QANU Research Review

Technology, Management, Policy and Industrial Engineering

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Content

Foreword

This report follows the Standard Evaluation Protocol 2009-2015 for Public Research Organisations (SEP) that was developed by VSNU, KNAW and NWO. The purpose of this report is to present a reliable picture of the research activities submitted for this review and to give feedback on the research management and quality assurance.

The review committee was supported by QANU (Quality Assurance Netherlands Universities). QANU aims to ensure compliance with the SEP in all aspects and to produce independent assessment reports with peer review committees of international experts in the academic fields involved.

QANU wishes to thank the chairperson and members of the review committee for their participation in this assessment and for the dedication with which they carried out this task.

We also thank the staff of the institutes under review for their carefully prepared documentation and for their co-operation during the assessment.

Quality Assurance Netherlands Universities

mr. Chris J. Peels
director

Dr. Jan G.F. Veldhuis
Chairman of the Board

1. Review Committee and Review Procedures

Scope of the assessment
The Review Committee has been asked to perform an assessment of research in Technology Management, Policy, and Industrial Engineering at Eindhoven University of Technology, University of Twente and Delft University of Technology. The assessment covers the research in the period 2003-2009.

In accordance with the Standard Evaluation Protocol 2009-2015 for Public Research Organizations, the Committee's tasks were to assess the quality of the institutes and the research programmes on the basis of the information provided by the institutes and through interviews with the management and the research leaders, and to advise how this quality might be improved.

Composition of the Committee
The composition of the Committee was as follows:

- Prof. Arthur Ringeling, Erasmus University Rotterdam, chairman of the Committee;
- Prof. Gunnar Eliasson, Kungl Tekniska Högskolan (Royal Institute of Technology), Stockholm;
- Prof. Kingsley E. Haynes, George Mason University, Fairfax, USA;
- Prof. Michael Howlett, Simon Fraser University, Department of Political Science, Burnaby, Canada;
- Prof. Deborah G. Johnson, University of Virginia, Charlottesville, VA , USA;
- Prof. Stefan Klein, Westfälische Wilhelms-Universität, Münster, Germany;
- Prof. Nico Vandaele, Catholic University Leuven-Kortrijk, Leuven, Belgium.

A brief curriculum vitae of the Committee members is included in Appendix A.

Dr. Barbara van Balen of QANU (Quality Assurance Netherlands Universities) was appointed secretary to the Committee.

Independence
All members of the Committee signed a statement of independence to safeguard that they would assess the quality of the Institutes and research programmes in an unbiased and independent way. Any existing personal or professional relationships between Committee members and programmes under review were reported and discussed in the Committee meeting. The Committee concluded that there were no unacceptable relations or dependencies and that there was no specific risk in terms of bias or undue influence.

Data provided to the Committee
The Committee has received detailed documentation consisting of the following parts:

1. Self-evaluation reports of the units under review, including all information required by the Standard Evaluation Protocol, with appendices.
2. Full texts of the five key publications per research programme.
3. Bibliometric analyses of the research output of the institutes concerned.

Remarks about the data provided

In general, the self-evaluation reports contained sufficient information to prepare the Committee members for the site-visit. However, in many places the self-evaluation reports referred to the midterm reviews. Therefore the committee requested to receive these midterm reviews of the institutes and programmes concerned in addition to the self-evaluation reports. The written documentation the Committee received did not cover or clarify a number of research aspects at the three technical universities (3TU). The interviews during the site-visits were very helpful to clarify the remaining issues. The site-visits were very informative and necessary to enable the Committee to make an argued judgement on the quality of the research.

Procedures followed by the Committee

The Committee proceeded according to the Standard Evaluation Protocol 2009-2015. Prior to the Committee meeting, each programme was assigned to two reviewers, who independently formulated a preliminary assessment. Four of the research programmes were assessed by external reviewers, who were asked to report on the quality of the research based on the self-evaluation report and the key publications. The final assessments are based on the documentation provided by the institutes, the key publications and the interviews with the management and with the leaders of the programmes during the site-visits. The entire Committee decided on the final judgements for all programmes. The Committee scored the programmes according to the procedures described in the Standard Evaluation Protocol. The final mark per criterion is the weighed performance of the programmes for the sub-criteria.

The Committee tried to develop a balanced view on the assessment. It did not acknowledge only the refereed top journals or citations on the Web of Science. Furthermore, it did more than looking at figures, counting and measuring. The judgments are the result of all four criteria and their components. The Committee does not consider one criterion more important than another.

The Committee points to the fact that the main difference between the criteria of 2003-2009 and 2009-2015 is broadening of the criterion of relevance. Societal relevance has got more importance and the way societal relevance has to be valued is more concrete. A programme is not socially relevant solely because a social problem has been studied, but has to meet more indicators. The Committee considered whether a research group had a policy to interact with stakeholders in society and if valued efforts were made by the research groups to contribute to important issues and debates in society as well as the societal impact and valorisation of the work.

The Committee has no doubt about the quality of the bibliometric analyses of the research output it received, but it considers the significance of these studies to be limited. These studies do not take into account the different communities to which disciplines and the research groups direct themselves. The Committee noticed tensions between publishing in the Web of Science journals, which yields high impact scores, and the necessity of publishing in other journals aimed at a broader public, given the character of the programmes and the faculties, which try to combine high academic standards and studying practical problems and being meaningful to everyday practice. The Committee recognizes that, in terms of competitive fund raising, the Web of Science journals and impact factors are important ranking and assessment vehicles.

The Committee visited all institutes and interviewed the management of the institutes, the programme leaders and PhD students. The site visits took place on 20—23 September 2010.

2. General Remarks

In general, the Committee members were impressed by the researchers' dedication to their work. They encountered enthusiasm and passion for research in all three institutions. The research in the broad field of Technology, Management, Policy and Industrial Engineering is growing. The research topics have strong links with the developments in society, like the almost exploding use of new communication tools and the huge amount of internet information, as well as the growing use of and attention for health care and health care services. The researchers we met approach these new developments with the enthusiastic eagerness and the willingness to understand them and to add to improvement and innovation of Technology, Management and Policy and Industrial Engineering.

Scope of this evaluation

In principle, there can be several motives for research assessment:

1. Comparison of the results of different research groups;
2. Delivery of policy information for deans and boards;
3. Enabling research groups to improve their performance.

Regarding the first motive, the committee would like to remark the following. The basis for this evaluation is the Standard Evaluation Protocol and all programmes are assessed along the same criteria. For this review a comparison between research groups has to be limited because of the wide variation in research subjects in the groups involved. The letter of the deans of the three faculties accompanying the self-evaluation reports (14 July 2010) confirms this notion. The letter describes that the research portfolio of these three academic units has a multidisciplinary character, bringing together research in the (industrial) engineering sciences and research rooted in social sciences and humanities. The Committee remarks that the comparability and probably also the added value of the assessment would be improved by having the researcher leaders choose in what cluster they would like to be assessed, or with what research programmes they would like to be compared.

For the second motive, the committee states the following. The three research programmes of the University of Twente focus on the private sector. The majority of research conducted in Delft is for the benefit of the public sector or is taking place at the interface between the public and the private sector. In Eindhoven, five research programmes focus entirely on private sector issues whereas four programmes are positioned at the interface between the private and the public sector. A comparison can lead to little more than a scan of extrinsic rather than intrinsic qualities of research groups. Extrinsic comparison is possible to some extent, but the latter would lead to a comparison of apples and oranges.

Table 1 Areas of application

	Delft	Eindhoven	Twente
ICT	X	X	X
Sustainable energy	X	X	
Construction	X		
Telecom	X		
Public transport infrastructure	X		
Spatial planning	X		
Healthcare		X	X
Industrial production & logistics		X	X
High tech systems & industry		X	X

The Committee considers the third motive mentioned above (enabling groups to improve their performance) as the most important for this research assessment. This report has been written in a way that opens opportunities to do so.

Financial constraints for research

The financial situation is one of the issues that were discussed extensively with all institutes. The management of the research institutes expressed major concerns with the future financial situation and the consequences of this situation for the quality and productivity of the research.

All universities in the Netherlands have seen their budget for research go down due to reallocation of research money to NWO (Netherlands Organization for Scientific Research). Universities can earn this money back by applying for individual research projects. The technical universities, however, report that they have difficulty getting their research projects funded by NWO ('second-stream funding'). They argue that their research is not in mainstream fundamental disciplines, but more in interdisciplinary applied sciences. The three technical universities state that they jointly experience the irreversible evolution from a decreasing direct funding to contract and competitive funding. However, the Committee noticed that some institutes and research programmes were more successful in attracting 'second-stream' funds than others. We would advise the institutes and research programmes to learn more from each other's strategies.

Interdisciplinarity

The Committee did notice a tension between the ambition of the research programmes involved to conduct interdisciplinary and innovative research and the knowledge that results on these interdisciplinary subjects are hard to publish in top journals. A similar tension could be described for the possibility to apply successfully for NWO funding with interdisciplinary research projects. These tensions might lead to a tendency towards more monodisciplinary research, which the Committee would deeply regret. Looking back at the site-visit and the entire assessment process, the Committee was especially enthusiastic about those research programmes which combined several expertises and disciplines aimed at socially and academically relevant issues.

Organisation

The internal organization of the three universities into institutes, schools, departments and programmes often appears to be a compromise between history and central management ambitions. As a consequence the Committee observed considerable overlapping between programmes. We did not evaluate these overlappings as such as a problem. It is possible however that the use of resources can be improved by reallocating researchers or by merging

research groups. Given the usual developments within the organisation structure of research institutes, we expect that the search for the most effective and efficient way to group researchers will remain 'business as usual'.

Growing interest

All three technical universities experience problems with the diminishing interest in technical education and as a result a diminishing income from that source. The faculties that were visited are stable or growing in numbers of students and are, in that sense, an exception to the general picture of the technical universities. The image of the departments within the technical universities has subsequently evolved from 'ugly ducks' (not being technical in the sense of the exact sciences) that turned into 'beautiful swans'.

Conclusion

We look back at an interesting, inspiring week with site visits in which we encountered, as mentioned, enthusiastic researchers, who, without exception, are highly productive and conduct high quality innovative research in a growing field. Despite the financial cutbacks universities in general and research in particular have to suffer in the near future, we see a promising future for this research field.

ASSESSMENT PER INSTITUTE AND PER PROGRAMME

3. University of Twente

3.a. Assessment on the Institutional Level

University: University of Twente
Faculty: School of Management and Governance
Departments: Operational Methods for Production and Logistics (OMPL), Information Systems and Change Management (ISCM) and Finance & Accounting (F&A).

1. The organization

Description
The research assessment covers three departments within the School of Management and Governance (out of a total of eleven):

- Operational Methods for Production and Logistics (OMPL),
- Information Systems and Change Management (ISCM), and
- (partly) Finance & Accounting.

The research in these departments is in the area of Industrial Engineering and Management. At the University of Twente, research is formally organized by multidisciplinary research institutes and the research in Industrial Engineering and Management is part of the research institute Centre for Telematics and Information Technology (CTIT). Also the Institute for Governance Studies covers parts of the research of both the Finance & Accounting department and the Information Systems and Change Management department. The organizational structure is difficult to understand. Due to the complex organisation it is not possible to point to one organizational unit for the research assessed in this project.

The research in Industrial Engineering and Management is formally structured within the research institute CTIT in the strategic research orientation 'Industrial Engineering and ICT' and the strategic research orientation 'Applied Science of Services for Information Society Technologies'. The goal of the research is formulated as follows:

> "To conduct high-quality interdisciplinary research and education embedded on an international, national and university level, to improve and innovate operational processes in the broadest sense in the field of Industrial Engineering and Management, based on improved ICT infrastructures and sound decision support systems with both a financial-economic and an operational focus. Transferring knowledge to industry and society at large (valorisation) is considered to be an indispensible part of each department's activities."

The focus of the research in Industrial Engineering and Management is on the following domains:

- Production and Logistics Engineering / Supply Chain Management
- Information Service Engineering
- Financial Engineering and Management Accounting
- Healthcare process engineering

Each department described above is firmly rooted in the School of Management and Governance and in the research institutes.

Assessment
The self-evaluation report drafted by the University of Twente was difficult to read. Apart from the small font, this is partly due to the complexity of the structure in which these programmes are operating and partly to the abundant use of abbreviations. The frequent use of acronyms and extensive lists did not contribute to readability.

The assessment of management and strategy in the research institute CTIT was beyond the mandate of the Review Committee. The Committee did not get a fully clear picture of the mission and goals, strategy and policy of the research institute with regard to the research programmes involved in this review.

The documentation of the three research programmes was presented in a format that made the review an onerous task: knowing that only three departments in the School of Management and Governance were assessed, the overall structure of the University and the School as well as the division into research institutes and teaching programmes were quite difficult to comprehend. On the basis of the presentations during the site-visits the Committee concluded that the programmes concerned are not aiming at making a big score, or selling their results. Modesty is the more dominant attitude. The Committee is of the opinion that this modesty is not necessary. We would advise to sell better the qualities of the research and researchers.

The research of the assessed programmes is well embedded in the region. The committee is of the opinion that, on average, the research of the University of Twente the committee assessed, could intensify its ties with the national or international arena. While the research groups have established extensive national and international links of collaboration, the groups do not portray themselves as global players.

The financial situation of the Faculty seemed to be healthy despite the diminishing direct financial flow. All three programmes exist of relatively small research groups, in particular Finance & Accounting. Investment by the university is necessary. Human Resources planning is essential, in particular with staff that is growing older. This planning is even more important when groups are relatively small. According to the Committee, improvements are possible. The research groups could benefit more from learning from each other in particular.

2. Academic reputation

Description
The University of Twente recently established the Twente Graduate School, aiming at a joint master-PhD trajectory for talented students. Only programmes and groups that satisfy high standards in terms of scientific reputation and clearly defined programmes are allowed to join this Graduate School. The Industrial Engineering and Management programme of the three departments formulated in cooperation with Applied Mathematics and Engineering Technology has been accepted as one of the first programmes in this School. The Service Science programme has been admitted to the Graduate School on 1 February 2010, also as one of the first programmes that have passed the quality review. ISCM has collaborated extensively with the Information Systems, Software Engineering and Databases groups in the school of Electrical Engineering and Computer Science to establish this programme.

On a national level, the departments are collaborating with partners in the joint Eindhoven-Twente Research School on Operations Management and Logistics Beta (accredited by the Royal Netherlands Academy of Arts and Sciences KNAW), as well as in several nationally funded programmes (e.g. TRANSUMO). Internationally, each group has close links with partner institutes in Europe and abroad.

Assessment
As mentioned previously, the Committee was not asked to evaluate the School of Management and Governance and was therefore not able to assess the position and reputation of this School.

3. Resources and organization

Description
Since the assessment of research programmes covers only three of the eleven departments of the School of Management and Governance, it was neither possible nor appropriate to present the information on these departments on an institutional level. Consequently, information on and assessment of resources and output are only described on the level of the research groups. The tables below present the aggregated data of the three departments.

During the site-visit, the management of the School gave some indications of the strategies to attract more funding. For historical reasons, the University of Twente is more heavily affected than other institutions by the 100 million euro budget shift to NOW. It is difficult to attract 'second-stream' money to compensate for this shift. The strategy for extending resources is mixed, aiming both at NWO and at contracts. The degree programmes linked to the research departments involved have been able to attract more students, so the relative share of 'first-stream' funding for the University of Twente is increasing.

Table 3A1 Research capacity of OMPL, ISCM and F&A

Research capacity in full-time equivalents (FTE)	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	8.52	8.97	7.36	6.73	6.64	7.94	8.64	54.80
Non-tenured staff	0.89	0.40	0.00	0.66	0.79	0.94	0.80	4.48
PhD students	6.20	9.59	9.14	9.31	7.93	8.85	10.57	61.59
Total research staff	15.61	18.96	16.50	16.70	15.36	17.73	20.01	120.87

4. Productivity

Table 3A2 Aggregated results of OMPL, ISCM and F&A

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	8	14	26	16	33	27	27	151
Non-refereed papers	0	1	1	2	6	1	0	11
Books	3	0	3	1	1	3	3	14
Book chapters	5	3	20	15	13	11	5	72
PhD theses	4	2	3	10	4	5	2	30
Conference papers	14	12	17	16	25	26	29	139
Academic publications	34	32	70	60	82	73	66	417
Professional publications	12	15	8	13	25	21	34	128
General public publications	5	1	3	2	4	4	4	23
Remaining	2	2	9	9	9	25	33	89
Other publications	19	18	20	24	38	50	71	240
Total publications	53	50	90	84	120	123	137	657

Assessment
The productivity and publication strategy of each of the programmes was reviewed as described below in the paragraphs concerning the research programmes. As mentioned above, assessment was not required for the institutional level because the Committee only evaluated three of the eleven programmes of the research institute.

5. PhD training

PhD students of the assessed research programmes are able to follow courses via several networks. PhD students of OMPL are educated on the basis of an education plan of the research school Beta. Beta has implemented clear procedures with respect to assessment of the quality of research projects and PhD applicants. During a PhD research project, progress is measured with respect to the PhD's education and with respect to the research per se. For each PhD student, an individual education plan is developed and appropriate fulfilment of this plan yields the Beta certificate. Assessment of PhD research progress has been established in a motivating format through the annual Beta PhD seminar, in which all PhDs in their third or fourth year present their research results to date.

ISCM has set up a 'PhD in Information Systems' training programme jointly with other information systems (IS) programmes in the Benelux (Belgium, the Netherlands, Luxembourg). The Benelux AIS chapter (BENAIS) coordinates this programme. The programme was established in 2008 and is hosted by the University of Amsterdam. Monthly full-day seminars are held in Amsterdam on various research topics and research methodology. Participation in doctoral consortia in the leading Information Systems conferences is encouraged. PhD students are also facilitated to spend part of their 4-year study abroad in a university or research institute.

PhD students of F&A are in a position to follow courses via several PhD networks. For example, finance and accounting PhD courses in the Netherlands are offered by the Limperg Institute, by the Netherlands Network of Economics, and by the Dutch Network on the Mathematics of Operations Research. Some PhD students participate in the research school Beta. At the start of the PhD programme, an appropriate study and research plan is developed for each PhD student. The research training involves taking courses on research methodology and related areas of research. These courses can be of an 'in-house' type or provided by national and European PhD networks.

Towards the end of the first year, each PhD student is expected to present a research proposal, which is developed in close cooperation with the student's supervisor. Supervision of PhD research is taken seriously. During the subsequent years, the PhD student undertakes well-focused original research that leads to the preparation of 2 or 3 working papers. These papers are presented at departmental research seminars as well as at national and international doctoral symposia and academic conferences. It is expected that this process will lead to submission of papers for publication consideration in international academic journals. The Department ensures that PhD students receive adequate research supervision and facilities.

Assessment
Training and coaching of PhD students are on an adequate level. Success rates and lead times of the PhD's trajectories are very good. During the site visit the Committee learned about the plans to establish a new Graduate School, which is possibly a good vehicle put in place. The Graduate school, as pointed out to the Committee during the site visit, has a clearly designed

structure for PhD education, combining course work, supervision, funding for travels, et cetera, which also guides the practices at the department.

The ISCM group has increased its number of PhD candidates over the review period. However, three of the four PhD candidates who graduated during the reference period needed more than four years. The committee has noticed that the group, in order to address this problem, has implemented a system of annual review and planning of PhD's. The results of this policy were, however, not yet visible.

The group of PhD students includes a growing number of external part-time candidates. Consequently, the range of topics has been broadened and a close link to industry is maintained. A special Executive PhD programme has been established and intensive workshops are offered to ensure the quality of external PhD projects.

The PhD candidates we interviewed were satisfied with the combination of the structured PhD education components, which have been embedded in customized training plans for each candidate.
The Committee was impressed by the commitment and good morale of the PhD students.

3 B. Assessment on a Programme Level

3.B.1. Operational Methods for Production and Logistics (OMPL)

Programme leader:	Prof. A.van Harten (2003-2005); Dr. M.C. van der Heijden (2005-2006); Prof. J.H.A. de Smit (2007); Prof. R.J. Boucherie (2008-2009); Prof. W.H.M. Zijm (2009)
Research staff 2009:	9.36 FTE
Assessments:	Quality: 3.6
	Productivity: 4.5
	Relevance: 4.5
	Viability: 3.5

Description
The mission of the OMPL group is to conduct high-quality interdisciplinary research and education on an international, a national and a university level in the general area of operations management, focusing in particular on planning and control of manufacturing systems and supply chains, healthcare logistics and purchasing management. Transferring knowledge to industry and society at large is considered to be an indispensible part of the group's mission.

The research of OMPL is divided into five themes:

1. Manufacturing and maintenance management
2. Supply chain management and service logistics
3. Transport and distribution
4. Healthcare logistics
5. Purchasing management.

These themes are clearly developed in the context of Operations Research (OR) in the field of Industrial Engineering and focus on production processes and increasing management efficiency procedures.

The research programme provided the following information on input and results.

Table 3B1 Research capacity of OMPL

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	2.99	2.77	2.27	1.87	1.88	2.81	3.37	17.96
Non-tenured staff	0.89	0.40	0	0.40	0.39	0.54	0.40	3.02
PhD students	1.40	1.59	4.30	5.31	4.39	4.84	5.59	27.42
Total research staff	5.28	4.76	6.57	7.58	6.66	8.19	9.36	48.40

Table 3B2 Funding of OMPL

Funding (%)	2003	2004	2005	2006	2007	2008	2009
Direct funding	90.3	78.9	57.7	71.5	64.4	57.2	50.7
Research funds	0	0	0	0	0	1.1	6.1
Contracts	9.7	21.7	42.3	28.5	35.6	41.7	43.2
Other	0	0	0	0	0	0	0
Total funding	100	100	100	100	100	100	100

The self-evaluation report indicates a sharp increase in total funding during the 2003-2009 period. This was attributable primarily to an expansion in external contract activity. Table 3B1 shows the impact of this expansion on the number of staff involved. This number almost doubled in six years' time.

Table 3B3 Results of OMPL

Results OMPL	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	4	6	7	7	13	13	12	62
Non-refereed papers	0	0	0	0	2	0	0	2
Books	0	0	1	0	1	1	0	3
Book chapters	1	3	3	6	3	1	0	17
PhD theses	3	0	1	2	1	2	0	9
Conference papers	2	1	5	2	2	14	4	30
Academic publications	10	10	17	17	22	31	16	123
Professional publications	10	11	7	9	21	16	28	102
General public publications	0	0	3	0	0	0	2	5
Other research output	0	0	0	1	1	1	8	11
Other publications	10	11	10	10	22	17	38	118
Total publications	20	21	27	27	44	48	54	241

Table 3B4 PhD success rates of OMPL

Enrolment				Success rates				Total		
Start in year	Gender m/f		Total	Graduated after ≤4 years	Graduated after ≤5 years	Graduated after ≤6 years	Graduated after ≤7 years	Total graduated	Not yet finished	Not completed
2003	1	1	2	2 (100%)				2 (100%)		
2004	2		2		1 (50%)			1 (50%)		1 (50%)
2005	4		4	1 (25%)	1 (25%)			2 (50%)	2 (50%)	
2006	3		3		1 (100%)			1 (33%)	2 (67%)	
2007	4		4						4 (100%)	
2008	2	1	3						3 (100%)	
2009	1		1						1 (100%)	
Total	17	2	19	2 (17%)	3 (25%)			6 (32%)	12 (63%)	1(5%)

Assessment

Quality

The present and new chair (2009) is an excellent leader with outstanding credentials, experience and a track record of success. This opens an expectation of future programme success and hopefully will correct for the past years of leadership gaps due to illness and death of the previous permanent chair. This gap was filled with stand-in or part-time leadership appointments. In spite of these gaps in permanent leadership, the programme has done surprisingly well in terms of quality and productivity. The assessment of this programme however should also be related to the situation (the leadership gap) in the past years.

This is a well targeted programme set up as a classic Operations Research (OR) programme. Besides its very good research production record in supply chain management, transportation and logistics and purchasing management, the programme targeted healthcare services and logistics as an area of future focus. This seems a reasonable future strategy in line with university priorities.

The research has a solid base in Operations Research, both in deterministic and stochastic modelling. Combining these two approaches is challenging but is definitely an asset. The

research group wants to develop new grounds along the lines of healthcare, service systems, purchasing, sustainability and transportation, all of which are relevant fields of academic and societal significance.

The funding had a shift from direct funding to contract funding. However, second stream (NWO) research funding is hardly present. This places a burden on future fundamental and contract research.

The programme expanded its Web of Science publications in response to the mid-term review, primarily in the Operational Methods area, and to some degree also in the Business Finance and Procurement area. The programme has its best linkages to national, rather than international, activities and was able to continue its publication levels in non-Web of Science outlets.

Most of the influential publications are not recent. This is supported by the bibliometric analysis: "The output is cited 2.21 times on average, after correction for self-citations. Compared to both the journal and the field average impact level, this group performs slightly below that average impact level. The output is published in journals at average impact level."

The national cooperation and links are undoubtedly active and the research group is visibly present in the national networks and research groups and schools (e.g. the Beta research school).

Productivity
Given the Standard Evaluation Protocol (SEP) criteria the committee considers the productivity as very strong. It reflects a strong strategic identification of goals that link directly to university research goals, particularly in the new healthcare research strategy and to expansion of professional Web of Science publications, while maintaining high levels of outreach to wider audiences.

Scrolling through the proposed publications and research output, the role of one or two high-class researchers appears dominant. This leads to excellent individual publication records with international visibility. The self-evaluation report mentions one person reaching an h-index of 19. However, it is a very vulnerable situation and proactive mid-term planning for follow-up is mandatory and urgent.

The team presents a plethora of source journals, including top international journals in the field. However, for some themes the list of key publications contains PhD dissertations, which should be considered as valuable 'intermediary' publications. These dissertations should turn into to high-level international journal publications.

There is a considerable increase in refereed papers.

The income from contract research is substantial and strong. This should be the ground for valorisation opportunities in terms of patents, software licences or spin-offs.

Societal relevance
Societal relevance is a forte of the programme as reflected in external contract activity and a strong national focus.

The research is embedded in sustainable supply chain management. A good start has been made with studying global and sustainable issues in this basic field: reverse logistics, (public) procurement, environmental issues and congestion effects in transportation. It might not be too big a step to include contemporary important issues like emissions, disruption management and financial considerations in the research portfolio.

The research team has many links with the actors in the applications field. Effective valorisation of the results should be on the agenda.

The university and the OMPL group specifically point out that healthcare is one of key fields in which to grow. This is undoubtedly true but the facts show that this becomes an overstatement in comparison to the dedication of resources to this field.

Vitality and feasibility
The split of the research programme into five themes is discussable as the tenured group constitutes a too small base (although recently growing) to carry out all five themes with sufficient focus and depth. At the moment the tenured capacity for the programme is small and too thinly distributed to deliver effective research in all of its target areas. This would suggest either an expansion of faculty and facilities, or a more limited goal set. From the entire staff only one person is focusing on healthcare logistics, although it is defined as a promising field and is one of the core research areas of the university as a whole. The same holds for the theme of purchasing management. The committee provides two options: either the group continues to drive on the rather low level of tenured staff, with the focus on fewer themes, or an increase in staff is required to be successfully develop the five themes. The group has reacted to previous suggestions of extending the staff base with young promising people. This was realized only partly; more will be needed to make an international stand (for instance in the field of healthcare logistics). Two persons with strong and successful research profiles will retire within a couple of years. Since the current research and publication impact is largely linked to these persons, a proactive action for the mid-term staff composition is urgent. In doing this, the international dimension needs to be intensified: on the level of PhD candidates (including attracting more female students), staff recruitment and effective international cooperation.

Results of the SWOT analysis seem to be very similar to those of other programmes and not particularly linked to the specific characteristics of this programme. The strategy reflects the programme's involvement in collaboration, flexibility and anticipation of change in research patterns as might be reflected in its future and expanding client base for its research activity. The robustness and stability of the programme was weak over 2003-2009 with strengthening seen in the last part of that period.

This is a small high-quality research programme with great potential. However, due to its modest size and its increasing dependence on contract funding, it remains vulnerable. There is a solid base for the future, but continuous care must be taken with regard to the critical number of staff, the research area focus, number of refereed publications and an increase in competitive research funding.

3 B2 Information Systems and Change Management

Programme leader:	Prof. J. van Hillegersberg	
Research staff 2009:	8.39	
Assessments:	Quality:	3.75
	Productivity:	3.5
	Relevance:	4.0
	Viability:	3.75

Description

The mission of the Information Systems and Change Management department (ISCM) is to conduct high-quality internationally leading research, valorisation and teaching in the field of services engineering for the networked society. The research of ISCM focuses on the design, composition and exploitation of ICT-enabled services with the target of properly matching supply and demand. The following themes have been developed:

1. 'Design and Value' focuses on a rational approach for the value-driven design of knowledge- and IT-intensive services. This theme is centred on business models, service models, process models and infrastructures during the life cycle of services.
2. 'Coordination and Integration' studies mechanisms for effectively searching and integrating services.
3. 'Change and Transformation' is aimed at the behaviour of networks, organizations, work units and employees in delivering, improving and innovating (e-)services including the design of performance management and measurement systems.

The self-evaluation report documents a period of transformation and reorientation. The arrival of professor van Hillegersberg has had a huge impact on the group and its strategy, orientation, practices and productivity. Moreover, the adoption of the Change Management group underlines the social and organizational orientation of the research and provides a unique set of interdisciplinary competencies. Positioned in an environment of large interdisciplinary research institutes, the department has spread its resources across a broad range of activities, projects and programmes. The five-year programme Information Systems for a Networked World (IS4NOW), which has now been refocused into Service Engineering for a Network Society (SENS), provides a thematic umbrella for the diverse activities and common orientation for the group. It is well aligned with the overall orientation of the university.

The group invested to build linkages to industry and other research groups, which has paid off in terms of an increasing volume of contract research. The current situation appears to provide a good platform to extend this research in the future. The documentation did not make clear to what extent the department is actually taking a lead in new projects or whether it is making valuable and unique contributions to initiatives largely driven by other groups.

The research programme provided the following information concerning input and results.

Table 3B5 Research capacity of ISCM

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	3.45	3.92	2.81	3.21	3.24	3.65	3.81	24.09
Non-tenured staff	0	0	0	0.26	0.40	0.40	0.40	1.46
PhD students	4.80	5.60	2.44	1.72	2.35	3.21	4.18	24.30
Total research staff	8.25	9.52	5.25	5.19	5.99	7.26	8.39	49.85

Table 3B6 Funding of ISCM

Funding (%)	2003	2004	2005	2006	2007	2008	2009
Direct funding	77.5	79.4	65.6	83.5	70.7	68.4	59.0
Research funds	0	0	0	0	0	0	0
Contracts	22.5	20.6	34.4	16.5	29.3	31.6	41.0
Other	0	0	0	0	0	0	0
Total funding	100	100	100	100	100	100	100

Table 3B7 Results of ISCM

Results of ISCM	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	2	4	7	6	11	9	8	47
Non-refereed papers	0	0	1	2	3	1	0	7
Books	2	0	2	1	0	2	3	10
Book chapters	2	0	17	9	7	9	4	48
PhD theses	0	0	2	3	1	3	2	11
Conference papers	12	10	11	13	21	12	23	102
Academic publications	18	14	40	34	43	36	40	225
Professional publications	1	0	0	2	3	3	5	14
General public publications	5	1	0	2	4	4	2	18
Other research output	2	2	8	8	7	19	20	66
Other publications	8	3	8	12	14	26	27	98
Total publications	26	17	48	46	57	62	67	323

Table 3B8 PhD success rates of ISCM

Enrolment				Success rates				Total		
Start in year	Gender m/f		Total	Graduated after ≤4 years	Graduated after ≤5 years	Graduated after ≤6 years	Graduated after ≤7 years	Total graduated	Not yet finished	Not completed
2003										
2004	2		2	1(50%)		1(50%)		2(100%)		
2005	1	2	3		2 (67%)			2 (67%)	1 (33%)	
2006	1		1						1 (100%)	
2007	2	1	3						3 (100%)	
2008	1		1						1 (100%)	
2009	4	4	8						8 (100%)	
Total	11	7	18					4 (22%)	14 (78%)	

Assessment

Quality

The research objective is clearly articulated ('service engineering for the networked society') and is well aligned to the goals of the Industrial Engineering & Management School. The research scope is defined by service industries and allows for a broad coverage of traditional industries such as logistics and finance, as well as industries that recently have gained more visibility within the Information Systems community, namely media and healthcare. Notably, this overlaps with the domains claimed by the research programmes 'Operational Methods for Production and Logistics' and 'Finance & Accounting'. Recently the research focus has been sharpened and articulated more clearly. The new structure provides a coherent framework to position the broad range of contributions across diverse application areas and disciplinary fields of specialization within information systems and change management. The

overall research topic is highly relevant and addresses the ongoing transformation of economic structures.

In line with the overall strategy of the school, the research group contributes to five major teaching programmes, two interdisciplinary research institutes, and two strategic research orientations within the CTIT. While this contribution clearly facilitates the diversity and richness of the research and allows building scale across a wide range of competencies, resources are spread quite thinly across the programmes. Moreover, this requires a high level of coordination. Under these conditions, it is more difficult to sharpen the international visibility and profile of the group despite the fact that a broad range of active links to other research groups and individual researchers were built and maintained. The group succeeded to establish a broad range of collaborative relationships with other research institutions in the Netherlands and internationally. Beta provides a framework for PhD education for the 'coordination and integration' stream.

The group was not successful with their NWO proposals. The notion that NWO focuses more on monodisciplinary research was mentioned by other groups and universities as well. Some groups have nevertheless succeeded to solicit funding from NWO.

The programme leader shows a strong sense of leadership and practises a participatory leadership style in order to facilitate identification of the department members, including PhD candidates, with the overall goals. The group developed a number of practices to strengthen its identity, academic collaborations and international visibility. Teaching on the Master level and research appear to be well aligned.

To the committee, it is not clear how the new themes, 'serious gaming' and 'global sourcing' support the research agenda.

The bibliometric analysis notes the high impact in Business and Information Science, while the impact is average in Computer Science and Information Systems.

Weighing all aspects that have been considered in regard to 'quality' the Committee concludes that the research of this group is good to very good. More very good than good. The research is internationally visible, some of the themes are even internationally competitive, and makes a significant contribution to the field.

Productivity
The group has taken a leading role in a broad range of research projects and contributed numerous research initiatives. Members of the group are actively involved in the wider academic community (journal and conference boards, et cetera).

The group was successful in increasing the number and impact of publications and, more generally, the level of productivity over the past years. Just to take one formal indicator, which obviously has to be looked at with caution: the average number of refereed journals over the 7-year period per tenured FTE was 1.95 (2.62 if only the last three years are considered); if conference papers are included the number rises to 6.19. The average overall output of publications over the last three years is about twice as high as during the first three years.

In accordance with the tradition in Information Systems, conference papers constitute the main publication genre, followed by 'other research output' which is typically geared towards

valorisation. Yet, in comparison with the other groups this committee assessed in this process, the output is not impressive and there seems to be a lack of focus in the journals used for publication.

Societal relevance
The University of Twente is a major economic factor in the mid east of the Netherlands. In line with the overall strategic motto of the University of Twente, 'Technology in Context', the group invested a lot of time and energy in building relationships with regional stakeholders (the breakdown of work effort lists 20% time allocated to valorisation). The group is consulting entrepreneurs in the region, including spin-offs from the university. In addition to successful contract research, it adopted specific practices of valorisation, such as PhD defences combined with public seminars. The part-time Executive PhD programme provides an additional link to industry. However, these part-time industry PhD candidates may need a longer lead time for completing all academic required activities for a PhD.
The Committee is therefore of the opinion that the relevance of the research is very good.

Vitality and feasibility
The management practices show a high level of awareness to building sustainable structures. The diversity appears to be well managed and is seen overall as an asset in terms of inspiration and interdisciplinary research. The group manages a complex portfolio of projects which requires quite a bit of coordination, but is also a good risk spreading strategy. As much as 41% (vs. 22.5% in 2003) of funding is based on contract research, which is a significant increase over the past five years and provides a good prospect for further growth in this area.

The SWOT analysis points to challenges regarding the unique position of the group: student numbers are not increasing and funding for basic research is difficult to acquire, which leaves growth options limited to contract research. The group does not expect to be able to fill future positions on the professor level (hl, uhd) solely based on teaching and is looking into ways of supporting them partially with external funding. Recently, two of the members, who had clearly contributed to the profile of the group and contributed a few high-profile publications, left the group. In the light of the high level of fluctuation, personnel management is obviously a critical task.

The group has provided convincing evidence of a positive transformation process over the past years. The new programme leader has introduced successful and innovative management practices and built a strong identity through his participatory style. However, the structural complexity of the research programme at the University of Twente is a matter of concern. It appears to absorb significant resources. While it contributes to the intellectual viability of the programme, it constrains the organizational viability and makes it difficult for the group to articulate their vision in a simple and convincing manner.

3B3 Finance & Accounting

Programme leader:	Prof. M. Wouters (2003-2005), Prof. N. Mol (2005-)	
Research staff 2009:	2.26	
Assessments:	Quality:	3.2
	Productivity:	3.2
	Relevance:	3.0
	Viability:	3.2

Description

The research in Finance & Accounting (F&A) concerns different areas of financial engineering with a focus on fundamental and applied research in quantitative finance motivated by meaningful problems in the financial industry. This includes traditional issues in pricing and risk management of equity and interest rate derivatives, as well as energy finance. The research in Finance & Accounting is conducted in two groups. The first group is part of the department of Finance & Accounting in the Faculty of Management and Governance and the second group is part of the department of Stochastic Systems and Signals in the Faculty of Electrical Engineering, Mathematics and Computer Science. The researchers from the second group did not participate in this assessment. Also, the research programmes on Corporate Finance and Public Management are not part of the review.

Scientific results and highlights can be divided into four themes:

1. Pricing and hedging of complex derivatives for managing risk
2. Risk management in insurance and pension funds
3. Financial management
4. Management accounting

The research group Finance & Accounting is located within the Faculty of Management and Governance that is composed of eleven groups, three of which are the subjects of evaluation. The research in the three groups is carried out for a large part, but not exclusively, in the well defined field of Industrial Engineering and Management, a multidisciplinary field that manifests itself in the form of considerable departmental overlapping.

Table 3B9 Research capacity of Finance & Accounting

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	2.08	2.28	2.28	1.65	1.52	1.48	1.46	12.75
Non-tenured staff	0	0	0	0	0	0	0	0
PhD students	0	2.40	2.40	2.28	1.19	0.80	0.80	9.87
Total research staff	2.08	4.68	4.68	3.93	2.71	2.28	2.26	22.62

Table 3B10 Funding of Finance & Accounting

Funding (%)	2003	2004	2005	2006	2007	2008	2009
Direct funding	96.7	90.7	100	98.8	91.1	84.2	81.6
Research funds	0	0	0	0	0	0	0
Contracts	3.3	9.3	0	1.2	8.9	15.8	18.4
Other	0	0	0	0	0	0	0
Total funding	100	100	100	100	100	100	100

Table 3B11 Results of Finance & Accounting

Results of F&A	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	2	4	12	3	9	5	7	42
Non-refereed papers	0	1	0	0	1	0	0	2
Books	1	0	0	0	0	0	0	1
Book chapters	2	0	0	0	3	1	1	7
PhD theses	1	2	0	5	2	0	0	10
Conference papers	0	1	1	1	2	0	2	7
Academic publications	6	8	13	9	17	6	10	69
Professional publications	1	4	1	2	1	2	1	12
General public publications	0	0	0	0	0	0	0	0
Other research output	0	0	1	0	1	5	5	12
Other publications	1	4	2	2	2	7	6	24
Total publications	7	12	15	11	19	13	16	93

Table 3B12 PhD success rates of Finance & Accounting

Enrolment				Success rates				Total		
Start in year	Gender m/f		Total	Graduated after ≤4 years	Graduated after ≤5 years	Graduated after ≤6 years	Graduated after ≤7 years	Total graduated	Not yet finished	Not completed
2003	3		3	3 (100%)				3 (100%)		
2004	2	1	3	3 (100%)				3 (100%)		
2005										
2006										
2007	1		1						1 (100%)	
2008	1	2	3						3 (100%)	
2009										
Total	7	3	10					6 (60%)	4 (40%)	

Assessment

Quality
The range of the field of Finance & Accounting is enormous. The department has touched down in two different areas of specialization with a limited common denominator, both as to problem orientation and as to methods, an organization that has an 'historic origin'.

The following themes were identified:

1A. Pricing and hedging of complex derivatives for managing risk, and
1B. Risk management in insurance and pension funds, on the one hand, and;
2A. Financial management, and
2B. Management accounting, on the other.

The two theme groups tend to publish in different journals. The Committee acknowledges that all the fields of academic inquiry are academically and societal highly relevant, but has some concerns about them being what is needed to support teaching and research within Finance & Accounting in the university as a whole.

The group emphasized the interdisciplinary nature of Finance & Accounting research in the self-evaluation report and the difficulties of both publishing and funding such interdisciplinary research, the latter being partly due to 'the strong tendency of the Netherlands' research councils to favour 'disciplinary research projects'. The Financial

Engineering group received no funding from those research funds during the survey period. The Committee noted that the department of Operational Methods for Production and Logistics and the department of Information Systems and Change Management made exactly the same observations. Nevertheless, the Finance & Accounting group was quite successful in publishing fairly extensively in specialized, non-multidisciplinary journals. It was acknowledged (in the interviews) that the difficulties of publishing and funding contributed to a drift away from multidisciplinary research.

Even though the Committee found the quality and scientific relevance of research and publishing above average, it expresses concerns about the sustainability of leadership, the resources and the long-term strategic concept and orientation of the department, and also about the training of PhD candidates.

Productivity
Scientific publishing was good in respected but specialized journals. Relatively little output, which is common in finance, was published in other forms. Publication rates in refereed journals (in relation to TFE of tenured staff = 3.3) were relatively high. The productivity of this group is in the opinion of the Committee on the whole good. The group could use a more focused publication strategy.

Societal relevance
The Committee concluded that there is no need to be concerned about the relevance of research in Finance & Accounting. The problem is rather how the different 'themes' of the group can be composed to both generate synergies in research and a broadly based support of PhD training. The committee is not fully convinced that the group is developing in that direction.

Considering the 'usefulness' of research in this field the Committee observed that contract work was on its way up though still not high.

Vitality and feasibility
The Committee found a strong overlap with Information Systems and Change Management, which is doing research and contract work that might as well find a natural place in the department of Finance & Accounting, for instance in business systems. This brought to the attention the question what a technical university needs in the form of coverage to be integrated under the departmental title of Finance & Accounting or Financial Engineering.

There are, of course, some relations between the two interdependent theme groups, but the Committee has some concerns about – if it may be expressed that way – the schizophrenic division of work. The Committee recognized that strong leadership, or departmental culture, was needed here to establish the necessary harmonic research environment and constructive cooperation among the researchers. Such a mode of organizing work is sensitive to choice and turnover of senior researchers, in particular in fields with such an attractive external professional market as Finance & Accounting. The research group changed its programme leader once during the period of evaluation, and both the tenured staff and the number of PhD candidates decreased during the period 2003—2009. Both the research group and the Committee consider these circumstances to be a problem. Although the Committee finds the group's SWOT analysis insightful, it is not convinced that a much-needed consolidation of research and training is in the making. To fit a 'whole' that is not yet fully clear to the Committee, and to support the entire university in this important area, external resources

have to be drawn upon to an extent that will be difficult to realize until the currently declining and volatile staffing of the department is turned around.

4. Eindhoven University of Technology

4.a. Assessment on the Institutional Level

University: Eindhoven University of Technology (TU/e)
Department: Industrial Engineering & Innovation Sciences (IE&IS)

1. The institution

Description
The Department of Industrial Engineering & Innovation Sciences was established in 1995, as a result of a merger between the former faculties of Philosophy & Social Sciences and Industrial Engineering & Management Science. The Department focuses on research and education in:

- Analysis, (re)design and control of operational processes in organizations, and information systems needed for these processes.
- Realisation and impact of technological innovations on the individual, organizational and societal levels.

The Department covers two research and educational areas: Industrial Engineering and Innovation Sciences. The Department recently decided to adapt the organizational structure to its research and education focus and established two schools, Industrial Engineering and Innovation Sciences. Each school has its own educational programme, research focus and financial household.

The dean is the head of the Department and is responsible for the overall research and education portfolio. The two vice-deans are, together with the dean, responsible for the two Schools. The managing director deals with financial management, human resource procedures and departmental facilities. The Department Board acts as the management team and consists of the dean, the vice-deans and the managing director.

The **School of Industrial Engineering** is a centre of fundamental and applied scientific research in the field of operations management in production, distribution and development of both new products and new services. The mission statement of the School is to conduct research and teaching in the area of: analysis, (re)design and control of operational processes in organizations and information systems supporting these processes. Research is organized in four research programmes, each contributing to knowledge development and knowledge transfer in the various fields of operations management.

The **School of Innovation Sciences** is a centre of basic and applied research in the interdisciplinary field of innovation sciences. The research activities in the School of Innovation Sciences focus on the interaction between technological, economic, psychological and social developments, with an emphasis on pervasive and long-term changes (technological transitions). The school combines various disciplines (economics, engineering, history, philosophy, psychology, sociology). The research is organized along five research programmes.

Assessment
The Committee has seen a strong Department with an entrepreneurial spirit, which is visible in this university. The Department has beautiful and very diverse research groups. This diversity is seen as a strong characteristic. The size of some of the groups could be reconsidered; some seem rather small, but this should not be a problem in itself. The Department has to decide whether reshuffling is likely to lead to improvement.

The dean's hand is visible in strategy and planning of research. The Department has a very clear Human Resources policy and aims at strategic recruitment. The Committee noticed a policy to stimulate the researchers to become excellent. This resulted in a widespread eagerness to excel. The renewal of staff has led to younger, ambitious full professors and a new culture. The Department also fits nicely in with the university's policy, with its research emphasis on Energy and Health. The strategy to establish two schools in the Department has turned out very positively. It seems that cooperation between the research groups of the respective schools improved after their establishment. The university's 2020 strategy acknowledges the increasing importance of social issues. It recognizes and emphasizes the roles of the Industrial Engineering & Innovation Sciences Department.

Besides these positive developments, the Committee also wishes to make some remarks for consideration:

- Is it wise to limit financing of the tenured staff to 'first-stream' money, in particular when you know that the 'first stream' is becoming smaller and smaller in the future?
- There seems to be a tension between groups shopping to give courses and to receive 'first-stream' money and the ambitions of their research programmes.
- The Committee noticed a diversity in public: an international player and at the same time grounded in the region, with relationships to business close by. It takes effort to maintain the balance in these publics.
- We noticed one-sidedness in the distributive model of the Department: only publications in Web of Science journals count. However, the tradition in History or Philosophy is to write books. In Information Systems, because of the quick developments in that field, conference papers are more important. This diversity should have consequences for the money distribution model within the Department.

2. Academic reputation

Description
The academic reputation of the **School of Industrial Engineering** is described in terms of achievements and performance of the researchers and research groups of the school. Researchers hold positions in editorial boards of ISI journals and have won research prices and awards. Several research groups have acquired funding from national and international scientific funding programmes.

Members of the **School of Innovation Sciences** have received scientific awards and research grants, have fulfilled editorships, were invited as keynote speakers at conferences, are member of the Royal Netherlands Academy of Arts and Sciences, are professors at other universities or are referees for A-journals.

Assessment
Formally speaking the School of Innovation Sciences is studying, technological innovation processes at the individual, organizational and societal levels, while the School of Industrial Engineering focuses on what happens inside the firm hierarchies. The reputation of the research of both schools is very good to excellent. As remarked above, the strategy to establish two schools has turned out very positively.

3. Quality and scientific relevance of the research

Description
The **School of Industrial Engineering** is the carrier of research activities in 'Management and Planning' at TU/e. This research area has a citation impact in the range of 1.50-1.99. The School of Industrial Engineering has been strongly involved in the establishment of the Dutch Institute of Advanced Logistics (Dinalog).

Researchers of the **School of Innovation Sciences** have received personal research grants. Many doctoral theses have been realized, including two cum laude theses. The School's researchers are leading in several international research programmes.

Assessment
The quality of the research in both schools is generally very good. The assessment is described in detail for each of the research groups involved.

4. Resources

Description
The university distributes the primary funding from the Ministry of Education, Culture and Science to its faculties on the basis of an output model. The Department uses 5% of this budget for policy objectives, which can be education, research or support. The primary funding for a research group depends on financial parameters in a distribution model. All income from research funds and contracts is fully at the disposal of the research group. The self-evaluation report provides information on funding in thousands of € on an institutional level.

Table 4A1 Funding and expenditure on an institutional level

Funding in thousands of €	2003	2004	2005	2006	2007	2008	2009
Direct funding	18,399	18,686	18,134	16,832	16,369	14,673	14,791
Research funds	438	764	1,074	1,277	1,293	1,232	1,041
Contracts	2,102	2,242	2,621	2,542	2,908	3,509	4,389
Other	1,591	809	824	839	642	720	586
Total funding	22,530	22,501	22,653	21,490	21,212	20,134	20,807

Expenditure	2003	2004	2005	2006	2007	2008	2009
Personnel costs	18,750	19,116	19,322	18,795	19,508	17,168	18,180
Other costs	3,543	3,652	3,293	2,801	2,705	2,793	2,818
Total expenditure	22,248	22,768	22,615	21,596	22,213	19,961	20,998

Funding in thousands of €	2003		2004		2005		2006		2007		2008		2009	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding	57.52	73	54.49	62	56.33	59	56.34	59	52.50	56	53.00	52	51.54	49

Research funds	11.79	15	17.45	20	19.44	20	19.48	20	18.08	19	19.91	20	18.20	18
Contracts	9.87	12	15.96	18	19.77	21	20.48	21	23.25	25	28.70	28	34.85	33
Other														
Total funding	79.18		87.90		94.54		96.30		93.83		101.61		104.32	

Table 4A2 Research capacity of the department of Industrial Engineering & Innovation Sciences

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009
Tenured staff	27.71	30,64	32.04	31.92	30.08	28.85	32.79
Non-tenured staff	7.32	7.67	8.79	10.86	13.64	25.57	24.69
PhD students	44.15	49.59	54.71	53.52	50.11	47.19	46.84
Total research staff	79.18	87.90	95.54	96.30	93.83	101.61	104.32

The self-evaluation report also provides an overview of the resources and funding for both schools.

The research capacity of the **School of Industrial Engineering** has shown a substantial increase during the period 2003-2009.

Table 4A3 Research capacity of the School of Industrial Engineering

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009
Tenured staff	16.05	17.41	17.73	18.04	15.98	15.44	17.84
Non-tenured staff	2.82	2.12	1.76	2.64	3.27	4.57	3.12
PhD students	21.86	23.47	27.30	30.54	29.21	31.18	30.88
Total research staff	40.73	43.00	46.79	51.22	48.46	51.19	51.84

The external funding of the School of Industrial Engineering almost tripled in six years' time.

Table 4A4 Funding sources of the School of Industrial Engineering in %

Funding (%)	2003	2004	2005	2006	2007	2008	2009
Direct funding	82	73	67	65	62	63	61
Research funds	5	9	14	13	15	14	8
Contracts	13	18	19	22	23	23	31
Other							
Total funding	100	100	100	100	100	100	100

The research capacity of the **School of Innovation Sciences**, too, has shown a substantial increase during the period 2003-2009.

Table 4A5 Research capacity of the School of Innovation Sciences

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009
Tenured staff	11.66	13.23	14.31	13.88	14.10	13.41	14.95
Non-tenured staff	4.50	5.55	7.03	8.22	10.37	21.00	21.57
PhD students	22.29	26.12	27.41	22.98	20.90	16.01	15.96
Total research staff	38.45	44.90	48.75	45.08	45.37	50.42	52.48

Despite the overall growth in research capacity the number of PhD students in the School of Innovation Sciences has dropped from 2006.

In terms of funding there is a shift from direct funds to research funds and contracts. The joint share of research funds and contracts increased from 38% to 63% in the period 2003-2009.

Table 4A6 Funding sources of the School of Innovation Sciences

Funding (%)	2003	2004	2005	2006	2007	2008	2009
Direct funding	62	52	51	51	49	41	37
Research funds	26	30	27	29	24	26	27
Contracts	12	18	22	20	27	33	36
Other							
Total funding	100	100	100	100	100	100	100

Assessment
As mentioned the Department has a very clear human resources policy and aims at strategic recruitment. The Committee noticed a policy to stimulate the researchers to become excellent. This resulted in a widespread eagerness to excel. The renewal of the staff has led to younger, ambitious full professors and a new culture of this Department. The research facilities are good, researchers are stimulated to reach out and to apply for 'second-stream' and 'third-stream' (contract) funding. The Committee admires the results of this policy.

5. PhD training

Description
All full-time PhD students of the **School of Industrial Engineering** join the research school Beta. They do course work and supervised research. For the course work, each PhD student joins the mandatory course 'Research Perspectives on Operational Processes' and a technical writing and editing course. Furthermore, students join PhD courses that are most relevant for their research area. These courses are taken from Beta itself and other national and international institutes. For research, the student is supervised by qualified researchers, who have to be a member of Beta (and therefore have to fulfil the entry requirements of Beta). All PhD candidates are co-supervised by a full professor and an associate or assistant professor.

PhD students are recruited via internationally posted positions. Each student is evaluated after one year, based on research performance, course work and contribution to the development of the detailed research proposal. Contracts of students with a poor performance are discontinued.

In the period 1995-2009, 129 PhD students started a project within the School of Industrial Engineering, 64 PhD projects were completed, 22 were unsuccessful and 44 are still ongoing. The average duration until completion was 54 months.

PhD students of the **School of Innovation Sciences** follow a personalized programme which is established in the first three months of the project. Each programme consists of three parts:

- Course work that provides the students with state-of-the-art knowledge of their research field. Courses are provided through memberships of several national research schools.
- Supplementary courses in international PhD schools.
- Supervised research, resulting in a PhD thesis. Each student is supervised by at least two experienced researchers.

Formal assessment of students takes place at the end of the first year. This assessment is used to decide whether the PhD student may continue.

During the period 2001-2005, 47 PhD students started within the School of IS, 34 PhD projects were completed successfully, and 10 projects are expected to be completed in 2010. Three projects did not lead to a successful PhD defence.

Table 4A7 PhD success rates of the School of Industrial Engineering

Enrolment				Success rates				Total		
Start in year	Gender m/f		Total	Graduated after ≤4 years	Graduated after ≤5 years	Graduated after ≤6 years	Graduated after ≤7 years	Total graduated	Not yet finished	Not completed
2001	4	3	7	1 (14%)	3 (43%)	1 (14%)	0 (0%)	5 (71%)	0 (0%)	2 (29%)
2002	5	1	6	0 (0%)	3 (50%)	0 (0%)	0 (0%)	3 (50%)	0 (0%)	3 (50%)
2003	8	2	10	3 (30%)	4 (40%)	1 (10%)	0 (0%)	8 (80%)	0 (0%)	2 (20%)
2004	9	7	16	1 (6%)	9 (56%)	2 (13%)	-	12 (75%)	2 (13%)	2 (12%)
2005	5	5	10	3 (30%)	1 (10%)	-	-	4 (40%)	5 (50%)	1 (10%)
Total	31	18	49	8 (16%)	20 (41%)	4 (8%)		32 (65%)	7 (15%)	10(20%)

Table 4A8 PhD success rates of the School of Innovation Sciences

Enrolment				Success rates				Total		
Start in year	Gender m/f		Total	Graduated after ≤4 years	Graduated after ≤5 years	Graduated after ≤6 years	Graduated after ≤7 years	Total graduated	Not yet finished	Not completed
2001	3	2	5	1 (20%)	0 (0%)	2 (40%)	2 (40%)	5 (100%)	0 (0%)	0 (0%)
2002	7	6	13	0 (0%)	7 (55%)	2 (15%)	2 (15%)	11 (85%)	0 (0%)	2 (15%)
2003	4	6	10	0 (0%)	2 (20%)	5 (50%)	0 (0%)	7 (70%)	2 (20%)	1 (10%)
2004	6	3	9	0 (0%)	4 (45%)	2 (22%)		6 (67%)	3 (33%)	0 (0%)
2005	6	4	10	2 (20%)	3 (30%)			5 (50%)	5 (50%)	0 (0%)
Total	26	21	47	3 (6%)	16 (34%)	11 (24%)	4 (9%)	34 (73%)	10 21%)	3 (6%)

Assessment
The Committee met enthusiastic and focused PhD students, who are very well supervised and have ample opportunities to attend courses that they need or wish to follow. The climate and culture in the institute is stimulating. The success rate of PhD students is very good. The PhD education is systematically structured. The group is an actively contributing member to Beta. PhD candidates are given a clearly structured educational programme, including teaching assignments. Each PhD student and his/her supervisor develop an individual course programme within three months after the PhD student has started, which has to be approved by Beta (for PhD students in the School of Industrial Engineering) or by Ecis (for PhD students in the School of Innovation Sciences).

6. Productivity

Description
The aggregated results of the **School of Industrial Engineering** are presented in Table 4A9.

Table 4A9 Results School of Industrial Engineering (IE)

Results School of IE	2003	2004	2005	2006	2007	2008	2009	Total
Refereed articles	87	92	81	83	82	96	115	636
Non-refereed articles	1	3	1	0	0	1	0	6
Books	6	11	6	1	4	2	6	36
Book chapters	28	36	82	23	27	28	45	269
PhD theses	8	12	3	7	8	9	6	53
Conference papers	67	86	63	103	103	99	89	610
Academic publications	197	240	236	217	224	235	261	1610
Professional publications	49	46	36	52	48	35	38	304
General public publications	1	6	0	2	0	1	1	11
Edited volumes	5	5	4	4	1	2	6	27
Journal editorships	5	7	11	12	14	16	17	82
Remaining	14	42	32	23	40	41	27	219
Other publications	74	106	83	93	103	95	89	643
Total publications	271	346	319	310	327	330	350	2253

The aggregated results of the **School of Innovation Sciences** are presented in Table 4 A10.

Table 4A10 Results of the School of Innovation Sciences (IS)

Results School of IS	2003	2004	2005	2006	2007	2008	2009	Total
Refereed articles	51	51	50	62	82	73	64	433
Non-refereed articles	3	2	2	1	3	4	2	17
Books	3	5	10	3	3	6	2	32
Book chapters	47	28	29	29	31	28	54	246
PhD theses	6	5	4	4	9	12	7	47
Conference papers	42	61	58	75	79	76	55	446
Academic publications	152	152	153	174	207	199	184	1221
Professional publications	26	30	50	28	27	12	11	184
General public publications	11	7	5	4	12	9	14	62
Edited volumes	5	3	2	4	4	4	7	29
Journal editorships	3	5	2	6	7	5	6	34
Remaining	19	25	25	38	22	26	35	190
Other publications	64	70	84	80	72	56	73	499
Total publications	216	222	237	254	279	255	257	1720

Assessment
In the view of the Committee, the productivity of both Schools is very good in general. The average publication rate for tenured staff is almost 5 per full-time equivalent (FTE).

7. Societal relevance

Description
Several research groups belonging to the **School of Industrial Engineering** acquired funding from national and international economic funding programmes and the European Framework Programmes FP6/ FP7. Most research groups were able to establish working relationships with specific firms to perform (PhD) research funded by these companies. Several scholars of the School of Industrial Engineering participate in advisory committees to the Dutch government. One research group has developed a knowledge sharing and research forum on supply chain management, in which about 25 companies are involved: the European Supply Chain Forum. Some research results have been converted into prototype software which is tested in industry.

The external dissemination of research results of the **School of Innovation Sciences** has taken a variety of forms including publication of several textbooks and policy manuals for a wider non-academic audience. The history group has developed a virtual exhibit in collaboration with major science museums in Europe ('Making of Technology') and participated in a programme of the Netherlands Study Centre for Technology Trends STT on transnational infrastructures. The Human-Technology Interaction group contributed to the STT exploration.

Assessment
As mentioned above, the Committee noticed diversity in audiences. Both Schools manage to maintain the balance in these audiences by publishing in high-ranked journals aimed at the international academic community and disseminating knowledge to a wider audience. The link with society is also visible in the various contract research projects and working relationships with public and private organizations.

8. Strategy

Description
The **School of Industrial Engineering** focuses on the management of operational processes, particularly in technology-oriented business settings and in healthcare. According to the self-evaluation report, the analysis and (re)design of operational business processes and the supporting information systems is strongly determined by the technologies used, state-of-the-art technological knowledge and the educational level of the people who control and coordinate these processes. Products, markets, technologies and knowledge are subject to fast, profound changes. Efficient adaptation to these changing circumstances is, according to the self-evaluation report, a key success factor. The research programmes are strongly linked to and aimed at these developments and challenges.

Considering the analysis that modern societies are unthinkable without modern technology and that technology affects almost all aspects of our life, the **School of Innovation Sciences** focuses on the interaction between technological, economic, psychological and social developments, with an emphasis on pervasive and long-term changes. The research programmes of the school cover different fields of the innovation sciences and draw on various theoretical strands. All five research programmes aim to make innovative contributions in their respective fields. During the period under review the School has improved interdisciplinary cooperation between the programmes (following the recommendation by the previous research evaluation). In the future the School will continue to foster existing research programmes; it will improve and intensify possibilities for cooperation and exchange across research programmes. It aims at increasing fund raising activity regarding PhD positions.

Assessment
As mentioned above, the renewal of the staff has led to younger, ambitious full professors and a new vital and vibrant culture of this Department. This development leads to good perspectives for the future. The Department also fits nicely in with the university's policy with its research emphasis on Energy and Health.

9. SWOT analysis

Description

The **School of Industrial Engineering** describes that, in view of developments in society, the focus on analysis, design and control of operational processes should be continued and may be strengthened. Opportunities for tertiary research (contract) funding are amply available and may increase, but may require specific personnel arrangements that must be carefully managed on a department and group level. The weak position in secondary research funding is difficult to change on the short term. The School would like to attract researchers and top PhDs in specific scientific disciplines who can feed the application-oriented mainstream research on operational processes in the department.

The **School of Innovation Sciences** describes that its strength is the breadth of disciplines which enables the school to bridge theoretical frameworks and topics. Facing the challenge of decreasing direct funding, the school shows a rapid growth in research funds and contract research.

Assessment

The SWOT analysis provided by both Schools gives a clear and honest reflection on the strengths and weaknesses of the Schools and the actions to be taken to ascertain future development.

10. Robustness and stability

Description

According to the self-evaluation, the **School of Industrial Engineering** can rely on relatively stable direct funding. The school is equipped to address social challenges such as those in the area of mobility and supply chains, new product development and entrepreneurship, and healthcare processes.

The **School of Innovation Sciences** has successfully coped with budget cuts in direct funding by obtaining significant funds through contract research.

Assessment

The position of the Department gives no reason to worry about its future. Despite the threat of diminishing 'first-stream' money for technical universities, the Department manages to keep its budget on level.

4B. Assessment on a Programme Level

4B1 Human Performance Management

Programme leader:	Prof. C.G. Rutte (2003-June 2007); Prof. J. de Jonge (July 2007 -)	
Research staff 2009:	5.36 FTE	
Assessments:	Quality:	4.0
	Productivity:	3.5
	Relevance:	3.5
	Viability:	4.0

Description

The research programme Human Performance Management focuses on the role of the human factor in operational processes. Its mission is to develop scientific knowledge and to test theories that explain psychological processes on an organizational, group and individual level within the context of operations management and innovation management. Recent changes motivated the research programme to focus on the theme 'performance enhancement': the optimal fit between human performance (including decision-making processes) and operational process performance in high-tech environments.

The researchers of the group are working together with researchers of the Beta Research School as well as with external researchers, for instance in the domain of healthcare management. Since the last assessment of research quality in 2002, the research group has been changing continuously. A large part of the review period was devoted to attracting new personnel and developing new research projects. Much of the output will appear in the years ahead.

Members of the research group fulfil editorships in academic journals and editorial boards. They have several advisory and executive functions in networks and boards. Several staff members spend some time in an exchange programme with another research institute.

The social and technological relevance of the research of this programme is reflected in the number of organizations that are willing to participate. Regarding the theme 'performance enhancement', the research group has long-standing relationships with and developed and implemented concepts for several companies. Regarding the theme 'organizational renewal,' the group has a long-standing relationship with Stork Food Systems. Also, a study was conducted at the Albert Heijn supermarket chain and several healthcare organizations.

The research programme provided the following information on input and results.

Table 4B1 Research capacity of Human Performance Management

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	2.84	2.59	2.75	2.90	2.33	2.45	2.70	18.56
Non-tenured staff	0.67	0.17	0	0	0	0	0	0.84
PhD students	4.00	3.04	4.00	4.27	4.80	3.01	2.66	25.78
Total research staff	7.51	5.80	6.75	7.17	7.13	5.46	5.36	45.18

Table 4B2 Results of Human Performance Management

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	6	16	10	10	7	15	24	88
Non-refereed papers	0	0	0	0	0	0	0	0
Books	0	0	0	0	0	0	0	0
Book chapters	4	6	5	3	6	3	6	33
PhD theses	2	5	0	1	0	3	0	11
Conference papers	5	5	4	2	2	4	0	22
Academic publications	17	32	19	16	15	25	30	154
Professional publications	3	3	1	0	1	1	1	10
General public publications	0	0	0	0	0	0	0	0
Edited volumes	0	0	0	1	0	0	0	1
Journal editorships	0	0	3	3	2	3	5	16
Remaining	0	0	0	0	5	0	2	7
Other publications	3	3	4	4	8	4	8	34
Total publications	20	35	23	20	23	29	38	188

The aim of the group is to focus on the theme of performance management as unique selling point and to strengthen relations with other programmes in the department.

Assessment

Quality
The present programme leader made a clear distinction in strategy and focus of the group between the period before and the period after his appointment.

Overall, the quality of the research of the Human Performance Management programme can be considered as 'very good' according to the Standard Evaluation Protocol scoring. The programme has achieved refereed papers in international journals, part of them having a very high impact rating (Academy of Management Journal, Journal of Applied Psychology, Journal of Organizational and Occupational Psychology, Journal of Organizational Behaviour).

This research is internationally visible and makes a valuable contribution in the international field. The programme content/goals described are plausible but also a bit general. A clearer and more distinguished profile seems possible; for instance, it remains unclear what makes 'Human Performance Management' different from 'Human Resource Management'.

The researchers developed a good international reputation in the areas of applied group studies and health at work/stress research.

Given the increasing numbers of publications in the past few years, the good connections in the research community (both national and international) and the additional research facilities, the Committee is optimistic that the quality of this programme will further prosper in the near future.

Productivity
In the assessment of the productivity the Committee used both quantitative measures and qualitative judgements. Qualitative arguments in this respect concern the publication channels, the publications strategy and the dispersion of the publications in the research group. The Committee considers the productivity of the research group as 'good' to 'very good'.

The present programme leader mentioned that he changed the publication strategy. The Committee was not yet fully convinced of the effects of this change, although the results of the bibliometric analysis are quite promising. The change of strategy and focus has influenced the judgement of the Committee in this respect. Next to these the Committee also considered the number of tenured staff in the programme and the difficulties due to the considerable changes to the programme and despite the disparity in the publication channels.

As one of the full professors has just started, the Committee expectd that the productivity of the programme will further improve very quickly in the years to come.

Societal relevance
The societal relevance of the work accomplished in this programme is 'good' to 'very good'. The general aim of contributing to sustainable health and innovation at work is genuine and is made available to external partners in various cooperation projects.

The group has shown effectively in the self evaluation report by listing 37 names of organisations that it interacts with stakeholders in society in a productive way. Research results are available and suitable for application in these organisations. The societal impact of the work will undoubtedly be good, this was however difficult for the Committee to assess.

Vitality and feasibility
Overall, the Committee considers the vitality and feasibility of the programme as 'very good', because the programme is dealing well with both internal and external challenges and changes, including personnel changes in the core research group and a constant decrease of direct funding from the government. Leadership changed in the middle of the period under review.

The focused research themes have high potential, and the general strategy in building a coherent programme is quite promising. Moreover, continuing research in the health sector as well as in the service sector and in high-tech companies reflects a good sense of upcoming opportunities consistent with the general research theme and strategy of the programme. Finally, the current weaknesses (e.g. number of PhD students, research funds and contract research) are identified, and adequate means considered. The future has to make clear to what extent these expectations can be met.

As a final remark, the Committee is wondering why cooperation opportunities with the Innovation Sciences School (e.g. with the Human Technology Interaction programme) are not considered more explicitly, given the general interest of the Human Performance Management programme in innovation management and high-tech companies and the relative small senior staff of the Human Technology Interaction group.

4 B2 Information Systems

Programme leader:	Prof. W.M.P. van der Aalst (2003-2006); Prof. P.W.P.J. Grefen (July 2006-2009)	
Research staff 2009:	13.47 FTE	
Assessments:	Quality:	4.25
	Productivity:	4.5
	Relevance:	3.75
	Viability:	4.0

Description

The research area of the Information Systems programme consists of methods, techniques and tools for analysis and (re)design of information systems for the support of operational business processes, both within the boundaries of a single organization and across these boundaries in the context of (dynamic) business networks. The research mission of the Information Systems programme is to perform research in the area described on an international level and to demonstrate this in tangible research output.

During the review period, the programme completed the transformation from a management information science-oriented programme into an engineering-oriented information systems research programme. To foster continuous innovation, the programme is organized in a dynamic research cluster structure. About half of the staff of the programme consists of experienced senior members and the other half of junior members. The programme houses a substantial number of temporary researchers. Six research clusters are operational within the programme: ICT Architectures for Enterprise Information Systems, Business Process Management, Cross-organizational Information Systems, Process Mining, Software Management and Healthcare.

The entire research programme is part of the Beta research school for Operations Management and Logistics and part of the TU/e research focal area Logistics Operations and Information Systems (LOIS). The programme cooperates with the department of Mathematics and Computer Science of TU/e and has ad-hoc contacts and collaborations with other departments of TU/e. The programme cooperates with a number of other research institutes. A structural exchange exists with Queensland University of Technology. The programme acquired three competitive research projects and one PhD scholarship and won a prize for the best PhD thesis. Members of the programme have positions in editorial boards of academic journals.

The research programme operates in a network of business relations, both on a national and an international level. The programme also conducts several research projects directly financed by business contacts and acquired a European research project and network funding during the review period. The research group is affiliated with the European Supply Chain Forum and one of the researchers is co-founder of the national Business Process Management (BPM) Forum. The group has (co)developed prototype software: Woflan (workflow analysis tool), YAWL (workflow modelling and execution tool) and ProM (process mining environment and plug-in tools).

The research programme provided the following information concerning input and results.

Table 4B3 Research capacity of Information Systems

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	3.53	3.71	3,36	3.70	4.06	3.94	4.03	26.33
Non-tenured staff	1.67	0	0	1.13	2.50	3.54	2.65	11.49
PhD students	5.20	7.11	10.94	11.20	8.60	8.69	6.79	58.53
Total research staff	10.40	10.82	14.30	16.03	15.16	16.17	13.47	96.35

Table 4B4 Results of Information Systems

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	24	19	17	16	32	36	34	178
Non-refereed papers	1	3	1	0	0	1	0	6
Books	3	4	0	0	1	0	0	8
Book chapters	10	16	36	5	8	6	22	103
PhD theses	1	4	0	2	4	1	4	16
Conference papers	34	38	25	71	65	62	53	348
Academic publications	73	84	79	94	110	106	113	659
Professional publications	21	13	9	30	32	20	26	151
General public publications	0	6	0	0	0	0	0	6
Edited volumes	4	4	4	2	1	2	5	22
Journal editorships	0	1	0	0	2	2	0	5
Remaining	3	10	13	14	22	10	7	79
Other publications	28	34	26	46	57	34	38	263
Total publications	101	118	105	140	167	140	151	922

The review period covers a period of adaptation and refinement of the research strategy along various dimensions. The thematic focus has been sharpened towards process modelling in order to contribute to the overall agenda of the university. The main targeted application domains are supply chains and logistics, high-tech manufacturing, the services industry and healthcare. The research approach targeted is an engineering one, in which modelling has a central position. The focus can be described as applied Computer Science in the field of process modelling. In response to the increasing emphasis on healthcare, an additional chair for healthcare and innovation science has been appointed. The research topics are managed as dynamic clusters, which are annually reviewed and adjusted when necessary.

Assessment

Quality

During the review period, the group exhibited a coherent profile, which has been well framed and articulated within and towards an engineering community (process modelling, business process management). The group is very well recognized in its specific international academic community and recognizes QUT Brisbane, Stevens Institute and Humboldt University as benchmarks.

The main application domains targeted, viz. supply chains and logistics, high-tech manufacturing, the services industry and healthcare, are highly overlapping with the Production, Maintenance, Materials Coordination & Transportation programme, which either is a spread of focus and resources (and implies a weakness) or a point of joint interest so that synergy and cross-fertilization might take place. Obviously, the Committee favours the latter and may urge the two programmes to take advantage of this opportunity.

In response to the institutional expectations, the group identified a differentiated set of journal lists which are used to inform about individuals' publication strategies. The different

lists reflect different goals such as visibility (general journals), high-quality high-impact journals as well as entry-level journals for PhDs. In this way, the lists also recognize the specific support requirements of junior staff.

The group pursued a portfolio strategy, mixing basic and applied research with a strong emphasis on real-world cases. The projects conducted during the review period reflect this portfolio strategy, combining national and European funding as well as basic and applied research. The conceptual and methodological repertoire has been applied and extended to novel fields such as inter-organizational workflow management and process mining.
The bibliometric analysis states: 'The research profile of Information Systems displays a strong focus (over 55% of all output) on research in the field of computer sciences, combined with very high impact scores. Remarkably enough, two other fields in the profile, both related to computer sciences, have low impact scores.' (p. 32). The publication strategy reflects the tradition in Computer Science and the publications receive high scores in the respective field.

The programme is well managed. The programme leader comes across as a confident leader of the group who introduced the necessary practices to ensure a high level of quality and productivity in the Innovation Sciences group. Strong emphasis is placed on collaboration within the group.

Productivity
The group has been highly successful in acquiring what appears to be a well balanced portfolio of funding across a range of funding sources. Research funding is on a total level of 51% (2009), with a high average of 25% of 'second-stream' funding (2003-2009), which underscores the emphasis that has been given to basic research.

The group's publication productivity is very high. Just to take one formal indicator, which obviously has to be looked at with caution: the average number of papers in refereed journals over the 7-year period per tenured FTE is 6.77; if conference papers are included the number rises to 20. In line with the research tradition in Information Systems and Computer Science, refereed conference papers have a large share in the publications. The publications focus on and are influential in the field of the process modelling. However, within information systems this is a relatively small area. Overall, the group shows an impressive productivity given the limited resources.

Societal relevance
The group interacts successsfully with stakeholders in society. The research programme developed a network of business relations, both on a national and an international level. For example, the research group is affiliated with the European Supply Chain Forum and one of the researchers is co-founder of the national Business Process Management (BPM) Forum. The work has clearly a societal impact.

The societal relevance of the research can furthermore be illustrated by the successfully acquired contract funding from industry directly as well as through the Dutch Technology Foundation (STW) and the Innovation Research programme (IOP).

The Committee assesses the relevance of the research programma as good to very good.

Vitality and feasibility
The research programme developed a dynamic thematic cluster structure, which facilitates a regular review and adaptation of research themes. Within this structure, health care receives

particular attention and is run across the other thematic clusters. In 2009, a second chair was appointed for Information Systems in Health Care, which clearly addresses one of the strategic orientations of the university. However, the impact of this appointment has not yet become visible. Healthcare appears not yet coherently integrated into the overall structure of the research group.

The level of thematic integration and collaboration with the other research groups appears to be relatively low. As stated above, this theme is embedded in the Production, Maintenance, Materials Coordination and Transportation programme. As the level of thematic integration and collaboration with the other research groups appears to be relatively low, the Committee is convinced that this is an opportunity for inter-programme cooperation.

The programme operates with typically eight internal and four external PhD students. Finding tenured staff seems to be a chronic problem in the research segment the group is operating in.

The period under review shows a process of consolidation, structural adjustment and significant improvement in terms of productivity. The group appears to be very well managed and systematically geared towards publications in high-quality journals and NWO-funded research projects. Linkages to a wide portfolio of industry contacts have been built and maintained, which provides a good platform for contract research. The group seems to be very vital and capable to react to important changes in the environment. The Committee has one hesitation considering this criterion, the success of the group seems to be highly dependent on the programme leader, which makes the group potentially vulnerable.

4 B3 New Product Development Processes

Programme leader:	Prof. G.M. Duijsters (2003-2007); Prof. E.J. Nijssen (2007-2009); Prof. F. Langerak (since 2009)	
Research staff 2009:	12.95 FTE	
Assessments:	Quality:	3.5
	Productivity:	4.0
	Relevance:	4.0
	Viability:	3.5

Description

In 2003-2007 this programme was called Innovation Management. The positioning and the name of the programme were changed in 2007 to New Product Development Processes (NPDP) to anticipate the growing importance of developing and bringing to the market new products. The reorganization of the department into two schools offered the opportunity to reallocate the programme to the research school Beta. The scope of the group's research was narrowed down to two themes: new product creation processes and new product commercialization processes.

The programme focuses on means for measuring and improving the process of designing, developing and launching new products. As such it encompasses both the strategic planning and operational activities of the process. Examples of particular topics of interest are integrated product development, learning and knowledge transfer in product development, inter-firm collaboration in New Product Development, and customer involvement in New Product Development. The programme's primary focus is on high-tech products.

Various scholars from universities abroad have been structurally involved in the programme. Researchers are encouraged to cooperate with scholars from other universities and institutions. The programme has a list of research collaborations. Researchers participate in editorial boards of academic journals, are invited to give key lectures, workshops and seminars and receive awards for their academic work.

The programme has joint research projects with leading firms like Philips and Sabic Innovative Plastics. Some PhD projects are externally funded. The group also participates in national innovation networks such as Syntens, the Product Development & Management Association and the Innovation Lab. The knowledge the programme's research is generating is disseminated through educational books and books for a wider general audience.

The research programme provided the following information on input and results.

Table 4B5 Research capacity of New Product Development Processes

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	5.24	6.07	6.86	6.04	4.39	4.51	5.84	38.95
Non-tenured staff	0	1.47	1.76	1.06	0.07	0	0.13	4.49
PhD students	5.63	6.56	5.60	6.59	7.73	6.37	6.98	45.46
Total research staff	10.87	14.10	14.22	13.69	12.19	10.88	12.95	88.90

Table 4B6 Results of New Product Development Processes

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	34	34	37	37	26	26	21	215
Non-refereed papers	0	0	0	0	0	0	0	0
Books	3	6	5	1	3	2	4	24
Book chapters	4	11	16	12	11	17	11	82
PhD theses	3	2	1	1	1	4	1	13
Conference papers	27	42	34	25	27	28	34	217
Academic publications	71	95	93	76	68	77	71	551
Professional publications	21	25	23	16	9	10	2	106
General public publications	1	0	0	2	0	1	1	5
Edited volumes	0	1	0	1	0	0	0	2
Journal editorships	2	2	3	3	3	3	6	22
Remaining	0	18	9	1	2	17	8	55
Other publications	24	46	35	23	14	31	17	190
Total publications	95	141	128	99	82	108	88	741

Assessment

Quality
New product development and commercialization is a common and important research field at any agile technical university, and the Committee notes with satisfaction that the programme has been divided into the two highly relevant themes:

Theme 1: New product creation, and
Theme 2: Commercialization.

Both themes also incorporate the role and the contributions of the customer, even though it is not exactly clear how these themes manifest themselves in actual research practice. The two themes were at least an explicit conceptualization of the programme platform, which the Committee has not met elsewhere. It recognized that by far the largest investment in product development occurs during the commercialization phase. This is a realistic economic view on the underlying engineering process. The programme takes a design science perspective on product development and an interdisciplinary perspective, linking engineering with organization studies and marketing.

In terms of publishing the department tended to orient itself towards journals such as Management Science, Journal of Marketing, Organization Science and Research Policy, all of which are journals of high quality. As for benchmarking, reference is made to similar and rather well defined programmes at MIT (ICMOT), USC (GPNDP) and Michigan State University (CES) in the USA and some departments of KU Leuven, University of Twente and Technical University Delft.

The impact of the publications is high: 'This output has a high impact, as CPP/FCSm is 50% above worldwide average field impact level. This output is also published in journals with an above impact position in the field to which these journals belong' (bibliometric analysis, p. 26).

The quality and scientific relevance of research, leadership, academic reputation, resources and PhD training are good to very good, with a high appreciation for the relevance and originality of research, leadership and PhD training.

Productivity
The publication strategy of this group is aimed at publishing in high-impact ISI ranked top journals. This is very much appreciated by the Committee. Both the number of publications in ISI journals as well as the overall productivity of this group is very high. Publishing has been quite extensive with a number of refereed papers per tenured staff of 5.5. Productivity is very high on both strategic goals and quantitative scores.

Besides several interesting refereed papers, also books and book chapters and a large number of conference papers are on the department's record, as are journal editorships. There was however no national science NWO funding despite extensive and quite successful publishing.

Societal relevance
The group has built and maintains close linkages to industry (the high-tech ecosystem in Eindhoven), whose willingness to fund PhDs provides evidence of its support.
The societal quality of the work is given the close co-operation with industries as mentioned above very good. This co-operation shows that the research group interacts in a productive way with stakeholders in society. A programme of this kind and scope is also a must in a Technical University.

Vitality and feasibility
Given the relevance of the programme, the level of contract funding is relatively low (average of 25% over the period under review), although as the group remarks, stable and robust during the review period. The researchers of this group had a relatively high teaching load and therefore guaranteed funding. There was no urgent need to apply for external research funding. In view of this context the group did very well in abstaining external funding for PhD projects.

Even though the conceptualization as well as the orientation and the factual content of the programme are decidedly relevant and the external visibility good, the Committee would have liked to see an analysis of the possibilities of this programme and a presentation of the strategies for the future. The Committee learned that a number of publications can be expected in the near future and external funding is increasing. The prospects can therefore be considered good to very good.

4B4 Production, Maintenance, Materials Coordination & Transportation

Programme leader:	Prof. A.G. de Kok	
Research staff 2009:	20.06 FTE	
Assessments:	Quality:	4.0
	Productivity:	4.0
	Relevance:	4.0
	Viability:	4.0

Description

The Production, Maintenance, Materials Coordination & Transportation (PMMT) programme focuses on quantitative model-based research into operational processes. The quantitative models developed support the design, planning and control of these operational processes. The focus is on empirically based quantitative models that represent the structural complexity of real-life operational processes. The mission is: 'Development of scientific knowledge with respect to the analysis, design, planning and control of operational processes in such a way that the researchers are acknowledged as leaders in the area of Operations Management by both the scientific community and the industrial community'.

The clarity of description is mixed but focused on empirically rooted real-world problems that can be analytically modelled for solution development. In the industrial sector this is articulated as a classic application of industrial engineering based on specific domain knowledge linking capital goods, physical distribution and logistics management to process industry operations. Recently this was extended to include retail operations and health care operations and services. This is a high-quality, model-based research team using hierarchical planning, inventory and production management in new topical areas such as carbon emissions and supply chain finance.

The research programme provided the following information on input and results.

Table 4B7 Research capacity of PMMT

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	4.44	5.04	4,76	5.40	5.20	4.54	5.27	34.65
Non-tenured staff	0.48	0.48	-	0.45	0.70	1.03	0.34	3.48
PhD students	7.03	6.76	6.76	8.48	8.08	13.11	14.45	64.67
Total research staff	11.95	12.28	11.52	14.33	13.98	18.68	20.06	102.80

Table 4B8 results of PMMT

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	23	23	18	22	18	20	36	160
Non-refereed papers	0	0	0	0	0	0	0	0
Books	0	1	1	0	0	0	2	4
Book chapters	10	3	25	4	2	2	6	52
PhD theses	2	1	2	3	3	1	1	13
Conference papers	2	3	0	5	11	6	2	29
Academic publications	37	31	46	34	34	29	47	258
Professional publications	4	5	3	6	6	4	9	37
General public publications	0	0	0	0	0	0	0	0
Edited volumes	1	0	0	0	0	0	1	2
Journal editorships	3	4	5	6	7	8	6	39
Remaining	11	14	10	8	11	14	11	79
Other publications	19	23	18	20	24	26	27	157

Total publications	56	54	64	54	58	55	74	415

Assessment

Quality
The quality of the research of the PMMT group is very good. The researchers are acting on an internationally competitive level and make a significant contribution to the field.

The PMMT group has a long-standing tradition in operations research and operations management. Its research is practically induced: starting from practical problem formulation and turned into quantitative modelling and empirically based testing. The domain is split into four application domains. Although these domains are of contemporary interest, the domain structure is not like the mainstream splits seen elsewhere but follows the lines of four Department curricula. The Committee believes that it is better to organize the research domains from the inherent content. Also, the level and reputation of the four individual domains are not equal, which distorts the proper balance in presentation, publications, awards, invitations and editorial positions. This leaves room for improvement on the new and more recent domains like logistics and health care.

Part of the Department research staff is internationally reputed, both on the basis of their academic writing and based on their presence in international forums. Many members of staff pay frequent international visits and research stays, some at top institutions. The fact that the group has received several prizes and awards, including the Franz Edelman Award Final, is striking, as it underscores the relevance of the research conducted.

In the past few years, there was a clear re-emphasis on refereed publications in top international journals in the field. The programmes offered have an international level, which has led to substantial international recruitment. Although staff and student populations are increasingly becoming international, additional efforts should lead to a more internationally diverse staff and PhD candidates.

Quality of output is strong and solid with increased growth in recent years because more emphasis is placed on top peer-reviewed journals. Hopefully this growth will further be reflected in an increase in staff diversity. However, the concern might be the finance and accounting area, which will require new resources if it is to be developed effectively and to contribute quickly to the next round of research assessment.

The analysis shows that the internationally refereed publications are spread among various journals, including the top journals in the field. The focus is on 'Operations research and operations management' and 'Engineering, manufacturing' with impact factors of 1.34 and 1.41 respectively. This shows a deep embedding in the methodological area. This is a very solid basis for various kinds of application fields and robust in terms of future developments. However, in terms of citations, the group 'gets cited on an average field impact level ... impact showing a decreasing trend ... the output of this group contains roughly 60% of publications that do not get cited in a four year time frame.' (Bibliometric analysis p. 26). This is a point of attention for the future.

There is a clear focus on international and national co-authoring, which supports the idea that international cooperation continues to expose a strong growth in research output.

Productivity
The productivity of the group is very good, in the international field on a competitive level.

The figures provided by the research programme indicate slowly rising direct and competitive research funding (in nominal funds) and a sharp increase in contract funding (from 6% to 32%) of total budget. Total staff has increased significantly. This rise in human resources is reflected positively in the expansion of publications, especially refereed articles and professional publications, and journal editorships.

The productivity of the research group is high and increasing, but must continue to expand if it is to positively reflect the increase in resources the programme has acquired.

In general, the output per FTE is increasing over the years as is reflected in the bibliometric data.

Societal relevance
The societal relevance of the research in this group is undoubtedly very high. The research topics of the group include elements of general interest (for instance, healthcare, carbon emission and congestion modelling) which provide ample opportunities for implementation. Furthermore, most of the research has its ground in industrial practice, which immediately underlines a societal dimension. The group participates in several projects with industry and representatives of society. The group mentioned implementations with a significant impact in terms of performance and efficiency improvement. The Committee sees nevertheless that the group has more untouched valorisation potential for implementation. The embryonic spin-off activities should be further developed.

Vitality and feasibility
The four domains are fine in relation to the number of tenured staff (5.015 = 20.06/4 FTE per domain, which should constitute a solid basis and enough critical mass for the future). Developments in the field of Finance Operations are promising but may dilute the focus in the group. This consistent focus in the past was undoubtedly the strength of the group. In the realignment of the PMMT programme to the Operations, Planning, Accounting and Control programme, care must be taken that the wider scope is not only attractive and but also exposes a vital and important component of the management science elements of the programme; the new table expresses that consideration. However, it needs to be more precisely designed and appropriately funded.

The ambition is to go for 30 ISI publications per year (1.5 per FTE). That ambition is challenging but not impracticable. Some individuals will have to continue their good publication records while others need to appear more in top level journals. As stated above, the focus on methodological research is a solid basis for the future.

4 B5 Philosophy of Technology: Ethics and Epistemology of Innovation

Programme leader:	Prof. A.W.M. Meijers	
Research staff 2009:	9.02 FTE	
Assessments:	Quality:	4.5
	Productivity:	4.5
	Relevance:	4.7
	Viability:	4.7

Description

The programme concerns philosophical research on technology and engineering. It focuses on analysis of moral and epistemological problems in this field, especially regarding innovative technologies, and clarification of central concepts and inferential practices. Issues are chosen for their philosophical, scientific and societal relevance. Research topics are: the relation between technical artefacts and human agency, the role of moral values in engineering design, ethical aspects of sustainability and risks, and the impact of technology on cognitive practices.

The research mission is threefold: to contribute to conceptual and critical reflection on technology and the engineering sciences, and to develop more general evaluative frameworks; to do outstanding and original philosophical research in this field and on related foundational issues in philosophy; and to contribute to societal debates concerning technology.

The researchers innovate and develop philosophical research into technology and engineering by applying concepts and theories from philosophical sub-disciplines such as epistemology, ontology, meta-ethics and applied ethics, philosophy of science and logic, and simultaneously enrich these fields with analyses of problems specific to the research area.

The research programme provided the following information on input and results.

Table 4B9 Research capacity of Philosophy of Technology

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	1.90	1.89	2.16	2.08	2.48	2.38	3.58	16.47
Non-tenured staff	0.59	0.80	0.80	0.53	0.63	1.98	2.28	7.61
PhD students	2.78	3.84	2.77	2.14	2.00	1.40	3.16	18.09
Total research staff	5.27	6.53	5.73	4.75	5.11	5.76	9.02	42.17

Table 4B10 Results of Philosophy of Technology

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	11	4	6	11	10	11	10	63
Non-refereed papers	1	0	0	0	0	1	0	2
Books	1	1	5	1	1	0	1	10
Book chapters	10	3	8	8	7	9	21	66
PhD theses	0	0	0	0	0	3	1	4
Conference papers	4	1	4	8	5	1	2	25
Academic publications	27	9	23	28	23	25	35	170
Professional publications	1	10	5	1	2	1	0	20
General public publications	11	7	4	3	10	3	2	40
Edited volumes	0	1	1	1	2	1	3	9
Journal editorships	1	1	0	3	2	2	3	12
Remaining	2	3	3	3	1	0	2	14
Other publications	15	22	13	11	17	7	10	95

Total publications	42	31	36	39	40	32	45	265

Assessment

Quality
This programme has doubled in the past few years and has been extraordinarily successful in defining its mission, finding support for innovative research and partnerships with other Dutch universities to establish the Netherlands as the best place in the world to study philosophy of technology. The research produced by the programme is highly original (especially because of its societal relevance) in comparison to work being done in most philosophy programmes in Europe and the USA.

The programme's research is published in first-rate journals and by first-rate book publishers. It is unusual for philosophy programmes to obtain external funding for their research, and this programme has been entrepreneurial and highly successful in obtaining funding. It has been able to do so by leveraging its context – in a Department of Industrial Engineering, in a School of Innovation Sciences, in Eindhoven University of Technology – and by partnering with Dutch philosophy programmes at other universities.

In partnership with the philosophy of technology programmes at Delft and Twente, the programme has created the 3TU Centre for Ethics and Technology which brings visibility to the programme and expands its impact. The Eindhoven programme produces high-quality research that takes careful and often foundational work on technology to philosophers, while also bringing important insights into the nature of engineering and the societal implications of technology.

Productivity
The productivity of the research group has been strong and consistent. The increase in staff did not immediately result in an increase in publications, which can be explained by the long time it takes to get articles and books published. It may be a matter of time to reap the results of an increase in staff. Books are important in the field of philosophy and since books take a long time to produce, the steady stream in the production of books with a peak in 2005 is very impressive. Another significant piece of evidence is the 35 academic publications including 21 book chapters in 2009. The latter is an important type of publication in philosophy, as a way of dissemination. Book chapters, whether they are solicited or competitive, are a sign that scholars are being recognized as central thinkers in a field. The low number of papers published in conference proceedings reflects that such publications are not common or highly valued in philosophy unless they are turned into books.

Because the programme is a philosophy programme, quantitative comparisons with other programmes in the Department are not reliable. The most notable difference is that in the quantitative measures books count as one publication although they stand for much more time, effort and importance than a single article. Nevertheless, the numbers of total publications per tenured FTE put the Philosophy of Technology programme above the average for the Department.

Social relevance
The programme tries to keep a balance between fundamental and applied research. The group focuses on design issues and aims to explore societal issues while technologies are still in the early stages of development. This seems an excellent focus for a programme in a

School of Innovation Sciences. Thus, the programme has relevance both in its local context and in the Dutch, European and global context.

Vitality and feasibility
Having grown enormously in the past six years, the programme now has 20-25 scholars including tenured and non-tenured staff and graduate students. The programme already established a strong position in the epistemology of technology by its central role in the Handbook Philosophy of Technology and Engineering sciences and by its two NWO programmes. This means that the programme is large enough to have a significant impact on its own. Its collaboration with other groups in the Netherlands extends that impact significantly.

The programme's mission complements and leverages its placement in the School of Innovation Sciences within the Department of Industrial Engineering and Innovation Sciences. The mission is to contribute to philosophy through a focus on technology and to bring philosophical insight to engineering and technology, especially to technological innovation.

The programme has been very successful at getting NWO funding and its partnership with two other Dutch universities has led to the 3TU Centre for Ethics and Technology, which was most recently funded to start an international graduate school.

The programme seems very viable in the sense that research topics it addresses – especially the issues having to do with the social implications of technology and technological innovation – will unquestionably continue to be highly relevant and are likely to draw even more public attention. In this respect the programme is well positioned to continue and grow and to be able to find external support and venues for disseminating its research.

Issues for the future may well be how to manage a changing portfolio of projects. Reliance on external support requires, for example, that, to some degree, the programme must continuously change focus. Another issue will be to distinguish the programme from other philosophy of technology programmes in the Netherlands. These groups have cooperated quite effectively and at some point it may be important for each programme to emphasize its unique identity. The Eindhoven group is in a good position to do that by further emphasizing its focus in epistemology. The group might consider an identity that leverages its context in Innovation Sciences or leverages other units in Eindhoven such as the Modern Societies in Transition programme.

4 B6 Psychology of Human-Technology Interaction

Programme leader: Prof. D.G. Bouwhuis, Prof. G.B. Keren (until 2007); Prof. C.J.H. Midden, Prof. A.G. Kohlrausch, Dr W.A. IJsselsteijn.
Research staff 2009: 23.55 FTE
Assessments: Quality: 4.0
Productivity: 4.0
Relevance: 4.0
Viability: 3.0

Description

The programme concerns psychological research into people's interaction with technology. The programme covers both experiential and social aspects of the human-technology interaction from a cognitive psychological and social psychological perspective. The first goal of the programme is to adapt technology to the needs and other psychological conditions of man, to understand in what ways and through what mechanisms technology affects people, and to facilitate technology's use in the interest of people, their performance and their well-being. The second goal is to build a highly visible group of internationally recognized experts in two application domains:

a. research on human-centred design of information/communication technology and
b. research on sustainability and social acceptance of innovative sustainability-relevant technology.

The research programme provided the following information on input and results.

Table 4B11 Research capacity of Psychology of Human-Technology Interaction

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	4.25	3.62	3.92	3.60	3.17	3.16	3.30	25.02
Non-tenured staff	1.68	1.35	1.60	2.20	3.87	10.62	12.28	33.60
PhD students	8.90	11.83	14.54	10.31	9.71	7.74	7.97	71.00
Total research staff	14.83	16.80	20.06	16.11	16.75	21.52	23.55	129.62

Table 4B12 Results of Psychology of Human-Technology Interaction

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	15	15	16	22	22	28	15	133
Non-refereed papers	0	0	0	0	0	0	0	0
Books	1	0	1	0	0	0	0	2
Book chapters	7	3	7	11	3	1	1	33
PhD theses	4	3	1	2	5	5	4	24
Conference papers	18	28	30	33	34	37	30	210
Academic publications	45	49	55	68	64	71	50	402
Professional publications	1	5	2	6	10	0	0	24
General public publications	0	0	0	0	0	0	0	0
Edited volumes	1	0	0	1	1	1	1	5
Journal editorships	0	0	0	0	1	0	0	1
Remaining	0	10	1	6	0	5	4	26
Other publications	2	15	3	13	12	6	5	56
Total publications	47	64	58	81	76	77	55	458

Assessment

Quality
The overall quality of the programme in the Psychology of Human-Technology Interaction is very good. It is a dynamic, well-run programme which features leading edge research in the field of man-machine relations. Its strong points include a dedicated staff and astute leadership which are cognizant of Department, University and national research goals and finds opportunities to combine these with individual and group orientations and areas of interest.

The programme is clearly aligned with the '3TU' process through its pursuit of a 3TU Centre of Excellence in human-technology interaction and with national programmes in teaching and research, and pursues many activities with other units in the School and the Department. The relevance and reputation of the programme is vouched for by the many international partnerships it has established with leading institutions in the USA, Japan and other countries.

The researchers publish in high level journals. The quality of the publications is very good, internationally visible and competitive. The research makes a significant contribution to the field

Productivity
Productivity is very good. During the review period, the researchers published 133 refereed papers in many leading journals in the field in addition to many conference papers and other types of publications. Its productivity per FTE is very high (average over the assessment period, 18.33 publications of which 5.32 refereed articles per tenured fte), and its focus is on the appropriate range of regional, national and international publication venues.

Societal relevance
The relevance of the research conducted by the programme is very good. The Committee endorses the statement by the group that the programme has a strong track record where it comes to societal relevance. The research is primarily of an applied nature and some work, such as lighting, is very relevant to local and regional industries and practices. The group lists several examples of collaboration with large and small companies and governmental organizations, which can be used as an indication of the societal quality of the work. Movements in the direction of games and the exploration of the nature of fun and enjoyment and in the areas of robotics and persuasive technologies underscore the flexibility of the programme and its staff and their ability to react quickly and positively to changing client needs and social concerns. The same is true of work on sustainability and persuasive technology. The collaboration with industry and governmental organizations also indicates the level of valorisation of the work. Research results are being made available for application in products, processes and services.

The overall subject matter of the programme is, of course, also highly relevant on the national and international levels.

Vitality and feasibility
In general the vitality and feasibility of the research programme can be assessed as 'good'. Although the Committee acknowledges the tension between the SEP requirement to react flexible and adequately to important changes in the environment and the SEP requirement to articulate a clear focus of the research group, in the view of the Committee this group can improve by defining a clear vision or strategy guiding its actions and interactions with other

units, programmes and universities, and more clearly its pursuit of research funds. Although a unit may always have to alter its activities somewhat in order to pursue grants, care must be taken to ensure this does not lead to a loss of focus in its primary mission and goals. The strategy of the group to engage in the energy programme of the university priorities and to be involved in the newly developed smart mobility programme is welcomed by the Committee.

An increase in undergraduate teaching has occurred and recruitment to its PhD programme is declining due, at least in part, to the retirement of two full-time Department members but also to the elimination of internal sources for funding of PhD students. More attention should be paid to the consequences of such developments for the continued vitality of the PhD programme and research and teaching balances.

4 B7 Technology flows, the knowledge economy and economic performance

Programme leader:	Prof. E. Szirmai, Prof. B. Verspagen (2003-2008); Prof. C. Snijders (2008-2009); Prof. K. Frenken (from May 2009)	
Research staff 2009:	6.60 FTE	
Assessments:	Quality:	4.5
	Productivity:	4.5
	Relevance:	4.5
	Viability:	4.5

Description

This research programme aims to increase the understanding of how flows of technological knowledge between societal actors relate to economic performance and how these are, and can be, influenced for public policy sources. The starting point of the formulation of this research theme is the notion that the economic impact of technological change is primarily an outcome of diffusion and not just of innovation.

The research programme comprises three focal areas:

1. the impact of technology flows on economic performance;
2. the role of networks, clusters and sectors in innovation processes;
3. technology policy and regulation.

In the first focal area, research has focused on growth rate differentials between countries and regions, and has taken an applied as well as a theoretical point of view in analyses.

The second focal area focuses on the nature and operation of (geographically embedded) innovation networks and sectors and the implications for innovation policy. An explicit goal of this research has been to strengthen the link between economic and sociological theory.

The third focal area had a special emphasis on dynamic industries (such as ICT), in which technology policy, competition policy and regulatory policy are intertwined.

The research programme provided the following information on input and results.

Table 4B13 Research capacity of Technology Flows

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	2.99	4.76	4.55	4.52	4.49	4.12	3.82	29.25
Non-tenured staff	0.20	0.67	0	1.00	1.72	2.19	1.12	6.90
PhD students	6.24	5.18	5.84	4.62	3.20	2.60	1.66	29.34
Total research staff	9.43	10.61	10.39	10.14	9.41	8.91	6.60	65.49

Table 4B14 Results of Technology Flows

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	17	16	12	14	14	20	25	118
Non-refereed papers	1	1	0	0	0	1	0	3
Books	0	2	1	1	0	2	0	6
Book chapters	8	12	7	4	9	6	13	59
PhD theses	0	1	1	2	2	0	1	7
Conference papers	7	17	13	17	16	31	11	112
Academic publications	33	49	34	38	41	60	50	305

Professional publications	15	5	31	9	9	2	5	76
General public publications	0	0	0	0	0	1	5	6
Edited volumes	0	0	0	0	0	0	1	1
Journal editorships	1	3	1	3	2	3	3	16
Remaining	13	11	13	25	12	13	2	89
Other publications	29	19	45	37	23	19	16	188
Total publications	62	68	79	75	64	79	66	493

Assessment

Quality
This is perhaps one of the most important social science programmes of a technical university. This programme was dedicated to developing (formalizing) the links from engineering processes all the way up to macro impacts even though this ambition has not been spelled out explicitly in documented research and teaching programmes. Publishing in and editorships of high-quality journals are significant and international research contacts are excellent. The international academic reputation of the researchers is therefore very good.

The quality, volume, relevance and innovative boldness of the research done, and even more the agenda for the future, are very good to excellent. The quality of the programme is also reflected by the high share of external funding, the coordination of the network of excellence and participation in various international projects.

The impact scores of the publications are according to the bibliometric analysis high, above expectation.

Weighing all aspects that have been considered in regard to 'quality' the Committee concludes that the research of this group is very good to excellent.

Productivity
Research in the programme scored high in academic publishing and in access to Dutch national science funding (ca. 44% in 2009, up from 26% in 2003). The number of refereed journal papers per tenured FTE (4.1) is very good. Productivity on all scores is very high, with the exception of contract research funding, which is rather low, even though rising a bit during the past few years. The productivity in 2009 shows a substantial dip, which can probably be attributed to the fact that two full-time staff left the programme. The Committee, however, expects that the group will soon publish again on the same high level as in the years before 2009.

Taking this expectation into regard the Committee assesses the productivity of the group as very good to excellent.

Societal relevance
Research of this group contributes directly to science, innovation and development policies. The researchers conduct various advisory activities for the public and the private sector and are involved in national policy think-tanks. The number of active cooperation relations is impressive. A highly rewarded activity is the EU-funded network of excellence, which the programme coordinates.

The societal relevance of the research topics in this programme is given the central role of innovation and technology change in socio-economic development very high to excellent and the programme, as now conceived, is important for the university and for teaching.

Vitality and feasibility
The research and PhD teaching strategies for the future are novel and ambitious. They are tailored to the needs of a Technical University. The research projects are very well managed. Research facilities and financial resources enable the group to continue in line with its achievements. Attention is needed to the shrinking number of PhDs and the loss of two full-time senior Department staff members. The international character of both the staff and the PhD population is excellent.

Weighing all aspects that have been considered in regard to 'vitality and feasibility' the Committee concludes that research programme's viability is very good to excellent.

4 B8 Modern Societies in Transition (19th/20th Centuries)

Programme leader:	Prof. H.W. Lintsen; Prof. J.W. Schot	
Research staff 2009:	8.67 FTE	
Assessments:	Quality:	4.75
	Productivity:	5.0
	Relevance:	5.0
	Viability:	4.75

Description

The programme covered initially two main research clusters:

- Technology and the Hidden Integration of Europe.
- Knowledge infrastructure and Innovation in the Netherlands.

In addition, the programme developed a third complementary research cluster on transition pathways.

In the period under review full emphasis has been put on developing a European History of Technology Research Programme: the 'Tensions of Europe' (ToE) research network including a research programme, a publication programme and a public outreach programme.

In Eindhoven, the overall agenda of the network was translated into four theme-specific research agendas:

a. transnational infrastructures;
b. European consumption in the light of Americanization;
c. European mobility;
d. (post-)colonial relationships.

The programme provided the following information on inputs and results. Remarkable is the recent decrease in number of PhD students.

Table 4B15 Research capacity of Modern Societies in Transition

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	1.92	2.36	2.88	2.88	3.16	2.85	2.95	19.00
Non-tenured staff	0.75	1.06	2.23	2.56	3.05	4.81	4.92	19.38
PhD students	3.44	4.00	3.33	3.84	3.19	1.07	0.80	19.67
Total research staff	6.11	7.42	8.44	9.28	9.40	8.73	8.67	58.05

Table 4B16 Results of Modern Societies in Transition

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	6	6	10	3	19	9	6	59
Non-refereed papers	1	0	2	1	1	2	2	9
Books	1	2	1	1	2	3	1	11
Book chapters	21	2	5	3	12	10	16	69
PhD theses	1	1	1	0	2	4	1	10
Conference papers	8	11	6	8	16	1	3	53
Academic publications	38	22	25	16	52	29	29	211
Professional publications	5	1	4	2	1	6	5	24

General public publications	0	0	1	1	2	5	7	16
Edited volumes	2	0	1	1	1	1	1	7
Journal editorships	0	1	1	0	2	0	0	4
Remaining	4	1	4	0	8	4	2	23
Other publications	11	3	11	4	14	16	15	74
Total publications	49	25	36	20	66	45	44	285

Assessment

Quality
This is a first-rate programme which might be described as the 'jewel in the crown' of the School and the department. It is innovative and entrepreneurial. With a relatively small number of tenured staff, this programme is enormously productive and has achieved visibility as a leader – a major player – in the history of technology. All the signs indicate that the programme is very well-managed. The programme was strategic in choosing topics that fit their context in with the Department of Industrial Engineering and Innovation Sciences while at the same time the topics are both underexplored and likely to have impact.

The programme has been extremely effective in partnering with other, international groups and seems to take a leadership role in these partnerships. The programme makes significant efforts at outreach with websites, exhibits and documents that ensure that their work has impact. Besides, the programme expresses vision and has indicates that it is planning for the future. The programme has done this while seemingly making very few demands on the Department or the University.

The programme has been extremely successful in obtaining external funds for its research and has funded large projects with significant impact. The programme received major honours, grants and prizes and has produced publications that appear in top journals and are published by top-rate book publishers. It has effectively leveraged its pool of talent by partnering with others in a collaborative research network.

The specific research topics of the programme, such as tensions in Europe, European consumption in the light of Americanization and European mobility, are original, coherent and strategic. The research the programme produces is published in the best journals and by the best book publishers, such as MIT Press and Johns Hopkins University Press.

The programme appears to consist of a group of energetic and innovative scholars. They do their work with a fairly small number of postdoctoral and PhD students.

Productivity
Given the small size of the tenured staff the programme has been enormously and consistently productive.

Because the programme is a history programme, quantitative comparisons with other programmes in the Department are not reliable. The most notable difference is that, in quantitative measures, books count as one publication when they stand for much more time, effort and importance than does a single article. This programme has produced eleven books in seven years plus another seven edited volumes. The books are on top of a steady stream of refereed journal papers and many book chapters and conference papers.

Societal relevance
The research of the programme is highly relevant to and complements the Department, the School of Innovation Sciences and the University by putting technology and engineering in context and providing an understanding of its social implications. Their research is important for the Netherlands, Europe and globally for understanding how technology shapes and is shaped by a variety of social factors and forces. Importantly, this programme has strategically positioned itself as a place where first-rate historians devote themselves to the history of technology. They study foundational history speaking to general historians, other disciplines and policy makers.

Vitality and feasibility
The programme has demonstrated its vitality and feasibility through its productivity and its impact over the past seven years. The programme is well managed and its decisions in the past few years demonstrate its vitality and feasibility to continue. Additional support could be used to leverage the impact of this programme even further.

Sustaining research programmes on external funds can be very challenging especially in such fields as history without a long tradition of external support. The programme has been very successful in this regard and it bodes well for the future. The programme could be more strongly supported in monetary as well as non-monetary ways. For example, within the Department a policy that recognizes the importance of publishing books in the discipline of history might help the programme compete with other programmes.

4 B9 System Innovations and Sustainability Transitions

Programme leader:	dr. G.P.J. Verbong and Prof. J.W. Schot	
Research staff 2009:	4.64 FTE	
Assessments:	Quality:	4.0
	Productivity:	4.5
	Relevance:	4.5
	Viability:	3.5

Description

The System Innovations and Sustainability Transitions (SIST) programme focuses on persistent problems faced by our society which have become apparent in particular in the field of sustainability issues. Examples are the unsustainable nature of the fossil fuel-based system of energy supply and the modern transport system. Because of the persistent nature of these problems, incremental improvements are insufficient to deal with these problems. Radical innovations or transition are needed. The objective of the SIST programme is to better understand, to identify and to influence the process of transitions.

At the core of the programme there is the dynamic interaction between transition experiments and the generation and application of knowledge. The programme is structured over two major research lines:

- historical research, looking at transitions in the past and drawing conclusions and learning lessons from the past;
- research focused on the governance of transitions and system innovations.

The research programme provided the following information on input and results.

Table 4B17 Research capacity of System Innovations

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	0.60	0.60	0.80	0.80	0.80	0.90	1.30	5.80
Non-tenured staff	1.28	1.67	2.40	1.93	1.10	1.40	0.97	10.75
PhD students	0.93	1.27	0.93	2.07	2.80	3.20	2.37	13.57
Total research staff	2.81	3.54	4.13	4.80	4.70	5.50	4.64	30.12

Table 4B18 Results of System Innovations

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	2	12	6	12	17	5	8	62
Non-refereed papers	0	1	0	0	2	0	1	4
Books	0	0	2	0	0	1	0	3
Book chapters	1	8	3	3	0	2	6	23
PhD theses	1	0	1	0	0	0	0	2
Conference papers	5	4	5	10	11	6	10	51
Academic publications	9	25	17	25	30	14	25	145
Professional publications	6	9	8	10	5	4	1	43
General public publications	0	0	0	0	0	0	0	0
Edited volumes	2	2	0	1	0	1	1	7
Journal editorships	1	0	1	0	0	0	0	2
Remaining	0	0	4	4	3	4	25	40
Other publications	9	11	13	15	8	9	27	92
Total publications	18	36	30	40	38	23	52	237

Assessment

Quality
This is a small programme with an important mission and seemingly high visibility. The programme, which started in 2004, has close links to the Modern Societies in Transition programme. Though young, the programme seems to produce a steady stream of high-quality research. With a relatively small number of Department and research staff, it has been quite productive in publications and in finding external support for its research. Based on a list of invited lectures and keynote addresses, researchers in the programme seem to have prominence and their publications have influence.

The leadership of this programme and the involved researchers is good and the academic reputation of the researchers is growing. Furthermore the bibliometric analysis shows a very high impact score of the publications. The citation information provided suggests that publications are influential.

The Committee assesses the quality of this programme as very good.

Productivity
The record of publications is quite steady, and the number of publications is impressive given the modest size of the programme. Although there is a marked increase in 2009, half of the publications in that year are classified as 'other publications', so it is difficult to determine the quality of the publications.

Generally speaking, humanities and social science programmes cannot compete with engineering programmes on quantitative measures of productivity. This is due in part to the fact that humanities and social science disciplines highly value books. However, while books take an enormous amount of time and effort, they count only as the equivalent of one refereed paper in the quantitative measures. Therefore, it is noteworthy and of significance that the productivity of this small programme is well above the average on two of the quantitative measures of programmes at Eindhoven assessed by the Committee, namely in average number of refereed publications per tenured group member and average number of total publications per total group.

Societal relevance
The two missions of the programme, namely to contribute to the understanding of transitions and the construction of a knowledge infrastructure and to contribute to the development and implementation of transition policies, have major societal relevance. The programme can help the Netherlands to make an effective transition from unsustainable to sustainable policies and practices and, in doing so, to provide knowledge to and serve as a model for other nations and regions making the transition.

The group managed to attract external funding by e.g. the Ministry of Economic Affairs, Kema, Alliander and the Netherlands Bureau for Economic Policy Analysis, which is an indication of the social quality of the research and the applicability of the research results.

Vitality and feasibility
As a small programme with a unique profile and a fairly specific mission, the programme might be described as a niche (or even 'boutique') programme. As such, the Committee raised the question whether the programme would be more efficiently managed and leveraged were

it merged with the Modern Societies in Transition programme. The justification presented for keeping these programmes separate is that this one is more social science than history. Although the Committee did not find this explanation adequate, the programme is still young, has established a good track record at obtaining funding and having impact and is well positioned to make an important contribution in the future. The midterm review raised this question of viability and, as a result, the programme was able to fill a tenure track position and a temporary assistant professorship. Thus, it might be better for now to let the programme continue as it is and to see how far it can go. The question of its viability should then be raised again in the next 3-5 years.

5. Delft University of Technology

5.A. Assessment on the Institutional Level

University: Delft University of Technology
Faculty: Faculty of Technology, Policy and Management

1. The institution

Description
The research carried out in the Faculty of Technology, Policy and Management of Delft University of Technology focuses on real-world problems at the interface of technology and politics, policy and management. The Faculty wants to contribute to:

- the development of advanced multi-, inter- and transdisciplinary approaches deliberately aimed at bridging the gaps between natural, social and engineering sciences;
- the design and development of solutions to real-world problems.

The Faculty has five research programmes: 'Innovation Systems', 'Multi-actor Systems', 'Next Generation Infrastructures', 'Philosophy of Technology, Design and Values' and 'Risk and Design'. Each programme has a programme director who is responsible for the content of the programme and innovation within the programme. The Faculty has a Director of Research who chairs the meeting of programme directors twice a year and represents the Faculty on research issues.

The Faculty comprises thirteen research groups, which are the heart of the organization. The groups acquire funding and are responsible for their own budget. The groups participate in both educational programmes and the research programmes named above.

The Faculty is an integrated part of Delft Technological University, which means that the Faculty of Technology, Policy and Management has taken on a strong design orientation. A great deal of attention is devoted to technical systems and the areas of application are of a technical nature.

The Faculty's policy is that research should be of a multidisciplinary nature but should also meet the quality standards of the individual disciplines involved. According to the description in the self-evaluation report, each programme must be able to vouch for the high quality of its research when evaluated against disciplinary standards.

Assessment
The Committee met a very self-conscious Faculty. Even when the funding is going down or is redistributed, the staff involved seemed quite relaxed. The staff is convinced that 'the future is formed here'. The Committee agrees to that when looking at the development of the Faculty. The Faculty achieved to attract 'big contracts for research programmes'. More than 50% of the Faculty is externally financed. The research is pretty well organized in relatively independent programmes. These research programmes look for their own audiences, markets and sources of finance. Two research programmes are strongly integrated with overlapping memberships.

All research groups are doing very well. The economics, risk and philosophy programmes have another history. Their integration in the Faculty has not yet been fully realized. The effects of merging two Faculties are still visible. The research programmes show diversity in intended public. The Faculty is working on the integration of these programmes without losing the advantages of diversity. The Committee recommends to pay attention to the valorisation policy.

2. Academic reputation

Description
The Faculty has been working over the last six years on strengthening the institutional relations and initiating cooperation on the level of programmes. The most visible result of these efforts is the leading role in the Technology, Policy and Management Consortium and the University Council of Engineering Systems.

Each programme has its own network of international partners. In the period under review contacts were developed with Bangalore, Harbin, Queensland and Singapore. These contacts are linked to the Europe/US network of the Faculty.

Assessment
The Faculty is internationally well positioned and recognized. The dean, the director of research and the programme directors all display a strong leadership and prominence in the respective research fields. The Faculty has strong links both to public and private organisations in the Netherlands and abroad as well as to leading academic institutes in the field.

3. Quality and scientific relevance of the research

Description
From the physical systems perspective the focus of research is not as much on the technical components as it is on the structure, value and behaviour of the physical systems. The system is studied in an engineering science perspective as governed by causal relationships.

The focus of the actor-network perspective on the other side is not much on individual decision makers but rather on the networks, coordination and interdependencies among these actors. The object of research of the Faculty is large-scale systems characterized by technical, social and institutional complexity. The research is part of the wider research portfolio of Delft University of Technology, with a strong emphasis on design issues.

Assessment
In general, the originality of the ideas and the research approach of the research programmes involved is very good. The assessment of the quality of research is described in more detail in the sections on the research programmes.

4. Resources

Description

Table 5A1: Funding on an institutional level

Funding in thousands of €	2003	2004	2005	2006	2007	2008	2009
Direct funding	6,419	6,664	6,749	7,000	8,165	7,937	6,789
Research funds		403	490	407	308	585	882
Contracts	3,331	1,789	4,914	6,780	6,2912	7,192	9,001
Other							
Total funding	9,750	8,836	12,153	14,187	14,765	15,714	16,672

Funding in %	2003		2004		2005		2006		2007		2008		2009	
	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
Direct funding		66		75		56		49		55		51		41
Research funds		34		5		4		3		2		4		5
Contracts				20		40		48		43		45		54
Other														
Total funding		100		100		100		100		100		100		100

Table 5A2 Research capacity of the Faculty of Technology, Policy and Management

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	21.96	23.01	24.52	29.09	32.21	32.73	36.43	199.95
Non-tenured staff	11.03	11.64	10.86	11.32	13.55	18.36	20.96	97.72
PhD students	30.49	40.02	45.27	42.93	56.55	68.72	77.91	361.89
Total research staff	63.48	74.67	80.65	83.34	102.31	119.81	135.30	659.56

Assessment
The research is well organized in relatively independent programmes. As mentioned above, these research programmes take care of their own audiences, markets and sources of finance.

5. PhD training

Description
Each PhD student must participate in the Faculty's PhD programme. This programme consists of two blocks.

- Block 1 is an introductory course for new PhD students. It supports the students in developing their research design by providing them with a portfolio of different paradigmatic examples of multidisciplinary Technology, Policy and Management research.
- Block 2 is an advanced course with a more methodological focus.

Next to this obligatory programme, PhD students are encouraged to take specific courses within their own discipline. PhD students can also take tailor-made courses, which require permission from their supervisor. Furthermore, PhD students discuss their work-in-progress with peers and senior Faculty members in tutor groups.

Starting in September 2010, the Technology, Policy and Management Graduate School will gradually replace the existing programme and develop a more comprehensive structure for PhD research.

The Faculty did not present management information about the success rates of PhD students in the self-evaluation report, but estimates that the rate of PhD students that finish their thesis in the intended time (four years) is around 20% while 40% have finished the thesis in five years' time. The Faculty considers the success rate of PhD students as too low.

Assessment
The PhD students the Committee interviewed seem all very satisfied with the supervision and facilities received. The Committee would however recommend provision of more transparency and structure to the PhD students with respect to the requirements they have to meet and the course programme they have to follow. It would also be advisable to monitor the progress of the PhD students in a systematic way and to set targets for success rates. The Committee considers it wise to shop around for courses to be followed by PhD students. The educational programmes for PhD students could be organized a little more.

6. Productivity

Description
The success rate in acquiring research funds varies considerably among the research programmes. The Philosophy of Technology, Design and Values programme is the most successful. It was awarded one NWO VENI grant and two NWO VIDI grants.

Table 5A4 Aggregated Results of the Faculty of Technology, Policy and Management

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	136	114	159	241	181	186	252	1268
Non-refereed papers	7	9	12	8	18	32	11	97
Books	24	22	24	12	21	30	27	160
Book chapters	148	98	105	105	113	144	147	860
PhD theses	4	19	18	9	18	12	22	102
Conference papers	188	249	384	367	315	416	455	2374
Academic publications	507	511	701	742	666	820	914	4861
Professional publications	147	137	188	138	135	118	104	967
General public publications	37	33	42	35	50	35	29	259
Remaining	69	121	144	129	138	158	134	882
Other publications	253	291	374	302	323	311	267	2108
Total publications	760	802	1075	1044	989	1131	1181	6969

Assessment
The productivity of the research staff is very high to excellent on average. The Committee was impressed by the number of publications resulting from the research programmes and even more by the number of external contacts and contracts the Faculty managed to achieve.

7. Societal relevance

Description
The Faculty wants to contribute to the development of new theories and concepts in the respective research fields and also wants to help solve real-world problems. It aims, in other words, for recognition from both its academic peers and society in general. A significant proportion of its applied research consists of contract research. Contract research is valued by the Faculty because it offers the opportunity of conducting research in the inner segments of governments and companies, which operate in a highly dynamic environment. Contract

research has become an important means for keeping pace with the 'living labs' of modern technological developments.

Assessment
The research conducted by this Faculty is beyond doubt very relevant. The research groups also manage to implement and disseminate the results of research and to maintain excellent contacts with stakeholders in society.

8. Strategy

Description
The Faculty has identified a number of areas of critical focus for the period to come, in addition to consolidating and expanding its past achievements.

The Faculty has developed relationships with several leading Asian universities and intends to strengthen that collaboration in the years to come with several bilateral and multilateral research programmes, for example on sustainability issues, comparative research on large-scale infrastructural decision making, infrastructural development, utility sectors and eco-cities.

Innovation at the Faculty of Technology, Policy and Management takes place along two paths:

- Identification of new areas of application such as health, the financial sector, climate issues and nanotechnology.
- Implementation of new initiatives such as gaming and simulation, infrastructure systems as socio-technical systems and value-sensitive design.

Furthermore, the Faculty intends to bring together a number of researchers who will codify the systems-actor research in the programmes and prepare an overarching Body of Knowledge publication on this topic. To avoid that the Faculty will become overly dependent on a limited number of researchers it developed the following initiatives:

- development of a programme for the very best tenured and non-tenured researchers in order to retain them;
- selection and education of a new generation of non-tenured staff;
- development of a Graduate School.

Assessment
The Committee is positive about the strategic plans of the Faculty and the perspectives of the Faculty for the near future. The research topics are all relevant and will remain relevant for several years. The Faculty also manages to react flexibly to changes and to anticipate in a relaxed way to threats and challenges.

9. SWOT analysis

Description
The Faculty did not provide a SWOT analysis on an institutional level.

10. Robustness and stability

Description
The policy of the Faculty aimed at retaining its position is described under 8.

Assessment
The Committee is of the opinion that the Faculty is very well occupied and facilitated to reach its strategic goals. The expertise in the institute is broad and fits excellent in with the goals it wants to achieve.

5 B. Assessment on a Programme Level

5 B1 Innovation Systems

Programme leader:	Prof. A. Kleinknecht	
Research staff 2009:	20.8	
Assessments:	Quality:	3.9
	Productivity:	3.7
	Relevance:	4.5
	Viability:	4.0

Description
The programme Innovation Systems started in 2004. Its mission is to contribute to the understanding of the economics and management of innovation. This should contribute to improvement of public innovation policy as well as the management of innovation in private firms and public organizations. The research programme is structured around two key questions:

- What factors influence the emergence and diffusion of technological innovations in private firms and in public organizations?
- What are the consequences of innovative behaviour for the performance of (private and public) organizations?

Research concentrates on intra- as well as inter-organizational factors. Input into the programme comes from various disciplines, the most important being economics, management sciences, organizational psychology and engineering. The research has a strong focus on the econometric analysis of (large) databases next to other methods like occasional case study work and participatory research, applied network analysis and simulation.

The programme presents, among other features, the following insights resulting from research as crucial:

- Labour market deregulation and flexible labour not only lead to a high labour turnover and lower costs of labour, but are also associated with significantly lower rates of labour productivity growth.
- Both Marshallian specialization externalities and Jacobian diversification externalities are crucial for regional innovativeness.
- Policies aimed at the growth of spin-off firms from universities tend to produce better results if there is organizational heterogeneity.

The research programme provided the following information on input and results.

Table 5B1 Research capacity of Innovation Systems

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	5.2	5.6	6.9	7.3	8.2	8.8	9.0	51.0
Non-tenured staff	0	0	0	0	0.6	0.6	0.1	1.3
PhD students	8.8	8.8	8	3.2	9	10.2	11.7	59.7
Total research staff	14.0	14.4	14.9	10.5	17.8	19.6	20.8	112.0

Table 5B2 Results of Innovation Systems

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	29	21	15	31	31	14	54	195
Non-refereed papers	5	1	4	5	13	14	4	46
Books	11	6	13	7	7	10	3	57
Book chapters	38	39	29	24	42	43	30	245
PhD theses	0	2	1	1	1	0	2	7
Conference papers	37	56	58	49	71	72	74	417
Academic publications	120	125	120	117	165	153	167	967
Professional publications	33	33	21	39	21	17	14	178
General public publications	21	22	19	30	35	17	11	155
Remaining	19	53	32	21	46	46	40	257
Other publications	73	108	72	90	102	80	65	590
Total publications	193	233	192	207	267	233	232	1557

Assessment

Quality
The Committee takes notice, with satisfaction, of the broad theoretical approach, but expresses some surprise that the programme strategy does not include the ambition to take the full step from studying the links between the innovation processes at the micro level, all the way up to the macro level. As to academic homes the Innovation Systems programme tended to associate with, and publish in, journals like Innovation Policy, Economics of Innovation and Technology, Structural Change and Economic Dynamics, Industrial and Corporate Change and Journal of Evolutionary Economics. These journals are all highly regarded in their field and on their way up to the international prestige listings.

The programme relates to similar departments or groups like ZEW at the University of Mannheim, Merit in Maastricht, SPRU in Sussex and the group headed by Stan Metcalf at the University of Manchester, all in Europe. On the other side of the Atlantic, the director of the Innovation Systems programme felt a relationship with some individuals rather than entire groups. This floating situation for non-neoclassical economics in the evolutionary tradition is also rather characteristic of similar research groups in Europe (and of similar programmes at the Universities of Twente and Eindhoven), which are all striving to find their appropriate definition and identity in an international context.

The group publishes in good and high profile journals in academic books (chapters), professional journals, conference papers and popular contributions to newspapers. Citations per publication are above average. The group is good in the research it does and it has achieved a comfortable position. The committee however, did not see a similar amount of ambition and energy in the group to go forward and aim at more.

Productivity
The number of refereed papers per tenured staff (FTE) is not extremely high (3.8). But the average productivity of this group is in the opinion of the Committee tending to very good. Direct funding dominates with 64% of total funding followed by contract research (31%). External national science foundation grants are small (5% for the whole period). Productivity is high, but productivity strategies are somewhat fragmented.
Weighing the mentioned aspects belonging to this criterion the Committee assesses the productivity as tending to very good.

Societal relevance

The efforts of the group to interact in a productive way with stakeholders in society are reflected by the involvement of researchers in national discussions and contributions to professional journals and national media. Societal relevance and quality, as well as impact, are high. The group has built close ties to policy makers, functions as a 'government think tank' and enjoys a high level of visibility in the media. The group managed to make research results available and suitable for application. The Committee is of the opinion that this research is highly relevant and can have a major impact in society. Therefore it assesses the societal relevance of this research programme as very good to excellent.

Vitality and feasibility
The SWOT analysis, as provided in the selfevaluation report, is excellent, it describes clearly the strenghts and weaknesses of the research programme. Furthermore the staff and resource situation is robust and stable. The Committee sees a lot of possibilities for this group, but the strategies for the future should however have been worked out more clearly in the selfevaluation report. The group however seems vital and capable and should have ample possibilities to grow well in the future. Therefore the Committee assesses the vitality and feasibility of this group as very good.

5 B2 Multi-Actor Systems

Programme leader:	Prof. W.A.H. Thissen	
Research staff 2009:	36.8 FTE	
Assessments:	Quality:	4.5
	Productivity:	4.5
	Relevance:	4.5
	Viability:	4.5

Description

The Multi-Actor Systems (MAS) programme aims to develop innovative concepts, methods and tools for understanding and facilitating multi-actor decision-making in large-scale socio-technical systems. The focus is on decision-making processes, while the research locus spans a diversity of socio-technical systems, energy systems, information systems for e-business, e-collaboration and e-government, and systems for water management and flood control. The programme has six research themes:

- Design and management of policy processes.
- Institutional design.
- MAS concepts, methods and tools.
- Serious gaming and simulation.
- Collaboration engineering.
- Supporting strategic decision-making under deep certainty.

Cross-fertilization of actor and system perspectives is stimulated in all themes.

The variety of disciplinary backgrounds and the knowledge and skills of MAS researchers afford multiple types of research: theory development, development of methods and tools, action research and experiments.

The programme is strongly intertwined with other programmes in Delft University of Technology.

Table 5 B3 Research capacity of Multi-Actor Systems

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	5.6	5.9	5.9	5.9	5.9	6.8	8.3	44.4
Non-tenured staff	2.3	2.7	1.7	2.8	3.8	5.8	6.7	25.8
PhD students	6.6	12.6	13.2	15.3	18.0	19.8	21.7	107.3
Total research staff	14.50	21.2	20.8	24.0	27.7	32.5	36.8	177.5

Table 5 B4 Results of Multi-Actor Systems

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	39	31	41	62	46	49	67	334
Non-refereed papers	0	2	7	2	3	14	4	32
Books	3	10	4	1	6	6	8	38
Book chapters	30	23	22	30	22	28	28	183
PhD theses	3	8	10	3	12	4	9	49
Conference papers	41	50	109	110	82	136	152	680
Academic publications	116	124	192	208	171	237	268	1316
Professional publications	29	37	95	44	35	26	37	303

General public publications	3	1	15	1	1	8	3	30
Remaining	26	17	34	37	36	57	38	234
Other publications	58	55	144	82	72	91	78	567
Total publications	174	179	336	290	243	328	346	1883

Assessment

Quality
The quality of the Multi-Actor Systems programme is very good to excellent. It is the leading one of its kind internationally and has internationally recognized senior and excellent junior researchers who promise to continue a tradition of excellence in the unit. Overall the programme is dynamic and well-run with dedicated staff and astute leadership cognizant of Faculty, University and national research goals and of the need to align staff interests to new and emerging areas of thought and practice.

The programme is well-regarded internationally and has recently expanded to Asia (China). Visiting scholars and other Faculty interactions promise to further enhance its profile through the pursuit of additional international linkages and partners in North America, South America, Africa and India where interest in the topic is growing.

The group publishes in very good and top class journals. The quality of the output in general is very good to excellent.

The group has in cooperation with the NGInfra group built and expanded gaming and simulation laboratories. This line of research is a significant development and has already had success in attaining competitive research funding.

Productivity
Productivity in the unit is very good, tending towards excellent. In its previous review the Faculty and the programme had been encouraged to enhance their output in high-ranked ISI journals. This has been accomplished since and the programme now generates a high percentage of total School publications in this area. This has been somewhat at the neglect of books, however, and the research group was encouraged by the Mid-Term Review to enhance its activity in this area to ensure that basic concepts and pedagogical materials in the field are available. Programme staff have continued to work in this area and are now producing texts and other teaching- and practice-related materials which will continue to help to advance the field but which will only appear after the period covered by this review.

Societal relevance
The societal relevance of the research in the programme is very good. The research is both conceptual and practical in nature as befits a topic of a sociological nature. As the SWOT analysis conducted by the units noted, while in earlier periods programme researchers focused on developing frameworks and conceptual structures, in the period under examination this shifted to an emphasis on practice in areas such as infrastructure. This has increased its links to applied work in the Faculty and the University and reinforced its links to the industry and the government.

Vitality and feasibility
The viability of the programme is very good. The programme is in the middle of a transition from earlier research groups focused on subjects such as institutional design and the design and management of policy processes to new orientations and efforts in fields such as gaming

and collaboration engineering and, even more recently, dealing with uncertainty. This evolution is entirely appropriate and reflects the flexibility and dynamism of the programme's structure, staff and leadership. However, as the Mid-Term Review and programme self-assessment SWOT analysis noted, there is a tendency for staff time to be increasingly sub-divided into ever finer slices, with the risk that some efforts are dispersed as a result. This might be due in part to the fact that the new orientations have been 'layered' on top of older priority areas and it is not clear that sufficient thought has been given to mechanisms whereby older programmes may be periodically re-assessed, and consideration given to shifting resources from these to newer programmes where appropriate.

5 B3 Next Generation Infrastructures (NGInfra)

Programme leaders:	Prof. M.P.C. Weijnen, Prof. E.F. ten Heuvelhof	
Research staff 2009:	54.19	
Assessments:	Quality:	5.0
	Productivity:	5.0
	Relevance:	5.0
	Viability:	5.0

Description

According to the self-evaluation report, infrastructures are the backbone of the economy and society. Especially network-bound infrastructures provide essential services that are enabling almost every type of economic and social activity. These systems show increasing complexity in the technological, organization and market dimension. Building on a cross-sectoral and interdisciplinary approach, the scientific mission of the NGInfra programme is to develop a generic framework for understanding, modelling, simulating, optimizing and managing infrastructure systems, and enabling users to learn across sectors.

The societal mission of the programme is to stimulate the development of more flexible, more reliable and more intelligent infrastructures with respect for consumer interests, which will better serve society in the future.

The programme is structured along five dominant knowledge themes:

- understanding complex networks;
- public values in infrastructures;
- flexible infrastructures;
- critical infrastructures;
- intelligent infrastructures.

The research programme provided the following information on input and results.

Table 5B5 Research capacity of NGInfra

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	4.55	4.20	4.29	8.70	10.65	8.96	10.54	51.89
Non-tenured staff	4.46	4.59	4.76	4.08	3.45	6.32	7.81	35.47
PhD students	11.50	13.29	17.30	17.31	22.72	29.21	35.84	147.17
Total research staff	20.51	22.08	26.35	30.09	36.82	44.49	54.19	234.53

Table 5B6 Results of NGInfra

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	41	37	59	105	60	79	85	466
Non-refereed papers	1	3	0	1	2	4	1	12
Books	8	4	5	4	5	13	9	48
Book chapters	72	23	34	40	39	61	54	323
PhD theses		7	4	5	3	4	8	31
Conference papers	83	88	153	147	129	154	182	936
Academic publications	205	162	255	302	238	315	339	1816
Professional publications	63	34	37	38	37	35	33	277
General public publications	11	6	4	3	11	8	14	57
Remaining	16	35	64	44	39	42	39	279

Other publications	90	75	105	85	87	85	86	613
Total publications	295	237	360	387	325	400	425	2429

Assessment

Quality
The data presented in the self-evaluation report indicate a large, high-quality, productive research group with excellent linkages to other programmes, across the country to other schools and universities – particularly in the technology area but also including critical economic linkages to Erasmus University Rotterdam – and, perhaps most impressively, to other universities across the globe. This is truly an international programme with international input and impact. The Committee has never seen a research programme as impressive as this programme in terms of quality, productivity and outreach.

The quality of scientific relevant research is outstanding. The originality of work, both analytically and technically, is excellent. The impact according to the bibliometric analysis is the highest in the Faculty. The programme is coherent and ties together a set of important but dispersed concepts and ideas ranging from complex technical issues in infrastructure to issues of governance and management of infrastructure systems. Formal modelling of agent-based complexity and technology diffusion in a hierarchical network systems model is linked to the diffusion and adoption of new technology across complex market structures and policy frameworks.

The programme is somewhat light in economics and overall financial integration of infrastructure, but where it contributes to these areas its Web of Science impact is among the highest according to the bibliometric analysis. Besides the outstanding academic work, the non-Web of Science output and its specific public communication and industrial linkage and interaction are among the very best, and it is growing.

The programme has very strong outreach activity and has mastered the decentralized research management operations seemingly in the best form possible. Obviously, their huge and effective competitive grant that made all of this possible is without a peer in this field and allowed them to weld together not only the impressive quality across Delft University of Technology but also linked to national technical universities and then to use that leverage internationally. However, without the backing of infrastructure industries, utilities, producers and consumers this would not have been possible.

Output of high-quality PhD students has been effective and impressive and the response to the midterm research review was open and effective in terms of shifting some resources and efforts to classical Web of Science indexed output while maintaining external industrial, government and public communications in non-Web of Science-related publications.

Leadership in this context cannot be fully expected unless the programme can be articulated effectively, budgeted appropriately and managed in such a way that participants are rendered supportive of each other and the larger programme goals. The programme leaders have made that happen and are still developing new strategies to continue programme development and expansion.

Financial and human resources are critical to the development of the programme and this means a need for attracting, supporting and equipping key personnel. To do this, direct financial support is important to add limited contract work. However, contract work is

usually not fully supportive of the long-term intellectual mission of the programme. The group has in cooperation with the MAS group built and expanded gaming and simulation laboratories. Of course, its competitive research funding is central to such activity and the role or combined roles of real research agencies and mission-oriented agencies are very difficult to integrate effectively. Nonetheless, this has happened, with the key support of Bsik. Winning this competitive programme was central to getting this activity off the ground at the level and effectiveness achieved. The NGInfra team also has used this opportunity to double its contract activity and at least triple its traditional NWO competitive research activity. It has built gaming and simulation facilities and used software development to make them effective.

Productivity
This is the leading programme in terms of output in the Faculty and the highest in productivity. The programme has both a self-support publication outreach strategy and a public communication strategy. It shifted its production strategy after the mid-term review and expanded its Web of Science output as recommended. The result over the previous period of review (1998-2003) was a 134% rise in academic output and a 126% rise in PhD theses. The quality productivity rating and the related impacts are 'off the charts' in terms of expansion rates.

Societal relevance
Social relevance is not a function of the subject of the research but rather a function of how that research is made relevant and helpful to society at large. It is the value added as an outcome of financing and executing the research and how that is communicated to the large public so that public can make use of it. Issues of infrastructure finance and infrastructure integration, management and governance are critical if they can be linked appropriately into public decision making. One way is communication and the other is drawing the public into the research activity. A list of individuals involved in the programme as well as graduates are provided in Appendices 1 and 2 to the self-evaluation report to give the reader an appreciation of the breadth of programme involvement. It is an impressive list. The rise in funding from external sources and in public and private contracts has grown by close to 100% over this period. Public communication on everything, from infrastructure pricing to regulation or deregulation, has been part of the relevant output activity of this group and it has grown significantly.

Vitality and feasibility
A strategy of continued programme development, renewal and expansion is important. Investment and collaboration are critical, and anticipation of future issues and development of management strategies is vital. In the self-evaluation report the NGinfra group identified the loss of Bsik support in 2012 as a critical future issue to be managed, but four months later that problem has been moved up to 2014 with alternative funding. Furthermore, new contract funding has expanded, but because of programme success none of the long-term concerns are lost due to the typical short-term focus on private sector priorities.

On the research output side, the work in gaming, simulation and related software integration has proved increasingly supportive of potential future resources for research support. The group has used the 'SWOT' project to focus on threats and opportunities and has already solved some of the issues identified. Last, but not least, the robustness and stability of the programme is reflected not only in its size, diversity and leadership but also in its intellectual depth.

This is a strong, high-quality, productive programme that is socially relevant and works to maintain that relevance. It is vital and flexible.

5 B4 Risk & Design

Programme leader:	Prof. B.J.M. Ale	
Research staff 2009:	7.91 FTE	
Assessments:	Quality:	4.5
	Productivity:	4.0
	Relevance:	4.5
	Viability:	3.0

Description

The mission of the Risk & Design research programme is to develop models and approaches to help designers, policy makers and managers to predict risks to safety, health and environment, choose integrated sets of measures to minimize those measures and learn from their successes and failures.

To achieve its mission, the programme distinguishes the following themes:

1. Risk modelling: predicting, modelling, understanding and prioritizing risks and the factors that can be modified to make structural reductions in them.
2. Design: supporting designers of technology, systems and organizations in their design processes, so as to achieve the maximum in inherent safety and to make the management of the remaining risks as easy as possible.
3. Management systems and culture: developing, using and evaluating risk control and safety management systems to minimize on-line risks in operations and maintenance.
4. Learning: developing learning systems so that risk control can adapt to changing technology, societal demands and organizational change and can learn from its mistakes.
5. Risk regulation: designing and evaluating governmental and societal regulation of risk to take account of risks and the diversity of risk perceptions.
6. Disaster management and security: developing disaster management and security systems to improve emergency preparedness and responses in case of both accidentally and intentionally occurring harm or loss.

The research programme provided the following information on input and results.

Table 5B7 Research capacity of Risk & Design

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	3.68	3.70	3.53	3.21	3.44	3.27	3.58	21.41
Non-tenured staff	1.20	1.33	1.80	1.07	0.33	0.61	0.16	6.50
PhD students	2.29	4.34	5.05	6.08	5.85	7.01	4.17	34.79
Total research staff	7.17	9.37	10.38	10.36	9.62	10.89	7.91	65.70

Table 5B8 results of Risk & Design

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	21	16	29	16	29	24	22	157
Non-refereed papers	1	3	1	0	0	0	1	6
Books	0	1	2	0	3	0	2	8
Book chapters	6	8	6	7	4	2	2	35
PhD theses	1	2	1	0	0	3	3	10
Conference papers	23	43	51	47	21	38	32	255
Academic publications	52	73	90	70	57	67	62	471
Professional publications	18	24	26	11	33	30	14	156

General public publications								
Remaining	6	11	10	20	13	4	6	70
Other publications	24	35	36	31	46	34	20	226
Total publications	76	108	126	101	103	101	82	697

Assessment

Quality
The overall score for the quality of the programme is in the category of very good to excellent. The work is published at international scientific peer-reviewed journals and presented at recognized scientific conferences. Looking at the total production a number of important contributions to the field can be identified. The Committee identifies two areas of special importance.

The group consists of well established and renowned senior researchers/professors. All professors should be highlighted for their work. The programme has been run professionally when it comes to management and the use of research infrastructure and resources. For this type of programme a special challenge is related to the nature of the research, which is predominantly multidisciplinary. This means that the research to a large extent needs input from different parties. The programme leadership is therefore faced with managing a network rather than a hierarchy. The programme leader has done a huge and very impressive job in this respect.

The scope and themes of the programme are highly adequate. It meets the challenges faced by society and the discipline of risk and safety is attempting to provide principles and methods for dealing with them. Risk assessment and modelling is a key tool and needs to be given due attention, but equally important are the other themes addressed in the programme. The strength of the programme is the ambition of integration of the traditional areas of research, both fundamental and applied. It is important but difficult to conduct. The willingness to do integrated research may be present but when it comes to the hard work of producing papers it is much more convenient to stay within the well-established areas. However, the problems faced nowadays need a broad perspective involving researchers from many areas and the challenge is to establish proper frameworks for this type of research. The present research programme represents in the Committee's view a strong contribution to this goal. The scope is ambitious but at the same time realistic about what its contribution can need in terms of time and resource constraints.

For successful realization of a programme like this, it is essential to develop a proper foundation for the multidisciplinary work: some common pillars for the research, without restricting the use of different approaches and paradigms when appropriate. The present programme has to some extent established such a foundation, for example by taking a systems view on risk assessment and management. It is recognized that risk arises in the design and use of technology and in confronting natural phenomena such as flooding and extreme weather, but that its control requires a coordinated and concerted effort not only at the on-line level of the use of technology by individuals or groups, but also on the level of organizational management of those interactions and at the higher system levels of government and the regulator. There is potential for strengthening of the programme by giving further attention to this issue.

The work is based on fundamental concepts like probability, uncertainty, risk and ignorance. However, the programme does not seem to point to a specific conceptual platform its

research is to be built on. This may not be desirable as it could put limitations to research. This concern has to be balanced against the desire to obtain an integrated research which does need some common pillars.

Productivity
The total research staff for the period is 65.7 FTE. The number of reviewed papers is 157, resulting in a rate of 2.4 papers per FTE. The corresponding rate for conference papers is 3.9. If tenured staff is taken as a reference (24.4 FTE) the rates become 6.5 and 10.6 respectively. In addition, the group has produced 8 books, 35 book chapters and 13 book editorships. Several of the members have been editors of journals (19). The group has produced 10 PhD theses in the period, which gives per tenured staff member a rate of 0.41.

The score on productivity is in the category of very good. The production certainly matches results obtained by other programmes internationally. Looking at the total research output, the Risk & Design group's scores are high and impressive.

Societal relevance
The programme scores in the category of very good to excellent. The fact that the group is used so extensively as experts for the media demonstrates the broadness of the societal impact of the work. Societal quality is clearly demonstrated by the many impacts the programme has had on public institutions and professional organizations and the strong position the group has in the international risk field. Master courses of high societal relevance have been developed as well as recently (from 2010) a specialization on Safety and Security in a master's programme. Other countries have had master programme specializations in safety and risk and even specific master programmes in these areas for many years.

Vitality and feasibility
The self-assessment provides a balanced SWOT analysis. A challenge for the group is the fact that the senior researchers reach retiring age. Talented young researchers have entered the Risk & Design programme, but yet the situation will require active management and follow-up.

Under the heading of quality some areas could be worthwhile to consider in future research in addition to the many ideas outlined in the self-evaluation report. Another issue that should be given due attention is the need for extended risk assessment approaches reflecting so-called black swans (surprises). Risk assessments are used to identify hazards/threats, to assess their consequences and to describe risk. The assessments provide a basis for evaluating whether risk is tolerable or acceptable and for choosing the most effective and efficient risk reduction measure. However, traditional assessments have strong limitations in their ability to reveal and adequately describe risk contributions from potential 'black swans'. The standard probabilistically based assessments have too narrow a perspective on uncertainties to be successful in this respect.

The research is certainly on an internationally high level and the work of the programme has had an important and substantial impact in the field. It has delivered strong contributions. The further development of the programme is strongly dependent on the ability to get internationally leading researchers replacing the professors who are retiring. The research programme is solid but, as discussed above, there is a potential for further developments, in particular related to the foundation of the programme.

5 B5 Philosophy of Technology, Design and Values

Programme leader:	Prof. P.A. Kroes, Prof. M.J. van den Hoven, Dr M. Franssen	
Research staff 2009:	15.62	
Assessments:	Quality:	4.75
	Productivity:	4.75
	Relevance:	4.75
	Viability:	5.0

Description

The programme's mission is to contribute to the overall aim of technology to improve the quality of human life through the philosophical and normative examination of modern technology, from a perspective focused on the design, development and implementation of technical artefacts by engineers in a societal context.

The programme has the following research objectives:

- Development of theories/frameworks for describing technical artefacts and modelling technical functions.
- Development of theories/frameworks for describing socio-technical systems including technical artefacts.
- Development of theories/frameworks for the analysis and comparison of functional decomposition of artefacts and systems.
- Development of case studies of and approaches to value-sensitive design.
- Development of conceptions of responsibility adequate for engineering practice.

The programme is structured through a focus on three domains:

1. moral issues in and about technology
2. engineering design
3. technical artefacts and socio-technical systems.

The research approach is primarily philosophical.

The research programme provided the following information on input and results.

Table 5B9 Research capacity of Philosophy of Technology

Research capacity in FTE	2003	2004	2005	2006	2007	2008	2009	Total
Tenured staff	2.93	3.59	3.88	3.96	4.02	4.86	4.97	23.24
Non-tenured staff	1.25	0.95	1.70	1.07	0.97	2.52	4.50	8.46
PhD students	3.10	3.05	2.65	3.35	5.35	5.00	6.15	22.50
Total research staff	7.28	7.59	8.23	8.38	10.34	12.38	15.62	55.20

Table 5B10 Results of Philosophy of Technology

Results	2003	2004	2005	2006	2007	2008	2009	Total
Refereed papers	6	9	15	27	15	20	24	116
Non-refereed papers	0	0	0	0	0	0	1	1
Books	2	1	0	0	0	1	5	9
Book chapters	2	5	14	4	6	10	33	74

PhD theses	0	0	2	0	2	1	0	5
Conference papers	4	12	13	14	12	16	15	86
Academic publications	14	27	44	45	35	48	78	291
Professional publications	4	9	9	6	9	10	6	53
General public publications	2	4	4	1	3	2	1	17
Journal editorships	2	5	4	7	4	9	11	42
Remaining	8	18	17	14	16	21	18	112
Other publications	16	36	34	28	32	42	36	224
Total publications	30	63	78	73	67	90	114	515

Assessment

Quality
This review reflects the period during which the programme began (in 2003), gained momentum and established a leadership role in philosophy of technology. The programme did this both independently and in partnership with the philosophy groups at Eindhoven and Twente. It is worth noting that because of research being done at these three universities, the Netherlands is now recognized as the best place to study philosophy of technology, especially ethics and technology, and the place with the most concentrated efforts and significant activity in the field. The 3TU Ethics Centre is the most visible evidence of this accomplishment and the Delft group has had a leadership role in this endeavour. With a grant from NWO, the 3TU Ethics Centre will begin a PhD programme in the autumn of 2010.

The programme is highly original in using philosophical expertise to illuminate engineering and technology and thereby providing important concepts, theories, understanding to philosophy, to engineering and to policy makers. The programme is coherent in the themes it has adopted with the latest focus being on value-sensitive design. This focus situates the programme to address real-world problems of the 21st century.

The programme is collaborating effectively with other programmes in the Faculty, with other Dutch philosophers and with other programmes in Europe, Australia and the USA. These collaborations and success at bringing in external funding has allowed the programme to grow significantly during the period under review. The programme has doubled in FTE by increasing the number of tenured and non-tenured staff and PhD students.

The quality of the publications of this group is excellent. The publications are internationally well known and generally acknowledged as a major contribution to the field. These publications appear in the best journals in the field and in books published by the most renowned book publishers

Productivity
The publication strategy has been highly successful. During the period under review numbers of academic publications increased steadily and strongly from a total of 14 in 2003 to an impressive total of 78 in 2009.

The programme's success in obtaining external research funds is impressive in that there is no tradition or expectation in philosophy that scholars are to find support for their research. Thus, the kind of projects they engage in, the level of funding they obtain and the fact that they have sustained this for more than a few years is extraordinary. Because the programme is a philosophy programme, quantitative comparisons with other programmes in the Faculty are not a good measure of success. The most notable difference is that books are much more highly valued in philosophy. Using quantitative tools, books count as only one publication

whereas the time and effort it takes to produce a book is much greater than for a paper, and books often have greater impact. The group's publications appear both in first-rate philosophy journals and in leading engineering journals.

Societal relevance
The programme defines its mission and its activities to be socially relevant; it takes as its mission to 'contribute to the overall aim of technology to improve the quality of human life'. It does this through a focus on three domains: moral issues in and about technology, engineering design, and technical artefacts and socio-technical systems.

Vitality and feasibility
Scholars in the programme are energetic and entrepreneurial. They have effectively leveraged their talents through collaborations (in Delft, in the Netherlands and internationally). They have been especially successful in showing the value of philosophical analysis to contemporary issues. The programme seems to be well-managed. It has built a programme of international prominence and a reputation as the very best place to do philosophy of technology. The challenge now is to maintain that position, to contribute to the success of the 3TU Ethics Centre graduate programme, and to expand its research enterprise even further. The group ought to continue with its successful strategies. It ought to continue to collaborate effectively while at the same time seeking to establish its own distinct reputation.

The primary question that might be raised here is the sustainability of reliance on external funding. Continuous pressure to bring in external funding and to rely on this funding in order to maintain the programme is a challenge. External funding often involves taking on ever new topics, which can lead to a cycle of ups and downs. The programme would be stronger with support to persist through the down periods. Also, it seems there are many opportunities for collaboration within the Faculty that have not yet been pursued.

APPENDICES

Appendix A: Curricula vitae of members of the Committee

Gunnar Eliasson is emeritus professor in Industrial Economics/Dynamics at the Royal Institute of Technology (KTH), Stockholm, and Senior Researcher at the RATIO Institute, Stockholm. He has been economic expert to the OECD on several occasions and to numerous Swedish Government Committees. He built up a business forecasting unit at the Federation of Swedish Industries and established a Nordic cooperation in long-term economic assessments. He has frequently been a consultant to private Swedish and foreign firms. He initiated (in 1974) and headed for many years the micro (firm)-based macro simulation modelling project of the Swedish Economy, the MOSES project, which has been documented in many books and academic papers including an early presentation in the American Economic Review in 1977, and the more recent studies on the dynamics of entering a New Economy (2004) and the macroeconomic consequences of a more or less competent venture capital industry (2006). He has been heading a study at the Swedish Academy of Engineering Sciences (IVA) on bio security (bio terror defense and emergency preparedness, and has just published a study (Springer 2010) on spillovers around Swedish aircraft industry and public procurement as industrial policy.

Deborah G. Johnson is the Anne Shirley Carter Olsson Professor of Applied Ethics in the Department of Science, Technology, and Society in the School of Engineering and Applied Science of the University of Virginia. She is the author/editor of six books on computers and ethical issues. She has published over 50 papers in a variety of journals and edited volumes. She has taught in courses on ethical theory; information technology, ethics and policy; engineering ethics; and values and policy. During 1992-93 she was a Visiting Professor in the Department of Civil Engineering and Operations Research of Princeton University where she worked on a National Science Foundation (NSF) project on ethics and computer decision models. In 1994 and 1995, she received National Science Foundation funding to conduct workshops to prepare undergraduate students to teach courses and course modules on ethical and professional issues in computing. During 2000-2003, she was co-principal investigator for another NSF grant which offered workshops on teaching computer ethics using the Web.

Kingsley E. Haynes built the School of Public Policy out of The Institute of Public Policy which he founded in 1991. He teaches classes in environmental system management, policy analysis, urban planning methodology and regional economic development. His recent research activities have focused on minimum information forecasting and intelligent transport systems. Research methodology has been related to risk assessment and decisions under conditions of uncertainty, mathematical programming applications, and the relationship between regional economic development, science and technology policy and smart infrastructure on domestic and international competitiveness.
He has been involved in regional economic development, environmental planning and natural resource management since the early 1970's including projects in Montana's Yellowstone Basin, the Lake Michigan and Ohio river regions of the US Midwest, the Nile River-Lake Nasser regions of Egypt, the Sudan and the Texas Gulf Coast. Using mathematical programming techniques for evaluating resources utilization for energy facility localization

and economic simulation for community water supply alternatives, he has been active in state resource assessment in New Jersey, Texas, Indiana, Massachusetts and Virginia.
In 2006, he was elected a Fellow of the Regional Science Association International and, also in 2006, he presented the ninth lecture for the UNESCO-sponsored Megacities Foundation and the Netherlands Institute for City Innovation Studies on 'Infrastructure: The Glue of Megacities' in The Hague. Kingsley E. Haynes is an elected member of the US National Academy in Public Administration and holds the Ruth D. and John T. Hazel, MD Endowed Chair at the School of Public Policy George Mason University Fairfax.

Michael Howlett is the Burnaby Mountain Chair in the Department of Political Science at Simon Fraser University and Visiting Professor at the Lee Kuan Yew School of Public Policy in the National University of Singapore, specializing in public policy analysis, political economy and resource and environmental policy. He was founding member and Secretary-Treasurer (1995-2006) of the British Columbia Political Studies Association and co-editor of its Proceedings. He was also English language co-editor of the Canadian Journal of Political Science (2002-2006) and is currently administrative editor of the Canadian Political Science Review (2007-2010) and co-editor of the World Political Science Review, the Journal of Comparative Policy Analysis (Book Review Editor 2001-2006), Policy & Society, the University of Toronto Press Series in Comparative Political Economy and Public Policy, and the Policy Press International Library of Policy Analysis. He served on the Editorial Boards of Canadian Public Administration (1996-2003) and Policy Studies Journal (1992-2003) and currently sits on the Editorial Boards of State and Local Government Review and the Canadian Journal of Political Science.

Stefan Klein is Professor for Interorganizational Systems, Associate Dean for International Affairs and a Director of the European Research Centre for Information Systems (ERCIS) at the Department of Information Systems, Münster University. His current research areas are Electronic Business policies and strategies, development paths of interorganizational information systems, real-time communication and virtual organizations. Since 1990, he has done extensive research and consulting with partners from the public and private sectors on Electronic Commerce, Electronic Data Interchange, strategic information management, communication security, and the business impacts of interorganizational systems. Currently he is involved in the EU Framework Programme 6 Integrated Project ITAIDE, which aims to develop innovative solutions for secure and competitive cross-border trade.

Arthur Ringeling is a professor emeritus of Erasmus University Rotterdam with a chair in Public Administration. He wrote or edited more than 15 books, more than 100 chapters in books and periodicals and several reports on subjects such as instruments of public policy, policy theories, policy evaluation, administrative organization and culture and public decision making. He is the author of 'Het imago van de overheid' (The Image of Government, 1993, 2004). He was an invited speaker in numerous congresses and symposia.
He has teaching experience on undergraduate, graduate and post-doctoral levels. From 1989 to 2001 he was core-professor of the Netherlands School of Government, an organization that provides top-training for government officials. From 2004 to 2009 he was the academic dean of the School for Police Leadership. He acted as consultant for a number of ministries and other public organizations in the Netherlands, both on the political and on the

administrative level. From 2009 on, he has been the chairman of the Accreditation Committee of the European Association for Public Administration Accreditation.

Nico Vandaele is, since 2010, related to the Catholic University Leuven-Kortrijk, Leuven, Belgium. Before 2010, he was Professor of Operations Management at the Universities of Antwerp and Leuven, where he taught Supply Chain Management, Production Management, Project Management and Performance Analysis of Manufacturing Systems. His research interests include planning systems, factory physics and traffic modelling. He has published in leading journals like IIE Transactions, Management Science, Transportation Research, European Journal of Operational Research and Interfaces. He is active in several executive training programmes and is consultant for many companies such as InBev, Atlas Copco, IBM, Baxter and Johnson and Johnson.

Appendix B: Explanation of the SEP criteria and scores

The **four main criteria** for assessment are: Quality, Productivity, Relevance, and Vitality & Feasibility. The assessment on the institute level primarily focuses on strategy and organization, whereas the assessment on the level of the research group or programme primarily focuses on performance and activities of researchers and the results of their work (output and outcome).

Quality	The level or degree of excellence of the research, compared to accepted (international) standards in that field. The scope of the term 'research' is not limited to the research results. Research management, research policy, research facilities, PhD training and the societal relevance of research are considered integrated parts of the quality of work in an institute and its programmes.
Productivity	The relationship between input and output, judged in relation to the mission and resources of the institute.
Relevance	Social, economic and cultural relevance. Aspects to be considered are: • *Social quality*: efforts of the institute or group to interact in a productive way with stakeholders in society • *Social impact*: how research affects specific stakeholders or procedures in society • *Valorisation*: activities aimed at making research results available and suitable for application in products, processes and services. Committee members can also comment on relevance for the academic community, but the assessment should focus on societal relevance.
Vitality & feasibility	The ability to react adequately to important changes in the environment. Also a vision on the future is considered.

The **scores** on a five-point scale are:

5 Excellent	Research is world-leading. Researchers are working at the forefront of their field internationally and their research has an important and substantial impact in the field.
4 Very Good	Research is considered nationally leading. Research is internationally competitive and makes a significant contribution to the field.
3 Good	Research is considered internationally visible. Work is competitive on the national level and makes a valuable contribution in the international field.
2 Satisfactory	Research is nationally visible. Work adds to our understanding and is solid, but not exciting.
1 Unsatisfactory	Work is neither solid nor exciting, flawed in the scientific and/or technical approach, repetitions of other work, etc.

Appendix C : time schedule site visits

SCHEDULE Research review Technological Innovation Management & Policy 19-23 September				
Monday 20 September 2010: University of Twente (UT)				
9:00	Committee meeting, welcome by the Rector and the Dean Internal meeting Review Committee			
11:00	UT Institute management	P. Apers		
12:00	Lunch			
13:00	UT 3: Information Systems and Management of Change	J.J. van Hillegersberg		
14:00	UT 2: Operational Methods for Production and Logistics	W.H.M. Zijm		
15:00	UT 1: Finance & Accounting	H. de Groot		
16:00	UT PhD students Ruimte (Space)			
17.00	Short break preparation feedback			
17:30	Summary/feedback by chair to management and staff. Drinks with staff UT			
18:30	Dinner Committee			
21:00	*Travel to Eindhoven*			
Tuesday 21 September 2010: Eindhoven University of Technology (Tue)				
9:00	TUe Institute management (A): Bertrand (vice-dean I.E.) Hermus (administrative director), Meijers (vice-dean I.S.), Romme (dean)			
10:00	TUe 1: Human Performance Management	de Jonge/Demerouti		
11:00	TUe 3: New Product Development Processes	Langerak, Duijsters, Nijssen		
12:00	Lunch			
13:00	TUe 2: Information Systems (IS)	Grefen, Reijers		
14:00	TUe 6: Psychology of Human-Technology Interaction	Midden, IJsselsteijn, Kohlrausch		
15:00	TUe 5: Philosophy of Technology: Ethics and Epistemology of Innovation	Meijers, Houkes, Peterson		
16.00	TUe 7: Technology Flows, the Knowledge Economy and Economic Performance	Frenken, Snijders, Romijn		
17:00	TUe PhD students in two groups	9 PhD students		
18:00	Drinks with staff Tue			
19:00	Dinner Committee			
Wednesday 22 September 2010: TUe and Delft University of Technology (TUD)				
9:00	TUe Institute management (B): Frenken (director Ecis), van Houtum (director BETA), Romme and Hermus			
10:00	TUe 4: Production, Maintenance, Materials Coordination & Transportation	De Kok, Fransoo, Van Houtum		
11:00	TUe 9: System Innovations and Sustainability Transitions	Verbong, Schot		
12:00	TUe 8: Modern Societies in Transition	Schot, Oldenziel		
13:00	Lunch			
14:00	Summary/feedback by chair of the Committee to management and staff			

15:00	*Travel to Delft*			
17:00	Drinks with staff TUD			
18.00	Check in hotel			
20.00	Dinner Committee			
Thursday 23 September 2010: TUD				
8.30	TUD Rector TUD and Dean			
9:00	TUD Institute management			
9:30	TUD 2: Multi-actor systems	W.A.H. Thissen		
10:30	TUD 1: Innovation Systems	A.H. Kleinknecht		
11.30	TUD 3: Next Generation Infrastructures (NGinfra)	M.P.C. Weijnen		
12:30	Lunch			
13:30	TUD 4: Risk and design	B.J.M.Ale		
14:30	TUD 5: Philosophy of Technology, Design, and Values	P.A.Kroes		
15:30	TUD PhDs			
16.30	Committee meeting			
17:00	Summary/ feedback to Dean, Director of Research and programme leaders			
18:00	Committee meeting			