, laws, regulatory instruments and subsidy schemes to steer housing development in the desired direction, with the issues to be regulated and the level and method of regulation and enforcement being subject to periodic review. Initially the legislation was aimed at the protection of individual consumer interests (health and safety). In later years the regulatory scope was widened to include general societal objectives such as usability, environmental protection and energy conservation. Over the years the construction industry itself has developed and implemented various instruments and quality assurance systems to ensure that the stated technical requirements are actually met in practice. Increasingly, market parties implement their own quality requirements in the form of industry labels or ‘seals of approval’ and quality assurance systems which are mandatory in the branch of industry concerned.

Conflicts emerge between the goals of the regulations and the restrictions and burdens they entail for housing consumers and other actors in the construction process. This is particularly apparent in the sheer number of requirements and the way they are (or should be) enforced. Almost all European countries once had traditional building control systems, in which local authorities played a key role. Such systems have undergone major changes, and although the situation varies widely between European countries, the role of private organisations (market parties) in the enforcement procedure has expanded considerably. Our research is situated within this ‘area of tension’. Both the government and the construction industry wish to ensure that at least a minimum standard is reached in construction works, and this must be regulated, executed and enforced in such a manner that the intended quality is realised in practice and the burden for all parties involved is minimised.

The following Figure identifies the main subjects of our research:

Figure 7 Research area of the Policy Instruments and Enforcement Instruments theme group



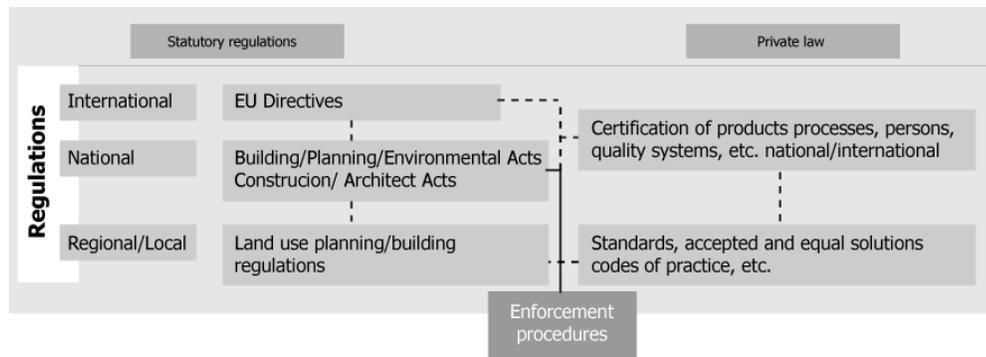
The starting point for our research is a country’s building regulatory system. This system establishes minimum quality standards for construction and sets out the roles, tasks and responsibilities of the main stakeholders involved. These demands can be incorporated into both public and private law and have both national as well as international components. Enforcement procedures (e.g. building permits and other mechanisms) are incorporated within the building regulatory system to ensure that the quality demands established in the regulations are actually met in practice. As they are an important subject of study in the theme group they are highlighted in a separate box. The central question of the theme group is:

How can the building regulatory system and enforcement procedures of a country best be designed to ensure the quality of new and existing dwellings?

As our research is internationally comparative we attempt to identify international trends with respect to the development of building regulatory systems.

Figures 8 and 9 elaborate the building regulatory system and enforcement procedures respectively.

Figure 8 Elementary components of a building regulatory system



Although building regulatory systems differ from country to country, they share broad systematic similarities. Figure 9 illustrates the elementary components of building regulatory systems. We take regulatory developments into account at the international and local levels, but the focus of our research is on national regulatory demands and especially on the building regulations of a particular country, more specifically, the technical requirements that define the minimum quality level. Most countries have established a statutory act or decree at the national level with technical requirements that set minimum quality standards for construction. In addition to regulations concerning the built environment, all countries have planning and environmental regulations as well as regulations concerning the building industry. In order to guarantee that regulations are adhered to, a Building or Housing Act dictates the administrative procedures that must be followed. The main research questions here are:

- What subjects are regulated in building regulations (e.g. technical requirements), how are they formulated, what is their scope (including developments)?
- Which quality aspects of housing are controlled by means of government regulations and other instruments which are left to ‘market forces’ and what developments can be recognised?
- What other instruments (apart from regulations) are implemented to guarantee and improve the quality of new and existing dwellings?

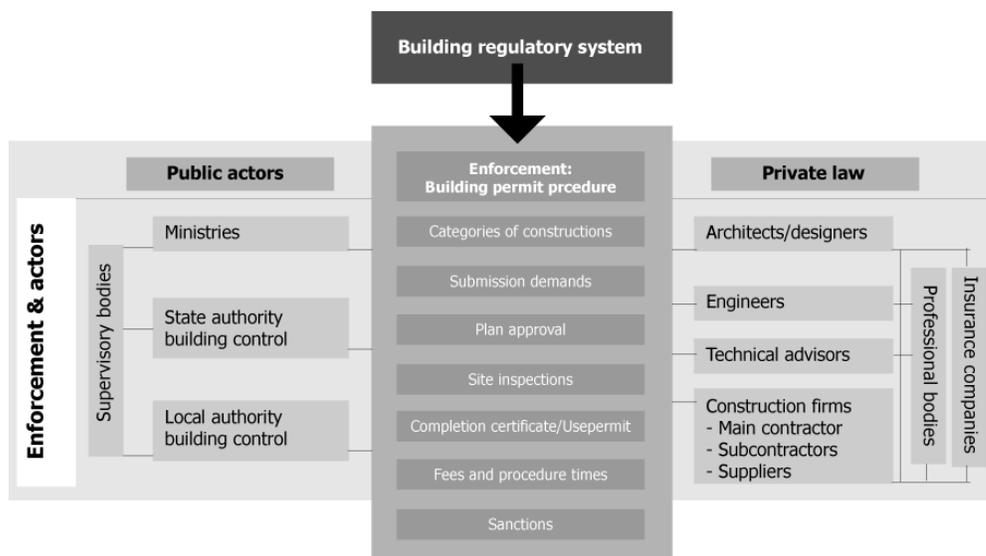
The second key subject of our research is the building permit process established to enforce the regulations and set out the roles and responsibilities of the main stakeholders involved in that process. As mentioned above, to guarantee that regulations are met, a Building or Housing Act dictates administrative procedures that must be followed. These acts regulate elements such as procedures for various types of construction works, the fee system, maximum procedure times and the tasks and responsibilities related to building control. In most countries, public authorities and parties within the construction industry both carry responsibility for building control. In addition to the regulations that are embedded in public law, most countries have established certifi-

on schemes in the construction sector for such elements as the people, products, processes and quality systems involved.

The main stakeholders are named in Figure 9. The main questions here are:

- What procedures have been established to guarantee that regulations are being met in practice, and how are building permit procedures structured?
- What are the tasks and responsibilities of stakeholders involved in building control and the enforcement of building regulations?
- How is it possible to guarantee that the actors responsible (both public as well as private) for building control and enforcement of the regulations can fulfil their tasks and responsibilities adequately?

Figure 9 Elementary components of enforcement procedures and actors involved



These questions are addressed in national and international comparative research projects. Our research intends to develop an understanding of the advantages and disadvantages of different aspects of regulatory systems and various enforcement regimes. The comparative research projects should also provide insight into the possible convergence or divergence of building regulatory systems in Europe.

Although national policy instruments are the main focus of research, the theme group also studies instruments and policies which are developed at a local level (e.g. municipality) to ensure the quality of dwellings.

Theoretical framework

The research of the theme group is multidisciplinary in nature, such that the research methods and theoretical framework can be associated with several academic traditions. Almost all of the research includes a significant policy-based component. Our research into policy, procedures and the way stakeholders interact with each other also touches upon legal studies (private and public law) and construction management science. An important aim of construction management is to keep the building process as efficient and effective as possible in terms of cost, time and quality. A factor that can have a considerable influence here is the content of building regulations and the responsibility for implementing and applying them. Using the principles of

business science and economics, we seek further understanding of how the construction process can be managed as efficiently as possible in order to achieve the minimum construction quality set out in the regulations. Numerous overlapping criteria and definitions derived from many sources have been established to analyse 'regulations'. Examples of these criteria are proportionate/adequate, accountable, consistent, transparent, targeting, necessary, effective, flexible/adaptable, and feasible. Members of the group use these criteria to analyse building regulations. The group has not yet established a uniform list of analysis criteria.

On the basis of both regulation and enforcement literature and economic literature we are attempting to establish a coherent framework of building control and enforcement models which can be applied when analysing building regulatory systems in various countries. On the basis of debates in regulatory literature about the strengths and weaknesses of different forms of regulation, enforcement strategies, enforcement styles and enforcement actors, Van der Heijden (2009) has developed various typologies of regulatory enforcement regimes. At one end of the spectrum there is a 'pure' public regime and at the other a 'pure' private regime, and in between we can find enforcement types that combine both public and private sector involvement. In the years to come it is our aim to fine-tune these typologies.

Although there are a growing number of internationally oriented research projects in the field of building regulations and building control procedures, a coherent international comparative research tradition into technical building regulations and building control is still lacking. In recent and ongoing European comparative projects, we have used convergence and divergence theories (which are predominantly based in the field of economics; e.g. Busch, 2002). We are attempting to embed our ongoing European comparative study within the framework of Europeanisation, a rather new branch in the regulatory sciences. The European Union (EU) is able to influence the regulatory systems of the member states, and this influence can be independent of all other international external developments (e.g. deregulation, convergence or harmonisation that may affect national policies, Vink, 2002). In recent years, the impact of the EU on its member states has become a topic of EU studies. Researchers are studying the effects of European integration on the politics, policies and administrative structures of the member states. Although there is no agreement about what 'Europeanisation' actually is, most research implies that it has to do with the process through which European integration penetrates – and in certain circumstances, makes adjustments to – domestic institutions, decision-making procedures and the public policies of the member states (e.g. Bulmer and Radaelli, 2004; Liefferink and Jordan, 2002).

In the field of technical requirements, progress has been made in the development of a theoretical framework that can be used to analyse the content and formulation of the requirements (Bowen 1997; Tubbs 2004). The performance systems' model for technical requirements that was developed by the Task Group on Performance Based Regulatory Systems of the CIB (International Council for Research and Innovation in Building and Construction) provides us with a useful tool to compare the technical requirements in various countries. In general, we do not study the exact contents of these requirements. In the case of energy and sustainability requirement regulations, however, we analyse the requirements in-depth (in close cooperation with the Sustainable and Healthy Housing theme group).

Future research

The most important future developments requiring new solutions through regulations and quality assurance (the aspects which inform the course of the research) include the greater importance now given to the quality of the existing housing stock

(especially aimed at energy performance) and the introduction of private compliance regulations (self-control) and private quality regulations (certification, quality labels). The latter developments are taking place European-wide and are part of the desire to streamline building control procedures and building process. Over the coming years we will be intensifying our research into these subjects.

Developments in building regulatory and enforcement systems

We will continue to study the building regulatory systems of European and other Western countries. The main goal is to obtain answers to the questions introduced in the previous section. Our research addresses the following subjects:

- The position of building regulations within the legislative system of the respective country
- The scope and content of the technical requirements that regulate the minimum quality level for buildings
- The enforcement procedures and the main features of the system of building control

We also wish to investigate whether the same past and present trends and developments in the eight European countries we have studied thus far can be detected throughout Europe. In short, do parts of the systems converge or diverge?

In our international comparative research we will cooperate with the Consortium of European Building Control (CEBC). The Consortium's mission is to assist in the promotion of the ideals of the European Union in relation to building control function.

We intend to deliver monographs that describe the building regulatory system of each EU member state or candidate, as well as Iceland, Norway and Switzerland. Subsequently, we plan to shift our attention to more in-depth comparisons.

The quality of existing dwellings

Building regulations (and other instruments) are mainly directed at new build houses, which add less than one percent a year to the total residential stock. Thus the effect on the quality of the residential stock at large is marginal. If we consider that the existing stock – or at least parts of it – no longer meets the standards demanded by many housing consumers, this seems to be an acute problem. In the coming years we aim to carry out research into the quality of existing privately owned dwellings and the role stakeholders such as municipalities and housing associations can play to safeguard and improve that quality. A wide range of quality aspects will be taken into account. However, in the light of the ambitious energy-saving goals of the EU and its member states, special attention will be paid to the energy quality of existing dwellings.

Energy use in the existing housing stock is relatively high. Although the overwhelming majority of all regulations and instruments aimed at improving the energy performance of houses are still directed towards newly built houses, attention is slowly shifting towards existing dwellings (Itard & Meijer, 2008). Recently, the Energy Performance of Buildings Directive (EPBD) was implemented in the EU. An important element of the EPBD is the obligation to have a certified energy label for each house when it is sold or rented to a new tenant. The energy label functions mainly as a communication instrument. It is assumed that transparent information about energy performance will influence the attractiveness of the house. However, it is questionable if the intended savings potential will simply and solely be reached by this communicative instrument, which is generally considered to be an additional instru-

ment, complementing economic and regulatory policy instruments (e.g. Kemp, 2000; Ekelenkamp et al., 2000). It seems logical that further solutions, other than communicative incentives, will be sought to improve the energy performance of the housing stock. Recent research (e.g. Sunnika, 2006) has shown that a rigid government policy and well-enforced public building regulations seem to be necessary for any major advances to occur. Tightening the regulations, however, will only be part of the solution, as the energy consumption of households is determined by their behaviour and the energy use of the household's appliances, and building regulations have little influence on energy consumption patterns. Information campaigns or subsidy schemes could have possible positive effects in this area; however, these instruments also have a drawback. Research has shown that subsidies for energy-saving measures suffer from a high share of windfall gain, and a large part of the measures would have been taken anyway without the use of financial incentives (e.g. Vermeulen, 1992; Kemp, 1995; Beerepoot, 2007). In brief, much effort is required to develop instruments and measures to improve the energy performance of the existing housing stock.

Innovation of Building and Maintenance Processes

Theme leaders: Dr A Straub and Prof. J.D.M. van Hal

Many studies show that traditional building and maintenance processes do not always satisfy contemporary quality requirements and that they entail high failure costs and transaction costs (Ang et al., 2004; arTB, 2002; Egan, 1998; Hughes et al., 2006; USP Marketing Consultancy, 2007). Although much has been achieved, further innovation in building and maintenance processes and related forms of cooperation is necessary. The need for higher energy performance and the integration of sustainability in an overall quality approach calls for process innovations, and the diffusion of those innovations that contribute to the sustainable quality of the housing stock should be stimulated.

The central question of this theme is:

What process innovations are needed and can be developed to stimulate integrated, up-to-date high-quality housing?

The research can be divided into three sub-themes and questions:

- How can building and maintenance processes be improved by cooperation within the building and maintenance chain?
- How can the diffusion of process innovations be improved?
- How can the technical management processes used by housing associations contribute to housing quality?

To introduce innovation into building and maintenance processes within the construction industry, strategies for change and the diffusion of innovations must be integrated into regular processes. In addition, these processes must change their orientation from costs of services to value and performance. Scientific theories such as Rethinking Construction (Egan, 1998), Revaluing Construction (Courtney, 2005) and performance-based building networks can be helpful. In the Netherlands, the Advisory Board on Technology Policy (arTB, 2002) pointed out the need for building process innovation. Ang et al. (2004) have also pointed out that procurement practices are of crucial significance when reforming the building and construction sector. It was found that more integrated forms of procurement provided better value for clients and also included other dimensions of competition, such as performance, speed and reliability. Research on new procurement or project delivery systems and contracts concentrates on new construction or private-public cooperation,

for example, design-build, Design and Construct, and PPS and PFI. In this theme group, other process innovations will also be studied. Most will focus on the existing housing stock because, unlike the whole life costing or net value approaches, attention to refurbishment and maintenance is still limited (Straub, 2007). In this theme, researchers will attempt to fill this gap and link new strategies in the construction industry to those concerning housing portfolio, refurbishment and maintenance management.

Technical management processes can be regarded as offshoots of housing portfolio policy, driven by strategies for the improvement and maintenance of complexes, performance requirements, and the costs and sustainability of improvements and maintenance (Straub, 2001). Data from technical management processes, for example realised and future maintenance costs and conditions scores, are being used in the housing portfolio policymaking process (Straub, 2009). The relationship between technical management and housing portfolio policy also indicates that housing associations develop a strategic vision of purchasing and contracting maintenance services. This means that it is possible to establish which maintenance service is important in achieving the objectives of the housing association, such as customer satisfaction, which forms of purchasing are appropriate, and what role the housing association plays in the chain of maintenance (Van Mossel, 2008). Parts of the process may be contracted out in a well-considered manner, with the requirements formulated in terms of technical specifications of the task, or as a functional request specified in terms of performance indicators and performance requirements. Research involves innovative technical management processes, including condition assessment, planning and procurement of improvements and maintenance, and performance control.

Theoretical framework

The terms of reference for innovation in building and maintenance processes are derived mainly from the construction sciences, business theory, real estate management (e.g. life cycle costing), transition management and economics. New institutional economics – transaction cost theory, property rights theory and agency theory – provides tools to analyse problems and present opportunities in a client-contractor relationship.

In new construction and maintenance chains, contractors often no longer work only as suppliers of capacity, but become active participants in the overall improvement and maintenance process of a project for a specific period. One of the research fields will be process innovation as a result of the performance approach and performance criteria that are explicitly stated by the client (Gibson, 1982; Sexton and Barrett, 2005; Straub, 2007). Performance-based contracting promises benefits to clients when compared to the traditional tendering of improvement and maintenance projects. The possible benefits are based on the general benefits believed to inhere in new procurement approaches, especially construction partnering and design-build contracts (e.g. Bresnen and Marshall, 2000; Saad et al., 2002).

The process of sustainable innovations in housing, as developed by Van Hal (2000) on the basis of Rogers (1995) and others, forms the theoretical framework for the study of innovation diffusion. The key elements of a successful innovation process are considered to be interdisciplinary cooperation, enthusiastic key players, influential supporters, effective marketing and communication, government stimulus and a general sense of urgency (Van Hal, 2000). Other theories that are used to support research on the dissemination of innovations are, for example, those of Fisher and Ury (1981) and Susskind (1981), dealing with the interests of and conflicts of interest between key players and their negotiations; Rotmans (1990) on transition manage-

ment; Peters and Wetzels' (2003) paradigm of interpreting reality and potential futures; and Hoytink's classification of consumers, based on Ray (2000).

Priority research lines

Our priority research lines are:

- Transformation processes and life cycle costing of housing
- New processes, roles and skills of contractors
- Implementation of performance-based cooperation
- Diffusion of sustainable innovations in housing

Transformation processes and life cycle costing of housing

When improving their housing stock, housing associations often only take into account initial performance and the necessary initial investment. Firstly, this is a consequence of the structure of the organisation and its procedures, that is, compartmentalisation of sections of the organisation which are responsible for new buildings and renovation, or for the management and maintenance, as well as the associated procedures, budgeting and control of spending means. Secondly, fragmentation within the building and maintenance market and a lack of cooperation in the building chain may also be responsible. Future research will focus, for example, on life cycle costing and the performance of investment and maintenance during the lifespan of dwellings. Furthermore, the investment required to implement new and existing technologies which reduce the use of energy will be compared to the financial profit gained.

New processes, roles and skills of contractors

One major change within the performance-based approach is contractors acting as maintenance-engineering consultants to clients and as service providers to end customers. The long-term involvement (including financial aspects) of contractors in the role of service providers implies that they must redesign their existing contract base to control their risks. Component (maintenance) services are passed on to the end customer unaltered (Van Mossel and Van der Valk, 2008). Contractors must consider new activities, such as the design of maintenance scenarios, performance measurements and conducting customer satisfaction surveys. The execution of these activities demands additional resources and capabilities (e.g. Palaneeswaran and Kumaraswamy, 2000; Van Mossel and Straub, 2007). Contractors need knowledge about concepts such as whole life costing and net present values, key performance indicators, life cycle assessment, communication and empathy skills, and skills in dealing with end customers in a client-friendly manner. Partnering between enterprises may be needed to deal with full maintenance contracts, and this calls for coordination skills.

Performance-based maintenance partnerships

Performance-based maintenance partnerships influence the internal structure of both the client and contractor organisation, as well as the selection of contractors. Parties to the relationship should have similar views and approach the partnership arrangement with similar perspectives. Partnering literature, for example Bresnen and Marshall (2000), Saad et al. (2002), emphasises the need for a thorough understanding of new concepts such as partnering. The appropriate form of partnership for a housing association depends on its size, its organisational structure, its in-house skills and knowledge and the maintenance service and commodities involved. Research will focus on the anchoring of the performance concept for the maintenance and renovation of dwellings in the organisation of housing associations and the relationship with

portfolio policies. Relationships with other key players in the housing chain, from suppliers to consumers, will also be studied.

Diffusion of sustainable innovations in housing

For innovations to be implemented in practice on a large scale, a process of innovation diffusion must occur. In theory, first a few frontrunners, the innovators, bring an innovation into practice on a small scale. When an innovation has proven its value, it is increasingly applied, until the majority of those involved have opted for the innovation. At that point, the process of innovation diffusion comes to an end (Rogers, 1995). In practice, however, there is quite often a missing link between the innovators/early adopters and the so-called early majority (Moore, 2002). In this research line, we focus on both parts of the innovation diffusion process: on promoting the successful first implementation, and on the processes that further the implementation of the tested innovations on a large scale. Passive house technologies will be one of the concepts studied.

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4 Urban and Regional Development

4.1 Introduction

a. Mission and research area

Research area: fragmentation of urban and governance systems

The Urban and Regional Development (URD) research programme deals with *the interrelationships between the ever growing complexity of urban systems and the extent to which the development of these systems can be influenced through policies and governance.*

It seeks to combine and integrate two different strands of research which in many academic research groups are carried out separately: territorial research and research into governance. The vast majority of our group carries out research in both domains

These two domains of urban systems and governance systems are both characterized by processes we would like to describe as *fragmentation*. The fragmentation of urban systems is visible in terms of both urban *form* and urban *structure*. The fragmentation of urban form is particularly recognizable at the *regional* level. Thanks to a continuous transport revolution and the supply of electricity instead of other spatially concentrated sources of energy, the twentieth century has shown an explosion of the classic contiguous, concentrated nineteenth century city. In most European countries various patterns can be discerned ranging from nebular types of urbanization to patterns which could be called either concentrated deconcentration – where some level of concentration still can be discerned – or deconcentrated concentration, where the level of deconcentration is substantially lower. Both oxymorons are known from spatial planning strategies. Here we use these well-known terms in a more neutral, analytical sense. What should be underlined is that both planners and researchers are looking for a new terminology which captures the increasing complexity of urban form and the great variety of patterns which can be found. The present research programme seeks to contribute to this ongoing discussion.

At *higher scale levels* such as the national, transnational and European – extensively addressed in URD research – the issue of urban *form* relates to patterns of cities and urban regions. Here concepts like polycentricity or monocentricity are in use. Polycentricity refers to dense patterns of cities in relatively close proximity to each other such as the Dutch *Randstad*, the Flemish Diamond, the Rhine-Ruhr metropolitan area and the British Midlands. Monocentricity refers to urban systems dominated by a large, contiguous metropolis. Paris and London are important exemplars here. However, in the literature monocentricity is gradually becoming an obsolete term as it becomes evident that for instance a region like the southeast of England that used to be regarded as monocentric is becoming more and more polycentric (Hall & Pain, 2006). At the other end of the spectrum, a quintessentially polycentric region like the Dutch *Randstad* is gradually becoming increasingly dominated by what is currently called the Amsterdam Metropolitan Regions – in other words, it is becoming less polycentric. The growing complexity of urban systems means that simple juxtapositions like polycentricity-monocentricity are no longer appropriate.

This brings us to a point where the functional structure of cities and urban regions and the underlying activity patterns of households and companies are starting to re-

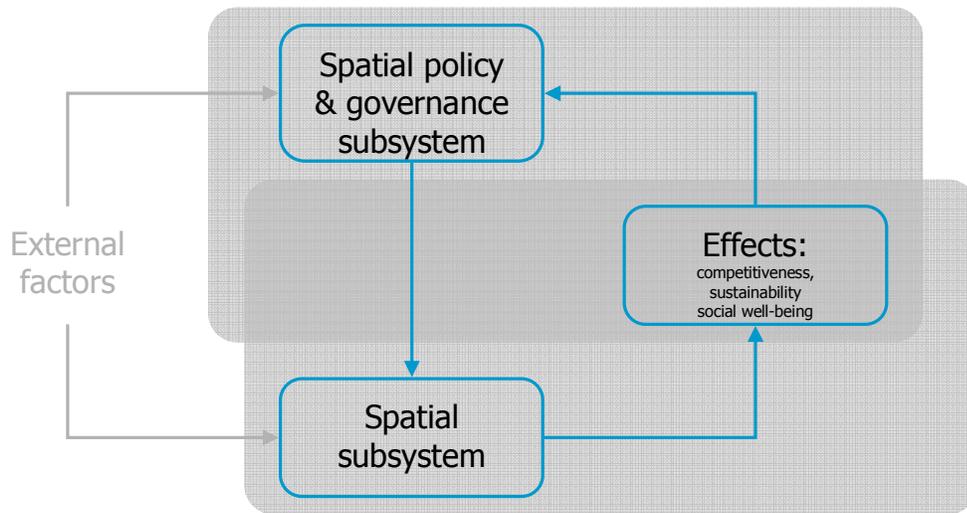
veal a mind-boggling complexity, with a clearly dominant trend towards multiscalar urban networks. Activities and localities are related to each other at the regional scale (for instance a company may have input-output relations within its own urban region), but also often have relationships at many other different levels: national, European and even global. Some relationships are fragmented at one scale level (for instance when a company outsources certain activities) and re-integrated at another, often higher level. Households and household members show increasingly complex activity patterns, especially when different time scales (days, weeks, months etc.) are combined.

The combination of all these developments influencing the form and structure of cities and urban regions has a huge impact on governance and governance capabilities. Complex urban systems like the Randstad have responded by developing all sorts of governance structures in addition to the classical three-level system (national, provincial and municipal). Similar developments have taken place elsewhere, leading to a search for new forms of meta-governance (Jessop, 2004; Allmendinger & Haughton, 2008).

As stated above, the URD research programme deals with the interrelationships between the ever growing complexity of urban systems and the extent to which the development of these systems can be influenced through policies, planning, visions and governance. Our studies concentrate on two main themes: 1) *spatial development* and 2) *spatial governance*.

1. Research into spatial development is concerned with the changes taking place across the urban system. We specifically investigate how these changes are influenced by the spatial and spatially relevant strategies of households, companies and institutions. The emphasis is on the *regional level* but we also investigate how developments at other scale levels influence this level. We look at the *form* of the (regional) urban systems, for instance by assessing what kind of agglomeration advantages and disadvantages occur within regional polycentric cities, how the shape and pattern of cities influence economic competitiveness in terms of knowledge and creativity and how this is related to the strategies of companies and companies. We look at the *structure* of urban systems by assessing the extent to which this structure shapes activity patterns and, alternatively, how the structure of urban systems is changed by the activity patterns of household and companies.
2. Research into spatial governance is concerned with the rescaling of governance: the break-up and re-institutionalization of governance capacity across different scale levels. We look at the way planning systems – in particular the Dutch system – are evolving: what changes are taking place in terms of the content and nature of strategic decision-making and the changing relationships with operational decision-making? We investigate the Europeanization of planning: how important is the EU as a level of territorial governance and how does the EU influence national planning systems and planning practice? We also carry out comparative research: we try to compare the changes of planning systems and practice across countries and develop research methods and instruments to facilitate such research.

Figure 1 Systems analysis representation of the URD research programme



The overall content and structure of the URD research programme can be presented as shown above. This systems analysis approach has the advantage of drawing a clear distinction between the factors which are internal and external to the (sub)systems involved.

One point clearly illustrated in the diagram is the existence of (many) external factors that influence both the 'spatial policy and governance' and the 'spatial (development)' subsystems. We do not study these factors themselves, but are only interested in the way they influence the subsystems in question.

Spatial development is the result of the spatial strategies of numerous actors ranging from households to aggregated actors like companies. It is influenced by spatial policy and governance and the general context (like 'the state of the economy' or cultural attitudes towards the use of a bicycle in transport).

Spatial development has effects which can be discerned and evaluated. In our research we focus on competitiveness, sustainability and social well-being. These effects – including those that are undesired or unexpected – are dealt with by spatial policy and governance. We are responsible for the selection of the effects to be studied and the criteria used to determine and evaluate them. While we can try to influence policy and governance in this field through our publications and other communications, it is the decisions taken and the frameworks set up within the spatial policy & governance subsystem that determine which effects will be identified and play a role in the actual adaptation of policy and governance. The spatial policy & governance subsystem shown in the above figure is composed of countless actors who form discourse coalitions (Hajer, 1995) which can play either a peripheral or a central role in decision-making. In fact, there is a whole world of power struggles behind this simple-looking box in our diagram. Hence, when considering the arrow between the 'Spatial policy & governance' and 'Spatial (development)' subsystems, we continually ask ourselves question like 'What is the meaning and substance of this arrow? Whose arrow is it and why is it there?'

Cross-thematic research

The importance of the above simple diagram is that it gives a clear overall impression of the way we view the structure of our research programme. In our opinion, the central area of this diagram is of particular relevance. In a SWOT analysis carried out as part of the self-evaluation serving as input to the 2007 external research evaluation, we concluded there is a tendency toward bifurcation of the research programme, with too much separation between our two main themes of spatial policy & governance and spatial development. The obvious threat is a loss of critical mass. Such fragmentation of our research programme would not be helpful in increasing our visibility in the academic world. We would like to avoid that through:

- Identifying a number of projects which address both governance and spatial development issues. Long-term projects are particularly important, because they tend to be more interesting from a scientific and academic point of view. Evert Meijers' project "Cities 'borrowing' size: Agglomeration advantages in Polycentric Urban Regions?", funded by a highly sought-after VENI research grant from the NWO (Netherlands Organisation for Scientific Research) is obviously important here. Although Meijers is mainly studying spatial development, the outcome of his research could have a significant policy impact by asking the question whether policy is based on the right sort of assumptions? Another highly relevant project is the three-year SUME ("Sustainable Urban Metabolism in Europe") project funded by the European Union 7th Framework Programme (FP7) which started in Autumn 2008. This project addresses urban development (viewing a city as an organism with its own metabolism) and the possibilities of influencing its development through policy and governance.
- Focusing our requests for further research funding from the NWO, the European Research Council and the EU Framework Programme on research issues which cover both the above-mentioned themes.
- Arranging for most of our research discussions (apart from necessary internal meetings and discussions within the spatial planning and spatial development theme groups) to take place at URD departmental level. We are thinking here for instance of discussions about key literature on the rise of urban networks and on novel concepts of place and space and how these ideas influence governance. We will also discuss and evaluate key policy and planning concepts, and will in particular ask ourselves whether these concepts are in line with the locational strategies of main societal actors or whether they need to be revised.

b. Relationship with previous programme

We would like to emphasize the following issues:

- We do not want to change the basic *structure* of the programme in the short term – the two above-mentioned themes were already the main components of the previous (2003-2008) research programme - but we do feel the need to study them *in greater depth* and to consider the *interrelationship* between them (see above). The structure of the programme might also change due to intensification of the research links between our department and the faculties of Architecture and Urban Design and of Technology, Policy and Management. For instance, certain sub-themes within our programme might be integrated with sub-themes of the programmes of these faculties. Depending on the future volume of research, the sub-theme 'the role of companies in economic competitiveness' (now part of the spatial development research strand) might become a separate theme. Whatever the choices, we do not see our research themes and sub-themes as organizational units: they are fields of investigation, and researchers can participate in more than one of them as they do at present.
- The challenges stated by the 2007 NETHUR research assessment committee have been taken to heart. The committee assessed the quality of our research programme for the period 2000-2006 as very good, but concluded that the URD

research group “...lacks a clear vision on the programme and an intellectual and academic core” and went on to define the task for this group as “...to develop a stronger conceptual and theoretical framework for the research programme in the future.”

- While there are of course plenty of theories and conceptual frameworks in our individual research projects and publications, we would agree with the assessment committee that it is possible and desirable to work on a unified theoretical framework for the programme as a whole. It should be stressed that the content of the present URD research programme is not the result of deliberate comprehensive research design, but that our current main research themes have grown out of a number of small- and large-scale research projects, some of which were developed internally while others were externally commissioned. This makes the development of an overarching theoretical and conceptual framework a challenge, but one which should not be avoided.
- We would like to take up this challenge in the following ways:
 - o We will adjust our research culture by emphasizing more and lengthier discussions on the theoretical framework of our research;
 - o We will dedicate research time to a deepening of the research area as indicated in the introduction to this report.
 - o The major academic research projects for which we seek external funding (NWO, European research council, FP7) will be guided by research questions which reinforce the theoretical underpinning of our research programme.
- The conditions for stronger academic profiling of the URD department have improved as the result of the creation of the new chair of Urban and Regional Development, to which Dr Wil Zonneveld has been appointed. The chair of Innovation and Innovation Policy in the Urban Economy (occupied by Marina van Geenhuizen) in the faculty of TPM, which has strong links with OTB and the URD research programme in particular, further reinforces our position.
- Our statement of the need for a stronger academic profile of the URD group should not lead us to forget that the research carried out within the group – and indeed within the OTB Institute and Delft University of Technology as a whole – is basically *technology driven*, i.e. its mission is to address societal problems. Carrying out purely academic (“blue sky”) research is not the role that URD or OTB as a whole seeks for itself.
- An important change between the new programme and the previous one is that URD staff are now more heavily involved in education in the faculties of Architecture & Urban Design and of Technology, Policy and Management. We see benefits in two directions from this. Education is important in terms of the transfer of knowledge. Furthermore, the teaching activities will allow URD staff members to identify promising PhD students who might come and do their research in our department. An additional benefit is that education improves the career perspectives for those seeking a position as senior lecturer (UHD in Dutch).

c. Scientific relevance

Our research area – the interrelationships between the ever growing complexity of urban systems and the extent to which the development of these systems can be influenced through policies and governance – enables us to position ourselves in the forefront of academic debate and research. The rise of what is often called the new relational geography is surrounded by numerous research questions. While many theories and concepts relating to urban systems and governance are based on territorially bounded perceptions of space and place, there is a need to develop new con-

ceptual frameworks. Much of the academic literature on this topic is highly theoretical, but the URD/OTB research model rests upon a combination of theory and solid empirical research guided by appropriate research methods.

d. Societal relevance

The trend towards complex, fragmented urban and governance structures and polycentricity is not without its problems. The core values of traditional spatial planning practice, such as participation and spatial quality, are under threat. This is also the case for wider objectives such as sustainability. Improved insights into the changes taking place across the urban system and the rescaling of governance (including Europeanization) are urgently needed.

e. Synergy between fundamental and applied research

We have outlined above the need to improve our academic profile while preserving our tradition of technology-driven research. Our strategy for achieving the desired synergy between fundamental and applied research rests on the following two pillars:

1. We will take advantage of our track record of research excellence and make full use of our network of contacts (which we will work to extend) to seek new applied research contracts which fit our research objectives. The areas in which we already have or are seeking research commissions include the following.
 - Application research: the performance of strategic planning and policy frameworks.
 - Effects of European instruments and policy frameworks such as environmental directives on planning systems and practices in Member States.
 - The effectiveness of policy instrument in land use development.
 - Study of land-use changes: which changes have taken place and what effects are these changes having on transport systems and transport behaviour?
 - The application and effect of the creative city thesis in current urban planning.

We will specifically target research programmes which have an intermediate position between applied and fundamental research. The most important examples for us are the ESPON 2013 programme (at EU level) and the Dutch urban research programme managed by the NICIS Institute.

The future funding situation of OTB in general as well as URD in particular will be more dominated by contract research. We will formulate a strategy aimed at promoting this type of research in the near future.

2. At the same time, renewed and stronger efforts are needed to safeguard the funding for fundamental research. NWO will be one of our main targets here, possibly in the field of Engineering Sciences. As interdisciplinary research proposals have a better chance of success, we will seek cooperation with others in our search for funding (Urban Design and TPM are prime candidates within TU Delft). We will also carefully explore the possibilities of 7FP and the European Research Council funding.

f. Internal and external collaboration

Our collaboration strategy can be summarized as follows:

- We will continue and deepen our co-operation in project work with other research groups within OTB. The most important groups for us in this connection are Geoinformation and Land Development (GiLD) because of its focus on land policy and planning legislation; Mobility Studies, mainly because infrastructure is so often used for passenger transport (which is part of URD's research remit); and – in terms of research tools – GIS Technology.
- The fact that the new URD programma chair is situated in the Faculty of Architecture and Urban Design means that we are developing ever closer relationships

with this faculty. Some of us cooperate closely with the department of Real Estate and Housing, especially in the field of Urban Areas Development, while others have strong links with the Department of Urbanism, in particular with the chair of Spatial Design and Strategy (generally known by its Dutch acronym RPS), which is occupied by Prof. Vincent Nadin. This co-operation includes teaching as well as research. The research programme of the 'Randstad Centre for Strategic Spatial Planning and Design' centred round the chairs of Vincent Nadin and Han Meyer, has several sub-programmes addressing research issues which are closely related to those at URD. This will inevitably lead to common research proposals, projects and activities. To facilitate this synergy Prof. Wil Zonneveld, the head of URD, is a member of the Randstad Steering Group which meets fortnightly while URD researcher Dominic Stead is on secondment to RPS (0.4 FTE) and also participates in the RPS section meetings.

- Cooperation with the faculty of Technology, Policy and Management includes education but also research under the aegis of the Chair of Innovation and Innovation Policy in the Urban Economy, which is occupied by Marina van Geenhuizen who in addition to being a professor at TPM is a staff member at URD.
- Various URD staff members co-operate with colleagues from other universities, mostly to prepare joint publications (papers; readers, books). Apart from links via NETHUR (the Netherlands Graduate School of Urban and Regional Research), there are no institutionalized forms of cooperation with other Dutch research institutes although there are many contacts and participation in ad hoc activities and projects. With the increasing importance of European funding for research (in particular via FP7, ESPON and INTERREG), co-operation with research institutes outside the Netherlands has become particularly important over the years. URD would be happy to intensify this transnational and European co-operation.

g. Relations with education

Several of the group's researchers have been teaching courses at both Bachelor's and Master's level for the SEPAM (System Engineering Policy Analysis and Management) degree programme in the Faculty of Technology, Policy and Management for some time. This situation will be continued in the period 2009-2014. In fact, this educational contribution is likely to increase as the number of Master's students grows. A few URD staff members (mainly Dominic Stead and Wil Zonneveld) will also give some courses in the Faculty of Architecture and Urban Design, though their input will probably not extend to entire semesters or modules. An indication of the importance of education for the URD programme is the fact that two URD staff members – Kees Maat (0.2 FTE) and Dominic Stead (0.4 FTE) – are on secondment to the Faculties of TPM and Architecture and Urban Design respectively. Both secondments also include research.

h. Researchers and other personnel

The composition of the research group is quite broad at the top and rather slim at the bottom: the majority hold a doctorate, while nearly all other group members are working on doctoral research projects. Two PhD students will finalize their PhD investigation during the next couple of years. This means that a new generation of young researchers will have to be recruited, some of them new PhD students. Acquiring funding for this is crucial, and will be a key ambition in 2009. The appointment of a full professor in July 2008 meant that one of our key ambition from the previous programme has been realized. Our next objective, as indicated above, is to get the new PhD projects started.

Table 1 Staff of the research programme and research themes

	Themegroup	
	Spatial Development	Spatial Governance
Prof. Wil Zonneveld	X	X
Dr Dominic Stead		X*
Kees Maat	X*	
Wendy Bohte	X	
Prof. Andreas Faludi		X
Prof. Marina van Geenhuizen	X	X
Eva Heinen	X	
Dr Erik Louw	X	
Dr Evert Meijers	X	
Jody Milder	X	X
Dr Arie Romein	X	X
Dr Marjolein Spaans		X
Dr Jan Jacob Trip	X	X
Dr B. Waterhout		X

*) Theme leader

i. Resources, funding and facilities

We strive to combine various funding flows, with government financing linked to indirect funding and, in certain cases such as European research, to projects in the commercial sector (particularly with regard to the production of international scientific publications).

The lion's share of the research conducted within our programme is interesting from the perspective of the international scientific debate. Accordingly, making a valid contribution to this debate is a priority for which research funds will be generated (within the allocation model currently applied by the university). Dutch national literature will not be neglected, since it is largely through this channel that research results with societal and/or political relevance can be brought to the attention of important target groups.

In order to ensure the continuity of fundamental research, government funding will be applied recursively: Scientific publications generate government funds (within Delft University's current financing structure) which can then be used for new research and new publications. At the same time, considerable effort will be devoted to acquiring funding for innovative research, by such means as the programmes of the Netherlands Organisation for Scientific Research (NWO), the European Research Council and FP7. Areas of research which are promising in terms of their ability to fill the gaps in existing scientific knowledge will be identified, whereupon research proposals (both theoretical and strategic) will be produced in response to the calls for proposals within these programmes.

We expect that commercial funding will become more important during the new research period because of the changing economic climate. In our acquisition efforts we will seek to combine our scientific interests and research objectives with our ability to answer questions that are important to market parties. This means that we will

devote particular attention to the acquisition of funding for scientifically interesting contract research. Potential sources and clients in this respect include the Ministry of Housing, Spatial Planning and the Environment (generally known by the Dutch acronym VROM,) Dutch provincial and municipal authorities, SenterNovem (the agency of the Dutch Ministry of Economic Affairs with a mission to promote sustainable development and innovation both in the Netherlands and abroad), INTERREG, ESPON and various EU organizations (such as the Committee of Regions). Research contracts will also be sought from NGOs and commercial organizations.

4.2 Ambitions for the period 2009-2014

The 2007 research assessment gave us the following scores out of 5:

- Quality: 3.8
- Quantity 4.2
- Relevance 3.3
- Viability 3.1

This represents an average score of 3.6. We would like to pull this up to 4.0 in the next research assessment. That would mean that we had achieved our ambition of becoming international leaders in our field. In terms of our 2007 score, we need to maintain the same good output but work harder to get our papers published in highly rated journals. Above all, we need to work on our relevance and viability. Our research should address issues that matter to society while at the same time being innovative and of long-term academic interest. In view of the knowledge that our research budget will depend on winning a larger share of contract research, these ambitions are quite challenging.

In terms of the content of our research, we seek to contribute to the *scientific debate* on the fragmentation of urban and governance systems and possible ways of dealing with this. Key concepts in our research are polycentricity of urban systems and governance; networked cities including transport behaviour in such cities; economies of agglomeration and innovation of the urban economy; rescaling of governance and governance instruments. Within the boundaries set by research funding programmes we would like to see future PhD research contributing to both main research themes of our programme, spatial policy & governance and spatial development.

In terms of *societal relevance*, we want our research to contribute to the debate about the following topics, amongst others: the changing structure of the *Randstad* – in particular its South Wing centred on Rotterdam and The Hague - and cities in the Netherlands in general; the Europeanization of the Dutch planning system and new planning instruments and planning concepts.

Other ambitions include the following:

- In terms of *networking and cooperation* we want to continue our co-operation with other OTB groups while at the same time intensifying our collaboration with the faculties of Architecture and Urban Design and TPM, especially to acquire funds from national and European research councils and programmes. This cooperation would help to give our research proposals the interdisciplinary nature which is often a prerequisite for success. European research projects generally demand international co-operation.

- We want to maintain our *international network* and keep and even improve our international visibility. Wherever possible we try to acquire international research contracts and projects if our financial conditions allow this.
- Our most important ambition in terms of *personnel* is the maintenance of a PhD group of 2-3 postgraduate students. Because we will depend more on contract research than in the past, we will probably have to recruit a number of junior researchers.
- We have already described to some extent (see above in this section) our ambitions as regards *publication output*: maintain our productivity but get more papers into highly rated journals and find well-known publishers for our books and readers. Because this is important for our visibility in terms of contract research we will increase our effort to publish in professional journals, both nationally (Dutch) and internationally. We would also like to increase the number of our staff members on the editorial board of planning journals.
- We want to finalize 5 *PhD projects* during the current research period: the three already under way plus 2 new ones.

4.3 Description of research programme and research themes

Spatial Development

This theme focuses on how the functioning of the spatial system affects the basic aims of spatial policy, social well-being, economic competitiveness and environmental sustainability. We address this research area with the aid of systems analysis, an approach which has proved useful in the study of complex environments including the urban environment.

The spatial system studied is basically the urban area. The task of defining the urban area has however become increasingly complex due to recent spatial processes resulting in urban fragmentation. For instance, urban sprawl has tended to disperse housing and employment away from towns and cities during recent decades. At the same time, there was a huge policy effort to retain cohesive city districts (*stadsgewesten*), which changed in the 1990s to a drive for monocentric, compact urbanization.

Of recent years, however, many authors in the spatial planning literature have maintained that societal and economic changes are leading to the development of a network society (e.g. Castells, 1996). The argument is that the actions of individuals and businesses take place in networked spatial structures, where living, working, leisure and amenities are becoming increasingly disconnected from one another. In addition, the spatial scale on which activity patterns manifest themselves is expanding, which means that actors are down-playing the importance of proximity in favour of nodes that are optimally situated to enhance network connectivity (Hajer & Zonneveld, 2000). The next step in the argument is that, as a result of this process, urbanization no longer manifests itself primarily as an expansion of more or less monocentric cities, but rather as a more complex spread of urban and peripheral nodes (Anas et al., 1998; Reijndorp, 2002); this process is commonly referred to as polycentric or network urbanization (Hall, 1997; Kloosterman and Musterd, 2001; Davoudi, 2003). This transition to interconnected polycentric urban regions may even lead to the merging of separate towns and villages to form continuous conurbations, thus blurring the formerly well-defined boundaries between urban and rural areas.

Our study of spatial development theme focuses not primarily on the process of physical development but on the developing behavioural patterns. To this end, we investigate how urban structures and dynamics, in particular network structures, in-

fluence (spatial) behaviour in a way that makes urban areas more economically competitive and environmentally sustainable, thereby increasing the well-being of its inhabitants and visitors. In other words, we investigate the extent to which companies and households reach their objectives, within the limits set by the requirements of environmental sustainability.

In general, our studies focus on the behaviour of individual urban actors, including residents, visitors and employees, and on that of organized groups of individuals such as households, companies and institutions of various types. Actors engage in various activities to reach their goals. Individual activities include visiting locations for work, amenities, shops, leisure, and so on, including the travel needed to bridge the distance between the different locations. Company activities include production, networking and travel. Individual or group behaviour can be aggregated into processes, spatial patterns and flows. Spatial patterns include location patterns and production networks, while flows refer e.g. to the transport of goods and the transfer of information. Such behaviour is generally difficult to explain when examined at an aggregate level. In the interests of better understanding, it is better to study developments at the actor level, such as location decisions, relational patterns (covering all the relations an actor maintains), activity patterns (grouping all the activities an actor participates in over a given period of time) and the related travel patterns, and company strategies. The interaction between spatial behaviour (or spatially relevant behaviour) and the physical environment in which the behaviour takes place is important for our research.

The relationships *within* the spatial system are said to be endogenous. However, the dynamics of the spatial system mainly have their roots outside of the system and are thus exogenous. The point of departure of our research on this theme is the increasing complexity of society, including demographic, economic, cultural, technological, environmental and governance trends. These concepts do not only refer to autonomous processes, but also to policy interventions. Exogenous influences on the urban spatial system include globalization, European governance, technological advances (in particular in such fields as IT and transport systems) and environmental problems such as climate change. The effects produced by the spatial system which we focus on in our research are individual well-being, economic competitiveness and environmental sustainability. The criteria for the assessment of the effects are determined by the spatial planning system, while the effects assessed also form the input for this system, which is discussed in greater detail in section 3.2 below.

Within the spatial system, we distinguish subsystems, of which we investigate three, namely (i) network cities and agglomeration advantages, (ii) interaction between the built environment and travel behaviour, and (iii) companies as competitive agents. Within each area, our research efforts focus on explaining how societal and spatial processes and spatial governance concepts influence spatial behaviour or spatial related behaviour and spatial patterns, with special reference to competitiveness, sustainability and well-being.

Network cities and agglomeration advantages

Cities exist because of agglomeration advantages. They provide public amenities and facilities, specialized products and services, a large and diversified urban market and easy exchange of information. Generally, the larger the city, the greater the extent to which agglomeration advantages have developed. However, these advantages have their limits: agglomeration disadvantages also increase with the size of cities. Examples include traffic congestion, social segregation, crime and environmental pollution.

Empirical studies of such agglomeration advantages and disadvantages traditionally focus on single cities. However, this focus is becoming less relevant in many countries as formerly self-contained cities increasingly become interconnected with neighbouring cities to form ‘polycentric urban regions’ (PURs) – also referred to as ‘urban networks’ in the policy literature. It has been suggested that the agglomeration advantages in PURs are proportional to their combined size, while the agglomeration disadvantages would remain limited to the size of the individual cities that go to make it up. This claim, however, has never been empirically validated. Past research, carried out by Meijers (2007a; 2007b), and more recent investigations by our group address this issue of the agglomeration advantages and disadvantages of clusters of cities. They focus on the development of agglomeration advantages and disadvantages in PURs over time, and the comparison of these with single cities. The factors that foster or hamper the development of agglomeration advantages and disadvantages in PURs are explored and unravelled. Further analysis concentrates on explaining why certain PURs perform well in this respect and others do not.

Our research is relevant to the contemporary academic debate on various issues. Firstly, there is the issue of agglomeration economies which has been attracting renewed interest recently. We contribute to this debate by exploring the role played by spatial structures and networks and by studying the new idea of ‘network economies’. A second topic highlighted by researchers is that of polycentric urban configurations. We examine polycentric and networked urban structures from a critical and empirical point of view, and aim to explore many of the claims made for polycentric urban regions which have not yet been empirically verified. The societal relevance of our research lies in exploring the benefits, costs and challenges associated with polycentric urban regions, which as remarked above are becoming increasingly important in most advanced economies.

Our research focuses particularly on the development of agglomeration advantages and disadvantages in PURs, which we define as collections of historically distinct and both administratively and politically independent cities located in close proximity, well connected through infrastructure and lacking one dominant city (Kloosterman & Lambregts, 2001). Classic examples include the Dutch *Randstad* and the Rhine-Ruhr metropolitan area in Germany, but many more urban regions, often of a more modest size, also fit this definition.

Empirically, the claims for PURs lack substantiation and are in need of empirical validation (Kloosterman & Musterd, 2001; Parr, 2004; Turok & Bailey, 2004). As empirical studies of agglomeration advantages tend to be traditionally focused on single cities, little is known about the extent to which cities in PURs can ‘borrow’ size from each other. This unresolved but strategically vital issue of whether agglomeration advantages can also develop in PURs (Lambooy, 1998) lies at the heart of our research programme.

Travel behaviour and urban form

One of the most striking societal problems related to land use is the turbulent growth of travel caused by the spread of activities and the supply of new transport possibilities. Our welfare is closely related to the ability to travel wherever we want. Travel is also important for society as a whole, as it enables people to engage in social and economic activities. On top of that, people derive benefits from travelling itself, such as a feeling of freedom, status related to the type of car one drives, or health related to cycling. However, travel is also associated with adverse externalities. The loss of accessibility through congestion and parking problems not only directly hinders individuals but also reduces the economic performance of urban areas (OECD, 2006).

The trends observed in the Netherlands are similar to those in other urbanized countries: a steep rise in car ownership and distance travelled by car, mounting traffic jams in urban areas and more and more kilometres being driven on congested roads (Hilbers et al., 2006; KiM, 2007). Furthermore, transport has a direct impact on the quality of the environment, and is hence largely responsible for the current poor levels of air quality, noise and safety. The recent debate on climate change (TRB, 2003; EC, 2007) and the need to reduce dependency on fossil fuels has increased the importance of these issues, while also the adverse effects on health of living in car-dependent neighbourhoods has also received considerable attention (Handy, 2002).

Among the strategies that could be used to solve these problems, the idea of manipulating the built environment seems to offer many possibilities since the spatial structure of housing, employment, services and leisure creates the context within which people travel. Assumptions about the ways in which travel behaviour might be influenced by manipulating urban form have found their way into diverse planning and design approaches such as the compact city policy, the recent policy on network cities, and the American neighbourhood design principles usually referred to as 'new urban design' (TRB, 2005). However, intervention in the spatial structure in order to influence travel patterns is not an easy option. Changing the spatial structure of the built environment requires long-term planning, is extremely costly, will have to last for generations and, once developed, will not be easy to modify or adapt (Van Wee & Maat, 2006). It is therefore crucial to determine whether spatial concepts really are effective in influencing travel behaviour before we embark on such schemes. Although the argumentation behind more compact urbanization seems rational, other mechanisms complicate human behaviour and may counteract the potential effects of urban form. As the relationship between the built environment and travel behaviour is very complex (see e.g. Arentze & Timmermans, 2004; Bhat and Guo, 2007), persuasive research provides more than simple associations and aims at unravelling the links between individual travel decisions and the characteristics of the built environment. Most recent research takes an activity-based approach, investigating not only separate trips but also daily activity patterns (Arentze & Timmermans, 2004; Maat et al., 2005). It has recently been suggested that in the context of residential choice households do not always align their travel behaviour with the urban form but may choose an environment that facilitates their travel preferences. This selection mechanism could then lead to a kind of reverse causality (see e.g. Mokhtarian & Cao, 2008; Bohte et al; 2009). Longitudinal research based on longer-term surveys is needed to resolve such causality issues. Research in this field is closely related to attitudinal theories (e.g. Ajzen, 1991).

The challenge facing researchers in this theme group is basically to provide knowledge that will facilitate the design of urban locations to permit households to travel as sustainably as possible while performing their desired activity patterns. Promising research will analyse and develop urban forms and structures that encourage environmentally friendly, energy-efficient or healthy travel behaviour. Such research may focus on urban designs, but also on spatial issues relating to sustainable travel options – such as Heinen's study on commuting by bicycle, or studies on alternative fuels for cars. We work together with TPM's department of Transport for our analyses of travel behaviour, while research on urban design requires further links with the Faculty of Architecture's department of Urbanism.

The role of companies in economic competitiveness

Western cities increasingly depend on their capacity for rapid and permanent innovation to remain competitive; this process requires creativity and the valorization of knowledge. Our research in this field encompasses two main approaches:

1) a business-oriented approach, which focuses on the behaviour of innovative or creative companies, entrepreneurs and knowledge institutions (Storper, 1997; Scott, 2000; Storper and Venables, 2002).

2) a people-oriented approach, which argues that jobs follow people (capital follows labour), that it is therefore important to attract and retain creative and innovative talent and that this requires quite specific urban qualities ('quality of place'), amenities and intangibles such as tolerance and authenticity (see Landry, 2000; Clark, 2004; and particularly Florida, 2002).

Both these approaches may be followed on a macro (city/region), meso (cluster, zone) or micro (company, entrepreneur) scale. Our research theme includes both approaches, and aims to study the relation between them on various scales, as well as their implications for local governance.

Firstly, Prof. Van Geenhuizen leads a business-oriented line of research in cooperation with the Faculty of TPM (see e.g. Soetanto and Van Geenhuizen, 2007). The focus is on the relevance of agglomeration/cluster advantages for growth and innovation and the spatial scales involved (cf. Van Geenhuizen, 2007a/b). There is a lack of understanding of the extent to which production and valorization of knowledge and creative ideas occur in the same city or urban region, and which factors influence the spatial patterns concerned. Knowledge valorization as a learning process is determined by the needs and capabilities of the actors involved, and by characteristics of the spatial environment (supply of necessary resources) such as core-periphery differences and city size. We need to determine the extent to which knowledge valorization is local or regional, whether the benefits of this valorization are enjoyed in the city or region where it is produced or externally to it, and which instruments could increase local or regional benefits. Finally, we need to understand more about the specific mobility needs of knowledge-based companies (concerning production activities and the travel requirements of employees) and the extent to which these companies are able to reduce their demand for transport; this question is related to the travel studies theme discussed in the previous subsection and interfaces with the discussion about the extent to which face-to-face communication can be replaced by electronic communication.

A second line of research – partially in cooperation with the Faculty of Architecture and Urban Design – mainly follows a people-oriented approach (Trip, 2007; Romein and Trip, 2009). Recent research focused on the assessment of quality of place and its role in urban redevelopment; the key elements of the creative city, both from a business-oriented and a people-oriented perspective, and their role in local policy; and the production and consumption of knowledge in university cities. The results of this research indicates that the importance of the symbolic value of amenities and places is increasing, and that society in general – and urban planners in particular – need to pay more attention to intangible urban qualities. This line of research will be continued by applying a 'scenes' approach – an innovative socially structured analysis of the role of clustered amenities in urban growth (Silver et al., 2007). We will explicitly add a spatial dimension to this, however. Relevant questions address the location of these amenities and their users, the relations between clusters of amenities, their importance to economic and population growth and their relation to the key elements of the creative city. This research will be conducted in cooperation with the University of Chicago.

Current research typically takes either a people-oriented or a business-oriented approach at one specific scale. However, to become truly competitive, cities must combine both approaches at various scales, for example because innovative entrepreneurs are unlikely to succeed in an innovation-unfriendly urban climate. Hence, we aim to combine these two lines of research in specific projects, to study the relation between people- and business-oriented aspects of innovation, knowledge valorization and creativity at various scales. This adds another significant innovative element to the research.

Spatial Governance

Spatial planning in the Netherlands, as in other countries in Europe and beyond, is under pressure to change from a number of directions. Factors such as globalization, demands for sustainable development and economic competitiveness, European integration, economic reforms and demographic change are all reshaping planning policies, practices and processes. At the same time, the scale and scope of spatial planning are also being redefined. Consequently, spatial planning has recently undergone, and is still undergoing, various reforms across many countries in the world, which makes research in this area both dynamic and challenging.

A number of important developments in the focus of spatial planning can be identified. The 1980s witnessed changes to spatial planning in the direction of greater flexibility, the relaxation of rigid zoning rules and the wider use of conservation designations. In the 1990s, changes included trends towards a pro-active, strategic approach based on strategically oriented plans, often in response to environmental concerns (Healey & Williams, 1993). Spatial planning in the first decade of the 21st century has experienced a move towards more collaborative and communicative forms of planning, especially in Western Europe (Adams, 2008). Whilst some pressures and changes are common to many countries, others are more specific to particular countries or groups of countries. In the Netherlands, there has been a shift from welfare state spatial planning to development planning (Zonneveld, 2006), France has experienced a significant change from top-down to bottom-up governance of spatial planning (Loughlin, 2007) and the United Kingdom has witnessed a move away from planning as a 'welfare profession' serving the public interest to a view of it as a skills-based profession providing a service (Evans, 1995).

The governance of spatial planning, like many other areas of public policy, is experiencing significant changes. Lidström (2007) points to four recent changes in territorial governance: (i) the redefinition of the role of the nation state; (ii) the strengthening of lower levels of self-government; (iii) the increased diversity, variation and even asymmetry between how territories are governed within the nation state; and (iv) the increased marketization of the public domain. Alongside these changes, spatial planning is becoming increasingly polycentric and fragmented: power is becoming more dispersed between different territorial scales and different agencies. Whilst the notion of polycentric governance is not new (see for example Ostrom et al., 1961), it currently represents a key issue facing the governance of spatial planning. Within the Netherlands and many other countries in Europe, multi-level governance is often the norm, involving continuous negotiation between nested governments and other bodies at several territorial levels, from supranational to national, regional and local. The consequence of multi-level or polycentric governance (coincident with the 'Type II' model of governance proposed by Hooghe & Marks, 2003) is that different jurisdictions exist for different areas of policy according to the nature of the policy sector or problem being addressed. According to Hooghe & Marks (2003), this type of governance is particularly prevalent in densely populated border regions in Western

Europe (and the United States). Consequently, a polycentric governance model would appear to be particularly important for the Netherlands.

Transnational influences on spatial planning are growing and have been accentuated by the processes of European integration (Sykes, 2008). Planners across Europe are now routinely involved in trans-boundary cooperation networks and inter-regional collaboration initiatives and thus subject to foreign experiences and exposed to a variety of planning approaches from other Member States (Dühr et al., 2007). The EU's INTERREG programme, for example, has facilitated cooperation between regions and actors, and has acted as a stimulus for Europeanization processes (Dühr et al., 2007; Waterhout, 2007). The Europeanization of spatial planning has contributed to the emergence of transnational spatial planning practices, the diffusion of certain spatial ideas across European countries and changes in the domestic patterns of spatial planning and regional policies, both in terms of approaches and institutional capacity (Böhme et al., 2004; Dabinett, 2006; Dabinett & Richardson, 2005; Giannakourou, 2005; Janin Rivolin, 2003; Janin Rivolin & Faludi, 2005; Pedrazzini, 2005). There is however little evidence to support the notion that spatial planning in Europe is converging. The effects of these Europeanization processes have been felt in different ways in different parts of Europe.

Members of the theme group are principally active in the following three closely interrelated research areas: (i) the evolution of spatial planning systems and practice; (ii) the spatial implications of European policies; and (iii) comparative planning methods. These three sectors are discussed in some detail below. A number of important issues cut across all three lines of research; the chief of these are sustainable development and regional competitiveness, which have already been discussed at length in connection with our spatial development studies in section 3.1 above.

The evolution of spatial planning systems and practice

This area of research focuses primarily on the changing nature of spatial planning in the Netherlands at the national and sub-national levels. This includes investigation of new planning instruments and their operation, the changing role and status of visions in planning amongst others in relation to operational decision-making, the emergence of new planning concepts and techniques, and the implications of changes in planning legislation and competences including the need for new forms and methods of 'meta-governance'. In addition to retrospective and evaluative studies, attention is also focused on prospective research in which the possible future character and role of spatial planning is explored. In this area of research, a distinction is made between strategic and operational planning, drawing on Faludi & Van der Valk (1994) who define strategic planning in terms of a broad approach involving fewer routines (and preceding operational planning), and operational planning in terms of '*prescribed search patterns... less complex problems and... more routine work*' (Faludi & Van der Valk, 1994, p. 3). The theoretical underpinning of this research area also includes theories of the application and performance of spatial planning (e.g. Mastop, 1997; Mastop & Faludi, 1997; Mastop & Needham, 1997). The research area has direct links with teaching in the Faculty of Technology, Policy and Management, particularly the MSc course in Systems Engineering, Policy Analysis and Management (which offers a specialization in Spatial Development) and also in the Department of Urbanism of the Faculty of Architecture. The research group has a strong national reputation in this area and a growing international reputation, both in terms of publications and involvement in collaborative research projects (e.g. various ESPON projects).

The spatial implications of European policies

A number of members of the theme group are actively engaged in research concerning the impact and implications of European policies (in particular on transport and regional development), policy concepts (such as polycentricity, urban-rural relationships and the European Social Model), policy processes (e.g. the Open Method of Coordination) and transnational and cross-border initiatives (such as the European Spatial Development Perspective and INTERREG/ETC), all of which can affect spatial planning in the Netherlands at the national, regional or local level. Research in this area employs methods such as case studies, discourse analysis and stakeholder interviews as well as other more quantitative analytical techniques. The theoretical basis of this research area includes theories of the application and performance of spatial planning (e.g. Mastop, 1997; Mastop & Faludi, 1997; Mastop & Needham, 1997) and theories on the Europeanization of national policy systems and practices. The research area has direct links with teaching in the Faculty of Technology, Policy and Management, particularly the MSc course in Systems Engineering, Policy Analysis and Management, which offers a specialization in Spatial Development. The research group already has an international reputation in this area, both in terms of publications and involvement in collaborative research projects (e.g. ESPON and INTERREG projects).

Comparative planning methods

Here attention is focused on developing and testing cross-national methods for comparing and assessing spatial planning systems and practice. Whilst comparative research is a well-established method of enquiry in the social and political sciences, it is less well developed in relation to spatial planning. The relations between welfare systems, planning systems and planning cultures and their parallels are of interest, especially in making links with welfare typologies (see e.g. Esping-Anderson, 1990). Also of interest are the debates about the changing nature of territorial governance and spatial planning (Loughlin, 2007), the convergence of European planning systems and the various effects of Europeanization processes on planning (Dühr et al., 2007). The transferability of policies, concepts and procedures is another aspect of this research area, drawing inspiration from literature on lesson-drawing (e.g. Rose, 2005) and policy transfer (e.g. Dolowitz & Marsh, 2000). This area has clear links to research activities in a number of other sections within OTB that are also involved in comparative research in related fields such as housing policy, urban regeneration, land law and property rights, and within the Faculty of Architecture where methodologies for comparative planning studies feature in both teaching programmes (e.g. European Master's degree course in Urbanism) and research (e.g. the Randstad research programme within the Department of Urbanism and the Urban Area Development research programme within the Department of Real Estate and Housing). The research group has a growing profile in this area.

The following questions summarize the research focus and direction of the spatial governance theme group:

- What is the future of strategic planning and where is spatial planning heading?
- How are the governance and content of spatial planning changing?
- What are the effects of European policies, concepts and processes on spatial planning?
- What are the best ways of comparing spatial planning governance and instruments?

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5 Neighbourhood Change and Housing

5.1 Introduction

a. Mission and research area

Neighbourhood Change and Housing is the research programmes of the OTB's department of Urban Renewal and Housing. It concerns the ways in which residential districts are ordered, organized and lived as everyday realities in a changing urban world. We study how changes on various scales impact *on* neighbourhoods. We also investigate everyday life changes *in* neighbourhoods, and how such changes affect the social structure and cohesion of urban neighbourhoods. We develop this approach to the neighbourhood as research subject and research site along three thematic or analytical pathways: neighbourhood stratification; neighbourhoods as changing social sites (where we study the ties between neighbourhood residents and what the neighbourhood means to them); and neighbourhoods as sites of governance and civic action. Throughout, the emphasis is on research at the interface of science, policy and practice.

b. Relationship with previous programme

The Urban Renewal and Housing research programme for the period 2003-2008 was structured around the various ways in which urban districts change. That is still a central focus of our programme. Based on our experience over the previous years, we have fine-tuned this broad theme into the three above-mentioned sub-themes.

We continue to study neighbourhood change with neighbourhoods as the unit of analysis. In our previous investigations, we asked what caused a neighbourhood to change (within the city hierarchy, in terms of demography or the social integration of its residents, see Logan & Molotch 1987; Galster 2007a, 2007b and Van der Laan Bouma-Doff 2007 respectively). We value such studies for their focus on structural processes and perspectives of political economy and continue to work along the same route, whilst constantly asking ourselves what we mean by 'neighbourhood' apart from an aggregate of individual households.

In this new programme, we also include the study of neighbourhoods as places that are made through people's actions and the interactions between them and as places with a constantly changing significance (De Certeau 1984; Harvey 1988; Massey 1999; Shields 1991; Wright 1986; Blokland 2001). We further take cognizance of the fact that neighbourhoods are increasingly being seen as 'conceived space', 'perceived space' and 'lived space' (see Lefebvre 1991; for an overview, see Hubbard et al. 2004: 210-13).

Apart from studying the significance of 'the neighbourhood' for matters such as social networks, identification and social interactions, we thus also consider conversely how social networks, processes of identification and disidentification, social interaction, institutional change and politics combine to define the meanings of 'place' – and in the present case of neighbourhoods – given the contexts in which such processes operate.

We have rephrased our focus on policy and policy processes by asserting that processes of government and governance impact on both the stratification of neighbour-

hoods and on their meaning, so that policy processes are an integral part of our research programme. We assign a special place to questions that address neighbourhoods not as statistical units nor as socially constructed places as indicated above but as crossroads of institutions in the broad sense².

In summary, then, our new programme differs from the previous programme in three ways:

1. We move from a focus on how and why neighbourhoods change towards the study of the social, economic and political *processes* that affect the positioning of neighbourhoods in a stratification of places.
2. We move from a focus on the meaning of neighbourhoods for their residents towards the study of how social interaction within a neighbourhood creates such meaning.
3. We move from a focus on policy processes and their organization towards the study of how neighbourhoods, situated as they are at crossroads of institutions, provide (or do not provide) *foci for change* in terms of individual and household mobility and especially in terms of providing collectivities of many sorts with a context for action.

c. Scientific relevance

Our programme derives its academic relevance from three of its core elements.

Firstly, we seek to contribute to some of the central current debates in the broad field of urban studies. In particular, we will use our strong empirical data on segregation, gentrification, social mix, social capital and social networks, and public space to test current theories on these themes, and to critically engage with existing theories.

Secondly, our programme moves beyond the duality that can at times be seen in urban studies. Certain scholars take neighbourhoods as self-evident units of (often statistical) analysis. While some authors acknowledge the constructed nature of neighbourhoods at the beginning and end of their publications, this has few consequences for either analyses or results. Others aim to understand the processes and mechanisms that affect the social cohesion³ of urban settings, often by case study based qualitative analysis of entities such as ties, individuals or social groups rather than neighbourhoods. They risk ignoring, or only superficially admit, the relevance of larger structural processes and regional and local politics, which often affect neighbourhoods or even whole cities. Ideally, both perspectives should be combined. This poses methodological and theoretical challenges, but it is precisely the steps taken to deal with these challenges that will give our programme academic relevance.

Thirdly, in social sciences and geography alike (see Savage et al. 2005, Lofland 1998, Massey 1991, 1995), as well as in some urban planning (Healey & Barrett 1990, Healey 1999, 2006) and housing studies (Jacobs 2001, Jacobs *et al.* 2003, see Blokland 2009b for a more detailed overview) there is a growing recognition that space is not a fixed 'thing' (cf. Hubbart, Kitchin and Valentine 2004 for an overview or).

The notion of space as a given has been replaced by a notion of space as constructed, through structural processes of the political economy and/or through interpretative social construction. This understanding has remained largely at a theoretical level, with limited translation into actual empirical research. It hardly influences research

² While the word 'institution' generally means some kind of organization in everyday language, we follow sociological usage here by referring to institutions as any pattern that has become institutionalized through repeated use and confirmation; see Zijderveld (1990).

³ Meant in the original sense of ties holding the social together.

that is not purely academic in its scope and nature. Our programme aims to contribute to the debate on social space precisely by embedding this notion of constructed space more thoroughly in empirical, strategic and policy-oriented research. This approach may help to pinpoint the limitations of urban theory: while some of the currently popular ideas on the construction of social space may be innovative and brilliant, what, if anything, is their contribution to everyday research and practice? In short, urban theory seems too little aware of policy, while policy studies do not engage enough with urban theory. We hope that our research programme may make a modest contribution to bridging this gap on both sides. It finds its strength in providing a theoretical underpinning for research problems, urban policies and programmes, and making study findings clearer and more understandable for policy-makers and practitioners. In short, our scientific relevance goes beyond theory to the world of practice.

d. Societal relevance

It goes without saying that urban neighbourhoods in today's big cities and smaller towns alike face the challenges of modernization and globalization that impinge on many everyday concerns, problems and chances. On the one hand, many neighbourhoods are no longer the focus of everybody's daily routines. On the other, they are still the loci of the most intense experiences of change and diversity.

This is increasingly so now that neighbourhoods that used to be predominantly mono-ethnic working class or lower middle class in their demographic profiles are becoming more mixed in race and ethnicity and, more recently, in social class. Migration has made a big contribution to the increase in racial and ethnic diversity for a few decades now, but the relevance of such trends gained enhanced societal and political relevance in Holland at the beginning of the 21st century.

Economic growth has given a large group of residents substantially higher incomes, resulting in higher qualitative housing demands and an increase in the demand for owner-occupied dwellings (Ouweland 2002). This demand has led to much greenfield development and the selective migration of middle and higher income groups out of the city. Lower income groups and newly arrived migrants have had to find a home in rental accommodation in the older neighbourhoods, especially those built after the Second World War which consist predominantly of social rental housing. These areas have rapidly changed in ethnic composition, and this has sometimes generated interethnic tensions. As such neighbourhoods seemed to lack the political attention the residents felt they deserved, this also led to major alienation from mainstream politics and a sharp increase in support for radical populist ideologies in the 2002 Dutch elections (Uitermark and Duyvendak 2008). The plight of these neighbourhoods had long had the attention of the local authorities, but it was the unprecedented public awareness of recent years that forced central government to introduce an enhanced neighbourhood development programme in 2002. Ethnic integration became one of the new explicit goals of the government's housing and urban renewal policy. This policy has been elaborated and strengthened by the new government elected in 2007, based also on pleas from two government advisory boards, the WRR (Scientific Council for Government Policy) and the *VROM-raad* (Advisory Board to the Ministry of Housing, Spatial Planning and the Environment) (see WRR 2005, *VROM-raad* 2006).

Obviously, the public relevance of and concerns about ethnic, racial and class divisions in the city and the political attention for a neighbourhood approach and area-based initiatives justify part of the focus of our programme. This ties in with the current desire to reinvent community and cohesion at the local level, combined with

widespread uncertainty about what community and cohesion really mean and what actors like housing associations and local government can do to enhance them.

There are two other immediate ways in which our programme is relevant to society at large. Firstly, the huge investments made by governments and other parties such as housing associations and private developers (both in the Netherlands and elsewhere in Europe) in the physical fabric of neighbourhoods are at least partly based on expectations about the social outcomes at the neighbourhood level that these investments will produce. While there is good, solid research to substantiate some of such expectations, this is not the case for all of them. Our programme will help generate knowledge about the preconditions, supporting contexts and barriers to the desired social outcomes.

Secondly, there is growing awareness in government and among other parties such as housing associations, developers, practitioners and residents that physical renewal alone is an insufficient response to challenges in urban neighbourhoods. For sustainable, liveable neighbourhoods physical and social interventions should be combined. There is general consensus for this need. But the precise ways in which to achieve such a combination are not easy to conceive. The general awareness of the lack of knowledge that still exists in this field leads to great interest in research findings and support from housing associations and other national institutions for new research programmes.

Our research will provide some of the much needed frames of reference and conceptual tools that will help professionals, practitioners and residents to sharpen their views on ‘social-physical’ planning (as it is commonly called in urban policy circles) without prescribing what such views should be.

Finally and most concretely, we present an integrated approach to a number of pressing issues for those working in neighbourhoods, providing both background or contextual knowledge and new empirical projects on issues like residents’ housing choices, patterns and causes of residential segregation, resident participation and collective efficacy, social integration, neighbourhood cohesion and social capital.

e. Synergy between fundamental and applied research

In contrast to the more technical oriented ‘hard’ scientific approach taken by many other research programmes within the Delft University of Technology, we make no distinction between what is sometimes called fundamental and applied research. Some of the research we have done and will do for customers in the commercial market will be highly practical and not academic in its scope. We will continue to strive to acquire research projects that are broad enough to have academic relevance even in the market, without detriment to their theoretical and methodological soundness.

Even in our more theoretical studies, our research is based on the premise that the disciplines from which we work are empirical in their very core: hence, we combine empirical work and theory in all our endeavours. Conversely, our applied research is based on the premise that thinking and careful conceptualization (including thorough literature studies) are essential even in our approach to the most apparently applied questions.

f. Internal and external collaboration

Relationship with the themes of other research programmes within OTB

The Neighbourhood Change and Housing research programme has several points of convergence with other themes of OTB research, including development of housing

systems, housing preferences, strategic housing stock policy and technical management, and sustainable and healthy housing.

Neighbourhood change cannot be considered in isolation. The research group welcomes collaboration and wishes to make use of the expertise of the members of other research groups within OTB and the wider TU Delft community, and wants to contribute to other research programmes as well. At present, this collaboration happens at the following four levels, on a pragmatic and incidental basis.

Firstly, there is collaboration in different research projects. Investigation of the relation between home ownership and empowerment of recent years has brought researchers from our group together with colleagues from the Housing Systems research group to permit application of a combination of different research methods to this topic. The first phase of this research was completed in 2008, and indicated that the empowerment of tenants brought about by sale of rental stock had been overestimated. These results have been discussed at an international conference, and joint proposals for continuation of the project have been formulated by our group and Housing Systems. Another example was the collaboration between our group, GIS Technology, Governance of Geoinformation & Land Development and Housing Systems some years ago on contract research concerning the delimitation of neighbourhoods. We will look to ways of expanding this collaboration with other departments in coming years.

Secondly, we collaborate with colleagues within OTB on joint authorship of papers and publishing of books.

Thirdly, we have been working with other departments of OTB in broader research programmes as the Delft Centre for Sustainable Urban Areas and will continue to do so in the future.

A fourth level of collaboration, of a more casual nature, is participation in discussions and seminars organized by other research programmes and opening our seminars, for instance the AA and B&B sessions to colleagues from other departments.

Relationship with research programmes outside OTB

External collaboration takes place at various levels.

Firstly, we work together with the department of Urbanism of the Faculty of Architecture. The full Chair of our programme will be appointed by the department of Urbanism; the holder of this Chair will work in our department but will also teach courses in Urbanism.

Secondly, we work together with colleagues from OTB and several Delft faculties such as Architecture (and in particular its department of Real Estate and Housing) in the Delft Centre for Sustainable Urban Areas. This has resulted in the publication of an English academic book on sustainable neighbourhood transformation (Gruis et al. 2006); at least two other joint books are listed for 2009.

Thirdly, we collaborate with other Dutch universities in the NETHUR Graduate School for Urban and Regional Studies. Members of our staff take part in the annual 'Day of the City', organize NETHUR workshops, teach classes in the NETHUR graduate programme and participate in other NETHUR activities. NETHUR provides a basis for informal exchanges with other Dutch scholars and offers further opportunities for co-authoring papers and books. As one of our activities in the context of NETHUR, we will work with the Faculty of Architecture's department of Urbanism to organize a two-day international NETHUR seminar on Public Space at Delft in 2009. It will bring together scholars from such diverse fields as architecture, urbanism, sociology, urban geography, cultural anthropology and spatial planning.

A fourth level of collaboration is formed by work we do with other universities in joint research projects organized by the NICIS Institute and similar projects within the framework of the 'Platform Corpovenista' and the government-backed BSIK research programme on the development of knowledge infrastructure (which is coming to an end in 2009). The work for NICIS has allowed us to form partnerships with the Universities of Amsterdam, Utrecht and Tilburg and with Erasmus University Rotterdam. The current work for Platform Corpovenista builds on the experience gained in their previous research programme, which was rounded off in 2008 with a well attended national conference and a book (Ouweland, et al. 2008). This platform of a number of large Dutch housing associations and Aedes, the federation of housing associations in the Netherlands, has been funded to develop and disseminate knowledge on neighbourhood change through research projects, reflection, seminars and the like. This platform will be supported by our staff. The successful large-scale BSIK 'Innovative Space Usage' research programme, undertaken by Habiforum between 2004 and 2009, will be completed in 2009. This programme encouraged the formulation of several long-term research projects of which six involved our group. Fifthly collaboration also exists with other universities in the co-supervision of the PhD-thesis of Wenda van der Laan Bouma-Doff with Prof. Sako Musterd (University of Amsterdam) and Peter Boelhouwer and of the thesis of André Ouweland with Prof. Jan Willem Duyvendak (University of Amsterdam) and Peter Boelhouwer. A sixth level of collaboration is found in the participation of different members of our staff in the European Network for Housing Research ENHR and its various working groups. Some of our staff have functioned as coordinators, and will continue to do so in the future.

In addition, several staff members participate in editorial boards of national and international journals (*St&RO* and *Vitale Stad* [Vital City] in the Netherlands, the *International Journal for Urban and Regional Research, Sociology, and City* at the international level) and act as peer reviewers for such journals.

g. Relations with education

So far, our group has made only a small contribution to education at Delft University of Technology by teaching a Master's course on urban restructuring. We will seek to enlarge this contribution, and hope that the establishment of a Chair in Neighbourhood Change will give a major impetus in this direction. Occasional guest lectures are given and Master's students are being supervised by our staff, not only at Delft but at other educational institutes in the Netherlands (University of Utrecht, Erasmus University Rotterdam, Hogeschool Rotterdam), both in normal Master's courses and in Master's Courses for post-graduate students and in other similar courses.

The department organizes an annual four-day post-graduate course on the restructuring and management of neighbourhoods (for the benefit of professionals in the field) as well as a course looking at aspects of allocation of social housing. We intend to expand this activity in coming years.

h. Researchers and other personnel

Table 1 Staff of the research programme and research themes

	Themegroup ³⁾		
	Neighbourhood stratification	Neighbourhoods as changing social sites	Neighbourhoods as sites of governance
Carlinde Adriaanse	X	X	
Saskia Binken		X	
Prof. Dr Talja Blokland** 1)	X	X	X
Eva Bosch	X	X	X
Dr Alexandra Curley	X	X	
Gwen van Eijk		X	
Dr Reinout Kleinhans	X*	X	X
Wenda van der Laan Bouma-Doff	X	X	
Dr Marco van der Land	X	X*	
André Ouwehand** 2)	X		X*
Ton van der Pennen	X	X	X
Leeke Reinders	X	X	X
Mariska van der Sluis	X		X

*) Theme leader

***) Programme leader

1) Up to February 2009

2) Temporary theme leader from 2009

3) The theme groups are not strictly separated, participation is dynamic, see page 110

i. Resources, funding and facilities

The Neighbourhood Change and Housing programme aims to conduct research at the interfaces of science, policy and practice. This desire is reflected by the working methods adopted. The long-term research programme has been drawn up with a view to attracting long-term funding. Participation in NICIS projects and the Platform Corpoventista research programme (mentioned in section 1.7 above), in which the group plays a prominent role, will do much to help us achieve our mission. In addition, the department has successfully developed a number of areas within which contract research can be acquired. We also intend to seek European funding and funding from the NWO (Netherlands Organisation for Scientific Research). Participation in long-term research projects has helped us to attract postgraduate researchers and to include doctoral research projects in our research programme.

5.2 Ambitions for the period 2009-2014

Our main ambitions for the coming research period are listed below. Some of these go further than our ambitions for the previous research programme, such as the aim to increase the volume of our academic publications. Others are unchanged, such as the ambition to appoint a Chair to spearhead our research programme. We want to emphasize that these ambitions are strongly related: we believe that we will only fully succeed as primary conditions as appointing a Chair – which was strongly recommended by the last review committee – are realized.

- a. Appoint a Chair to increase the level of academic leadership and further strengthen the coherence of our work.
- b. Enhance our academic reputation, through more and more influential publications in international peer-reviewed journals than realized in the previous research period (relative to the number of staff).
- c. Pro-actively generate research funding from the market that fits our research agenda.
- d. Maintain a middle ground between what is 'hot' in academia and what matters most in society outside the university.
- e. Strengthen our thematic focus, revitalizing the discussion culture in theme groups to advance one another's work, and intensifying and broadening our international cooperation.
- f. Increase the proportion of researchers with a PhD in our department.
- g. Seek funding for a larger number of PhD students.
- h. Consolidate and strengthen our academic research culture by organizing brown-bag debates (lunchtime discussions) on literature classics and recent articles (our so-called B&B's and AA's), by initiating and organizing seminars conferences, including NETHUR courses for PhD students, inviting guest researchers, etc.

5.3 Description of research programme and research themes

General framework: why do we study neighbourhoods?

We approach the field of urban studies primarily from a neighbourhood perspective. We will explain here why we do so. Cities are synonymous with change: ever since the early writings of Georg Simmel (1903) and Max Weber (1966) on the city (this book was first published posthumously in 1921; the reference here is to a more recent English translation) and the publications of the Chicago School (Wirth 1938; Park, *et al.* 1925) it has been acknowledged that while nothing in the world remains the same, cities display, embody and encourage change faster and with greater intensity than do towns, villages, regions or countries.

Neighbourhoods, then, can be said to be sites where many of the changes at other scales⁴, or even changes with no 'scale' at all⁵, become most visible, most directly experienced, most pronounced and at times most conflicting. After all, while the entire world may change, urban residents still live in houses in streets and on squares that are organized in units that we call 'neighbourhoods'.

The social meanings of such units may change. They may be renewed, reconstructed, gentrified, or impoverished, and their borders may be redrawn. But we all still live in a place, however temporary such a stay may be. This motivates our choice to focus a programme of urban and housing studies on neighbourhood change (without necessarily limiting ourselves to the study of neighbourhoods only, as will become obvious below).

It is in neighbourhoods that people are most directly interdependent with others and where these others become most visible. We are all interdependent on a global scale in a much wider sense. But such interdependencies (cf. Elias 1939) are often entirely anonymous. They involve people we don't know and will never meet (cf. Blokland 2003). Others in the urban neighbourhoods may also be anonymous to us personally.

⁴ On the notion of scales, see Brenner (2004).

⁵ For example, individualization or secularization as part of the modernization process can hardly be said to have a specific 'scale' in a geographical sense, but definitely do affect (urban) life.

But they still are concrete other people. As such, our interdependence is bound to involve interactions, however superficial. We rub shoulders while entering a local store, when taking the bus or while using the lift in an apartment block. Even the professionals who design policies that affect people's everyday life have a much higher degree of visibility in neighbourhood-oriented programmes than they do when involved in policies on a larger scale.

In short, social change through chains of interdependencies has a particular salience at the neighbourhood level. We distinguish five arenas of social change in neighbourhoods, for which the neighbourhood provides a specific unit of analysis *or* a site where such change is visible in its most immediate consequences. The next section is devoted to a detailed description of these five arenas .

Five arenas of neighbourhood change

Changes in social networks

Firstly, social networks change. We use the term social networks to designate the webs of social ties between people that are somewhat durable and in which people are personally involved, such as ties between neighbours, family ties and ties with friends, colleagues and acquaintances (on social networks, see Hannerz 1980; Wellman and Leighton 1979).

Neighbourhood change here, then, means two things. It means that the spatiality of social networks changes over time. As such, the geographical relevance of a neighbourhood also changes. It further means that the meaning and content of local attachments, to other local people as well as to the place as such, change as the result of changing values, meanings and expectations that people have of each other and of their community – a community that they may understand to be local, non-local or to include both local and non-local social ties of various sorts.

Changes in public space

Secondly, there are changes in the public space and all the brief, incidental interactions in which people engage in their navigations through the public space. We certainly develop and maintain social networks in the public space (some of us more than others). Yet such networks only partly cover the *sociality* of public space⁶. Many of our frequent everyday interactions with other people do not concern people whom we know by name, or will ever see again. Most of our everyday interactions take place with people with whom we are at most familiar in public – if that. Neighbourhoods are more than most urban public spaces sites likely to enjoy a degree of public familiarity⁷. There is the inescapable fact that we have to live somewhere and that very few of us stay at a place too short to not become familiar with a number of local residents. And our homes are the starting points from which we develop everyday routines. Such routines imply routes. Along such routes we are most likely to cross the paths of others over and over again. They, too, are just going about their daily routines. In the neighbourhood more than anywhere else, routines tend to result in some degree of public familiarity. That is, knowing some facts about other people and recognizing them without necessarily knowing them personally. When everyday routines become less synchronized, lifestyles become more varied and mobility rises, this affects the ways people relate to each other in public space (cf. Blokland 2003; Blokland 2009a: 27-29). They may do so superficially and briefly, but these

⁶ On the notion of sociality, see Simmel 1952.

⁷ On public familiarity, see Fisher (1982) and Blokland (2003, 2008 and 2009a).

ways are nevertheless important to our understanding of the social world surrounding us (cf. Lemert 1995).

Changes in the built environment

Thirdly, there are changes in the built environment. Housing, local facilities and even streets may change. Such changes may be physical, but are nonetheless man-made, planned or often unplanned in their consequences, and therefore have physical and social components.

Here, structure matters a great deal. Current neighbourhood developments do not take place on a *tabula rasa*. Instead, structural factors that have historically determined certain ways of urban design and urban planning continue to have their impact on today's neighbourhoods, in their physical make-up as well as in the social processes that occur there.

While use of the expression 'path dependency' may suggest more causality than we envision, our point of departure is the idea that historical configurations spatially, structurally and culturally influence contemporary neighbourhood changes. They define the contexts in which current agents act, without determining the outcomes of their actions.

One of the goals of our research programme is to take history seriously in two ways. Firstly, we understand history as a process that brings the current built environment about. Secondly, we see it as a process that influences the symbolic meanings of contemporary neighbourhoods and through which such meanings are reproduced and reformulated. In The Hague, for example, the line between houses built on sand and those on peat was a border of status ever since they were built, and continues to delineate the distribution of social classes in the city. This difference can also be cultivated more discursively. In Rotterdam, neighbourhoods like Hillesluis to the south of the river Maas that cuts through the city had lower social status than neighbourhoods on the Northern bank of the river. This status difference cannot be ascribed entirely to the demographics of the neighbourhood but was also the result of historical forces. Survivors of the Plague in the 17th century were isolated in the South of the city. When migrants from the Zealand islands and Brabant moved from agricultural towns to the city during the industrial boom of the 19th century, South re-established its reputation as backward, negative and of lower social status than its Northern counterpart. This social border continues to be of relevance today.

We study current changes (like urban renewal or the redevelopment of large estates) at the intersection of physical urban design interventions and social processes through which such interventions are organized. We are also interested in the social outcomes of physical interventions, given the historical context in which they occur.

Institutional changes

Fourthly, neighbourhood change may include institutional changes. Here we mean changes in the infrastructure that provides residents and others sites for participation and communication, for meeting and at times for mating, for getting things done together for their neighbourhood or for getting ahead through, for example, local schools. This arena of change is often, but not necessarily, related to the fifth arena of policy-related change discussed below. Not necessarily, because some institutional change has very little to do with intentional policies, and yet may have a profound impact on neighbourhoods. For example, secularization not only results in different belief systems of individual people (as does the growth of religions that were previously uncommon here) but also affects the social infrastructure of a neighbourhood. The parish-based Catholic Church, for example, used to have a strong network of local youth groups known in Dutch as the *Patronaat*. The diminished role of this or-

ganization in the neighbourhood has had profound effects on the availability of facilities and on the inclusivity (or more often exclusivity) of their availability. The social capital in the neighbourhood as hub of network ties changed accordingly. And self-evident status hierarchies in sub-groups in neighbourhoods were challenged, influencing governance.

To give another example, when a contemporary Evangelical congregation actively promotes youth groups in order to win their souls, this increases the facilities available to local youth. There is more for them to do. But when young Muslims make use of the facilities in Evangelical youth clubs of whose religious signature their parents were initially ignorant, as was the case in Rotterdam North recently (when the parents eventually found out, this led to escalating conflicts!), such initiatives create institutional change. And such change has effects in the arenas of networks and public space too. These effects then linked to the larger-scale processes mentioned above, but have little connection with government policy initiatives.

Changes due to policy intervention

Fifthly, neighbourhoods can be seen as geographical groupings of people that are in part the outcome of past policy interventions resulting in housing stock characteristics and allocation rules for specific households. These features can become the target of new policy interventions today which will in their turn have an effect on the neighbourhood. Throughout the history of social engineering since the 19th century, policies have shifted repeatedly from an emphasis on sectors such as employment or education to an integrated area-based approach. Currently, areas-based policies are the preferred policy strategy in the Netherlands (see also our discussion of societal relevance in section 1.4) as they are in other European countries (Anderssen 2001). As such, policy becomes immediately visible as social process and as producing certain outcomes (both planned and unplanned) at the neighbourhood level.

Moreover, the arrangements through which decisions on policy intervention are made, the role of politics in such arrangements, the implementation of policies and the actual participation of various parties in policy-making and policy implementation all have an impact on neighbourhood change. In short, processes of decentralization, deregulation and bureaucratization alongside privatization have severely altered the playing field on which policy is made and implemented. We can no longer assume that policy is the outcome of the decision making process of a certain body called 'government'. While the urbanism that defined governance in the late 19th and early 20th century is also no longer self-evident, as explained by Rae (2003), the scale of the neighbourhood is becoming all the more interesting given the fact that market parties (housing associations, developers, landlords) often own buildings that cannot be moved, while other parties cannot exchange their site for other reasons (local governments).

In other spheres where questions of market, state and governance have become dominant and widely discussed (health, energy), one may take out the money and enter another playing field. This is far less realistic for many parties in neighbourhoods than it is for others in other playing fields. An energy business may expand its market; a phone company may start selling satellite dish subscriptions or the other way around. In the world of real estate property – and that is, after all, what all neighbourhoods always will continue to consist of – the playing field is of a fundamentally different nature. This, then, creates a specific scale of change at the level of neighbourhoods, as the literally vested interests of citizens and other stakeholders are nowhere so closely bound to the built environment and its geographical and social setting as they are here.

Three overarching research problems and a matrix of questions

The arenas of change discussed above can only be distinguished conceptually. In practice, they overlap strongly. Still, each one implies its own definition of 'neighbourhood' and constitutes an arena in which residents and others engage in 'place making', i.e. symbolically defining what a neighbourhood means to them.

In all these five patterns of change, we see a mixture of intentionality of actors (*agency*) and the unintended consequences of the actions of individuals and groups throughout history, a subtheme to which we hope to contribute through our research programme (see the discussion of constructed reality in section 1.3 on Scientific relevance). Our programme, then, aims to be neither spatially, historically or economically deterministic nor overtly focused on human agency, but to achieve a balance between structural and constructionist elements.

The above considerations led us to define three central, overarching research problems. We cluster the related research questions in three thematic groups - neighbourhood stratification, neighbourhoods as changing social sites and neighbourhoods as sites of governance - that guide our daily work in the department. Almost every member of research staff participates in more than one theme group: there is no watershed between them, they act as platforms more than as organizational divisions. The theme leaders will describe each of the themes in more detail in section 3 below. The five arenas of change evoke research questions in each of the three themes we have defined. The matrix below shows examples of such questions. These are examples **only**: they suggest the type of questions that we will ask, but we certainly will not be able to address each of them. Nor do we necessarily address these, as our research agenda is often defined in consultation with funders and also depends on the preferences and capacities of individual researchers. It is, then, our aim to eventually have all five arenas of change covered in each research theme, but it should be stressed that it is these arenas rather than the research themes that reveal the nature of neighbourhood change.

Figure 1 Matrix of arenas of neighbourhood change against main research themes: examples of research questions

Arena →	Changes in networks	Changes in public space & interactions	Physical changes	Institutional changes	Changes in policy, organization and politics
↓ Research theme					
Neighbourhood stratification	<i>How do neighbourhood reputations change when residential composition changes?</i>	<i>How do demographic changes affect neighbourhood reputations?</i>	<i>What implications of area-based interventions affect neighbourhood stratification?</i>	<i>How do changes in housing choice (arrangements) and allocation models affect neighbourhood choice, liveability and stratification?</i>	<i>How do area-based policy changes affect neighbourhood stratification?</i>
Neighbourhoods as changing social sites	<i>How do social support systems change when local networks change?</i>	<i>How do contested meanings of public space come about, and in what ways do people claim public space as their own?</i>	<i>How do people 'use' the built environment to build social identities, and how does radical change, as in urban renewal, affect such usage?</i>	<i>How do institutions hamper or facilitate the development of social networks, neighbourhood attachment and other local attachment (if at all)?</i>	<i>How do meanings of neighbourhoods as seen by professionals and residents impact policy strategies to enhance liveability and sustainability of the social climate?</i>
Neighbourhoods as sites of governance	<i>How do local networks of residents and others provide a structure of social capital in which definitions of neighbourhood interests are set?</i>	<i>What context does public space provide for participation, or for common interests to develop (not only between residents)? Do changes in claims of public space impede on collective understanding of interests?</i>	<i>What is the role of the built environment in understanding of responsibility and citizenship, and how do changes alter this?</i>	<i>How do institutions, in and beyond the neighbourhood, affect the collective efficacy of a neighbourhood? How do changes in institutional settings affect collective efficacy?</i>	<i>How do partnerships between different parties affect policy implementation plans, and how are such processes connected to politics?</i>

Research themes

Theme 1: Neighbourhood stratification

Our critical discussion of neighbourhoods, even when considered structurally, as socially defined and not given, fixed entities implies a need to regard neighbourhoods as functioning and changing relative to one another within a wider urban and societal system. This being the case, we can distinguish a hierarchy or stratification of neighbourhoods. Different trajectories may change the position of individual neighbourhoods within the wider stratification. Moreover, “political, social, and economic inequality among places should be understood not only as the *result* of differentiation, but also as a *cause* of the particular pattern of differentiation which evolves. More precisely, the competition among places normally reinforces the existing stratification, because initial advantages – translated into political power – can be maintained” (Logan 1978: 406; cf. Logan & Molotch, 1987).

Within this theme, we take neighbourhoods as the central unit of analysis and study them within the context of the wider system of urban stratification – in the city, in the region or in comparisons between cities. The overall **research problem** indicates the processes and mechanisms that are central to the study of neighbourhood change within this theme. From this overall problem, a range of more specific research problems may be distilled. We start by asking the following basic question.

Which social, economic and political processes, mechanisms and interventions affect urban neighbourhoods in their spatial, social and economic position?

For example, how do these processes, both from outside and from within neighbourhoods, affect the stratification of neighbourhoods and places (in a wider urban and/or societal system), as well as the spatial, social and economic position of individual neighbourhoods and places?

These processes, mechanisms and interventions include both large-scale developments such as globalization and individualization, and smaller-scale processes such as residential moves within urban contexts, whether or not caused by changes in residential preferences, policy interventions and other events. Processes and mechanisms operating *within* neighbourhoods are also relevant, as long as they can be studied in terms of how they affect the position of a neighbourhood within a wider urban and/or societal system.

Considering the societal, political and scientific debates and discourses, as well as our own research strengths, interests and past performance, we have selected a number of specific processes and mechanisms for further study. These are discussed in further detail below. We are especially interested in key factors that make and change the development trajectory of neighbourhoods and their position in the local hierarchies of place. Apart from intended and unintended consequences of area-based interventions, we identify housing choice and housing allocation processes and mechanisms as such key factors. We formulate the questions partly in terms of neighbourhood assets and resulting positions in urban hierarchies, but also in terms of neighbourhood reputations, which can affect resources and the local positions of areas (see Blokland 2009b)

Changes in the built and social environment: Upward and downward neighbourhood change

Neighbourhoods, whatever their definition, delineation and appreciation, are, to reiterate, no static entities. They change over time, through external as well as internal causes. The literature on neighbourhood change in which neighbourhoods are the units of analysis concerns three principal questions: what are the causes of neighbourhood change, what aspects of neighbourhood are changing, in what direc-

tion and at what pace, and, finally, what are the consequences for individuals, the neighbourhood in question and possibly other neighbourhoods? (Lupton & Power, 2004).

A recurring theme is the question of tipping points in neighbourhood development. Several relationships between neighbourhood development and a range of specific indicators (e.g. house prices, poverty) are expected to show a non-linear pattern with a clear tipping point (Galster 2001, 2007a, 2007b). The literature on this topic has also described how an influx of supposedly 'undesirable' household types caused a substantial out-migration of settled residents, once a certain threshold had been passed (e.g. Schelling 1971). The reverse principle may also apply in the gentrification of neighbourhoods. Tipping points are hard to pinpoint empirically, due to specificities of place and social context. Perceptions of neighbourhood change are likely to be very important in residents' decisions to move or stay put, apart from actual physical and social changes (see e.g. Amérgo & Aragones 1997; Lupton & Power 2004).

In connection with the general research problem of theme 1 (the stratification of neighbourhoods), our research question here is: which processes of neighbourhood change affect urban neighbourhoods in their spatial, social and economic position and the stratification of neighbourhoods and places (in a wider urban and/or societal system)? More specifically, we aim to perform a historiographic study of the way in which specific events or developments caused a marked speeding up or other change in neighbourhood trajectories because they embodied a tipping point or a somewhat broader tipping 'zone'. This is highly relevant for urban policy, since an understanding of tipping points and the ways in which they come about enables a more targeted policy approach to neighbourhood problems and provides a basis for deciding when the time has come to intervene in a certain situation because the neighbourhood trajectory appears to approach a tipping point or tipping zone.

Institutional change and policy change: Area-based interventions in neighbourhoods

A general trend in urban policies (housing, safety & liveability, welfare, education) is the continuing popularity of area-based interventions (ABIs). The Netherlands are not unique in this respect; similar discussions are at the forefront in many other countries (e.g. Anderssen, 2001; Andersson & Musterd, 2005; Lawless, 2006). Despite critical remarks and ongoing debate, there is still firm support from many practitioners and policy-makers for the idea of interventions in predefined areas, as they believe that this brings them 'close' to the perceived problems, even though they may be aware of the possibility that the true origins of the problems lie at other, higher and lower scale levels than that of the neighbourhood.

The general question is: to what extent do specific ABIs affect the target neighbourhood but also other neighbourhoods? Do the effects directly change the position of the area in the wider neighbourhood stratification? Or do ABI effects cause neighbourhood actors (such as residents, housing associations and retailers) to respond in ways which may, indirectly, affect the position of the area in the wider urban system of stratification?

For example, the revitalization of a neighbourhood shopping centre may result in rising prices of retail space without a corresponding inflow of new clientele, forcing many existing shopkeepers and small retailers to relocate to cheaper floor space elsewhere. This can adversely affect the amenities of the neighbourhood for current residents and, hence, its ranking in the wider neighbourhood stratification.

More generally, we will investigate to what extent curative and preventive ABIs differ in their potential to change the ranking of the area in the wider neighbourhood stratification, if at all. And here again, an important question is how residents and other

actors in neighbourhoods react to certain ABIs, especially those residents with a limited freedom of choice, i.e. those who lack the means and resources needed to leave the neighbourhood.

Policy change: Spill-over effects of policy interventions

The theme of spill-over effects is closely related to issues of area-based intervention and neighbourhood stratification. In the context of urban and neighbourhood development, spill-over effects are due to phenomena, events or interventions in one area that have an impact on another area or areas (see e.g. Schill *et al.* 2002; Haurin *et al.*, 2003). While such spill-over effects may be unintentional, they pose challenges to urban policy that warrant the attention of urban researchers. Much urban research aims at the policy effects in specific target areas, while the effects of the policy on non-target areas are disregarded or only superficially monitored. The current discussion of the ‘waterbed effect’ in the Dutch housing literature (Slob *et al.* 2008; Kleinhans & Slob 2008) is a good example of this. Within the wider urban stratification, neighbourhoods may be affected by policy interventions in other neighbourhoods or places. While many observers are convinced that spill-over effects occur, they are notoriously difficult to pinpoint. We will therefore investigate the extent to which spill-over effects actually occur, along which lines and processes and on what spatial scales. We aim to study, for example, whether (forced) relocation patterns of residents affect receiving neighbourhoods in such ways that spill-over effects can be discerned and tracked by longitudinal research designed to achieve a realistic assessment of the impact on neighbourhoods and neighbourhood stratification.

Institutional change: Housing choice and housing allocation

Dwellings have their place within a wider housing and neighbourhood hierarchy. This affects the influx and efflux of residents with certain characteristics (age, household types, education, income, ethnicity, lifestyle), and hence, the population composition of the neighbourhood. Housing choice plays a major part in residential mobility and is a well-established topic in the literature (Clark & Dieleman, 1996; Mulder, 1996; Mulder & Hooimeijer, 1999; Brown & King, 2005).

A major issue in this context is ‘freedom of choice’, which has been a matter for public and academic debate for decades. While the term is highly problematic in itself, it remains a label for offering citizens more options with regard to their health care insurance, personal banking and in other domains. Freedom of choice has also been a key concept in the Dutch housing policy of the past two decades (see e.g. Ministerie VROM 2000; Van Daalen & Van der Land 2008). Housing associations, regional and local authorities are creating rules and arrangements, such as housing allocation systems and rent/sale price reduction schemes, with the objective of providing more choice. Hence, freedom of choice is not necessarily accompanied by deregulation.

Further, more options do not necessarily mean more freedom of choice, if the options are not realistic or feasible for the target groups in question. We will therefore study changes in the arrangements set up to enhance public choice and how these affect choice in general (e.g. via programme-related effects), and, more specifically, choice of a certain neighbourhood as a place to live or work and possibly the narrower choice of certain locations within the neighbourhood, and the impact these factors may have on the population and liveability of the neighbourhood in question. Moreover, recent developments in urban and regional housing markets result in efforts of housing associations and private landlords to design allocation models which accommodate certain lifestyles. Amongst others, the aim is to create socially stable blocks or neighbourhoods which accommodate a demand for comparable life styles and ‘people like us’. We aim to study whether these designs really work out well, in

the opinion of both residents and housing providers, and how they affect the position of these blocks or neighbourhoods in the local stratification.

Changes in demographics, networks and public space: Reputations of neighbourhoods and other places

Reputation refers to the meaning and esteem that residents and various other actors attribute to a neighbourhood (Hortulanus, 1995). Reputation is a relational concept *par excellence*: neighbourhoods and places acquire and develop reputations relative to each other, based on the perceptions of both residents and non-residents: residents of other neighbourhoods as well as professionals (Firey, 1945; Wacquant, 1993; Hortulanus, 1995; Hastings & Dean, 2003; Blokland, 2008). These reputations are partly made within neighbourhoods themselves, but predominantly by events or images that are interpreted by people and institutions not located in or connected to that specific neighbourhood. Moreover, neighbourhoods can be perceived as a reflection of one's socioeconomic position in the wider society, one's preferences and life style (Firey, 1945; Hortulanus, 1995). The processes by which meaning and esteem are ascribed to neighbourhoods can result in a positioning of neighbourhoods in a wider league table (cf. Galster, 2001).

The general question then is: how do reputations arise and how are they deliberately or unconsciously changed by supra-neighbourhood processes, which may or may not be policy-driven? Following Massey (1995a), Permentier et al. (2008) acknowledge that history can be an important factor in determining the reputation of a neighbourhood, and propose discourse analysis and ethnographic approaches as fruitful research strategies, as they can shed light on the dynamics of reputations and the shifting power of actors in their construction.

In view of the fact that it generally takes a long time for bad reputations to improve significantly, an important question is how residents and other actors in neighbourhoods react to and engage with certain (poor) reputations, especially those residents with a limited freedom of choice, i.e. those who lack the means needed to leave the neighbourhood. To what extent do residents' active involvement, quiet resignation and all other attitudes between these two extremes affect the neighbourhood's position in the wider stratification? Moreover, housing associations, private developers and other actors can also actively target neighbourhood reputations, for example by branding; see Reinders (forthcoming) in this connection. Attaching a new brand or label to blocks or areas may attract new target groups with specific life styles, change patterns of in- and outflow, and hence alter the reputation of these locations in the wider stratification.

Another topic is the relationship between neighbourhood reputation and social mix. Social mix is a dominant theme in urban policies in the USA, Europe and Australia (see e.g. Kleinhans 2004; Berube 2005; Bailey *et al.* 2006; Joseph 2006; Kearns & Mason, 2008). Both researchers and policy-makers want to know whether creating and enlarging the social mix in a neighbourhood can improve its reputation relative to other locations. In the light of our expertise with social mix research, we will extend our work to cover the relation between social mix and neighbourhood reputation. The increased application of different forms of housing mix policy is raising the relevance of this issue to government policy and society as a whole.

Theme 2: Neighbourhoods as changing social sites

As we have shown above, the neighbourhood has reached a new peak in popularity in several European countries as the locus for interventions and integration since the large-scale urban renewal operations of the 1970 and 1980s. At the same time, and in

response to continuous individualization and fragmentation of society, much neighbourhood-related social research has moved away from a focus on the scale of the neighbourhood and its one-dimensional meaning as a fixed unit that would function as the locus for integrating individuals in a society that is envisaged as unchanging. Instead, they have turned to detailed analysis of the importance of individuals and collectivities for the functioning of local sociality, as well as for the liveability of neighbourhoods. How people define and act out their relation to the neighbourhood, in its multiple meanings, has thus become a prominent field of research for social scientists and geographers, and our theme group aims to make an active contribution in this field. In contrast to theme 1, this theme does not have the neighbourhood as such as the unit of analysis, but rather the people and groups who have some relation with the neighbourhood. The neighbourhood here is the site where changes in meanings manifest themselves; in contrast to the formulation in our earlier research programme though, our focus of attention is not what the neighbourhood means for people, but what people mean for the neighbourhood. The theme of neighbourhoods as changing social sites brings us to the following overall research problem:

How do neighbourhoods become places in the process of people giving significance and attaching meaning to what they perceive as being 'their' neighbourhood?

This research problem concerns the many ways in which people in neighbourhoods – most importantly residents, but in principle all those making use of the neighbourhood, working there and (co-) governing it – attach meaning and significance to 'neighbourhoods.' Our theme group thus focuses on the relations between residents, visitors, workers and policy-makers on the one hand and the practices of ascribing meaning to and appropriating the locality that we call the neighbourhood on the other. Here we aim to study how the process whereby a neighbourhood acquires meaning and importance depends on the many ways people identify with and feel attached to the neighbourhood, enter into social relations and negotiate social contacts in it, use the dwellings in the neighbourhood together with its amenities and public spaces, are subjected to formal institutions impacting on social networks and attachment to specific places in the neighbourhood, and, finally, how they themselves impact on policy strategies for the neighbourhood.

As this is very much a dynamic process, not least because of the social interactions involved, but also triggered by policy interventions like urban restructuring, our focus is on changes in neighbourhood meanings and neighbourhood ties, how meanings and ties originate and develop in and through social relations, and how these processes are building blocks of relations between people and places.

Processes of ascribing meaning to and appropriating neighbourhoods are by no means the exclusive domain of environmental or social psychology but have important sociological and geographical dimensions. Hence, their study demands a multidisciplinary approach. We will therefore try to involve a wide variety of disciplines dealing with neighbourhood meaning, such as sociology, human geography, anthropology, environmental and social psychology, housing and policy studies in our investigations. We aim to contribute to the academic debate by empirically based research on social practices and policy issues and practices. This thus implies a focus on empirically grounded studies, qualitative or quantitative or a mixture of the two depending on the specific research question. We will structure our research questions and research strategies with reference to the above-mentioned five arenas of neighbourhood change as described in greater detail below.

Dynamics of social networks and place attachment

Local social networks and their dynamics of change are crucial for an understanding of the lived experience of neighbourhoods (Young & Wilmott, 1957). As social networks are based on durable ties between people with strong mutual personal involvement, they provide social and cultural capital for their participants which they can use to cope with daily life. Changes in social networks are closely related to the affective bonds between people and places (Tuan 1974). Changes in social networks, influenced by large-scale developments such as new communication and travel technologies which tend to compress both time and space, have not abolished but merely altered the relevance of social networks for residential life.

Whereas social policies often continue to achieve sustainable neighbourhoods through attempts to build strong local networks, existing research (Flap and Völker 2005, Völker 2005) indicates that there is much work to be done on the question of how far personal networks and neighbourhood networks overlap. We will, in addition, also ask how ideas about community relate to the size and scale of social networks, and what role the local scale may play in this.

Even though networks are starting to show increasing diversity in the extent to which they include local ties, this does not imply that residents without such local ties have no sense of home. Existing research (Savage *et al.*, 2005; Butler 2002) indicates that feeling at home does not only depend on local ties, and sometimes does not depend on such ties at all. How, then, do residents of neighbourhoods construct feelings of being at home? And how does such place attachment interact with other categories of identification? How are place attachment and participation in social networks related?

Finally, then, as many of the areas in which we conduct research have undergone enormous changes of recent years, we also need to investigate how interventions like urban restructuring can influence the capacity of social networks to act as social capital for neighbourhood residents, and how policy interventions impinge on place attachment processes.

Public space and changes in appropriation

The importance of public spaces in the creation of ties with neighbourhoods and the ascribing of meaning to them is largely based on the inherent social character of public spaces as places where individuals can identify with others and construct categories based on shared understandings of other people. The first question we have to ask within this research theme is thus which conditions help people to feel at home in public spaces.

Social identification and categorization are processes through which people mark their social position in relation to others and are thus inherently connected with the perception of being at home – or of not being at home. Such social identifications and categories are fluid and relational, and refer to groups of individuals sharing certain characteristics, either because they recognize these as such or because others ascribe these to them (cf. Blokland, 2003). Public space not only functions as a space in which people can reproduce already established bonds with one another (and thus reinforce their categories). More importantly, it may give people the opportunity to constitute a non-private, even parochial sphere where they can familiarize themselves with other people from the neighbourhood through repeated observations and by acquiring knowledge about them (cf. Lofland, 1989, 1998). The public familiarity that

this produces enables people to judge whether they can trust others or not (Blokland, 2009a).

As Blokland and Soenen (2004) have shown, processes of parochialization and privatization of public space, however, also result in claims on public space that may conflict with the potential claims of others. Hence, some of the questions to be asked are how people claim public space as theirs, how they use public space to make the neighbourhood part of their home and how are potential tensions and conflicts in neighbourhoods constructed and reproduced in the context of public space?

Moreover, the potentially conflicting nature of claims on public space also brings us to ask how mechanisms of social control function in a neighbourhood's public space and how is public space regulated by interventions from formal institutions?

Institutional change

Institutions, in the sociological sense of social systems like the family, the state, religion or education, provide individuals with an infrastructure for participation and communication (Zijderveld, 1990). Changes at this 'macro' level manifest themselves particularly at the micro level of daily life in the neighbourhood, where ties are formed and people attach meanings to the neighbourhood. We investigate how institutional change hampers or facilitates the development of social networks, interferes with place attachments or otherwise relates to use of the neighbourhood.

Research questions here include how changes in institutions affect ties and meanings as they are formed in daily life, but also how changes in meanings in turn influence institutions in neighbourhoods.

Policy interventions and neighbourhood significance

The neighbourhood is subject to cycles that are similar in a way to business cycles: every few years it resurfaces in the policy arena as the dominant scale level for policy interventions. Like residents, professionals dealing with neighbourhood change also attach meanings to the neighbourhood. They hold opinions about the importance and the supposed benefits of such heavily value-laden policy concepts as social cohesion and liveability. Housing associations in the Netherlands have, for example, increasingly strong ideas about the best way to steer the social composition of neighbourhoods. We study how their definitions of the 'good neighbourhood' are expressed in neighbourhood interventions and how that affects strategies to enhance the liveability and sustainability of the social climate. The theme group will deal with research questions about the way in which both local government and housing associations influence the social composition of neighbourhoods. How do such interventions in turn affect social networks and place attachments? We will also consider how policies and policy interventions, as well as the personal perceptions of professionals, affect the way residents attach meaning and significance to neighbourhoods.

Theme 3: Neighbourhoods as sites of governance

It is now commonly accepted in Dutch cities and elsewhere that strong, sustainable neighbourhoods are places where residents, local government and other parties such as housing associations work closely together in the interests of local improvement. Such ideal images, however, are not always congruent with reality. It often remains a challenge to realize substantial residents' participation and influence in decision-making. With the retreat of the state, the need to find new forms of local governance becomes pressing (see Sywngedouw 2005 for a critical appraisal). This objective raises important questions of scale and of the meaning of citizenship that go far beyond the neighbourhood level but become particularly pronounced at this level.

The remarkable salience of one's living environment, where unwanted situations are hard to escape other than through complete exit (moving elsewhere) makes the neighbourhood a core site for getting things done to improve the quality of life. While the overall argument for studying social change at the neighbourhood level is partly informed by this recognition of the key importance of neighbourhoods, the relevance of local vested interests to residential neighbourhoods is most pronounced within this research theme. In this context, we understand the neighbourhood primarily as a political or institutional unit, or as the network of parties engaged one way or the other in getting things done in an area. This process of getting things done may affect the participants' understanding of neighbourhood and attachments to it, and may also build on this understanding and attachment. Moreover, the way things get done, if at all, may influence the stratification of neighbourhoods and the position of the neighbourhood in question in the league table, so that themes 1, 2 and 3 are thoroughly intertwined at this point.

This theme group thus aims to study neighbourhoods as the spatial sites where people get together to get things done, or act on their own behalf to try and change things that affect the sustainability and liveability of a residential environment. As, again, everybody has to live somewhere, neighbourhoods are inevitably better positioned than any other spatial unit for the study of collective action, political mobilization and the like.

But not only residents and property owners have an interest in the local area. For example, schools that wish to maintain a mixed population in times of residential segregation face particular challenges. Mixture in the educational background of parents influences both the classroom processes and the social capital on which a school can draw to enhance its performance and that of the individual students. Since neighbourhoods are prime sites of policy intervention, this theme group focuses on the overarching research problem:

How do various groups⁸ get things done in local neighbourhoods? In other words, how do they build structures for collective action (in the broad sense of the term)? What is the role of institutions, mutual understanding of interests, power balances and imbalances and decision-making processes in how groups get things done in a local area?

This research problem can be elaborated into a number of main themes that define the core mission of this theme group.

Residents getting things done through networks

The way in which networks of people to access resources and act together is subject to change, and the changing role of the locality in such networks also affects how residents get together to get things done. While such actions may not be a social movement in the normal sense of the term, the literature on social movements suggests that both the political opportunity structure in which groups of people act and the internal differentiations and motivations for people to act together affect the outcome of collective action. Without losing sight of the political opportunity perspective, we focus here on *how local networks of residents*, alone or in association with others – both those engaged in the neighbourhood arena and other useful allies – *establish a position of power to get things done*. We have pioneered a little into this direction with

⁸ For example resident associations, partnerships between residents and others, and governance coalitions.

analyses of the mobilization potential of social networks for neighbourhood action (Blokland 2006), with a focus on the relevance of various welfare state regimes. But who defines the relevant issues in an area cannot be seen as simply a matter of ‘the residents’ as if they can be understood as one collectivity (cf. Merton 1967). Instead, residents form various coalitions, some do not participate at all, others claim representative roles without clear legitimization for these roles, or are nominated as spokespersons without their consent (cf. Blokland, Maginn & Thompson 2009). We will therefore study the importance of social capital from two perspectives.

Firstly, we will look at social capital as a collective asset for neighbourhood residents who want to get things done to enhance the quality of life in the neighbourhood, including ‘residents’ who do not live there but for example come there to work. The questions asked in this connection include the following: How do residents’ local networks facilitate participation in governance, either at the local level or beyond, or how do they hinder such participation? What *are* residents other than people sharing the same residential environment and what is the collective understanding of the neighbourhood, if any, on the basis of which they participate, if at all, in neighbourhood budgets, neighbourhood organizing and neighbourhood participation?

Secondly, we study social capital as a form of access to resources through membership of social networks in the neighbourhood. Here we focus especially on how network ties and mobilization allow certain neighbourhood issues to be put on the agenda while others are swept under the carpet. For example, as Blokland (2009b) has argued, the ways in which residents jointly recall historic episodes of neighbourhood ‘history’ in their local, but not all-encompassing networks sets the context for the image of the neighbourhood presented in the political arena. This image in turn helps to determine which issues are put on the agenda as key aspects of the desired neighbourhood improvement. Relevant research questions here are: How do residents develop knowledge about getting access to the relevant organisations to make their desires, concerns and wishes for the quality of life in their neighbourhood known, if at all? How do residents and other actors get together to get things done, and how do they turn potential resources into collective assets – if they manage to do so at all?

The built environment, markers of responsibility and citizenship

Our second main research theme in this field is the actual design and symbolic understanding of the built environment and how changes here relate to governance.⁹ We address these issues from the perspective that the built environment and its qualities – in building as well as in maintenance – generate markers that can be interpreted socially by its users. For example, when we expect residents to take care of their environment, they must be able to develop a sense that others also care about the area as they are expected to do. For this they do not only look at the actions (or the free riders behaviour) of other residents. Especially when residents have little familiarity with each other, they need to derive clues of *other people’s* understandings of an area from the built environment and its qualities. We thus ask how residents derive clues about the reputation of their neighbourhood by people that are involved with their area.

For example, the local authorities may want residents to exert social control in the neighbourhood. But if the residents notice that the local authorities do not do a good job of keeping the streets clean or of waste collection, or that the housing association does not respond quickly and efficiently to complaints about vandalized windows in

⁹ This issue is close to that of neighbourhood reputation discussed in section 3.1.5, but seen from a different perspective.

a hallway, they will reason that if others do not care about their neighbourhood, why should they? (see Blokland 2009a).

There is thus a quite direct but under-researched connection between people's willingness to act and their expectation of the outcome of such action on the one hand and the physical structure of the areas where they live and its maintenance on the other. This leads us to the general question of the role of the built environment and its maintenance in engendering civic responsibility (of residents and others) and citizenship and to more specific questions like: How do professionals involved in a neighbourhood see the sharing of responsibilities between home owners (such as housing corporations), the state and its employees (e.g. the street sweepers working for the local authorities) and their 'clients'? How do they put this vision into practice; and how do local professionals use their own discretion, based on their knowledge of the local context, to fine-tune the application of the general policies of organizations for which they work?

Public space and institutions

Coordinated action is required if local actors are to be effective in their efforts to improve the quality of life in a neighbourhood or its sustainability. The most flexible governance model also assumes that there will be local channels for communication and local settings for meeting others that will help form the networks needed for governance to take shape, especially when we also expect residents to be part of such governance processes. If not, then all that is possible is the participation of existing institutions in new meetings, new decision-making processes and the like. This assumption is not shared by current urban policy-makers in the Netherlands (nor, for example, by those responsible for *Quartiersmanagement* – neighbourhood management – in Berlin). Their approach to the general idea of increasing participation is that *new* groups of people should be brought into the process and that new organizational structures need to be created to this end. But defining such structures remains a challenge. This thus results in a twofold set of questions to be addressed by our research group:

a. We ask how *public space* – increasingly seen as a space where conflicts may be played out, especially in diverse neighbourhoods – enables everyday politics and participation, and as such is a public space as well as a public domain as understood by Habermas (see also section 3.2.2 above), but with the added dimension of democratic rights and citizens' claims to public space. More specifically, to what extent do local areas provide settings in which residents and other actors can meet without the aim of meeting, to what extent can such meeting be seen as participation, and does this, as suggested by some authors (Lofland 1998; see for an overview also Blokland 2009a), result in a sphere of tolerance that make the public space a democratic space? If so, to what extent can such short interactions and experiences of difference and tolerance be translated beyond street politics into the more formal arenas of participation and democracy?

b. We also ask how institutions in and beyond the neighbourhood affect the collective efficacy of an area. As noted in section 2.2.4 above, neighbourhood change may entail institutional change, by modifying the infrastructure that provides residents and others sites for participation and communication, for meeting and at times for mating, for getting things done together for their neighbourhood or for getting them done individually. As such institutions change, so does their viability in providing opportunities for residents to meet and to organize if necessary, and in serving as

foci for residents of diverse backgrounds and lifestyles. What local institutions are successful in ensuring resident participation, what participation model do they use, and to what extent is the success of this model bound to specific contexts? What is the empirical basis for various forms of self-governance at neighbourhood level (including neighbourhood budgets and their variants such as the public-private funding used with success in the Dutch city of Deventer) that might lead us to favour these models over more centrally-led models of government? How can we historically understand this shift from government to governance in the context of Dutch cities, and what effects are to be expected?

Policy and institutions: Street level professionals and discretionary space

Street level bureaucracies form partnerships with other local actors engaged in neighbourhood policy and planning to implement plans, often in close connection with political processes. The theme of *street level bureaucracies* follows and adapts Lipsky's seminal work (1980) on this theme. It addresses the question of how street level bureaucracies with neighbourhood aims¹⁰ use their discretionary space. On the one hand, they incorporate dominant views of needs and wants in local neighbourhoods as expressed in politics and the public debate, while adhering to their own views on how to implement change. On the other, they must manage to incorporate the specific situational factors of the contexts in which they work into their approach. Tensions arise as a result of these conflicting aims. We strive to contribute to the central question of how partnerships of different parties engaged in neighbourhood policy implement plans and how such processes are connected to politics.

In particular, we aim to investigate how professionals working in neighbourhoods subject to urban renewal relate to residents, how they differentiate between various subgroups of residents, and what sort of conflict management and resolution tools they would use in contentious situations. We will also continue our studies of how existing professional actors within neighbourhoods form alliances, how they determine what problems or challenges need to be tackled, and how pre-existing networks between professionals influence their ability to act. Finally, we investigate how housing associations and other actors relate to the public imagery of the areas in which they work, and what knowledge they need to build up a realistic understanding of urban areas and their residents.

¹⁰ For example community developers, local housing association managers and local social service officers.

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6 Transport Studies

6.1 Introduction

a. Mission and research area

The sustainability of freight and passenger transport systems and networks is increasingly becoming one of the hottest issues for transport researchers, professionals, policy-makers and the transport industry. The last-mentioned group comprises the users of transport services, transport operators, infrastructure providers and the manufacturers of the related facilities and equipment.

In general, ‘sustainability’ in this context means reducing the adverse effects of transport networks and systems on the environment and society and maximizing the societal benefits while keeping the consumption of non-renewable natural resources in this field below the prescribed target levels.

While research on transport sustainability has been growing, there is still disagreement on the meaning of this term, ambiguity in interpretation and relatively frequent conflicts of interest among the research and policy communities and transport industry actors. Nevertheless, the issue of sustainability would seem to be to be particularly relevant to the future development and enhancement of multimodal freight and integrated passenger transport systems and networks.

The research programme of OTB’s Mobility section described below, which is in part an extension of the previous research programme for the period 2003-2008, will therefore generally focus on study of the sustainability of particular intermodal (freight) and integrated (passenger) transport systems and networks, the main emphasis being on freight.

The scope and content of the proposed research programme are wide and complex, demonstrating the Mobility section’s awareness that contemporary research on the sustainability of freight and passenger transport systems and networks in the 21st century must be based on multidimensional examination of the performance of the systems and networks in question. This is in line with the increasing diversity and complexity of the requirements of the various bodies commissioning our research. However, only some of the topics and issues mentioned in the description of the scope of our main research theme in section 3 below will actually be addressed; the choice will depend on the resources and expertise available within the section, on external factors (in particular funding), internal interests and requirements and other relevant circumstances.

b. Relationship with previous programme

Transport services and other supporting activities constituting freight and passenger transport systems and networks are usually carried out on the same transport infrastructure. Both freight and passenger requirements influence the spatial distribution of the socio-economic activities, land use, and other external burdens at local (regional), national, and international levels. If the sustainable development of society is an objective, transport sustainability should certainly make a substantial contribute to it. This would seem to be particularly relevant in cases where decisions have to be made about the expansion of the transport infrastructure in order to continue to serve growing demand efficiently, effectively and safely. Usually, such expansion re-

quires changes in land use on the one hand, and redistribution and reallocation of particular socio-economic activities on the other. Consequently, the recognition of the complex nature of the far-reaching and inherently interrelated problems involved leads to the conclusion that our studies during the coming research period will inevitably continue the line of the research from the previous period (2003-2008) to a very great extent. This implies that we will continue to deal mainly with the problems and challenges of unimodal and intermodal freight transport systems and networks, and only to a limited extent with their passenger counterparts. The innovative aspect of our research for the coming period is without doubt the stress on the issue of sustainability, which implies considering simultaneously and with equal attention the infrastructural, technological, operational, economic, environmental, social and institutional performance of the systems and networks involved and the interrelationship between these various factors.

c. Scientific relevance

The sustainability of transport systems and networks has continued to be one of the main research topics on the research agenda at both international and national levels. For example, the EU (and its specialized agencies) has addressed the issue in its 4th, 5th, 6th, and 7th Framework Programmes. The transport, spatial and environmental issues have also been the focus of research and policy-making activities at the national (Dutch) scale over the past two and a half decades. They are likely to continue to be of equal interest in the future, due to:

- The inherent complexity of the transport systems and networks, which may consist of many unimodal and multimodal components (sub-networks);
- The multidimensional structure of the performance of the transport networks and systems, which means that at least seven separate and yet interdependent dimensions usually need to be considered – infrastructural, technological, operational, economic, social, environmental and institutional;
- The involvement of many actors with different (often conflicting) interests and objectives such as the transport infrastructure providers, manufacturers of transport facilities and equipment, users of transport services, transport operators, policy makers, and the public at different levels – regional, national, and international; and
- The lack of sufficiently coherent tools for multidimensional assessment of the performance of particular systems, taking the interrelationship between the system dimensions into account and combined with appraisal of overall system sustainability.

Hence we propose multidimensional examination as the coherent and integrative methodological approach to the above-mentioned complex problems to be dealt with in studying the sustainability of intermodal (freight) and integrated (passenger) transport systems and networks.

d. Societal relevance

The societal relevance of studying the sustainability of freight and passenger transport systems is self-evident when we consider the scientific, professional and policy efforts required to achieve this sustainability at different spatial and institutional scales (regional, national, and international).

These systems have a complex infrastructural, technological, operational, organizational and market structure. The gradual shift in transport markets towards globalization and liberalization, consequent increases in the demand for higher-quality, cheaper transport and logistics services, an increased number of competing transport

operators, lack of space for the desired expansion of the infrastructure and increased transport externalities have generated an increasing need for permanent trade-offs between the positive and negative impacts of these systems on individual actors and society as a whole. In this context, the following specific interests of particular actors may be noted:

- Users – shippers of freight and passengers – usually prefer frequent, easily accessible, cheap, punctual, reliable, safe and secure services.
- Infrastructure providers prefer to see optimal use of the infrastructure and reasonably good spatial opportunities for expansion;
- Transport operators prefer achievement of their business objectives such as profitability, safety and security on the one hand and user satisfaction on the other.
- The manufacturers of facilities and equipment want problem-free marketing of their reliable, safe and profitable products to the system operators.
- Local communities want to maximize the benefits and minimize the negative impact of transport systems on their neighbourhood. The generation of employment and the availability of efficient transport links to other localities are always the obvious benefits. Noise and air pollution, and the risk of injury, loss of life and damage to property due to traffic accidents represent the most common disadvantages;
- Policy-makers are mostly interested in achieving the optimum trade-off between the overall benefits and externalities of the transport system - local and national employment and GDP, contributions to internalization and globalization of manufacturing, trade, investment and tourism on the one hand, and the costs involved in the global protection of people's health and the environment on the other.
- Lobbies and pressure groups often organize campaigns against what they see as the harmful global effects of polluting systems (including the transport system) on people's health and the environment. In the case of transport systems, they often do their best to prevent further contributions of these systems to global warming by strong opposition to the physical expansion of the transport infrastructure (sometimes in association with representatives of the local community);
- The public uses media such as radio, TV, the Internet and newspapers to get information about transport systems, and pays particular attention to the launch of innovations, severe disruption of services, major accidents and substantive changes in the prices of transport services.

One of the main ways in which our section's mobility studies can be socially relevant is to perform investigations that respond to, or at least show awareness of, the above-mentioned interests of actors in an integral and consistent way *that is in line with the resources and expertise available to the section.*

e. Synergy between fundamental and applied research

The synergy between fundamental and applied research in the field of mobility may be expected to continue and even increase. In this context, fundamental research is aimed at identifying the key problems involved, and if feasible offering an effective methodology for their understanding and possible solution. The results of such studies will be concretized through applied research performed to meet the needs of bodies commissioning research such as actors in the transport industry and decision-makers at local, national or international level.

f. Internal and external collaboration

Cooperation between our section and the various partners indicated below in the scope and content of the proposed research programme is expected to continue and to be further consolidated during the coming research period.

Internal (Level 1)	OTB: Departments of Urban and Regional Development, GIS Technology and others
Internal (Level 2)	TU Delft: Development of Delft Research Initiatives in collaboration with the Faculties of Civil Engineering & Geosciences, Technology, Policy & Management (TPM) and Mechanical, Maritime & Materials Engineering (3mE); collaboration with the following Delft Research Centres: Next Generation Infrastructures, Mobility & Transport (TRC-D), Rotterdam-Delft Port Research Centre and Delft Centre for Aviation (DCA);
External: National	TRAIL Research School (run jointly by TU Delft, Erasmus University Rotterdam the Universities of Groningen and Twente and Radboud University Nijmegen), TNO, <i>Vrije Universiteit Amsterdam</i> , Erasmus University Rotterdam; Eindhoven University of Technology, Other national transport research groups and consultants.
International	Universities and consultants involved in current and future EU and other international projects and project proposals. International conference and research networks such as the TRAIL research school, AIRNETH, the Network on European Communications and Transport Activities Research (NECTAR), ETC, the World Conference on Transport Research (WCTR), ATRS and the Transportation Research Board (TRB) in the USA.

Specifically, collaboration at internal Level 1 means taking part in joint research projects with other OTB departments and disseminating the research results obtained. Collaboration at internal Level 2 means taking part in research projects carried out by TU Delft and dissemination of the research results. Collaboration at the national level will include participation in different consortia carrying out research in the wider national interest. The international collaboration implies taking part in research sponsored by the EU and other international bodies, and dissemination of the research results at all levels through different international research networks such as NECTAR, TRB and WCTR.

g. Relations with education

The section's contribution to education both within TU Delft and in a wider context is expected to increase during the coming research period, at least for the following three reasons:

An increase in the number of PhD candidates supervised by members of our academic staff (we have two PhD candidates at present, and another one is forthcom-

ing). In the past, most PhD projects in the field of mobility studies were supervised by members of other faculties (in particular TPM);

The planned appointment of a new Chair of Mobility Studies, to be shared between our section and the Faculty of Civil Engineering and Geosciences. This Chair is expected to develop at least one Master's degree module covering the majority of the aspects of freight transport systems mentioned in this report and thus complementing the existing transport-related modules taught at the Faculty. In view of the links with the Faculty of Civil Engineering and Geosciences, this module will still be taught largely from an engineering prospective, but the influence of the new Chair will help to give due weight to the other aspects;

It is expected that the research themes covered by our section (in particular theme c mentioned in section 3.2) will contribute to a PhD course on Freight transport logistics for the TRAIL research school. This theme will also provide material for the post-MSc courses provided by the Delft Foundation for Postacademic Education (Dutch abbreviation PAO), and for the wide range of courses on intermodal transport systems taught at the faculty of TPM.

h. Researchers and other personnel

The section's research team is expected to comprise a Chair (the Professor to be appointed), senior researchers, postdoctoral students or the like, junior researchers and PhD students. More specifically, the section's research staff during the coming research programme are expected to be as follows:

Table 1 Staff of the research programme and research theme

	Themegroup
	Sustaina- bility of freight & passenger transport systems
Prof. Milan Janic	X*
Dr Bart Wiegmans	X
Dr Jaap Vleugel	X
Rob Konings	X
Nam Seok Kim	X
Mo Zhang	X
Dr Ekki Kreutzberger	X

*) Theme leader

i. Resources, funding and facilities

The section's research programme is expected to be funded from a combination of the following sources:

- Government funding: (for specific research projects);
- Indirect funding: (from the Netherlands Organization for Scientific Research NWO and similar national funds)
- Commercial funding: (from various national and international market-based sources; EU funding is also included under this heading)

The precise division of funding between the particular sources is likely to change over time. This will have a crucial influence on the themes and topics covered by the proposed research programme.

The section already has all the basic research facilities and equipment (in particular computers and the library) it needs. Due to the theoretical nature of the section's work, funding for laboratory experiments is not required. In some cases, additional computer software and access to specific databases will be needed, but the requirements for such resources cannot be predicted accurately in advance.

6.2 Ambitions for the period 2009-2014

The section aims to continue its study of the sustainability of freight and passenger transport systems (with the main emphasis on freight). The precise research themes and topics covered will be highly dependent on the available funding and the specific requirements of particular clients who commission research. In addition, the entire subject of mobility studies continues to be of growing scientific, policy and societal relevance at the regional, national and international levels. Consequently, the section's ambitions may be summarized as follows:

- Maintaining a strong link with the previous research programme in terms of the existing and/or planned research themes and topics, the methodologies used and the expertise gained;
- Building up a viable research portfolio based on fruitful cooperation within OTB and with other faculties at TU Delft (in particular TPM); the planned creation of a new Chair shared with the Faculty of Civil Engineering and Geosciences is likely to strengthen the links with this faculty substantially;
- Making the section's research content attractive for cooperation with similar research programmes outside Delft, both nationally and internationally;
- Ensuring that the section has the expertise and content needed to carry out both fundamental and applied (contract) research;
- Making the section's research content sufficiently attractive to allow us to get funding from various sources such as the transport industry, national governmental organizations, the EU and appropriate international funding bodies;
- Creating a solid basis for improving our scientific credibility internally (within OTB and in the wider TU Delft community), nationally and internationally, and dissemination of our research results through regular publishing in peer-reviewed scientific journals, presentations at international conferences, writing chapters of collective works, producing entire monographs in the field of mobility studies, etc.
- Enabling gradual but viable growth of the section in terms of FTEs/year, which implies making the research programme attractive to young researchers, PhD students, research fellows, and of course to current staff members as well; and
- Improving the working atmosphere within the section and the conditions for continuous, consistent self-development of staff members including specialization in particular sub-fields leading to the acquisition of new advanced knowledge, which would help to reinforce the section's internal synergy and increase its funding capabilities.

6.3 Description of research programme and research themes

Introduction

Freight transport systems and one of their subsystems - intermodal transport systems - are gaining in importance nowadays and will continue to do so in the future mainly due to the overall increase in the quantity and diversity of goods to be transported as well as the need for their increased unitization, i.e. packaging in loading units such as

containers, swap bodies and semi-trailers. Passenger transport systems will be offering more door-to-door services by combining different transport modes through adjustment of scheduling transfer nodes (railway and bus stations and/or airports) in addition to the setting up of interfaces for efficient, effective and safe modal exchange. It thus seems likely that the freight transport systems of the future will be increasingly intermodal, while the passenger transport systems will be increasingly integrated.

More specifically, intermodal freight transport systems will be increasingly enhanced at both national and international level by improvement of the physical infrastructure (rail, road and inland waterway links and controlled airspace), the multimodal terminals (ports and freight villages), and the connecting uni- and multimodal transport services. Integrated passenger transport systems will include large railway and bus stations and airports as their main nodes and the related infrastructure links and services connecting them.

In general, both types of systems will have to supply more capacity to accommodate the growing demand for transport. The other but no less important requirements that they will have to fulfil are as follows (EC, 2001; EIRAC, 2004):

- Seamlessness, i.e. mitigation or elimination of barriers to modal exchange;
- Reliability, i.e. punctuality, safe delivery of goods and secure, safe passenger transport;
- Availability, i.e. convenient transport service frequencies with departures at the times during the day and week desired by users;
- Affordability, i.e. a competitive offer of transport services at attractive prices to customers, which will provide sufficient revenues for transport operators and other actors involved in the transport chain; and . .
- Sustainability, i.e. the proper balance between social revenues and costs for all actors involved (which means society as a whole) including efficient and effective use of space (spatial efficiency).

The main objectives of the proposed research programme are to elaborate the prospective alternative solutions and policy recommendations for improving existing sustainable national and international freight and passenger transport systems and developing such systems in the future. As indicated above, the intermodality of freight systems and the integration of passenger systems will play a substantive role in this context. In order to fulfil these objectives, the section's research will have to include the multidimensional examination of the performance of these transport systems as spelled out in the following table (see Janic, 2008):

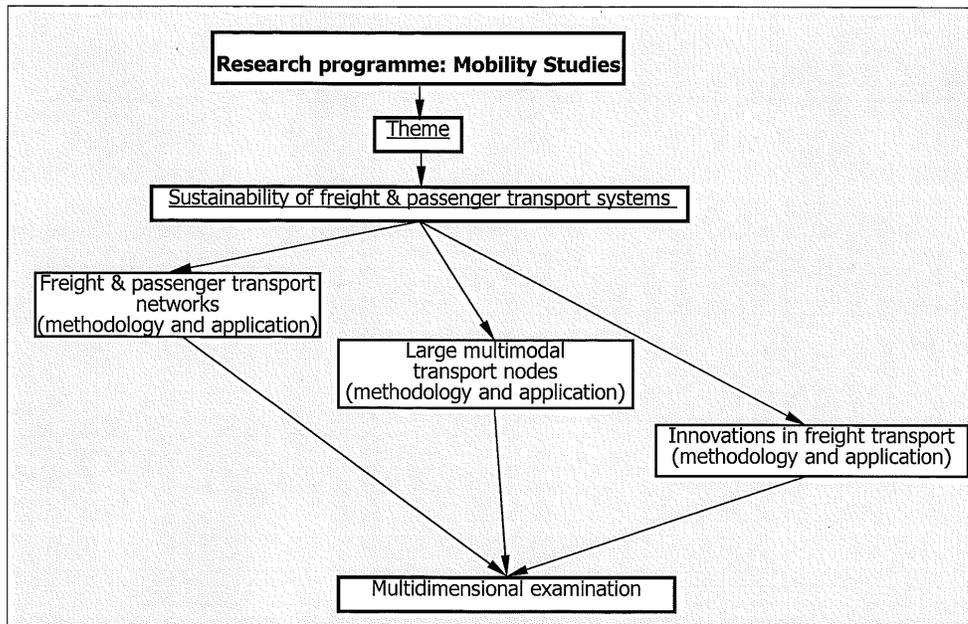
Dimension of examination	Scope of action and research domain
Infrastructural	Planning & design of the elements of transport infrastructure at the conceptual level
Technological	Inventory, analysis, forecasting and assessment of innovations
Operational	Analysis and forecasting of demand; Estimation of capacity; Assessment of the quality of services; Optimization of resources of transport systems while matching the capacity to demand under given conditions.
Economic	Estimation of (generalized) costs and revenues of particular actors; Assessment of the economic feasibility of particular (alternative) solutions for matching capacity to demand.
Environmental and spatial	Estimation of the impact of transport systems in terms of air pollution, noise, and land use (land take) on society and the environment; Assessment of the costs of this impact (in economic terms, the externalities). Providing input for assessing policies on space usage for human activities, including transport, in the socially most efficient and effective way.
Social	Assessment of feasibility of operating particular alternative systems by comparing their full social benefits and costs (i.e. assessment of their sustainability from the social perspective).
Institutional/policy	Providing input for and assessing policies on particular alternative solutions enabling development of the more sustainable transport systems.

The above-mentioned scope and content clearly demonstrate the section's awareness of the complexity of dealing with the sustainability of current and future freight and passenger transport systems at regional, national and/or international level. However, as mentioned above, in view of the available resources in terms of FTEs per year and the current and prospective knowledge possessed by section staff, it will not be possible to examine all the dimensions given in the above table. The choice at any given time will depend on section capacity and other circumstances.

Research themes

The programme consists of a single broad research theme, with three specific sub-themes or topics. These, if sufficiently developed, could emerge as individual research themes in their own right. The various topics are complementary in terms of scope, content and research methodology (system analysis, operations research techniques and methods, some mathematical methods, micro- and macro-economic models, etc.). Figure 1 shows a schematic view of the research programme, the main theme and the particular research topics contained in it.

Figure 1 Schematic view of the structure of the Mobility Studies research programme



The research theme and the individual mutually complementary research topics to be elaborated through multidimensional examination make the work of the Mobility Studies section unique within OTB and TU Delft, and even beyond the boundaries of our research community. The individual research topics are mutually interrelated since they refer to an inherent relationship between the systems as a whole and their components. Each topic is expected to contribute to fulfilment of the ambitions of individual researchers and/or the section as a whole. Progress made within each topic will be monitored by the research programme leader every 1-2 years, after which a decision will be made whether to continue, modify, or even abandon the topic. The preliminary content of the individual research topics is described below.

1. Analysis and assessment of performance of existing and future (sustainable) freight and passenger transport networks (Methodology & application)

This is a rather wide research topic embracing different but challenging aspects of the investigation of the operational features and other characteristics of uni- and multimodal freight transport systems that could influence their performance and hence their sustainability. The most relevant research issues – only some of which some will probably be addressed during the coming research period – may be summarized as follows (see EIRAC, 2004 and Konings et al., 2008):

- Assessing the consequences of further standardization of existing loading units for intermodal freight transport and development of new ones, i.e. the conceptual design and conditions for implementation;
- Definition, analysis and assessment of intermodal transport terminals (transfer nodes), which will enable more seamless transfer of loading units in the given regions;

- Investigating options for creating optimal combinations of transport modes serving particular door-to-door transport chains and investigating ways of giving equal market opportunities to all modes;
- Investigating the quality of services involving particular combinations of transport modes and the measures needed to improve this quality while maintaining efficiency and safety;
- Investigating the most efficient methods and techniques for transferring loading units between particular combinations of transport modes in terms of capacity, efficiency, effectiveness and safety;
- Investigating possibilities for creating unified intermodal transport networks in which the shippers of goods on the one hand and transport and node operators on the other operate on a cooperative basis rather than through today's conventional client-supplier relationships;
- Investigating prospective relationships between (intermodal) freight transport systems and 'last kilometre' (city) logistics;
- Definition and assessment of requirements for the conceptual design of IT systems that would be able to serve the needs of all actors involved in particular logistics chains;
- Developing the models and tools required to identify, understand and design transport policy options at the strategic and tactical level for operation, management, and investments in the capacity and innovations of (intermodal) freight transport systems;
- Assessing the short- and long-term (life-cycle) environmental impact in terms of noise, air pollution, land take, waste, security and safety on the one hand and the overall social benefits on the other from different combinations of multimodal transport modes serving various door-to-door chains;
- Investigating the effects of introducing different caps (quotas) on particular impacts, optimization of use of particular transport modalities, and use of alternative energy sources on the sustainability of (intermodal) freight transport systems;
- Evaluation of particular technological, operational, economic, business and policy innovations in terms of their overall contribution to greater sustainability of freight transport systems and networks.

**2. Analysis and assessment of operations and accessibility of large multimodal transport nodes (deep-sea ports and airports)
(Methodology and application)**

The research issues involved in this topic are as follows (see EIRAC, 2004 and Janic, 2008):

- Analysis and forecasting of demand for multimodal transport nodes such as deep-sea ports and airports;
- Assessment of the capacity of large multimodal nodes (deep-sea ports and airports) and their individual components;
- Investigating the operational, economic and policy measures needed for more efficient and effective matching of the capacity of large multimodal transport nodes (deep-sea ports and airports) to demand and other constraints;
- Development and assessment of alternatives for improvement of the inland accessibility of deep-sea port terminals;
- Assessment of feasibility of establishing off-shore port facilities;
- Assessment of contribution of loading/unloading facilities and equipment (for example, fast cranes enabling both horizontal and vertical transshipment of deep-

see containers) to the local and overall efficiency and effectiveness of port operation;

- Assessment of the potential of the EU concept of “motorways of the sea” as a means of improving the sustainability of door-to-door freight transport chains involving regional ports and deep-sea ports; and
- Assessment of alternative solutions for improving the sustainability of large airports through improvement of their air and ground accessibility.

Evaluation of innovations in freight transport systems (Methodology and application)

This topic complements the other two research topics of the Mobility Studies section. Its scope applies to both services and processes using individual transport modes (rail, road, sea, inland waterways) and their combinations, i.e. intermodal transport systems. This theme will be approached mainly from the economic and technological perspectives discussed in section 3.1. It embraces the following research issues (see Chang and Chen, 2004; Tidd et al., 2001; Wiegmans et al., 2007)

- Analysis and assessment of particular technologies and processes used in existing freight transport systems;
- Inventory of current and prospective innovations embodied in particular individual and intermodal freight transport systems;
- Evaluation of existing and prospective innovations in freight transport systems from an economic and operational perspective;
- Investigation of internal and external factors influencing the economic success and failure of particular innovations in freight transport systems;
- Assessment of the marginal and overall contributions of particular prospective innovations to the sustainability of freight transport systems;
- Development of input for policies aimed at promoting the economic success of particular innovations in freight transport systems.

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7 Governance of Geoinformation and Land Development

7.1 Introduction

a. Mission and research area

The central aim of the Governance of Geoinformation and Land Development programme is to improve the knowledge available for effective land management. “Land management is the process by which the resources of land are put to good effect” (UNECE, 1996, 12). From an institutional perspective, land management includes the formulation of land policy, the legal framework, resource management, land administration arrangements, and land information management. It entails both government and private initiatives.” (UNECE, 1996, 59) “The concept of ‘land management’ is a comprehensive expression for activities aiming to fulfil established goals for the use of certain land resources.” (Larsson, 1997, 9). These activities may be either administrative in nature, such as the management of geoinformation or land administration, or aimed at land development, i.e. bringing about changes in existing land use. Land management may be defined in various ways. The present research programme has its roots in a tradition where land management covers such concepts as “land administration, land reform, land consolidation and land development” (Mansberger and Heine, 2004, 25). Institutional arrangements for land management differ widely between countries and regions and reflect local cultural and legal contexts (Enemark *et al.*, 2005).

The focus in the present programme is on land law, the administrative, legal and organizational aspects of geoinformation, and the institutions (organizations, processes, legal rules and financial or other instruments etc.) that may be used in the spatial development of both urban and rural areas. Within this broader field, the programme examines three areas in depth, namely: Land development (the interaction between governments and property markets in a planning context); Land tenure and property rights (the legal relations between people and organizations with respect to land); and Geoinformation studies (the organization of geographical or spatial information into a spatial data infrastructure or SDI).

The programme’s mission to improve the knowledge available for effective land management fits in well with the overall mission of Delft University of Technology (TU Delft, 2007, 19) that aims at ‘user-inspired basic research’; this implies that researchers should both seek a fundamental understanding of the topics they study and be guided by considerations of utility.

b. Relationship with previous programme

The present programme is based on the Geoinformation and Land development research programme (2003-2008), which covered only two main research themes. The overall programme has been restructured and a new research theme (Land tenure and property rights) added.

The Geoinformation and Land Development programme was last evaluated in late 2003 by an international review committee chaired by Professor Michael Batty of University College London, on the basis of the results for 2000-2002¹¹ along with the 2003 review data. At that time, the review committee gave it the following scores out of 5:

- Quality 3
- Productivity 3
- Relevance 4
- Viability 4

The committee expressed concern about the ‘chequered history’ of the group, with its part-time chairs, few PhD students and low level of contract income, but expected that “the group will have greater stability during the coming years”. The committee further suggested that the heavy involvement in teaching may have reduced the group’s productivity and international focus, but praised the “scope and quality of the publications”. It assessed the productivity as “quite good”, but noted a “strong concentration of publications in Dutch”. Moreover, the group had “not made much impact on the wider constituency in terms of boards, committees etc at national level.” The group’s funding came mainly from the University. There were no NWO (Netherlands Organization for Scientific Research) funds. “The programme has, however, acquired considerable international links and this has helped them secure a decent profile recently when their stability has been under threat.” Finally the Batty committee stressed the imperative need to fill the vacant Chairs.

The results of this evaluation, and the previous evaluation carried out in 2000, prompted the group to take decisive action to recruit more PhD students and to find suitable candidates to occupy the vacant Chairs. The group’s new position in the OTB Research Institute for Housing, Urban and Mobility Studies has led to a change in orientation towards contract research; some contracts concern educational activities, such as the real-estate economics courses provided for officials from the Dutch Government. The financial position is excellent. Two NWO projects previously acquired have resulted in the desired deliverables. Links have been built up with other groups within OTB, such as Urban Renewal and Housing on the organization of urban restructuring, Housing Systems on the relationship between housing and land markets, Urban and Regional Development on regional land development policies, Sustainable Housing Transformations on building codes and GIS Technology on geoinformation infrastructures. The international visibility has been improved not only via more publications in refereed journals and other publications with an international academic audience, but also by the involvement of the group in relevant international academic and research networks. Researchers are increasingly being asked to review articles for journals and to attend conferences. The group’s research capacity has been internationalized by the recruitment of more research staff and post-doctoral students from abroad and by attracting visiting researchers. The teaching workload had been reduced but is already starting to pick up again, with members of academic staff teaching Land Use and Development courses at both BSc and MSc level in the Systems Engineering, Policy Analysis and Management (SEPAM) degree programmes of the Faculty of Technology, Policy and Management (TPM) at Delft and the inter-university MSc Geographical Information Management and Applica-

¹¹ In 2000, the performance of the programme along with other research activities within the Faculty of Civil Engineering and Geosciences in the period 1995-1999 had been reviewed by a committee chaired by Professor Emeritus Jelle Witteveen.

tions (GIMA) degree programme. They also made smaller contributions to other programmes, such as the Geomatics MSc course at Delft and various courses at Wageningen and the ITC International Institute for Geo-Information Science and Earth Observation in Enschede, as well as contract training courses.

Overall, all the threats identified in the 2003 evaluation report have been turned into opportunities. The group has increased the overall number of staff members, especially those with a doctorate. Furthermore, visibility in the international sphere has been increased by continuing the growth both in the number of refereed articles in prestigious international journals and in attendance at international congresses and other forms of networking.

Taking into account the growth of the programme and the existence of three Chairs within the group, the current plan is as mentioned above to work on the following three themes:

- Geoinformation studies
- Land tenure and property rights
- Land development

GI studies will focus on the provision of geoinformation, which to a certain extent includes land administration. However, the topic of security of tenure – one of the goals of land administration – will fall under the heading of land tenure and property rights. This theme also includes the newly developed research into the human-rights aspects of property rights in relation to government interventions like planning. The study of multiple space usage will form the bridge between this theme and that of land development, where the emphasis will be on designing instruments for intervention in land markets in urbanized areas and on the evaluation of existing practices of governance of land development in an international perspective.

The proposed changes take into account the stated need to modify the focus of the group's activities, while still preserving and nurturing the valuable aspects of its research tradition. They also leave space for active concentration on more recent research topics such as the accessibility of geoinformation, planning and human rights, and Europeanization.

c. Scientific relevance

The group will aim at a comparative, multidisciplinary research approach. Delft's mission of 'user inspired basic research' makes the multidisciplinary necessary, since practical requirements are not confined to any single scientific discipline. The quest for fundamental understanding demands a level of abstraction that rises above that of specific concrete applications, and a comparative approach is one of the ways of achieving this.

Three disciplines play a relative large role within this multidisciplinary approach.

1. A part of the traditional field of land surveying, which is about the interaction between property rights, legal instruments, valuation and geoinformation. This field contributes to a clear engineering approach in the sense of 'designing' instruments, even though these are mostly legal and institutional instead of technological. There is also a great need for comprehensive research from an institutional

- perspective to understand the way these instruments work (or fail to work) in different or changing contexts, including the impact of information technology.
2. Law. The group includes a Chair of Property Law. The Land tenure and property rights research theme has a strong legal bias, and legal considerations also help to condition the scientific relevance of the other two themes covered by the group (Land development and Geoinformation studies).
 3. Planning – which is in itself a multidisciplinary scientific discipline. Within this field, one important aspect the group will address is the interaction of land-development decision-making and planning and another is how different planning agencies can work together for improving the built and natural environment.

Reflection on the effects of intervention mechanisms is an element that is common to all these approaches.

The decision to perform user-inspired research has consequences for the research methods used. As Simon (1996) puts it, a technological object is formed both by its physical characteristics and by its function. ‘The function cannot be isolated from the context of use of a technological object: it is defined within that context. Since that context is a context of human action, we will call the function a human (or social) construction.’ (Kroes, 1998, 18). The governance of land, property or geoinformation systems must address both the physical system and the function to be performed by it. A single physical object may be used for different functions, and a single function can be realized in different ways. Although the functions of an object are partly determined by the observer and are not entirely dependent on its physical condition, ‘...the practice of engineering, and more generally the practice of everyday life, show that functional claims contain genuine knowledge about the world which is different from knowledge contained in structural claims.’ (Kroes, 2001, 8). Normativity plays an important role in the evaluation of functionality, for example the collapse of a bridge is not necessarily a bad thing in pure science, since we may be able to learn more from it than from a bridge that performs flawlessly (Houkes, 2002) – but it is a disaster from a functional perspective. Technological research requires that the research object must be placed in a context of human intentions, wishes and deliberations. It is therefore essential to discuss the functions of land development, land tenure and property rights and the geoinformation infrastructure as part of the present research programme.

d. Societal relevance

Land management has a big role to play in fostering sustainable development, and sustainable land management is part of Agenda 21, agreed on at the UN Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. Specific knowledge is needed to ensure the right relationship between private property and public goals such as sustainable land management (Cocklin *et al.*, 2007; Bennett *et al.*, 2008). Not only sustainability but also other societally relevant concepts such as inclusiveness and territorial cohesion have a strong impact on land management and governance issues in relation to land development and geoinformation.

The interaction between government and markets is of growing societal relevance, due to the introduction of market-based instruments and the retreat of governments from sectoral funding. Legal instruments are changing to cope with these changes in land development processes, and local authorities are reconsidering their roles in this field.

Research on land tenure and property rights may be applied at various levels: nationally (e.g. leading to improvements in the use of Dutch instruments of land law), at a European level (e.g. comparative research on European land law and systems of land administration against the background of the development of a common mortgage market) or in a global context (e.g. improvements in land registration in developing countries). The challenges of the increasing complexity of our society can often only be met by increased understanding of spatial patterns and processes.

To this end, the right geo-data should be available and easily accessible to different categories of users. A few of the many examples that could be mentioned here are real-estate markets, environmental protection, disaster preparedness and location-based services like navigation.

e. Synergy between fundamental and applied research

An engineering approach is essential to this group's research activities. In other words, the ultimate aim of research is not just to explain or understand reality but also to design better ways of dealing with it. It follows that the concept of function, which is not value-free, plays a role in steering our research. The emphasis is however not on repetitive work but on answering more fundamental questions raised by various aspects of the programme. This is in line with the mission of 'user inspired basic research' formulated by Delft University of Technology (TU Delft, 2007, 19), which implies that research should combine a quest for fundamental understanding with considerations of utility.

f. Internal and external collaboration

The group participates in the activities of two largely Dutch-based research schools. Researchers with a legal background working on Land tenure and property rights belong to the Property Law section of the Ius Commune Research School. Other researchers in the group are associated with NETHUR, the Netherlands Graduate School for Urban and Regional Research, where they work under the coordinating theme Effective Governance of Urban and Regional Change.

As mentioned in section 1b. above, the group works together with other groups in the OTB Research Institute for Housing, Urban and Mobility Studies, e.g. with Housing Systems on housing markets in relation to land markets, Housing Quality and Process Innovation on building regulations, Urban Renewal and Housing on the organization of urban renewal, Urban and Regional Development on land development, and GIS on geoinformation studies. It also works with other OTB groups such as Urban and Regional Development and Housing Quality and Process Innovation to develop a European perspective on issues of joint interest.

At an international level, researchers participate in the Association of European Schools of Planning (AESOP), especially in the theme group on Planning Law and Administration and its offspring organization, the International Academic Association on Planning, Law, and Property Rights (PLPR). They may also be found in the European Network of Housing Research (ENHR), especially in its Housing Law working group, in the International Federation of Surveyors (FIG) and in the Global Spatial Data Infrastructure Association (GSDI); in fact, one of the group's researchers, Bas Kok, is the current President of the last-mentioned organization. The

group's involvement in these organizations leads to all kinds of co-operation with other participating researchers and institutions.

The addition of Land tenure and property rights as a new research theme within the group will lead to links with the International Alliance on Land Tenure and Administration (founded in 2007). The group also has contacts with international organization such as UN Habitat, the World Bank and FAO in this field.

Two researchers have been recently appointed to a part-time chair at other academic institutions, thus strengthening the links with these bodies. These are the chair of Real Estate Law at VU University Amsterdam and the chair of Land Administration Systems at the ITC International Institute for Geo-Information Science and Earth Observation in Enschede.

Next to these international networks, the group participates in national networks with such diverse partners as the Dutch *Kadaster* (Land Registry); the Data and IT Service (Dutch abbreviation DID) of the Ministry of Transport, Public Works and Water Management; the Ministry of Housing, Spatial Planning and the Environment; the Ministry of Agriculture, Nature and Food Quality; sector associations such as GeoNovum, the national Spatial Data Infrastructure (NSDI) executive committee in the Netherlands; local authorities, market players and their professional organizations. The group expects to be doing contract research for a variety of these parties, as it has in the past.

g. Relations with education

Researchers from the Land development and Land tenure and property rights theme groups coordinate and teach courses on land use and land development at both BSc and MSc level in the Systems Engineering Policy Analysis and Management (SEPAM) degree programme of the Faculty of Technology, Policy and Management (TPM).

The group's researchers are also active in part-time education, contributing to extensive courses on such subjects as land development instruments and practice and teaching shorter courses on land law and land registration.

The research within the Geoinformation studies theme group is closely related to the teaching of the institutional aspect of geoinformation (infrastructures) in various MSc programmes, in particular the interuniversity GIMA (Geographical Information Management and Applications) MSc degree programme provided jointly by the TU Delft together with Wageningen University, the University of Utrecht and ITC). We also teach a course in the TU Delft Geomatics MSc degree programme and contribute to other courses elsewhere.

h. Researchers and other personnel

The group aims to strengthen the capacity of the research team in two ways:

- by attracting junior staff as PhD students, in line with the overall policy of the OTB Research Institute for Housing, Urban and Mobility Studies.
- by offering hospitality to visiting researchers. For example, Professor Harlan Onsrud of the University of Maine and Dr. Sang Bong Im of the Rural Research Institute of Korea are due to stay at the institute for several months in 2009. It is planned to continue this hospitality programme on a regular basis.

Table 1 Staff of the research programme and research themes

	Themegroup		
	Geoinformation studies	Land tenure and property rights	Land development
Prof. W.K. Korthals Altes			X*
Prof. J. de Jong	X	X	X
Prof. J. Besemer	X	X	
Prof. H.D. Ploeger		X*	
Prof. J.A. Zevenbergen	X*	X	
Ir H.W. de Wolff			X
Dr D.A. Groetelaers		X	X
Dr B. van Loenen	X	X	
Dr T. Tasan-Kok			X
B. Kok	X		
H. Koerten	X		
Ir F. Welle Donker	X		
Ir M. Jellema	X		
Ir P. van Asperen		X	

*) Theme leader

i. Resources, funding and facilities

The previous research programme was funded by a combination of money from large (government-backed) schemes with two projects being supported by BSIK [BSIK is a Dutch acronym for ‘Order concerning Subsidies for Investment in Knowledge Infrastructure’; this is a government scheme set up in 2004 to stimulate innovation throughout the Netherlands] and further research funding from NWO, and a mixture of smaller projects, to avoid dependence on a single major contract. We plan to continue this construction in the present research programme, thus ensuring a robust financial basis for our research activities that is less vulnerable to unforeseen developments within one single flow of funds.

7.2 Ambitions for the period 2009-2014

The group aims to establish a position as an international leader in the study of the role of local authorities in land development and of the role of Single European Market rules in land development and their impact on urban regeneration practice. Our research on the introduction of a new Spatial Planning Act in the Netherlands, with a separate chapter on land development, aims to make a significant contribution to understanding of the way legal instruments for land development can be formed. The Land tenure and Property rights theme group aims to build on and further strengthen the existing research on land law and land registration performed in the past, and to contribute in a substantive way to the ongoing legal debate on the influence of EU policies and legislation on land law and land registration. Geoinformation studies have become highly relevant of recent years with regard to access policies within the Netherlands and Western Europe, and our Geoinformation studies theme group has been increasingly participating in agenda-setting events. Building on this basis, we aim to increase our scientific visibility by developing conceptual models

and assessment frameworks permitting increased understanding and comparison of developments in and between countries, as part of existing and extended cooperative projects.

More operational ambitions are as follows:

- The publication of more, and more influential, papers in international peer-reviewed journals.
- Combining research with a direct application in a practical context with scientific reflection on the issues involved.
- Maintaining a proper balance between retaining our position as a national player in our field and increasing our involvement in international networks.
- Making sure that the group produces at least one PhD a year.
- Participation in international research networks.

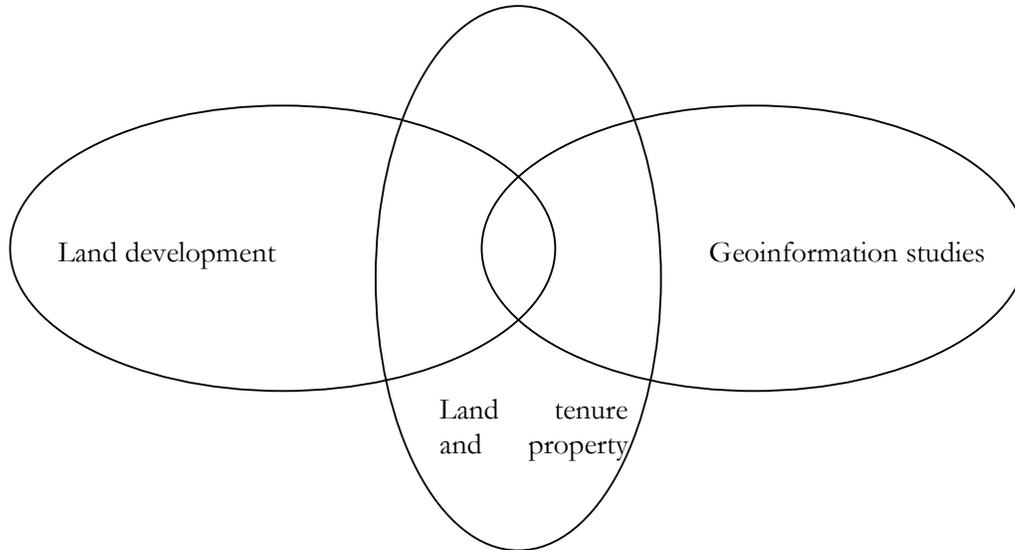
7.3 Description of research programme and research themes

The Governance of Geoinformation and Land Development programme undertakes research in real estate law, the administrative, legal and organizational aspects of geoinformation, and the instruments that are (or may be) used in the spatial development of both urban and rural areas. The group studies three themes in depth:

- Land development, which is about the interaction between planning and property markets, and the possible conflict between the private interests of landowners on the one hand and common societal goals and the interests of larger regions on the other.
- Land tenure and property rights, which will focus on the content of the legal relations between people and land, especially in the field of the multiple use of space, the transparency of the way these legal relations are implemented by land administration authorities, and the balance of public and private interests (i.e. the human rights aspect of land development).
- Geoinformation studies, which deal with the institutional arrangements whereby geographical or spatial information (which supports a wide range of societal activities) is provided for in the public sector by private companies and by private persons. With proper coordination, these activities lead to the creation of a coherent spatial data infrastructure (SDI).

As illustrated in Figure 1, the theme of Land tenure and property rights forms the link between the other two themes, Land development and Geoinformation studies. The activities of the latter two theme groups diverge away from the common ground of Land tenure and property rights.

Figure 1 Research themes



Governance is a key concept for the research group as a whole. Stoker (1998) defines governance as the complex set of institutions that are drawn from governments but go beyond government. This complicates the task of legitimizing responsibilities for tackling specific issues, and means that significant power dependencies are involved in the relationships between the institutions active in this field. There is a tendency for self-governing networks to be formed, in which people work together to allocate resources. Questions then arise about accountability (which leaves a role for government) and about ‘the capacity to get things done’ (Stoker, 1998, 24), not solely through the power of government or authority, but also by the use of new regulatory tools and techniques. The governance networks in land development, land tenure and property rights and geoinformation are different, but share some common nodes (see Figure 1 again).

Europeanization is a common characteristic of all three areas studied by the group. We use the term ‘Europeanization’ in its most common sense, as a process of “...adapting national and sub-national systems of governance to a European political centre and European-wide norms” (Olsen, 2002, 924). In the field of land development planning, the European rules governing state aid and public procurement may structure planning practice. The legal aspects of land tenure and property rights have traditionally been considered to be a strictly national matter, but the involvement of the European Union in the real estate market and the influence of the European Convention of Human Rights have changed this. The European influence on geoinformation studies comes from such EC Directives as that on re-use of public-sector information (PSI) or the directive for an European SDI (INSPIRE). Study of these effects of Europeanization will be a focal point for our research plan, allowing our researchers to contribute to the ongoing academic and social debate on the European dimension of all three themes.

We will describe the plans for the three theme groups in turn, in considerable detail, below.

Land Development

Land development is about the transformation of land, for example the conversion of agricultural land or rundown industrial areas into a new built environment. The literature offers different conceptualizations of this process; for example, it may be based on institutional analysis (Healey, 1992), which also stresses the potential role of regulations in the development industry (Healey, 1998), development cultures (Guy and Henneberry, 2000; Guy *et al.*, 2003) and transaction costs (Alexander, 2001; Buitelaar, 2004). Alexander (2001) has developed a generic model of the land development process, which includes the following transactions: (1) land purchase and assembling, (2) financing, (3) land preparation and development, (4) land disposition, (5) construction, and (6) property transfer. Our research programme focuses on the impact on steps 1, 3 and 4. This does not mean that effects on other transactions are unimportant, only that these are outside the immediate scope of this research programme as are transactions relating to construction and property transfer. It may be noted that in the UK development and building are sometimes combined in one firm, which purchases a site, prepares and develops the plots and builds and sells homes (Ball, 2003). This construction is rarely or never seen in the Netherlands

The Land development theme group will focus on three interrelated subjects: 1) new legislation governing land development; 2) the authorities as land developers; and 3) the European Single Market and land development. In all three topics, researchers will not be content to explain or understand the subject matter but will also try to formulate strategies aimed at improving practice in the relevant field. This in its turn will raise questions about how different forms of action can be evaluated. For example, a strategy aimed at land development in full conformity with the original plan may turn out not to be the best one if other evaluation criteria are used (Faludi, 2000; Korthals Altes, 2006b; Korthals Altes, 2008).

New land development legislation: better practice?

Land development law in the Netherlands has recently been changed. The new Spatial Planning Act (which came into effect in mid 2008) contains a new chapter on land development that introduces a plan for the collection of development contributions from landowners and developers to help fund the cost of growth. The idea is that landowners who are not willing to pay this contribution may have their land expropriated. The new law also makes it easier to reach contractual agreement about development contributions before the development plan is decided on. It has further led to changes in the *Wet voorkeursrecht gemeenten* or Pre-emption Act (the law governing the pre-emptive rights of local authorities to acquire land). The Rural Planning Act (*Wet inrichting landelijk gebied*) has also recently been introduced.

National legislation and planning policies may influence both the strategies of local authorities and the structure of the building industry (Adams, 2004). In the coming years we will study the consequences of the above-mentioned changes in Dutch legislation for land development strategies. Does the new legislation strengthen development planning in terms of the quality of development, its timing and financing? These investigations continue the line already established within the research group of studying the effects of legislation and the use of legal instruments such as the Pre-emption Act (De Wolff, 2000; De Wolff *et al.*, 2000; De Wolff and Groetelaers, 2005), land consolidation instruments (Van Dijk, 2004; Van Rij and Korthals Altes, 2008) and legal instruments used by local authorities for land development (Groetelaers, 2004). The group strives to publish actively in this field, both in national journals and in international publications as part of the international academic

debate on legal instruments and their use. Some of these publications will position national developments in an international context (De Wolff, 2004; Groetelaers and Korthals Altes, 2004) and may perhaps serve as an inspiration to others in this way, while in other cases the publication may be devoted to the possibilities of transplanting an instrument for use in another setting (Van Dijk, 2006; Van Dijk *et al.*, 2007).

Governments as land developers and private enterprise as project developers: does it work?

In some countries such as the Netherlands, it is common practice for the local authorities to buy undeveloped land from landowners for the purpose of construction. The local authority then provides infrastructure and sells the serviced plots to developers and end users (Lefcoe, 1978; Needham, 1992). In this way, they seek to promote a coordinated approach to development: the local authority internalizes the profitable aspects of land development through land ownership, while also retaining the power to set land prices for functions such as affordable housing lower than for market-sector housing or office buildings. By producing serviced plots - buying the land, servicing it and selling it - local government bears the long-term risks over boom-bust cycles, with private enterprise developing short-term projects in the second stage. This division of interests has its advantages, as the private sector is not eager to take on the long-term risks of complex urban projects (Gordon, 1997; Needham, 1997; Adair *et al.*, 2003), and local authorities are more likely to emphasise the quality of urban development. These policies are followed not only in urban extension areas but also in plans for urban regeneration, especially in times like the present when many grants have been abolished and local authorities are increasingly dependent on market forces for financing re-development (Korthals Altes, 2007).

Can provinces be land developers?

Dutch provincial authorities are also currently reflecting on their role in relation to land development (Korthals Altes, 2006c; de Jong and Spaans, 2009). Land development planning for rural areas in the Netherlands developed out of the practice of land consolidation (*ruilverkaveling* in Dutch), which was originally intended to serve the interests of agriculture, horticulture, forestry and cattle breeding, as laid down in the Ruilverkavelingswet (Land Consolidation Act) of 1924 and its subsequent amendments in 1938 and 1954 (Van Dijk, 2004). The scope of land consolidation was later extended to include nature conservation and recreational facilities, and all these activities now fall under the umbrella of 'landscape quality improvement' (Van Rij and Korthals Altes, 2008). The idea that provinces must be willing to implement direct development fits in well with the Dutch tradition of urban land development, in which local government land ownership plays a crucial role. It is still unclear how much the Dutch provinces will be able to change in order to facilitate their new role in regional development planning.

Financially sound?

Land development projects run by local authorities may involve huge investments and impinge on major interests. Research on 'mega-projects' - in general large infrastructure projects e.g. for railways, tunnels, airports and highways - shows that costs tend to be higher than anticipated, while the benefits are often fewer than predicted (Flyvbjerg *et al.*, 2002; Flyvbjerg, 2007). Land development projects differ from infrastructure projects, however. Unlike a typical large infrastructure project, which fails if it is not realised in its entirety (De Bruijn and Leijten, 2008), individual plots and buildings in a land development scheme can be used before the entire project is finished, and the lay-out of parts of the plans can be changed in the light of new infor-

mation or insights gained during the development process. The relationship between the agencies involved is also different. Development companies do not realise the project as a contractor for the government, but sell their finished products to investment companies or end users, whereas the government is responsible for public spaces. Hence, there is much more flexibility in the land development process than in large infrastructure projects. The plans for an area can be refined in response to changing market demands – for example, offices can be replaced by housing or vice versa. This market dependency may make a variety of demands on local authorities (Korthals Altes, 2007). An analysis of local government estimates and accounts by this research group reveals that the provision of infrastructure by local authorities in the Netherlands is an exception to the general rule of budget overruns and benefit shortfalls. The profits made by local authorities from land development are growing, while the costs, revenues and results are, on average, underestimated by local authorities. There are a variety of possible explanations for this. Firstly, the land development process lends itself more effectively to the generation of a range of different products. Secondly, the option value of future actions may result in better revenues. Thirdly, it is in the interest of the various actors involved that estimates of the projected results should be on the conservative side. The fear that their funds will be redirected to other ends causes land development agencies to be cautious with regard to the financial results of future projects. Finally, this situation may simply result from the principle of prudence (Maltby, 2000), which is fundamental to the system of book-keeping used in land development projects. One of our aims during the current research period is to improve our understanding of such matters. One conclusion may even be that analysis of the conformance between plan and outcomes, as performed e.g. by Flyvbjerg et al. (2002), is less relevant to land development projects than was thought because of the learning processes that occur in the course of the project (Korthals Altes, 2006b).

What is the impact of the Single European Market on the governance of land development?

Land development, the intervention in property markets, takes place in an institutional setting that has an impact on both cities and property agents (Taşan-Kok, 2007). The focus of much recent research has been on the balance between globalization and local practices (Taşan-Kok and van Weesep, 2007) and the impact of the restructuring of the welfare state (Priemus, 1995; Korthals Altes, 2002). Europeanization is clearly relevant in this context, and the group will devote much effort to study of the impact of the Single European Market rules about state aid and public procurement on land development practice (Korthals Altes, 2006a). This impact may be considerable, since land development involves much intervention in planning processes and property markets. The example of state aid in the UK (Adair *et al.*, 2003) demonstrates that European market rules co-determine the kind of policy instruments that may be used, even forcing public organizations to follow a procedure of direct development in which the infrastructure is provided by the government instead of government-subsidised developers. Works delivered in kind on the basis of development obligations built into the development contract may meet serious challenges from European public procurement rules, as may the sale of land by local governments at preferential rates as a form of building concession. However, apart from operational considerations the practice of local government to use its property to stimulate selective development fits reasonably well in the current context of *reterritorialization* and *rescaling* of territorial organization (Brenner, 1999), since localized governance networks are constrained by the Single European Market regulations. Nevertheless, these dynamics have a variety of consequences for individual land development systems as the way the principles of globalisation, competitiveness and

cohesion work varies in practice (Maloutas *et al.*, 2008). Europeanization may impact on the institutional structure of the development process, changing the various national development cultures by opening up markets (Guy *et al.*, 2003). Within a specific context, a specific institutional constellation of local authorities and property agents may develop (Taşan-Kok, 2006; 2007). In some cases, the building of networks between local authorities and development companies is seen as beneficial in balancing competitiveness and cohesion. Guy *et al.* (2003) make a plea for 'locally based forms of property investment and development' (p.1194). However, this may conflict with the concept of a Single European Market which aims to create a level playing field for all enterprises. Good relations between local government and developers play a major role at present, and housing associations use their relationship with local government to obtain their share of the housing programme (Needham and De Kam, 2004). This idea of good relationships between local market players and the local authorities does not seem to be really consistent with the notion of a Single European Market.

In what way does Europeanization frame the constellation of actors, and what new modes of operation are emerging?

The EC Public Procurement Directive may put a stop to the long-standing practice of development obligations in kind which exists in many European countries. Under the Scala ruling, land developers who have a contract with local government to provide infrastructure on their own land are regarded as contractors of public works. Although some have questioned the existence of a pecuniary interest (one of the criteria for establishing whether there should be public procurement according to the European rules) in contracts covering specific kinds of obligations in a given national context, the general consensus is that in many cases this procedure should be followed. Subsequent judgements of the Court of Justice in Luxembourg have reiterated this (Elvin and Banner, 2008). However, in many European states the practice of land development agreements has not ended; in fact, contracts are still being concluded that seem to take no account of these new insights and are hence susceptible to legal action.

Another shock effect might come if long-established practices are questioned in the courts. Planning practices may then have to be changed overnight. The Single European Market may dictate the effects of the instrument that agencies use to change the ownership and use of land and real estate and, at the same time, may alter the performance of concerted use of instruments as land policy. Such changes could have an enormous impact on the planning principles underlying spatial policies.

Developing new 'Europe-proof' land development instruments

The above-mentioned trends will probably lead to a need for development of new planning instruments that satisfy the demands of the EC Public Procurement Directive without abandoning the underlying principles of development planning. As European law is necessitating these changes, it might be useful to look at the solutions already implemented in different Member States and use them as a basis for improved practices. Procedures that comply with EU legislation must be transparent and facilitate competition between different market parties; land ownership must not be the decisive factor in contracting works. This may also have significant ramifications for the land development industry itself, which will have to adapt to the new context. Less adaptive enterprises might find themselves out of business. Creating a single market has implications not just for the market but also for the planning agencies that must comply with these rules and be more transparent in their relationship with market parties, and which may need to build up capacities to play an active role

in direct development in urban regeneration areas. The mere existence of a specific national development culture may constitute a major barrier to Europeanization, since it may be one of the sources of undesired extra transaction costs. It is therefore important to ascertain how the different instruments of the Single European Market policies affect these national development-planning practices.

This research theme group expects that its analysis of the above-mentioned subjects, carried out in close cooperation with other research institutions, will give it a leading position in international research on the role of local authorities in land development, the role of European Single Market rules in land development and the impact of such rules on urban regeneration practice. In particular, we aim to make a significant contribution to understanding of the way legal instruments for land development can be formed through our study of the new Dutch Spatial Planning Act, with its separate chapter on land development.

Land Tenure and Property Rights

Research within the “Land tenure and property rights” theme group focuses on the relation between law and land market practise. This new theme group builds on the study of legal and land-registration topics performed during the previous research period and the expertise gathered, often in mutual cooperation with the GIS Technology section of the OTB Research Institute. During that period, the Geoinformation and Land Development sections of the old research group had already built up a substantial position in the national and international academic debate on land registration. Our contribution to the study of Dutch land law had already attracted the attention of our peers outside the world of the Dutch universities of technology, as illustrated by the recent appointment of one of our staff members to the chair of Real Estate Law and land registration at VU University Amsterdam. Our staff members also publish actively in both national and international journals, and produce an appreciable number of preliminary reports. Our aim is to reinforce our position yet further in this field of research during the current research period. It was decided that the best way to bring this about was to create a new theme group that would bring together the field of rights in land (as traditionally studied by the practitioners of land law) and the registration of these rights, and would also devote more attention than in the past to developments at the European level.

Property market

The cross-border mortgage credit market is getting a lot of attention from the European Commission. A marked increase in cross-border real-estate transactions within the European Union creates a demand for easy, reliable access to information from the national land administrations of the Member States. This will have an impact on the area of land registration. Major developments have taken place in this field of recent years. First of all, the European Union Land Information Service (EULIS) started to operate in 2007 and aims to provide cross-border access to information on rights and restrictions on real estate, using the information in the participating land registries (Ploeger and Van Loenen, 2004; Gustafsson and Drewniak., 2008). In the same year the European Commission published its White Paper on the Integration of EU Mortgage Credit Markets (CEC, 2007), in which it announced the first steps to be taken to harmonize the different land registration systems within the EU. Against this background, we had started studying the need for and possibility of a common system of land registration within Europe even before the appearance of the White Paper (Ploeger and Van Loenen, 2005; 2006; 2008). This research, reinforced by in-

put from international partners, will continue and will also take in account the situation in the USA where similar developments are dealt with under the heading of title insurance.

Land registration, as part of the wider field of land administration, supports not only (international) mortgaging but also the real-estate market and land management in general. Different approaches are applied in different countries, but these are increasingly being studied, compared and improved with the aid of more generalized conceptual models such as the Land Administration Domain Model. Outside the Western world, few successful systems for this purpose are in operation, and those that are often fail to serve large parts of society – in particular the poor. Innovative approaches, both in legal and geoinformation technology terms, are being developed in joint research between this theme group, the GIS Technology section of OTB, and the ITC Institute in Enschede (where one of our researchers holds a part-time chair in Land Administration Systems). These innovative approaches include the Social Tenure Domain Model and more flexible ways of recording land tenure.

Fundamental rights

In general, government has a strong influence on land development. Nonetheless, the process of urban land development and the use of instruments to this end are not matters of government policy alone. A balance needs to be struck between public goals and private interests in this field (see Conseil Européen des Urbanistes, 2003). The human-rights approach offers a framework for structuring this process and suggests standards for the application of land-development instruments. The European Convention of Human Rights (ECHR), in particular the fundamental rights to property (article 1, Protocol 1 ECHR), the protection of one's home (article 8) and procedural safeguards (article 6), helps to balance these interests. It will be clear that these considerations also apply to the application of land development instruments (Ploeger and Groetelaers, 2007). The research performed by the group in the past will provide a basis for our future activities, in which we aim to clarify the significance of the human-rights framework specified by the ECHR for the practice of urban land development with special reference to the plan implementation level, i.e. the actual use of instruments by planning authorities, as this is where interference with the fundamental rights of citizens most often arises.

Complexities of modern land use

Urban areas have to cope with a dense population in a limited area. What is the best way of dealing with the increasing number of claims on that limited space by a multiplicity of users (transport, industry, housing, recreation etc.)? One answer is the multiple use of space. The land is then no longer the exclusive domain of one owner (or group of owners), who uses it for one purpose only (for instance, housing or industry). A more efficient use of the available space, above and below ground, may be obtained by the legal division of this space in the third dimension (multi-level constructions), or in the fourth dimension (time-share). In the long term, the success of multiple use of space depends not only on the technical quality of the buildings but on clear definition of the mutual rights and duties of the various parties involved.

In this respect we focus on the legal architecture ('juritecture') of the built environment (Ploeger, 2003; Groetelaers and Ploeger, 2007). We argue that the complex nature of multiple-use projects means that the role of the lawyer is changing. He or she needs to be involved right from the early design stages and must therefore work together with planners and architects to reach optimal solutions. Comparative research

is required to determine whether solutions from different European countries will help us to identify the principles that will help us to reach a better basis for security of land tenure in a complex urban setting. The interplay between land law and technical factors is also highly relevant to our research. This approach proved valuable in the past in our study of the possibilities of a 3D property registration system to provide greater insight into the complex ownership relationships that may prevail in urban environments (Stoter and Ploeger, 2003; Doner *et al.*, 2008). This line of research recently went one step further by considering the possibility of a 4D registration system that takes into account not only the three dimensions of space but also the fourth dimension of time. This study has been performed in close cooperation with the GIS Technology section and international partners. We expect that this research topic, linking as it does aspects of land law and land registration, will continue to be of importance in the years to come.

A multidisciplinary approach

The Land tenure and property rights theme group aims to take a multidisciplinary approach to the topics investigated. Unlike the detailed study of the theory behind legal rules and principles as performed by our peers in the Law Faculties of Universities in the Netherlands and abroad, we focus on law in action by evaluating ongoing practises in the field of property rights and land tenure by means of case studies (e.g. interviews) and quantitative analysis. The ultimate objective is to support efficient use of existing instruments and the design of new, improved instruments. The influence of Europe in this field, via European Union legislation and policy on one hand and the European Convention of Human Rights on the other, is becoming increasingly clear (see Schmid and Hertel, 2005; Sparkes, 2007). These developments in a changing Europe offer a challenging background to the study of land tenure and property rights. By further strengthening existing research and putting additional stress on developments at a European level, we hope to make a substantive contribution to the ongoing legal debate on the influence of the Europe Union on the systems of land law and land registration used by Member States.

Geoinformation studies

Access to geoinformation is important for the well-being of society. Technological advances allow improved access to a wide variety of geoinformation and the use of sophisticated new access methods. New technology also enables new methods of collecting, processing and using geoinformation, resulting in more efficient and less expensive data collection and improved data sharing. It has further stimulated the collection and processing of geoinformation by non-professionals without specific geoinformation technology expertise. These technological advances represent a challenge to existing institutional principles concerning access to geoinformation, and will continue to do so in the future.

In view of these technological advances, to which the GIS Technology section of OTB contributes and whose significance we study in conjunction with them, the Geoinformation studies theme group investigates the accessibility of geoinformation from an institutional perspective with special reference to three user segments:

- the geo-market, and in particular the position of (private sector) value-added resellers here;
- geoinformation within the context of e-government (e.g. European INSPIRE, Dutch base registers and sector arrangements) (Masser *et al.*, 2007) [base registers are national systems that identify the basic units of society, such as physical persons, enterprises and corporations, buildings and real estate];
- the general public (citizen), both as (end-)user and increasingly as data provider.

Vast amounts of geo-data have been and are constantly collected and processed in response to specific user needs. Nevertheless, much geo-data can be used for other objectives as well, with little or no need to re-collect or re-process it. Since the sharing of geo-data is considered to be in the general interests of society as a whole, from an environmental, social and economic perspective, there is an overall drive to increase the sharing by improving access, removing technical, legal and financial barriers and devising appropriate organizational structures (Van Loenen and De Jong, 2007; Besemer, 2008) without forgetting the possible consequences for the freedom and privacy of the individual.

To truly capitalize on these developments, it is important to focus much more on the interests and needs of the geo-data users, and less on those of the (large) data suppliers, who generally dominate this sector. More attention also needs to be paid to the diversity of the user segments, each with its own needs, especially in relation to the trade-offs between data quality, service level and the price users are prepared to pay. The collection and processing of geo-data is and will remain relatively expensive, and the costs of dissemination through an increasing complex array of services should also not be underestimated, especially when a high service level is aimed at. Attention should also be paid to the difference between (physical) data that can be (re)collected by different actors if needed, and (socio-economic) data that is generated as part of societal interactions (mainly transactions).

The impact of technological advances on the availability, access, and use of geographical information, and on the institutional setting within a SDI, are key drivers for the research performed in the Geoinformation studies theme group. This also applies to the effects of societal and governance trends like (de)centralization, e-governance, outsourcing and rethinking of the role and size of public administration. We give below brief details of a number of topics that the Geoinformation studies theme group is expecting to address in the coming years.

Increased efficiency

Technology has provided new ways of sharing geoinformation among different organizations. A number of programmes at national (e.g. the Dutch e-government programme 'Different Government') and European level (in particular INSPIRE, the EC Public Sector Information (PSI) directive, GMES, Galileo and the EC Water Framework Directive) have made people - at least within the geoinformation sector - aware of the need for increased data sharing and improved access. The final legal outcomes of these programs are, however, quite limited in their prescriptive provisions. The Dutch laws regulating the use of base registers focus on applications within the government sector, and leave a wide range of options for the level of access by the private sector. The INSPIRE directive only requires the free availability of search services, and free access to environmentally relevant geo-data for institutions of the European Commission. There is some margin of appreciation left to Member States in the transposition of both the PSI and the INSPIRE directive. The extent to which data sharing is promoted may differ between Member States, raising the questions whether some Member States are more successful in meeting SDI objectives than others (Giff *et al.*, 2008).

Service provision: public sector or market?

New technologies provide many new opportunities for providing geoinformation answers to today's societal questions. At the most basic level, GoogleEarth and Virtu-

alEarth are examples of commercial access points bringing together data from public, private and other sources. Other more advanced services provide opportunities for the public sector to inform and involve citizens through new geo-web services about their environment as part of the e-government programme (see www.Atlasleefomgeving.nl, www.bodemloket.nl, www.digitaleplannen.nl, www.risicokaart.nl, www.leefbaarometer.nl and the interactive noise map provided by the Dutch Ministry of Transport, Public Works and Water Management ¹²). The public sector may also employ special modules to receive feedback from well-informed citizens in a way similar to that used by the *Landesvermessungsamt* (regional surveying service) in NordRhein-Westphalia (Germany) for its topographic mapping. This may result in new public tasks or public sector activities that were previously the domain of the private sector alone, thus possibly changing the balance between market activities and public-sector activities (Van Loenen and Zevenbergen, 2006; Welle Donker and Zevenbergen, 2007).

New business models required?

The new technology has also led to a shift in business methods from the traditional sale of products to provision of free access to products to generate ‘traffic’ which attracts companies that want to put their advertising banner on the site in question. Intellectual property rights traditionally used to protect the product to generate revenues from sales are now used to attract customers through freely available products as a way of merchandizing other products. The question arises whether government can still rely on the traditional business models when these new ways of doing business become increasingly common (people will eventually expect or even require free access to data). Digital Rights Management (DRM) systems may provide feasible solutions to this problem.

New demands?

Technological developments influence not only the availability of, access to and usability of geoinformation, but also the roles played by the public and private sectors and citizens in the geoinformation infrastructure. The traditionally dominant national mapping agencies (such as the Ordnance Survey in the UK) and the like may need to move from a leading to a more secondary or facilitating role. The private sector and citizens may become the drivers for future development (Rajabifard *et al.*, 2002; Van Loenen, 2009). In the near future, geoinformation may become part of the infrastructure like water and electricity supplies, which are only noticed when they break down – as e.g. when people complain “the server is down” or “the map is not available” (Star and Ruhleder, 1996). This new infrastructural role for geoinformation might require re-assessment of not only the required data quality characteristics, but also the access policies accompanying the data. This all increasingly calls for the continuing development of SDI assessment frameworks (Crompvoets *et al.*, 2008). The Geoinformation studies theme group aims to include the assessment of the institutional component of SDI as one of its research topics (Giff and Crompvoets, 2008). Improved technology now also facilitates the comparison of data sets from a variety of sources. INSPIRE will further stimulate this trend through its metadata and harmonization implementation rules. Experience gained with the RGI-006 GeoPortal Network project showed that when integrating or combining data from different sources, the user is very likely to be confronted with semantic differences which can-

¹² A literal translation of these website names is DwellingEnvironmentAtlas, SoilHekpdesk, DigitalPlans, Risk Map and QualityOfLifeBarometer. For the noise map, see <http://www.rijkswaterstaat.nl/geotool/index.aspx?projecttype=geluid&cookieload=true>

not be easily resolved. Current developments seem to be heading towards a new balance between the (generic) needs of the infrastructure and the peculiarities of different (application) sectors and jurisdictions (local government versus national governments, or individual countries versus supranational initiatives).

New data and data providers

Previously data was only available from a few, often a single, (public) data provider. Now there is often a wide array of similar data offered by many different public, private and other parties. Citizen involvement has been stimulated by hand-held GPS receivers, and further promoted by the locational tools increasingly incorporated in cell phones, PDAs and even MP3 players and iPods. The data these non-professionals collect goes far beyond traditional limits and includes photographs, sound and movies all linked to a specific location. Examples are Google's Streetview, YouTube, and Openstreetmap where citizens create topographic maps with a GPS receiver and a simple GIS tool. TeleAtlas also offers many gigabytes of movie data of the road network which may be used for 3D animations. Now that new technology is moving data collection away from its traditional roles, will the role of government shift from data provision to quality control and certification?

New threats?

New technological advances also pose new threats to society. For example, locational tools may enable Location Based Services (LBS), but may diminish privacy (Van Loenen and Zevenbergen, 2007). The issue of privacy protection sparks public debate every time technological developments permit or simplify the collection, combination or application of new sets of person-related data.

These new technologies also challenge existing institutional arrangements protecting privacy. While technology is typically introduced and used on a global scale, legislation addressing new technological threats is traditionally a national responsibility. The pace of technological development sometimes tends to outstrip the development of privacy protection, which also puts personal privacy at risk.

Justification: is spatial special?

Although many of the institutional issues described above also relate to other forms of information, there are good reasons for studying geoinformation from an institutional perspective in its own right because of the specific nature of geo-data and the way it is collected and processed, the vast numbers of users that may benefit from its use, the way the geoinformation sector is organized and the ongoing trends towards increased sharing and accessibility and the development of SDIs (Besemer, 2008). Obviously this should not, and is not, done in isolation from fields like information law and information systems.

Approach

The main institutional aspects on which the Geoinformation studies theme group focuses are:

1. access policy and its legal and financial context, including, privacy, intellectual property rights and DRM (digital rights management), (harmonized) licensing agreements and business models (National Research Council, 2004; Longhorn and Blakemore, 2008; Van Loenen, 2009);
2. the dynamics of the roles of stakeholders within SDI – in particular, market players and government - and the thin line between government control and what is better left to the private sector; the increased role of non-professionals in infor-

mation gathering and its impact on the traditional geo-sector (Welle Donker and Zevenbergen, 2007);

3. assessment of the success and impact of the development of (in particular national) spatial data infrastructures (SDI) on the use of geoinformation in society, with special reference to the influence of European directives and the differences in implementation of these directives in the various Member States (especially with respect to PSI and INSPIRE) (Crompvoets *et al.*, 2008; Giff *et al.*, 2008).

The application and user context are considered in each case studied, causing the three above-mentioned segments to be highlighted to varying degrees in different cases.

The primary institutional context applied will be that of the European Union. Comparison of the developments in different European countries, especially in relation to the implementation of EU directives, is the main route followed in the development and testing of conceptual models and also acts as a source of inspiration for various solutions. The results of our research are shared and compared with peers throughout the world, in particular in the North American and Asian Pacific regions at present; the GSDI (Global Spatial Data Infrastructure) Association is an important platform for such exchanges (Giff *et al.*, 2006x). The theme group also receives input from the Dutch public policy and private sectors, and has significantly influenced developments in these sectors.

Conclusion

The Governance of Geoinformation and Land Development research programme combines strong societal relevance with an engineering approach. In other words, the group's investigation of practical cases throws light on governance practices in land management systems and gives it a strong foothold in the academic debate on geoinformation studies, land tenure and property rights and land development – the three main themes covered by the group.

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8 GIS technology

8.1 Introduction

The Spatial Information Infrastructure (SII) serves the same purpose as the nerve system for human beings. The nerve system is crucial for the functioning of humans and covers the information flows from sensory receptors (seeing, hearing) via processing, analysis and planning (storing information, thinking) and communication (in speech and writing) to control of actions (walking or moving in other ways, building). SII forms the nerve system of the human environment, both man-made and natural. Our society has realized this and after many isolated initiatives is now heading towards a sustainable SII, in which spatial information or geoinformation can be shared and re-used.

SII is a new concept and much work remains to be done, both in science and practice, before it can be operational in an effective and efficient manner. Important organizational steps are currently being taken; e.g. the EU Directive INSPIRE and the EU GMES (Global Monitoring for Environment and Security) Initiative. Several areas of EU FP7 (the European Commission's Seventh Framework Programme) and other programmes support research and development through various projects covering such topics as agreed (formal, machine-processable) definitions of key data sets, definitions of a range of key services (catalogues; viewing systems; data; processing services such as coordinate transformations and buffers), and future geoinformation handling systems (vario-scale spatio-temporal 3D/4D models and processes). SIIs are developed within global initiatives (the Global Spatial Data Infrastructure GSDI), national initiatives such as the *stelsel authentieke basisregistraties* ('authentic basic registration system') in the Netherlands, or by single organizations such as *Rijkswaterstaat* (the Directorate-General for Public Works and Water Management) in the Netherlands and the multinational company Shell.

GIS technology, or Geoinformation Technology (geo-ICT), is a part of the more general discipline of geoinformation science. Geoinformation has been applied throughout the world for many centuries or even millennia, so why bother doing scientific research in this area? The answer is that the unprecedented increase in the volume of geoinformation means that we need to find improved ways of handling it. The overall goal of the research at OTB's GIS Technology section is to provide and/or develop the technology, including the knowledge behind it, needed for the realization of a SII. The impact and potential of geoinformation are growing, because the information and the services needed to deal with it can be readily transported by electronic means via (wireless) networks and geoinformation is more and more combined with emerging sensor, visualization and interaction technologies. SII nodes throughout the world are increasingly using an underlying geo-DBMSs (geo-DataBase Management Systems) to store the geoinformation involved. Many applications make use of geoinformation and related technologies. The GIS Technology group devotes particular attention to developing and/or providing geoinformation technology and knowledge for use in crisis management and spatial information infrastructures.

Crisis (or disaster) management is a very demanding application, where data is coming from various heterogeneous sources, where users come from diverse backgrounds (and are often unfamiliar with geoinformation), the tasks have to be completed in unusual situations (under pressure and stress), and the amounts of information to be processed are enormous. Both existing geoinformation and new geoinformation (obtained from a wide variety of sensors during and after the disaster) are indispensable in crisis management. All aspects of geoinformation handling are challenging. These include real-time data integration from heterogeneous sources (via a reliable SII), integration of 3D indoor and outdoor models, interaction with advanced wireless communication and positioning technologies, performance of real-time 2D/3D spatial analyses and simulations (e.g. for the purposes of evacuation or navigation), 2D/3D geo-visualization, and use of formal semantics to maximize machine ‘understanding’ of the context of a task or user (by searching for, combining, aggregating and transforming geoinformation).

The pressure on the available space in our physical environment will continue to increase. Managing the scarce resources – land, real estate, roads, railways, waterways and utilities – in an efficient manner requires a huge amount of spatial information (historic, up-to-date and future), together with appropriate processing and dissemination methods. The traditional two-dimensional thinking that has been used for a long time in maintenance, planning and development work is or soon will be no longer fit for purpose. Three-dimensional solutions, taking the space below and above the surface of the earth into consideration, and even four-dimensional approaches (which also take account of the time dimension), are therefore becoming increasingly applied. Tunnels, underground constructions, stacked constructions (e.g. buildings above a road or railway) are becoming more common. These systems will require proper support from 3D spatio-temporal information management. There are multiple sources of geoinformation in use and multiple users of geoinformation, ranging from non-experts to professional users.

a. Mission and research area

Mission: ‘geo-serving the networked society via top quality GIST research and education towards sustainable SII, within the framework provided by the overall mission of Delft University of Technology’

The best way of ensuring that geo-services make efficient and effective use of geoinformation is to create geoinformation ‘communities’ that share the appropriate information in an efficient manner. This requires a good SII, which in its turn demands effective use of key register geoinformation data, geoinformation services (functions, analysis), networks and geoinformation protocols and standards.

As far as geoinformation data collection is concerned, advances in sensor and sensor network technology have led to significant increases in data resolution and acquisition frequency. While this yields excellent opportunities for improving the quality of geoinformation and increasing update rates, it also presents tremendous challenges in terms of processing the huge amounts of data involved. Moreover, these data have to be integrated and analyzed together with existing information. Due to the data volume (and the time pressure e.g. in crisis management), data interpretation by human means is no longer fully feasible and data need to be interpreted automatically. To realize this, hitherto unsolved research problems in the fields of knowledge engineering and formal semantics must be addressed.

In order to take full advantage of the rich sources of geoinformation, it is necessary to archive data products and make them widely available. This demands the development of appropriate services, protocols and standards for national and international SII. Many challenges can be identified here; for example, how is data to be collected in real time from the expanding global networks of sensors, many in remote locations? How often we need to update and/or archive sensor data? How do sensor and communication networks need to be configured for robust and failsafe operation (e.g. by building in alternative routes, ensuring adequate performance etc.)? Which models are most appropriate for specific geoinformation? How can we ensure prompt delivery of data to users with time-critical needs, while maintaining quality control and accessibility for lower-priority users? How should we prepare geoinformation for different display devices? How can heterogeneous data flows be processed quickly enough to prevent data volumes from overwhelming managers and users? How can data be recorded in such a way as to enhance search capabilities?

The research mission of the GIS Technology section (often abbreviated to GIST) is therefore to underpin the establishment of SII by laying secure technological foundations for it, based on developments in the field of geo-ICT. Since the technology platforms can be numerous, the GIS Technology section concentrates on the geo-DBMS (database management system) as a core enabling technology for which models, services, protocols and standards need to be developed. The main research areas related to this core technology are 3D spatio-temporal modelling, computational geometry (spatial data structures and algorithms), distributed GI processing (network protocols / interoperability / web services / cloud computing), mobile GIS (location-based services, LBS), and knowledge engineering (with special reference to ontology and semantics).

Our research looks at the relevant developments in a global context, with a specific attention to the Netherlands.

Research area

The most important innovations in GIS technology research are characterized by infrastructure concepts for the handling of geoinformation. Analysis of the two selected application areas (crisis management and SII) and of deficiencies in the current technology allows us to trace knowledge gaps. Further research is then used to develop improvements and solutions, which are tested in practice. SII will enable the effective sharing of resources (spatial information and spatial services). The realization of the SII will result in a strong increase in the number of both professional and non-professional users of GIS, including some who differ markedly from traditional user categories. Recent developments such as Google Earth and Google Maps, Microsoft LifeSearchMaps and MS Virtual Earth 3D, and TomTom navigation, are only few of the examples in this field.

An analysis of changing geoinformation application requirements reveals a number of transitions, which are either ongoing or expected to take place in the near future. These transitions must be supported by scientific/technological and societal innovations. The four main transitions are:

- From ad hoc (project) spatial information to SII; from ad hoc demand to structural demand. There are as yet hardly any operational national SII, due to technological and societal factors. Research is required into issues such as linking our national models to the international (European) SII, solving the

modelling and harmonization problems, finding technical solutions for the realization of SII, and keeping in line with the developments in international standards, in particular those set by the Open Geospatial Consortium (OGC) and the International Organization for Standardization (ISO).

- From static 'maps' to dynamic models of space: the traditional way of working with 2D static spatial information (maps) has been augmented by methods for 3D and 3D+time data and processes, multimedia and virtual/augmented reality tools. This has been driven by both the technological developments, such as sensors for data collection and software for architecture and construction design (e.g. the building of information models), and the scientific and societal needs. Research is required to obtain knowledge related to (3D and 4D) spatio-temporal modelling, to understand how the user perceives the presentation of spatial information and the interaction methods used, and to find a basis for development of new man-machine interaction taking into account the context of the tasks to be performed by the geoinformation and the user.
- From traditional map production to dynamic (possibly participatory) data collection and positioning 'on the fly': crisis management and many other SII applications use dynamic geoinformation or at least they need to obtain the current position of the user, for example via global navigation satellite systems (GNSS) such as the American GPS or the planned European Galileo System. New possibilities emerge, as services can be dynamically chained via wireless communication networks and the geoinformation process chain is traversed in 'real time'. Research is required into issues such as the kind of models needed to integrate the new data acquisition with the existing data from large data providers (dynamic positioning), and how to connect the different knowledge domains to make this operation successful.
- From the implicit semantics of geoinformation to explicit knowledge: within a given domain (e.g. the police, fire services or land registration) it may not be necessary to make the semantics explicit as the limited number of users all interpret the basic geoinformation within their domain in more or less the same way. However, it will be clear from the examples given above that many users within a given domain will not be familiar with the meaning of information from other domains. It is therefore necessary to capture the explicit semantics of different geodata sets in different ontologies.

The research objective of the GIS Technology section is to provide technological support for the realization of SIIs, with special emphasis on the core geo-DBMS technology. Our research thus differs from that in most other universities and research institutions, since the main drive of our investigations is to enable the development of better GIS tools rather than to use these tools for various spatial applications.

b. Relationship with previous research programme

Many of the objectives of the GIS section's 2003-2008 research programme will remain unchanged in 2009-2014. One important new aspect, however, is the fact that the research is now organized into two application-oriented theme groups, Crisis management and Spatial information infrastructure, which share several types of basic geo-ICT technologies.

c. Scientific relevance

On the basis of its research programme, the GIS Technology section aims to achieve its ambition of making TU Delft one of the top three universities in the world in the field of GIS technology in general, and the leading university in the field of geo-DBMS research. Inspection of the table given below, which gives the scores awarded for various aspects of our research work in the assessment for the period 2003-2007 compared with that for 2000-2003, indicates that we are going in the right direction.

	Quality	Quantity	Relevance	Viability	<i>Average</i>
2000-2003	4.0	3.0	3.0	4.0	<i>3.50</i>
2003-2007	4.6	3.2	4.6	4.6	<i>4.25</i>

Our recent academic reputation is also highlighted by the following awards and other honours recently granted to the section as a whole and to various students and members of research staff working within it. It goes without saying that we hope to continue this tradition in the future.

- Prof. Tienstra prize awarded by the Netherlands Geodetic Commission of the Royal Dutch Academy of Arts and Sciences KNAW): Jantien Stoter for her PhD Thesis on a 3D land registration system (2004)
- Best Geodesy graduate: Thijs Brentjes (2005)
- Selected to open the First Gi4DM (Geoinformation for Disaster Management) Symposium: Sisi Zlatanova (2005)
- Best Geo-Info paper – Association ‘Geo-Informatie Nederland’: Friso Penninga (2006)
- BSIK – RGI Geo-innovation award (Science category) for the 3D Topography project (2007) [for an explanation of BSIK-RGI, see the next paragraph]
- ORACLE spatial education & research excellence award (the first one outside the USA): Peter van Oosterom (2007)
- First student from the GIS section to graduate with distinction from the GIMA (Geographical Information Management and Applications) Master’s degree programme at Delft: Jan van Bennekom (2008)
- ISPRS Schermerhorn award: Sisi Zlatanova (2008)
- BSIK – RGI Geo-innovation award (Science category) for the Usable well-scaled mobile maps project (2009).

The GIS Technology research programme is not isolated, but fits within the overall geoinformation science research agenda initially developed in the Netherlands by means of the BSIK – RGI innovation support scheme. BSIK is a Dutch acronym for ‘Order concerning Subsidies for Investment in Knowledge Infrastructure’; this is a government scheme set up in 2004 to stimulate innovation throughout the Netherlands, which has come to an end in 2009. And RGI stands for *Ruimte voor Geoinformatie* = ‘Space for geoinformation’. Now that BSIK is phased out, RGI will continue under the name ‘FES impulse’; see section 1.i and section 2 below. The fact that a large number of our RGI proposals have been approved and that we are also participating in a large number of other RGI projects led by other establishments underpins the scientific relevance of our research programme.

The GIS technology section has led the following RGI projects (including several top-ups): RGI-011 ‘3D Topography’; RGI-026 ‘LBS-24-7 – a definition study on Location Based Services with respect to Public Safety’; RGI-149 ‘Geo-info-to-go’;

RGI-150 '3D positioning infrastructure in built-up areas'; RGI-232 'GeoInfoNed: a multimedia geo-database infrastructure'; RGI-233 'Usable (and well scaled) mobile maps for consumers'. Detailed information about these projects can be found on the website www.rgi-otb.nl (some of this information is in English, some in Dutch).

The GIS Technology section also participated in the following RGI projects: RGI-001 'Definition study geographical dimensions of risk management'; RGI-002 'Generating and use of base maps for integrated querying of digital spatial plans'; RGI-008 'Dealing with uncertainty in spatial plans'; RGI-013 'Virtual reality and urban safety'; RGI-029 'Geoinformation management in large civil engineering works'; RGI-116 'Survey of innovations of geo-standards for NGIP'; RGI-128 'Geoinformation for risk prevention'; RGI-239 'Geospatial data infrastructure for disaster management'; RGI-404 NEDGEOS.

Other geoinformation research agendas

Knowing what is happening, and what is planned to happen elsewhere, helps to avoid duplication in research and assists in identifying potential research partners. This section lists some of the major geoinformation initiatives and organizations with relevant research agendas worldwide to provide a global picture of geoinformation science before zooming in to the national level. The BSIK-RGI report on the NEDGEOS project (Holsmuller & Van Oosterom 2008) contains a selection of research agendas of the following organizations: ISPRS, ICA, FIG, AGILE, JRC, OGC Europe, EuroSDR, EuroGeographics, USA University Consortium GIS, Australian Cooperative Research Centre (CRC) for Spatial Information (SI 2002-2010), Canadian GEOIDE (phase I: 1999-2002, phase II: 2003-2005, phase III: 2005-2009). Apart from these organizations and their research agendas, related work in the field of standardization is also going on, for example within the framework of INSPIRE (Infrastructure for Spatial Information in Europe: <http://inspire.jrc.ec.europa.eu/>) and ISO TC 211 (Land Administration Domain Model, http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=51206).

The research agenda of the KNAW/NCG (Royal Netherlands Academy of Arts and Sciences/Netherlands Geodetic Commission) provides a framework at the national level for such investigations in the medium to long term. The NCG has two relevant subcommissions, Geoinformation Infrastructure and Core Spatial Data, both of which have their roots in the former Geoinformation Models Subcommission. The current research agendas of these two subcommissions are indicated below (see http://www.ncg.knaw.nl/index_eng.html).

The Geoinformation Infrastructure Subcommission aims to advance the geoinformation infrastructure by stimulating the knowledge and the research of the stakeholders:

1. the definition and the description of the geoinformation infrastructure;
2. the international context;
3. input of knowledge among others in due form of best practices;
4. output of knowledge in due form of research plans, publications, seminars and opinions;
5. data input in the flow of information within the infrastructure;
6. research on: a. main sticking points; b. standards; c. technology; d. retrieval.
7. quality control;
8. monitoring of the use and advancement of the geoinformation infrastructure;

9. aspects of the use and the demand for output of information of geoinformation infrastructure;
10. the organization of the geoinformation infrastructure.

The Core Spatial Data Subcommittee is engaged with the following questions:

- How will the need for topographical core data develop, especially for professional use?
- What kind of services will be demanded in this context?
- Which technological developments in the field of sensors, extraction of information, (visual) representation and IT are relevant for the future supply of products and services with regard to topographical core data?
- To what extent do these developments offer possibilities for new specifications of topographical core data and new kind of services in this context?
- Which institutional roles are there to fulfil in this context?

It is clear that the Core Spatial Data Subcommittee is concerned not only with collecting data but also with questions such as which core data will be important in the future and how these core data can be represented. The subcommittee's field of research is divided into ten themes, which may be grouped as follows:

General:

Theme 1. User Requirements

Research on raw core data:

Theme 2. Raw Data as Core Data

Theme 3. Massive Data Management

Theme 4. Interpretation of Raw Data

Research on interpreted core data:

Theme 5. Harmonization of Concepts and Data Models

Theme 6. Integration of Interpreted Data

Theme 7. Multi-scale Issues

Theme 8. Time and History

Theme 9. 3D Geo-information

Theme 10. Shared Mapping

The fact that GIST is represented on both subcommittees creates excellent opportunities for us to harmonize our research agenda with that of other members of the Dutch scientific community.

d. Societal relevance

The involvement of the GIS Technology section in the following past and ongoing activities illustrates the importance of our research for society:

- 3D Cadastre (land registration system): many nations already have (or are considering) 3D extensions to their land registration system;
- ISO 19152: Land Administration Domain Model (LADM);
- UN HABITAT STD (LADM) system to combat African slums;
- US Secretary of State: stabilization of post-conflict areas (application of LADM in Afghanistan);
- INSPIRE: data specification drafting team and thematic working group on land registration parcels; see Infrastructure for Spatial Information in Europe: <http://inspire.jrc.ec.europa.eu/>;
- Influence on mainstream geo-ICT via Geo-Database Management Centre (GDMC); Oracle (topology, 3D), Bentley Systems (seminar) and ESRI;

- Work on a basic geoinformation model for Dutch standard NEN3610; 4 years R&D on the new TOP10NL digital topographic database used by the Dutch *Kadaster* (Land Registry Office), involvement in models for spatial planning (IMRO), topography (IMTOP), cables and pipelines (IMKL), cultural history (IMKICH), public order and safety (IMOOV), multi-scale IMTOP, 4 GML relays;
- Geoinformation for disaster management (Gi4DM): organization of 5 conferences on this topic;
- CityGML: extensions for geological objects and utilities.

The management of sustainable environments requires geoinformation and geoinformation processing. Geo-ICT technology is very much needed by society and there is a high demand from both end-users (often central, regional or local government) and the geo-ICT industry (GIS, CAD and DBMS software vendors, consultancy and engineering firms). This section explains our model for cooperation with the geo-ICT industry, in particular the Geo-Database Management Centre (GDMC), and GI organizations in practice. This is both a prerequisite for advanced geo-ICT research and a channel for the dissemination of research results via new or enhanced industrial products. GIS is also trying to increase its value for and impact on society via the organization of international events and membership in professional organizations.

GDMC: participation of the Geo-ICT industry in our research

GIS technology is growing at an enormous rate, on the basis of general IT developments in Database Management Systems (DBMSs), (mobile) communication and the Internet, computer graphics (Virtual/Augmented Reality), object-oriented software (e.g. based on the Java platform), as well as specific developments in geographical information technology. A single university cannot keep track of all these developments or anticipate new developments without external assistance. In order to achieve its ambition of becoming one of the three top universities in the world in the field of GIS Technology, TU Delft has decided to set the Geo-Database Management Centre (GDMC), which allows the geo-ICT industry to become involved in this important line of research. The GDMC's research programme concentrates on geo-DBMSs. The GDMC is a research and development centre for all activities related to the modelling, storage, retrieval, analysis, presentation and distribution of geoinformation. It is physically located on the premises of TU Delft, and is a member of the Open Geospatial Consortium (OGC). Other current members include Oracle and Bentley Systems, two American companies that are major world players in this field.

Cooperation with GI organizations in practice

Several important Dutch organizations share GIS's vision of the necessity of setting up an effective SII. The GIS Technology section therefore has (often multi-year) cooperation agreements with a number of these key organizations, in particular the Data and IT Service (abbreviated to DID in Dutch) of *Rijkswaterstaat* (the Directorate-General for Public Works and Water Management), *Kadaster* (the Dutch Land Registry Office) and Geonovum (the National Spatial Data Infrastructure Executive). These cooperation agreements give GIS excellent opportunities for combining theory and practice (e.g. by inventorying existing problems and assessing the extent to which new theories and technologies solve them). These agreements are reviewed periodically to see whether they still serve the interests of both parties. Details of these cooperative arrangements are given below.

RWS-DID

The Directorate-General for Public Works and Water Management (*Rijkswaterstaat* in Dutch or RWS for short) manages the main roads and waterways (including dikes and other flood defence systems) in the Netherlands. According to information translated from this body's website

(<http://www.rijkswaterstaat.nl/rws/agi/home/html/menu2/geoservices.htm>), geo-information is important for the activities of RWS and many others public bodies. RWS's Data and IT Service (abbreviated to DID in Dutch) plays a key role in such geoinformation applications. Since the rise of Internet technology, there are many new ways of sharing and using geoinformation in GIS applications. 'Web services' is a collective name for the development, implementation and organization of a web-based GIS infrastructure. The web services within RWS (which are managed by DID) have the goal of ensuring:

- general availability of all geoinformation within RWS, also for outside users, e.g. for the purposes of crisis management;
- easier data management (lower costs, single storage, multiple use);
- supply of the most up-to-date information at all times;
- access to geoinformation in an efficient, effective and reliable manner;
- uniformity of geoinformation data and applications within RWS.

Thanks to the realization of these goals, the web services offer a number of clear advantages: a standard browser will suffice for most applications (ensuring easy application management and a wide range of utility), while geoinformation from multiple sources can be easily and efficiently combined with the aid of systems based on open standards.

Kadaster (Dutch National Land Registry)

According to information translated from the website <http://www.kadaster.nl>, the mission of the *Kadaster* is to improve the legal security of real-estate transactions (including transactions involving ships and airplanes), to optimize the geoinformation infrastructure and to provide the public and other interested bodies with reliable information in this field at the lowest possible cost. In line with this, the stated ambitions of the *Kadaster* are to be seen as open, secure and ambitious.

This implies:

- providing the necessary services for consumers together with its partners and stakeholders on the basis of clear agreements;
- making sure that the services provided are of high quality, low cost and lead to high customer satisfaction (and monitor and publish compliance with these criteria as laid down in statutory requirements);
- aiming at further improvement of the services offered by the *Kadaster* and strengthening its position as the supplier of real-estate information and geoinformation in the Netherlands, and as a leading player in this field in Europe.

Geonovum

Geonovum is the National Spatial Data Infrastructure (NSDI) Executive Committee in the Netherlands (see <http://www.geonovum.nl/english.html>). It formulates and manages the geo-standards necessary to implement this goal. The activities of Geonovum are subsidized by the Ministries of Housing, Spatial Planning and the Environment (VROM), Agriculture, Nature and Food Quality (LNV) and Transport, Public Works and Water Management (V&W), the Dutch land registry (*Kadaster*) and TNO (Netherlands Organisation for Applied Scientific Research). Its main goals are:

- to develop and standardize the geoinformation infrastructure while also being innovative;

- to build up and disseminate knowledge in the area of the geoinformation infrastructure;
- to make the geoinformation infrastructure more accessible to administrative bodies, institutions and departments in the Netherlands and the European Union.

Organization of international events

The GIS Technology section has long been involved in many international events (some through its membership of the relevant scientific programme committees). There are four series of events in which the involvement of the GIS Technology section goes much further and deeper: Spatial Data Handling (SDH), the symposium held by the Urban Data Management Society (UDMS), 3D Geoinformation (3DGeoInfo) and the Symposium on Geoinformation for Disaster Management (Gi4DM). The last-mentioned was in fact initiated by GISt in 2005. It is strongly supported by the international scientific community, including the EC's Joint Research Centre (JRC) in Ispra (Italy), various Directorates-General of the European Commission, AGILE, EuroSDR (the European network for spatial data research), FIG, ICA, ISPRS, ISDE, OCG, UNOOSA and the WHO (World Health Organisation). After Delft (2005), Goa (2006), Toronto (2007), Beijing (2008) and Prague (2009), the 6th Symposium planned to be held in Turin in 2010 is in preparation. In addition to these regular events, the GIS Technology section is also involved in organizing international scientific workshops and new symposia in a more ad hoc manner (in the near future, possibly FOSS4G and/or GIScience). Staff members are also active in other programme committees of important conferences, e.g. ACM-GIS, AGILE, GIScience, FIG and ISPRS.

Membership of professional organizations

The Open Geospatial Consortium is: "an international industry consortium of 368 companies, government agencies and universities participating in a consensus process to develop publicly available interface specifications. OpenGIS® Specifications support interoperable solutions that "geo-enable" the Web, wireless and Location Based Services, and mainstream IT. The specifications empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications" (www.opengeospatial.org).

AGILE, the Association of Geographical Information Laboratories in Europe, involves the active participation of university research and training groups from all over Europe, including the members of the GIS Technology section.

FIG, the International Organization of Surveyors, was founded in Paris in 1878. It is a federation of national associations and is the only international body that represents all surveying disciplines. It is recognized by the UN as a non-government organization (NGO) and its aim is to ensure that the discipline of surveying and all who practise it meet the needs of the markets and communities they serve. It realizes this aim by promoting the practice of the profession and encouraging the development of professional standards. As far as OTB's GIS Technology section is concerned, the cooperation concentrates on Commission 3 'Spatial Information Management' and Commission 7 'Cadastre and Land Management' (See also: <http://www.fig.net/>).

The International Society for Photogrammetry and Remote Sensing is a non-governmental organization founded in Vienna in 1910. The organization is devoted to the development of international cooperation for the advancement of the science and technology of obtaining reliable information from noncontact imaging and other

sensor systems about the Earth and its environment, and other physical objects and processes through recording, measuring, analysis and representation. GIS technology is involved in Commission IV (Geodatabases and Digital Mapping) and more specifically in Working Group IV/8 '3D spatial data integration for emergency management and environmental monitoring'.

The Urban Data Management Society (UDMS) was founded in 1971 in Bonn and aims at providing a forum for the discussion of urban planning processes, sharing of information on available technology and demonstration and promotion of successful information systems in local government. The initial focus has been on urban applications, but regional and rural issues have grown in importance recently. Members of GIS are part of the UDMS Board.

The GIS Technology section actively participates in standardization activities via membership of various committees and experts groups both at national and international levels (in the Dutch Standards Institute NNI and the ISO respectively); GIS members participate in the ISO 19152 committee and in the NNI geoinformation committee. They also support and participate actively in the Dutch Geoinformation Association (*Geo-Informatie Nederland*). As mentioned in section 1.c, GIS staff members likewise participate in the KNAW/Netherlands Geodetic Committee and two of its subcommissions (Geoinformation Infrastructure and Core Spatial Data); the mission of this committee and its subcommissions was described at length in section 1.c.

e. Synergy between fundamental and applied research

The GIS Technology section carries out fundamental geo-ICT research concerning the use of spatial data types, operators, functions, clustering and indexing in Database Management Systems. The importance of the (geo-)DBMS is increasing in the transition to the SII, because not only one organization but the entire (geo)information community depends on it. The section's fundamental geo-ICT research is divided between the two application-oriented research themes 'Crisis management' and 'Spatial Information Infrastructure'.

The main characteristic of the research approach chosen by GIS is its strong focus on the core technology: a geo-DBMS and its adaptation for use in the SII. The GIS Technology section has the ambition to be one of the leading partners in a network of technology R&D centres involving private and public sector organizations, and universities working in geographic sciences. Once the relevant geoinformation research theme (targeted innovations with respect to the geo-DBMS and related topics) has been selected, the following choices further characterize the scientific approach and methodology:

1. mission driven: a common, shared SII (rather than the 'each for oneself' approach);
2. developed software available as open source (rather than new software not being available to the outside world);
3. working in teams on projects, papers, etc. also internally (rather than a set of individuals).
4. individual scientific and technological research projects (rather than one big project).
5. participation in, and initiation of, national and international research networks and projects (rather than working solely within the Delft University of Technology setting);
6. demonstration projects to show the integration of scientific research from the different themes. These are application-driven, so as to reveal further knowledge

- gaps (pure research will not show how the various technologies involved are integrated and will not have the application drive needed);
7. scientific research focused on the main theme of geo-DBMS (rather than attempting to investigate the entire geoinformation process chain);
 8. education and knowledge dissemination as an explicit part of the research programme, close coupling with the MSc courses Geomatics and GIMA (Geoinformation and Land Management) at Delft (rather than a focus on knowledge development and the application of knowledge in separate domains);
 9. links to the BSIK 'Space for Geoinformation' project (through active participation in several research projects) and its planned successor, the 'FES impulse' 'Nederland Geoland' project of 2009 are seen as important (rather than letting these BSIK/FES knowledge projects show up the key problems in this field and develop generic GIS tools to solve them themselves);
 10. an active part in the organization of international symposia, workshops and conferences, resulting in formal publications (books or edited proceedings). The alternative approach of not initiating any serious scientific events and not producing any scientific publications derived from them would most probably reduce the scientific impact of the GIS Technology section's research;
 11. evaluation of individual research projects, both internally and externally, at different phases of the project. (Lack of interim evaluation would preclude 'half-way' adjustments to the projects and hinder assessment of the overall impact of GIS research.);
 12. networks (such as the SII) require standards. These are currently being created at the international level: GIS's links with the OGC, INSPIRE and ISO TC/211 are highly relevant here;
 13. cooperation with the international leading geo-ICT industry will provide a level of basic technology (which is advancing rapidly) on which research initiatives can be developed, tested and delivered to society (rather than working in an academic 'ivory tower', developing everything ourselves and producing only scientific papers, which may not be used by industry or society for a very long time).

f. Internal and external collaboration

Many internal collaboration relationships exist, both within OTB and with research groups in other faculties at Delft:

- OTB: Geoinformation and Land Development section: Geoinformation theme (3D and 4D land registration system);
- OTB: Urban Studies section: Spatial Development theme (Mobile GIS);
- Faculty of Architecture: (design based) 3D modelling;
- Faculty of Aerospace Engineering: 3D modelling (survey based) and data acquisition;
- Faculty of Electrical Engineering, Mathematics and Computer Science: virtual reality, knowledge engineering;
- Faculties of Aerospace Engineering, Technology, Policy & Management and of Civil Engineering & Geosciences: teaching – in particular MSc Geomatics courses.

We expect to establish collaborative links with the OTB Mobility Studies section in the years to come.

External collaboration

There is a high demand for geo-ICT technology both from end-users (often central, regional or local government) and from the geo-ICT industry itself (GIS, CAD and DBMS software vendors, consultancy and engineering firms). National research groups with which the GIS Technology section collaborates include the following

(many of the national and international links mentioned below have already been discussed in sections 1c. and 1d. above):

- BSIK Ruimte voor Geo-Informatie (RGI) ('Space for Geoinformation');
- International Institute for Geoinformation and Earth Observation, Enschede (ITC);
- Utrecht University;
- Wageningen University;
- Dutch Land Registry Office and its Topographic Survey service
- RWS-DID (Data-ITC-Dienst = Data IT Service) of the Directorate General for Public Works and Water Management) (framework contract);
- TNO;
- Geonovum (framework contract).
- Centrum voor Wiskunde en Informatica (Mathematics and Information Sciences Centre), Amsterdam (CWI)

International research groups with which the GIS technology section cooperates include:

- Open Geospatial Consortium (OGC);
- ISO TC211;
- EU: INSPIRE;
- EU: HUMBOLDT;
- Ordnance Survey in the UK;

Several foreign universities, in particular the University of Aveiro, Portugal (1 PhD student together with OTB's Geoinformation and Land Development section), Queensland University; Australia; Karadeniz Technical University, Turkey; Middle East Technical University, Turkey.

Within the framework of the BSIK RGI projects the section has extended its collaboration with a number of universities and institutes: City University London, University College London, University of Glamorgan (Wales), TU Wien, Leibniz University Hannover and the Weierstrass Institute for Applied Analysis and Stochastics (WIAS, Berlin). It is intended to continue this collaboration in the future.

International geo-ICT industry (Oracle, Bentley Systems, ESRI, Intergraph, 1Spatial). The majority of the companies involved participate in the Geo Database Management Centre (GDMC), a research and development centre that (as mentioned in section 1.d above) is part of the OTB Research Institute at TU Delft (www.gdmc.nl).

g. Relations with education

The section aims to be a recognizable, attractive centre of technology-based excellence within the international geo-science community. We strive to achieve this ambition by performing high-quality research having close links with education. In fact, most courses in Master's degree programmes at Delft are closely related to research activities within the University. This is especially true of thesis projects, but also of case studies and other research or engineering assignments. Most of the recent case-study reports and theses produced by the students (in Geomatics and GIMA) at the GIS Technology section are available on the web at www.gdmc.nl (under 'Publications'). The fruits of the close links between education and research become very clear here. The GIS Technology section shares responsibility for the various mainstream academic programmes at the Master's level listed below, some of the courses in question being provided by our researchers.

- MSc Geomatics (www.geomatics.tudelft.nl), involving the faculties of Aerospace Engineering, Civil Engineering & Geosciences and Technology, Policy & Management. Attempts are being made to involve the Faculty of Electrical Engineering, Mathematics & Computer Science as the fourth partner in this MSc programme.

The following courses are provided by GIST:

GM1040	:	GIS Basic Principles
GM1050	:	GIS Advanced Principles
GM1020	:	3D Geoinformation Systems
GM1080	:	Geo DBMS
GM1110	:	Geoinformation Technology for Crisis Management
GE4612	:	Geoweb Technology
GE4622	:	Quality of Geoinformation
AE4-E07	:	Location Based Services
GE4732	:	Spatial Information in Utilities

- MSc in Geoinformation Management and Applications (GIMA) (www.msc-gima.nl), involving Utrecht University, Wageningen University, ITC and TU Delft.

GIST staff contribute to the following modules:

GIMA0	:	Introduction
GIMA2	:	Basic Applications
GIMA5	:	Advanced Methods and Techniques
GIMA6	:	Advanced Applications
GIMA8	:	MSc thesis project (coordination)

Our researchers supervise students during their graduation project in both Geomatics and GIMA. Students carry out their graduation project in various ways. There is a good mix of internal and external MSc thesis projects. Most MSc thesis research leads to professional or scientific publication(s), often in collaboration with the GIST staff who supervise the research. In addition, some of our staff teach courses at BSc level in the faculties of Civil Engineering & Geosciences and Technology, Policy and Management.

h. Researchers and other personnel

GIST staff include one full professor (who is also the section leader), one associate professors, four assistant professors, other tenured staff, postdoctoral students and PhD researchers. In addition, there are a number of external PhD students, usually from abroad, who have an unpaid position within the section (known in Dutch as a ‘0 aanstelling’). The section has a relatively small proportion of staff without tenure (PhD students and postdoctoral students). Joint research between staff members is encouraged in order to improve the quality of our work and to enhance job satisfaction at GIST.

Table 1 Staff of the research programme and research themes

	Themegroup	
	Crisis management	Spatial information infrastructure
Prof. Peter van Oosterom		X
Dr Sisi Zlatanova	X*	
Dr Jantien Stoter		X*
Dr Tjeu Lemmens	X	X
Dr Hugo Ledoux		X
Wilko Quak		X
Theo Tijssen		X
Edward Verbree	X	X
Marian de Vries	X	X
Martijn Meijers		X
Wiebke Tegtmeier	X	X
Fan Zhengjie	X	
Elfriede Fendel	X	X

*) Theme leader

i. Resources, funding and facilities

GIS was heavily involved in BSIK RGI projects during the period 2004-2008; this yielded substantial revenues for the section. The RGI NEDGEOS (Dutch Geoinformation Research Infrastructure) project was important not only in this respect but also because of its focus on the definition of the future geo-research programme and the establishment of a graduate school for PhD students. We will include the results obtained from the NEDGEOS project in our proposal for a new project within the framework of the ‘FES impulse’ programme (see sections 1.i and 2 above) in the Knowledge, Innovation and Education domain under the theme ‘water, climate, space’.

During the past research period, GIS was also actively involved in a number of Delft Research Centres (DRCs), in particular the Delft Centre for Sustainable Urban Areas (e.g. on the PhD research on 3D topography and cooperation on several internal projects); and Delft Earth (via a PhD research project shared with the Faculty of Aerospace Engineering on monitoring subsidence using PS-InSAR). TU Delft is planning to replace the DRCs by DRIs (Delft Research Initiatives). GIS is already involved in the DRI on Environment, and has written the text for the item on geoinformation infrastructure within this framework.

In addition, GIS has received substantial financial support from the Dutch Land Registration office, TNO and from the framework contracts with DID-RWS and Geonovum. This has resulted in a healthy financial buffer for the section, which grew during the previous research period from zero to the maximum allowed under TU Delft/OTB financial regulations – namely half of the section’s annual budget.

Of recent years, we have submitted many proposals to NWO/STW (the Technology Foundation of the Netherlands Organization for Scientific Research – one of the main sources of funding in our field). While most of these achieved a good rating in

the first assessment round, unfortunately none were approved in the end. The expected drop in direct funding in the coming years is a further cause for concern. GIST will have to do its best to keep its financial position healthy in the period 2009-2014, e.g. by the following means:

- Intensify our efforts to get research funded by NWO/STW;
- continue the framework contracts with DID-RWS and Geonovum;
- establish framework contracts with Dutch Land Registry Office and TNO;
- participate in the Seventh Framework Programme for Research and Technological Development (FP7) and successor or other EU programmes;
- work on SII projects in the new DRI (Delft Research Initiative) on the Environment;
- help set up and participate in the FES impulse programme (the successor to BSIK-RGI) for 2009 in the category 'water, climate, space' – once again with respect to SII; for further details, see section 2;
- boost indirect funding flow via research projects for companies, larger municipalities, etc.

8.2 Ambitions for the period 2009-2014

This document presents a vision of the GIS Technology section's future research. The research agenda is based on the expected transitions in geoinformation handling due to changes in science, technology and society. Our two application-oriented research themes 'Crisis management' and 'Spatial Information Infrastructure' are both based on fundamental geo-ICT research. We have chosen one main focus area for our research: the Geo-DBMS (Geo- Database Management System), which will form the foundation of the Spatial Information Infrastructure of the future. This research theme and the role of GIST fit in very well with the overall international and national research agendas in this field.

The research approach chosen is based on cooperation with leading organizations and the geo-ICT industry, which will be given form within the Geo-Database Management Centre (GDMC) hosted by our own research section, in which GIST will perform technology research alongside selected participants from the Geo-ICT industry such as Oracle, Bentley Systems, Intergraph, Sun, CA and PGS. The research goal and the scientific approach are chosen with the aim of making Delft one of the top three universities in the world in the field of GIS technology (and number one in the field of geo-DBMS research). We hope that this will be reflected in the scores awarded to the section by the Association of Dutch Universities (VSNU) assessment committee in 2013. Our ambition is to achieve minimum scores of 4.5 for each of the four aspects considered, compared with the 2003-2007 scores of between 3.2 and 4.6, with an average of 4.25. Of course, this can only be achieved through sufficient research and teaching output, and by winning sufficient assignments and contracts (to generate the necessary financial resources).

GIST wants to be involved in the set-up and execution of new research collaboration programmes based on the common vision of the added value of an SII. Within TU Delft, we have taken part in the set-up of the DRI (Delft Research Initiative) on the Environment and have written the text for the item on geoinformation infrastructure. Given this important infrastructural role, we expect to be actively involved in the execution of the DRI. Furthermore, we are currently participating in the definition of the successor to the BSIK-RGI programme, which comes to an end in 2009.

The Dutch national government has reserved 500 million Euro for work on 8 research themes in this new 'FES impulse' programme (*Fonds Economische Structuurversterking* = Economic Structural Reinforcement Fund) in the knowledge, innovation and education domain. FES impulse starts in 2009, and the GIS Technology section has been invited to write the SII part of the proposal for the theme 'Water, Climate and Space' ('Water, Klimaat en Ruimte' in Dutch). Finally, the section aims to continue its international research collaboration (LADM and ISO TC211 activities, INSPIRE and related EU programmes), and to carry on research along the lines established within the BSIK-RGI programme.

8.3 Description of research programme and research themes

Vision

Our long-term research aspiration, which we hope will set GIS apart from the other research groups in this field around the world, is the work on a '5D super model' (3D + time + scale) for both discrete and continuous spatial phenomena as a basic model concept for SII. This would then provide the basis on which all future models would be founded. To achieve this end, the models will have to become more and more formal (e.g. by increased stress on ontology). The main features of the SII based on a DBMS with the 5D super model at its core, to be realized in the long term, are integration of the various data sets involved (e.g. indoor/outdoor, surface/subsurface, designed/surveyed), real-time or at least 'daily fresh' maps (via sensor web + formal semantics + automatic processing), combination with positioning and wireless communications technologies (to enable the system to deal with moving objects).

Background

Having described the research requirements resulting from the expected transitions in geoinformation handling and the national international research agendas, we now describe the specific research theme of the GIS Technology section in greater detail. The main innovations relate to thinking in terms of infrastructure when developing geoinformation handling systems (which requires technological innovations enabling optimum use of geo-data and services) and increased focus on modelling aspects and the geographical man-machine interaction. The foundation of SII consists of geo-DBMSs filled with geographical data. We have formulated a consistent GIS technology research programme concentrating on the central theme of a geo-DBMS. All research projects will have geo-DBMS roots and from this angle cover such topics as 3D spatio-temporal modelling, computational geometry (spatial data structures/algorithms), distributed GI processing (network protocols/interoperability/web services/cloud computing), mobile GIS (LBS) and knowledge engineering (ontology and semantics).

In addition to modelling 2D and 3D spatial aspects of features, the modelling of changes in features over time becomes increasingly important. This will depend on the nature of the changes involved, which may be discrete (e.g. ownership of a parcel) or continuous (e.g. movement of dunes). The integration of this fourth dimension into existing data structures such as rasters, TINs and DEMs, represents a major research topic involving a wide range of issues, from the translation of logical and conceptual models described in the Unified Modelling Language (UML) to the implementation of the associated physical model in a DBMS. The level of detail (or

scale) should be treated together with the other spatial and temporal dimensions to yield a 5D super model. In the past, spatial data management has been handled by GIS software outside the DBMS. As DBMSs are nowadays spatially enabled, GISs have migrated (or will soon migrate) towards an integrated architecture: all data (spatial and thematic) is stored and managed in one DBMS. As stated above, the next step will be the creation of a shared SII for related organizations, the so-called information community. It will be a major challenge to integrate the temporal and scale aspects into the traditional 2D/3D models to replace their separate temporal and scale treatment.

The realization of the '5D super model' is a huge challenge. By first extending the traditional 2D models in different dimensions (third spatial dimension, temporal dimension, scale dimension) independently, important experience will be gained with the resulting different types of 3D models based on research which should be well feasible and in reach. Besides developing these advanced models, it will also be investigated how these models can be realized within in an extended spatial DBMS environment. Some of the resulting models are even already operational, e.g. 3D space, though there is still room for improved modeling; e.g. support for true 3D topology is lacking. Next the combination of two extended 3D models will be explored; e.g. 3D space and time, or 3D space and scale, or 2D space and time and scale, resulting in different types of 4D models. These currently belong to hardly explored types of models, but also these are expected to be feasible (in part) and give is more insight in complex integrated modeling. Finally, using all these experiences the '5D super model' is aiming at integrating 3D space with both time and scale. Currently we do not know whether and how such a model could be developed. The next step after that will be investigations aimed at expanding the DBMS by addition of the capabilities needed to handle this integrated 5D data model.

Research issues and questions

The importance of the geo-DBMS is increasing with the transition to the SII, because not just one organization depends on it, but the geo-information community as a whole. The main use will be query oriented and less update oriented. Only one organization will be responsible for updating a specific type of data, all others query and use these data. As the query aspect is dominant and the cost of memory chips falls, VLM (Very Large Memory) DBMSs might offer a very suitable technical solution. They are powerful enough to serve large numbers of users via the Internet. Further work is needed to increase the bandwidth of the network infrastructure to get the data to the (mobile) users in time. Developments in hardware, software and database technology will contribute to the future shape of the geoinformation infrastructure. Current extensible DBMSs are very capable of storing 2D spatial data. Simple queries like zooming in and zooming out can also be handled efficiently by making use of spatial indexing and clustering. However, more complex operations like map overlay, on-the-fly generalization, enforcing correct topology during updates and 3D analysis are not yet within the reach of these systems. New developments in DBMS technology, like extensible (object relational) DBMSs, object-oriented DBMSs and VLM databases, will underpin the new generation of DBMSs. At the same time, data sets are being made bigger and bigger; this poses serious challenges in DBMS management, such as the handling of point clouds in AHN2 (actual height model of the Netherlands, version 2) or high-resolution imagery.

The SII discussed here is based on interoperability standards and advanced geo-DBMS technology, and can be used to re-implement existing GIS applications in a

more efficient and effective manner. It will integrate sectors that have been hitherto separate. Apart from re-using general geoinformation knowledge (perhaps first discovered in one domain and then applied in other domains), the SII will also give an impulse to the use of geoinformation and services from other domains. A prerequisite is that these different domains ‘understand’ each other, i.e. share a common ontology. It is already difficult enough to share the concepts within a single geoinformation domain (transportation, topography, geology, groundwater, surface water, land registration, elevation, land use, utilities etc.), so one can imagine the difficult task ahead when concepts have to be shared between different domains. Finally, the SII can be used to build new, sophisticated applications such as mobile location dependent applications, VR (Virtual Reality) and AR (Augmented Reality). As stated above, we are in the middle of a number of fundamental developments. However, there are still many open problems. The GIS Technology section aims to help to solve these problems by carrying out research on the standardization of complex features, the inclusion of quality in the DBMS (perhaps at data type level), 3D modelling and visualization and the usability of VLM databases for GIS applications.

As stated above, the most important innovations in GIS technology research are characterized by conceptual exploration of the infrastructure needed for handling geoinformation. By analysing specific GIS applications, our researchers identify deficiencies in the current technology and knowledge gaps. Scientific research provides a basis for the development of improvements and solutions which are then tested in practice. Developed (prototype) solutions will be made available as open source software. Making GIS technology research results available in the form of freely accessible open source software is, from the academic point of view, perhaps as important as publishing a scientific paper. It allows others to evaluate the new developments and to build further on them. It works in two directions: GIS has used open source software made available by other researchers to jump-start the development of our new prototypes and then made the software we developed available as open source – thus allowing others to reuse our ideas while at the same time enhancing our academic reputation. We therefore intend to make all the software we develop available as open source, and to refine this approach in the near future by providing easier access, more documentation and better version management. Research at GIS is divided into the two application-oriented theme groups discussed below, which share several types of geo-ICT base technologies.

Theme groups (application-oriented research)

- *Crisis management:* The theme group on Geoinformation for crisis management focuses on building advanced frameworks, developing solutions and testing prototypes that permit knowledge-based use of geoinformation to assist the decision-making process in crisis situations, taking into account the time constraints, communication, network and visualisation limitations. The research of the theme group is derived from, and therefore shared with, the fundamental technological research on geo-DBMSs performed at GIS.
- *Spatial information infrastructure:* The SII theme group focuses on the technological aspects of the realization of a spatial information infrastructure. One important prerequisite here is the establishment of key data sets, such as those containing topographic and land registration information. SII developments are currently ongoing at various levels such as the set of authentic registrations (and the relationship with Dutch standard NEN3610 on base model geoinformation) in the

Netherlands, INSPIRE at European level and the Land Administration Domain Model (LADM – ISO/TC211) at global level.

Basic Geo-ICT technology

- *Core research theme: geo-DBMS.* The GIS Technology section carries out fundamental research on the use of spatial data types, operators, functions, clustering and indexing in Database Management Systems. The geo-DBMS is becoming increasingly important in the transition to the SII, because not only one organization but the entire geo-information community depends on it. The research topics within this theme are topology structure management within the DBMS, the handling of 3D, temporal and dynamic objects within the DBMS, large point cloud data sets, comparative functional and performance benchmarks and XML (eXtensible Markup Language) support at the DBMS level.
- Additional research themes, all linked to geo-DBMS:
 - o *3D spatio-temporal modelling:* This research topic focuses on the challenges related to (static and dynamic) data modelling in various systems (such as geo-DBMS, GIS and CAD) and the investigation of new representation and modelling concepts. Research on 3D spatial modelling and 2D spatio-temporal modelling is ongoing, and some preliminary research on 3D spatio-temporal modelling has been started. Furthermore, various aspects of data integration and data harmonization are undergoing extensive investigation.
 - o *Computational geometry (spatial data structures/algorithms):* Linking GIS to computational geometry, spatio-temporal modelling and simulation models permits simpler, faster, more powerful and flexible use. An important related theme is generalization. The temporal component plays an important role in these models, leading to the development of dynamic geographic information systems.
 - o *Distributed GI processing (network protocols, interoperability and web services):* This theme emphasizes research in the field of distributed GISs, data transfer between various systems, interoperability, geoinformation standards, spatial models and query languages. Geoinformation processing will need to be subjected to geodetic quality control in the phases following data capture, such as data modelling, analysis and visualization. Such aspects as components and storage of quality, meta data and error propagation also have to be taken into account.
 - o *Mobile GIS (LBS):* Mobile GIS or Location Based Services involve the integration of at least three types of technologies: positioning (GPS, Galileo), wireless communication (GSM, GPRS, UMTS) and GIS (geo-DBMS, geocoding, routing, user interface, small-display cartography). Due to the dynamic and mobile aspects, this type of environment brings obvious potential benefits to a number of applications (navigation/travel support, localized news services, traffic and fleet management, field observations and data collection, etc.), but also has its own research challenges (in particular the architecture and design of these systems).
 - o *Knowledge engineering (ontology and semantics):* Agreeing on the syntax and formats of spatial data and the development of systems to be used for handling such data is the first step towards interoperability. But getting the syntax and format right does not yet mean that we understand one another's information – the essential next step is to reach agreement on the domain (or thematic) models to be used. Study of the semantic aspect of information is not only important to help human beings to understand each other, but is also essential if we want machines to process this information in useful ways. To this

end, the semantics will have to be formalized with the aid of semantic webs, ontologies, etc. OWL (Ontology Web Language) is a useful new tool in this field.

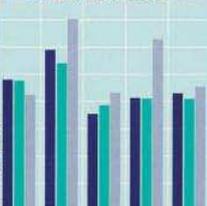
- Supporting research themes and technologies:
 - o Spatial data capture
 - o Positioning and geo-information
 - o Geo-visualization

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OTB Research Institute for Housing,
Urban and Mobility Studies
Delft University of Technology
Jaffalaan 9, 2628 BX Delft, The Netherlands
Postbus 5030, 2600 GA Delft, The Netherlands
Telefoon +31 (0)15 278 30 05
Fax +31 (0)15 278 44 22
E-mail mailbox@otb.tudelft.nl
www.otb.tudelft.nl