INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI 2005–2010

RC-Specific Evaluation of PARTICLE – Pharmaceutical Technology and Industrial Pharmacy

Seppo Saari & Antti Moilanen (Eds.)
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### Title:

### Summary:
Researcher Community (RC) was a new concept of the participating unit in the evaluation. Participation in the evaluation was voluntary and the RCs had to choose one of the five characteristic categories to participate.

Evaluation of the Researcher Community was based on the answers to the evaluation questions. In addition a list of publications and other activities were provided by the TUHAT system. The CWTS/Leiden University conducted analyses for 80 RCs and the Helsinki University Library for 66 RCs. Panellists, 49 and two special experts in five panels evaluated all the evaluation material as a whole and discussed the feedback for RC-specific reports in the panel meetings in Helsinki. The main part of this report is consisted of the feedback which is published as such in the report.

Chapters in the report:
1. Background for the evaluation
2. Evaluation feedback for the Researcher Community
3. List of publications
4. List of activities
5. Bibliometric analyses

The level of the RCs' success can be concluded from the written feedback together with the numeric evaluation of four evaluation questions and the category fitness. More conclusions of the success can be drawn based on the University-level report.

### RC-specific information:

| Main scientific field of research: | Pharmaceutical technology, industrial pharmacy, drug, drug product, formulation, drug delivery system, materials research, crystallization, polymorph screening, particle design, process induced transformations, nanotechnology, nanomaterials, PAT, protein pharmaceuticals, veterinary formulations, paediatric formulations |
| Participation category: | 1. Research of the participating community represents the international cutting edge in its field |
| RC's responsible person: | Yliruusi, Jouko |

### Keywords:
Research Evaluation, Meta-evaluation, Doctoral Training, Bibliometric Analyses, Researcher Community
Foreword

The evaluation of research and doctoral training is being carried out in the years 2010–2012 and will end in 2012. The steering group appointed by the Rector in January 2010 set the conditions for participating in the evaluation and prepared the Terms of Reference to present the evaluation procedure and criteria. The publications and other scientific activities included in the evaluation covered the years 2005–2010.

The participating unit in the evaluation was defined as a Researcher Community (RC). To obtain a critical mass with university-level impact, the number of members was set to range from 20 to 120. The RCs were required to contain researchers in all stages of their research career, from doctoral students to principal investigators (PIs). All in all, 136 Researcher Communities participated in this voluntary evaluation, 5857 persons in total, of whom 1131 were principal investigators. PIs were allowed to participate in two communities in certain cases, and 72 of them used this opportunity and participated in two RCs.

This evaluation enabled researchers to define RCs from the “bottom up” and across disciplines. The aim of the evaluation was not to assess individual performance but a community with shared aims and researcher-training activities. The RCs were able to choose among five different categories that characterised the status and main aims of their research. The steering group considered the process of applying to participate in the evaluation to be important, which lead to the establishment of these categories. In addition, providing a service for the RCs to enable them to benchmark their research at the global level was a main goal of the evaluation.

The data for the evaluation consisted of the RCs’ answers to evaluation questions on supplied e-forms and a compilation extracted from the TUHAT – Research Information System (RIS) on 12 April 2011. The compilation covered scientific and other publications as well as certain areas of scientific activities. During the process, the RCs were asked to check the list of publications and other scientific activities and make corrections if needed. These TUHAT compilations are public and available on the evaluation project sites of each RC in the TUHAT-RIS.

In addition to the e-form and TUHAT compilation, University of Leiden (CWTS) carried out bibliometric analyses from the articles included in the Web of Science (WoS). This was done on University and RC levels. In cases where the publication forums of the RC were clearly not represented by the WoS data, the Library of the University of Helsinki conducted a separate analysis of the publications. This was done for 66 RCs representing the humanities and social sciences.

The evaluation office also carried out an enquiry targeted to the supervisors and PhD candidates about the organisation of doctoral studies at the University of Helsinki. This and other documents describing the University and the Finnish higher education system were provided to the panellists.

The panel feedback for each RC is unique and presented as an entity. The first collective evaluation reports available for the whole panel were prepared in July–August 2011. The reports were accessible to all panel members via the electronic evaluation platform in August. Scoring from 1 to 5 was used to complement written feedback in association with evaluation questions 1–4 (scientific focus and quality, doctoral training, societal impact, cooperation) and in addition to the category evaluating the fitness for participation in the evaluation. Panellists used the international level as a point of comparison in the evaluation. Scoring was not expected to go along with a preset deviation.

Each of the draft reports were discussed and dealt with by the panel in meetings in Helsinki (from 11 September to 13 September or from 18 September to 20 September 2011). In these meetings the panels also examined the deviations among the scores and finalised the draft reports together.

The current RC-specific report deals shortly with the background of the evaluation and the terms of participation. The main evaluation feedback is provided in the evaluation report, organised according to the evaluation questions. The original material provided by the RCs for the panellists has been attached to these documents.
On behalf of the evaluation steering group and office, I sincerely wish to thank you warmly for your participation in this evaluation. The effort you made in submitting the data to TUHAT-RIS is gratefully acknowledged by the University. We wish that you find this panel feedback useful in many ways. The bibliometric profiles may open a new view on your publication forums and provide a perspective for discussion on your choice of forums. We especially hope that this evaluation report will help you in setting the future goals of your research.

Johanna Björkroth
Vice-Rector
Chair of the Steering Group of the Evaluation

Steering Group of the evaluation
Steering group, nominated by the Rector of the University, was responsible for the planning of the evaluation and its implementation having altogether 22 meetings between February 2010 and March 2012.

Chair
Vice-Rector, professor Johanna Björkroth

Vice-Chair
Professor Marja Airaksinen

Chief Information Specialist, Dr Maria Forsman
Professor Arto Mustajoki
University Lecturer, Dr Kirsi Pyhältö
Director of Strategic Planning and Development, Dr Ossi Tuomi
Doctoral candidate, MSocSc Jussi Vauhkonen
Panel members

CHAIR
Professor Lorenz Poellinger
Cancer biology, cell and molecular biology
Karolinska Institute, Sweden

VICE-CHAIR
Professor Cornelia van Duijn
Genetic epidemiology, Alzheimer’s disease and related disorders
Erasmus Medical Centre, the Netherlands

Professor Johanna Ivaska
Molecular cell biology, cell adhesion, cancer biology
University of Turku, VTT Technical Research Centre, Finland

Professor Olli Lassila
Immunology, medical microbiology
University of Turku, Finland

Professor Hans-Christian Pape
Neuroscience, neurophysiology
University of Münster, Germany

Professor Thomas Ruzicka
Dermatology, allergology
Ludwig-Maximilians-Universität (LMU) München, Germany

Professor Lars Terenius
Experimental alcohol and drug dependence research, mental disorders, preventive medicine
Karolinska Institute, Sweden

Professor Peter York
Physical pharmaceutics, pharmaceutical chemistry, pharmaceutical technology
University of Bradford, Great Britain

The panel, independently, evaluated all the submitted material and was responsible for the feedback of the RC-specific reports. The panel members were asked to confirm whether they had any conflict of interests with the RCs. If this was the case, the panel members disqualified themselves in discussion and report writing.

Added expertise to the evaluation was contributed by two evaluators outside the panels and by three members from the other panels.

External Experts
Professor Olli Carpén
Pathology, cancer cell metastasis
University of Turku
Finland

Professor Anders Linde
Oral biochemistry
Faculty of Odontology
Göteborg University
Sweden
Experts from the Other Panels
Professor Jan-Otto Carlsson, from the Panel of Natural Sciences
Professor Danny Huylebroek, from the Panel of Biological, Agricultural and Veterinary Sciences
Professor Holger Stark, from the Panel of Natural Sciences

EVALUATION OFFICE
Dr Seppo Saari, Doc., Senior Adviser in Evaluation, was responsible for the entire evaluation, its planning and implementation and acted as an Editor-in-chief of the reports.
Dr Eeva Sievi, Doc., Adviser, was responsible for the registration and evaluation material compilations for the panellists. She worked in the evaluation office from August 2010 to July 2011.
MSocSc Paula Ranne, Planning Officer, was responsible for organising the panel meetings and all the other practical issues like agreements and fees and editing a part the RC-specific reports. She worked in the evaluation office from March 2011 to January 2012.
Mr Antti Mollanen, Project Secretary, was responsible for editing the reports. He worked in the evaluation office from January 2012 to April 2012.

TUHAT OFFICE
Provision of the publication and other scientific activity data
Mrs Aija Kaitera, Project Manager of TUHAT-RIS served the project ex officio providing the evaluation project with the updated information from TUHAT-RIS. The TUHAT office assisted in mapping the publications with CWTS/University of Leiden.
MA Liisa Ekebom, Assisting Officer, served in TUHAT-RIS updating the publications for the evaluation. She also assisted the UH/Library analyses.
BA Liisa Jäppinen, Assisting Officer, served in TUHAT-RIS updating the publications for the evaluation.

HELSINKI UNIVERSITY LIBRARY
Provision of the publication analyses
Dr Maria Forsman, Chief Information Specialist in the Helsinki University Library, managed with her 10 colleagues the bibliometric analyses in humanities, social sciences and in other fields of sciences where CWTS analyses were not applicable.
Acronyms and abbreviations applied in the report

External competitive funding
AF – Academy of Finland
TEKES - Finnish Funding Agency for Technology and Innovation
EU - European Union
ERC - European Research Council
International and national foundations
FP7/6 etc. /Framework Programmes/Funding of European Commission

Evaluation marks
Outstanding (5)
Excellent (4)
Very Good (3)
Good (2)
Sufficient (1)

Abbreviations of Bibliometric Indicators
P - Number of publications
TCS – Total number of citations
MCS - Number of citations per publication, excluding self-citations
PNC - Percentage of uncited publications
MNCS - Field-normalized number of citations per publication
MNJS - Field-normalized average journal impact
THCP10 - Field-normalized proportion highly cited publications (top 10%)
INT_COV - Internal coverage, the average amount of references covered by the WoS
WoS – Thomson Reuters Web of Science Databases

Participation category
Category 1. The research of the participating community represents the international cutting edge in its field.
Category 2. The research of the participating community is of high quality, but the community in its present composition has yet to achieve strong international recognition or a clear break-through.
Category 3. The research of the participating community is distinct from mainstream research, and the special features of the research tradition in the field must be considered in the evaluation.
Category 4. The research of the participating community represents an innovative opening.
Category 5. The research of the participating community has a highly significant societal impact.

Research focus areas of the University of Helsinki
Focus area 1: The basic structure, materials and natural resources of the physical world
Focus area 2: The basic structure of life
Focus area 3: The changing environment – clean water
Focus area 4: The thinking and learning human being
Focus area 5: Welfare and safety
Focus area 6: Clinical research
Focus area 7: Precise reasoning
Focus area 8: Language and culture
Focus area 9: Social justice
Focus area 10: Globalisation and social change
1 Introduction to the Evaluation

1.1 RC-specific evaluation reports

The participants in the evaluation of research and doctoral training were Researcher Communities (hereafter referred to as the RC). The RC refers to the group of researchers who registered together in the evaluation of their research and doctoral training. Preconditions in forming RCs were stated in the Guidelines for the Participating Researcher Communities. The RCs defined themselves whether their compositions should be considered well-established or new.

It is essential to emphasise that the evaluation combines both meta-evaluation1 and traditional research assessment exercise and its focus is both on the research outcomes and procedures associated with research and doctoral training. The approach to the evaluation is enhancement-led where self-evaluation constituted the main information. The answers to the evaluation questions formed together with the information of publications and other scientific activities an entity that was to be reviewed as a whole.

The present evaluation recognizes and justifies the diversity of research practices and publication traditions. Traditional Research Assessment Exercises do not necessarily value high quality research with low volumes or research distinct from mainstream research. It is challenging to expose the diversity of research to fair comparison. To understand the essence of different research practices and to do justice to their diversity was one of the main challenges of the present evaluation method. Understanding the divergent starting points of the RCs demanded sensitivity from the evaluators.

1.2 Aims and objectives in the evaluation

The aims of the evaluation are as follows:

- to improve the level of research and doctoral training at the University of Helsinki and to raise their international profile in accordance with the University’s strategic policies. The improvement of doctoral training should be compared to the University’s policy.2
- to enhance the research conducted at the University by taking into account the diversity, originality, multidisciplinary nature, success and field-specificity,
- to recognize the conditions and prerequisites under which excellent, original and high-impact research is carried out,
- to offer the academic community the opportunity to receive topical and versatile international peer feedback,
- to better recognize the University’s research potential.
- to exploit the University’s TUHAT research information system to enable transparency of publishing activities and in the production of reliable, comparable data.

1.3 Evaluation method

The evaluation can be considered as an enhancement-led evaluation. Instead of ranking, the main aim is to provide useful information for the enhancement of research and doctoral training of the participating RCs. The comparison should take into account each field of science and acknowledge their special character.

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1 The panellists did not read research reports or abstracts but instead, they evaluated answers to the evaluation questions, tables and compilations of publications, other scientific activities, bibliometrics or comparable analyses.

2 Policies on doctoral degrees and other postgraduate degrees at the University of Helsinki.
The comparison produced information about the present status and factors that have lead to success. Also challenges in the operations and outcomes were recognized.

The evaluation approach has been designed to recognize better the significance and specific nature of researcher communities and research areas in the multidisciplinary top-level university. Furthermore, one of the aims of the evaluation is to bring to light those evaluation aspects that differ from the prevalent ones. Thus the views of various fields of research can be described and research arising from various starting points understood better. The doctoral training is integrated into the evaluation as a natural component related to research. Operational processes of doctoral training are being examined in the evaluation.

**Five stages of the evaluation method were:**

1. Registration – Stage 1
2. Self-evaluation – Stage 2
3. TUHAT\(^3\) compilations on publications and other scientific activities\(^4\)
4. External evaluation
5. Public reporting

### 1.4 Implementation of the external evaluation

**Five Evaluation Panels**

Five evaluation panels consisted of independent, renowned and highly respected experts. The main domains of the panels are:

1. biological, agricultural and veterinary sciences
2. medicine, biomedicine and health sciences
3. natural sciences
4. humanities
5. social sciences

The University invited 10 renowned scientists to act as chairs or vice-chairs of the five panels based on the suggestions of faculties and independent institutes. Besides leading the work of the panel, an additional role of the chairs was to discuss with other panel chairs in order to adopt a broadly similar approach. The panel chairs and vice-chairs had a pre-meeting on 27 May 2011 in Amsterdam.

The panel compositions were nominated by the Rector of the University 27 April 2011. The participating RCs suggested the panel members. The total number of panel members was 50. The reason for a smaller number of panellists as compared to the previous evaluations was the character of the evaluation as a meta-evaluation. The panellists did not read research reports or abstracts but instead, they evaluated answers to the evaluation questions, tables and compilations of publications, other scientific activities, bibliometrics and comparable analyses.

The panel meetings were held in Helsinki:

- On 11–13 September 2011: (1) biological, agricultural and veterinary sciences, (2) medicine, biomedicine and health sciences and (3) natural sciences.
- On 18–20 September 2011: (4) humanities and (5) social sciences.

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\(^3\) TUHAT (acronym) of Research Information System (RIS) of the University of Helsinki

\(^4\) Supervision of thesis, prizes and awards, editorial work and peer reviews, participation in committees, boards and networks and public appearances.
1.5 Evaluation material

The main material in the evaluation was the RCs’ self-evaluations that were qualitative in character and allowed the RCs to choose what was important to mention or emphasise and what was left unmentioned. The present evaluation is exceptional at least in the Finnish context because it is based on both the evaluation documentation (self-evaluation questions, publications and other scientific activities) and the bibliometric reports. All documents were delivered to the panellists for examination.

Traditional bibliometrics can be reasonably done mainly in medicine, biosciences and natural sciences when using the Web of Science database, for example. Bibliometrics, provided by CWTS/The Centre for Science and Technology Studies, University of Leiden, cover only the publications that include WoS identification in the TUHAT-RIS.

Traditional bibliometrics are seldom relevant in humanities and social sciences because the international comparable databases do not store every type of high quality research publications, such as books and monographs and scientific journals in other languages than English. The Helsinki University Library has done analysis to the RCs, if their publications were not well represented in the Web of Science databases (RCs should have at least 50 publications and internal coverage of publications more than 40%) – it meant 58 RCs. The bibliometric material for the evaluation panels was available in June 2011. The RC-specific bibliometric reports are attached at the end of each report.

The panels were provided with the evaluation material and all other necessary background information, such as the basic information about the University of Helsinki and the Finnish higher education system.

Evaluation material
1. Registration documents of the RCs for the background information
2. Self evaluation material – answers to the evaluation questions
3. Publications and other scientific activities based on the TUHAT RIS:
   3.1. statistics of publications
   3.2. list of publications
   3.3. statistics of other scientific activities
   3.4. list of other scientific activities
4. Bibliometrics and comparable analyses:
   4.1. Analyses of publications based on the verification of TUHAT-RIS publications with the Web of Science publications (CWTS/University of Leiden)
   4.2. Publication statistics analysed by the Helsinki University Library - mainly for humanities and social sciences
5. University level survey on doctoral training (August 2011)
6. University level analysis on publications 2005–2010 (August 2011) provided by CWTS/University of Leiden

Background material

University of Helsinki
- Basic information about the University of the Helsinki
- The structure of doctoral training at the University of Helsinki
- Previous evaluations of research at the University of Helsinki – links to the reports: 1998

The Finnish Universities/Research Institutes
- Finnish University system
- Evaluation of the Finnish National Innovation System
- The State and Quality of Scientific Research in Finland, Publication of the Academy of Finland 9/09.

The evaluation panels were provided also with other relevant material on request before the meetings in Helsinki.
1.6 Evaluation questions and material

The participating RCs answered the following evaluation questions which are presented according to the evaluation form. In addition, TUHAT RIS was used to provide the additional material as explained. For giving the feedback to the RCs, the panellists received the evaluation feedback form constructed in line with the evaluation questions:

1. Focus and quality of the RC’s research
   - Description of
     - the RC’s research focus.
     - the quality of the RC’s research (incl. key research questions and results)
     - the scientific significance of the RC’s research in the research field(s)
   - Identification of the ways to strengthen the focus and improve the quality of the RC’s research

The additional material: TUHAT compilation of the RC’s publications, analysis of the RC’s publications data (provided by University of Leiden and the Helsinki University Library)

A written feedback from the aspects of: scientific quality, scientific significance, societal impact, innovativeness
   - Strengths
   - Areas of development
   - Other remarks
   - Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

2. Practises and quality of doctoral training
   - Organising of the doctoral training in the RC. Description of the RC’s principles for:
     - recruitment and selection of doctoral candidates
     - supervision of doctoral candidates
     - collaboration with faculties, departments/institutes, and potential graduate schools/doctoral programmes
     - good practises and quality assurance in doctoral training
   - Identification of the RC’s strengths and challenges related to the practises and quality of doctoral training, and the actions planned for their development.

The additional material: TUHAT compilation of the RC’s other scientific activities/supervision of doctoral dissertations

A written feedback from the aspects of: processes and good practices related to leadership and management
   - Strengths
   - Areas of development
   - Other remarks
   - Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

3. The societal impact of research and doctoral training
   - Description on how the RC interacts with and contributes to the society (collaboration with public, private and/or 3rd sector).
   - Identification of the ways to strengthen the societal impact of the RC’s research and doctoral training.

The additional material: TUHAT compilation of the RC’s other scientific activities.

A written feedback from the aspects of: societal impact, national and international collaboration, innovativeness
   - Strengths
   - Areas of development
   - Other remarks
   - Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)
4. International and national (incl. intersectoral) research collaboration and researcher mobility
- Description of
  - the RC’s research collaborations and joint doctoral training activities
  - how the RC has promoted researcher mobility
- Identification of the RC’s strengths and challenges related to research collaboration and researcher mobility, and the actions planned for their development.

A written feedback from the aspects of: scientific quality, national and international collaboration
- Strengths
- Areas of development
- Other remarks
- Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

5. Operational conditions
- Description of the operational conditions in the RC’s research environment (e.g. research infrastructure, balance between research and teaching duties).
- Identification of the RC’s strengths and challenges related to operational conditions, and the actions planned for their development.

A written feedback from the aspects of: processes and good practices related to leadership and management
- Strengths
- Areas of development
- Other remarks
- Recommendations

6. Leadership and management in the researcher community
- Description of
  - the execution and processes of leadership in the RC
  - how the management-related responsibilities and roles are distributed in the RC
  - how the leadership- and management-related processes support
    - high quality research
    - collaboration between principal investigators and other researchers in the RC
    - the RC’s research focus
    - strengthening of the RC’s know-how
- Identification of the RC’s strengths and challenges related to leadership and management, and the actions planned for developing the processes

7. External competitive funding of the RC
- The RCs were asked to provide information of such external competitive funding, where:
  - the funding decisions have been made during 1.1.2005-31.12.2010, and
  - the administrator of the funding is/has been the University of Helsinki
- On the e-form the RCs were asked to provide:
  1) The relevant funding source(s) from a given list (Academy of Finland/Research Council, TEKES/The Finnish Funding Agency for Technology and Innovation, EU, ERC, foundations, other national funding organisations, other international funding organisations), and
  2) The total sum of funding which the organisation in question had decided to allocate to the RCs members during 1.1.2005–31.12.2010.

Competitive funding reported in the text is also to be considered when evaluating this point.

A written feedback from the aspects of: scientific quality, scientific significance, societal impact, innovativeness, future significance
- Strengths
- Areas of development
- Other remarks
- Recommendations

8. The RC’s strategic action plan for 2011–2013
- RC’s description of their future perspectives in relation to research and doctoral training.

A written feedback from the aspects of: scientific quality, scientific significance, societal impact, processes and good practices related to leadership and management, national and international collaboration, innovativeness, future significance
- Strengths
- Areas of development
9. Evaluation of the category of the RC in the context of entity of the evaluation material (1-8)

The RC’s fitness to the chosen participation category
A written feedback evaluating the RC’s fitness to the chosen participation category
- Strengths
- Areas of development
- Other remarks
- Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

10. Short description of how the RC members contributed the compilation of the stage 2 material
Comments on the compilation of evaluation material

11. How the UH’s focus areas are presented in the RC’s research?
Comments if applicable

12. RC-specific main recommendations based on the previous questions 1-11

13. RC-specific conclusions

1.7 Evaluation criteria

The panellists were expected to give evaluative and analytical feedback to each evaluation question according to their aspects in order to describe and justify the quality of the submitted material. In addition, the evaluation feedback was asked to be pointed out the level of the performance according to the following classifications:
- outstanding (5)
- excellent (4)
- very good (3)
- good (2)
- sufficient (1)

Evaluation according to the criteria was to be made with thorough consideration of the entire evaluation material of the RC in question. Finally, in questions 1-4 and 9, the panellists were expected to classify their written feedback into one of the provided levels (the levels included respective descriptions, ‘criteria’). Some panels used decimals in marks. The descriptive level was interpreted according to the integers and not rounding up the decimals by the editors.

Description of criteria levels

Question 1 – FOCUS AND QUALITY OF THE RC’S RESEARCH

Classification: Criteria (level of procedures and results)

Outstanding quality of procedures and results (5)

Outstandingly strong research, also from international perspective. Attracts great international interest with a wide impact, including publications in leading journals and/or monographs published by leading international publishing houses. The research has world leading qualities. The research focus, key research questions scientific significance, societal impact and innovativeness are of outstanding quality.

In cases where the research is of a national character and, in the judgement of the evaluators, should remain so, the concepts of “international attention” or “international impact” etc. in the grading criteria above may be replaced by “international comparability”.

10
Operations and procedures are of outstanding quality, transparent and shared in the community. The improvement of research and other efforts are documented and operations and practices are in alignment with the documentation. The ambition to develop the community together is of outstanding quality.

**Excellent quality of procedures and results (4)**
Research of excellent quality. Typically published with great impact, also internationally. Without doubt, the research has a leading position in its field in Finland.

Operations and procedures are of excellent quality, transparent and shared in the community. The improvement of research and other efforts are documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of excellent quality.

**Very good quality of procedures and results (3)**
The research is of such very good quality that it attracts wide national and international attention.

Operations and procedures are of very good quality, transparent and shared in the community. The improvement of research and other efforts are documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of very good quality.

**Good quality of procedures and results (2)**
Good research attracting mainly national attention but possessing international potential, extraordinarily high relevance may motivate good research.

Operations and procedures are of good quality, shared occasionally in the community. The improvement of research and other efforts are occasionally documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of good quality.

**Sufficient quality of procedures and results (1)**
In some cases the research is insufficient and reports do not gain wide circulation or do not have national or international attention. Research activities should be revised.

Operations and procedures are of sufficient quality, shared occasionally in the community. The improvement of research and other efforts are occasionally documented and operations and practices are to some extent in alignment with the documentation. The ambition to develop the community together is of sufficient quality.

**Question 2 – DOCTORAL TRAINING**

**Question 3 – SOCIETAL IMPACT**

**Question 4 – COLLABORATION**

**Classification: Criteria (level of procedures and results)**

**Outstanding quality of procedures and results (5)**
Procedures are of outstanding quality, transparent and shared in the community. The practices and quality of doctoral training/societal impact/international and national collaboration/leadership and management are documented and operations and practices are in alignment with the documentation. The ambition to develop the community together is of outstanding quality. The procedures and results are regularly evaluated and the feedback has an effect on the planning.

**Excellent quality of procedures and results (4)**
Procedures are of excellent quality, transparent and shared in the community. The practices and quality of doctoral training/societal impact/international and national collaboration/leadership and management are documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of excellent quality. The procedures and outcomes are evaluated and the feedback has an effect on the planning.

**Very good quality of procedures and results (3)**
Procedures are of very good quality, transparent and shared in the community. The practices and quality of doctoral training/societal impact/international and national collaboration/leadership and
management are documented and operations and practices are to large extent in alignment with the
documentation. The ambition to develop the community together is of very good quality.

**Good quality of procedures and results (2)**

Procedures are of good quality, shared occasionally in the community. The practices and quality of
doctoral training/societal impact/international and national collaboration/leadership and
management are documented and operations and practices are to large extent in alignment with the
documentation. The ambition to develop the community together is of good quality.

**Sufficient quality of procedures and results (1)**

Procedures are of sufficient quality, transparent and shared in the community. The practices and
quality of doctoral training/societal impact/international and national collaboration/leadership and
management are occasionally documented and operations and practices are to some extent in
alignment with the documentation. The ambition to develop the community together is of sufficient
quality.

**Question 9 – CATEGORY**

**Participation category – fitness for the category chosen**

The choice and justification for the chosen category below should be reflected in the RC’s responses to the
evaluation questions 1–8.

1. *The research of the participating community represents the international cutting edge in its field.*
2. *The research of the participating community is of high quality, but the community in its present
   composition has yet to achieve strong international recognition or a clear break-through.*
3. *The research of the participating community is distinct from mainstream research, and the special
   features of the research tradition in the field must be considered in the evaluation.* The research is
   of high quality and has great significance and impact in its field. However, the generally used
   research evaluation methods do not necessarily shed sufficient light on the merits of the
   research.
4. *The research of the participating community represents an innovative opening.* A new opening can
   be an innovative combination of research fields, or it can be proven to have a special social,
   national or international demand or other significance. Even if the researcher community in its
   present composition has yet to obtain proof of international success, its members can produce
   convincing evidence of the high level of their previous research.
5. *The research of the participating community has a highly significant societal impact.* The
   participating researcher community is able to justify the high social significance of its research.
   The research may relate to national legislation, media visibility or participation in social debate,
   or other activities promoting social development and human welfare. In addition to having
   societal impact, the research must be of a high standard.

**An example of outstanding fitness for category choice (5)**

The RC’s representation and argumentation for the chosen category were convincing. The RC recognized
its real capacity and apparent outcomes in a wider context to the research communities. The specific
character of the RC was well-recognized and well stated in the responses. The RC fitted optimally for the
category.

- Outstanding (5)
- Excellent (4)
- Very good (3)
- Good (2)
- Sufficient (1)

The above-mentioned definition of outstanding was only an example in order to assist the panellists in
the positioning of the classification. There was no exact definition for the category fitness.

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5 The panels discussed the category fitness and made the final conclusions of the interpretation of it.
1.8 Timetable of the evaluation

The main timetable of the evaluation:

1. Registration   November 2010
3. External peer review    May–September 2011
4. Published reports  March–April 2012
   - University level public report
   - RC specific reports

The entire evaluation was implemented during the university’s strategy period 2010–2012. The preliminary results were available for the planning of the following strategy period in late autumn 2011. The evaluation reports will be published in March/April 2012. More detailed time schedule is published in the University report.

1.9 Evaluation feedback – consensus of the entire panel

The panellists evaluated all the RC-specific material before the meetings in Helsinki and mailed the draft reports to the evaluation office. The latest interim versions were on-line available to all the panellists on the Wiki-sites. In September 2011, in Helsinki the panels discussed the material, revised the first draft reports and decided the final numeric evaluation. After the meetings in Helsinki, the panels continued working and finalised the reports before the end of November 2011. The final RC-specific reports are the consensus of the entire panel.

The evaluation reports were written by the panels independently. During the editing process, the evaluation office requested some clarifications from the panels when necessary. The tone and style in the reports were not harmonized in the editing process. All the reports follow the original texts written by the panels as far as it was possible.

The original evaluation material of the RCs, provided for the panellists is attached at the end of the report. It is essential to notice that the exported lists of publications and other scientific activities depend how the data was stored in the TUHAT-RIS by the RCs.
2 Evaluation feedback

2.1 Focus and quality of the RC’s research

- **Description of**
  - the RC’s research focus
  - the quality of the RC’s research (incl. key research questions and results)
  - the scientific significance of the RC’s research in the research field(s)
- **Identification of the ways to strengthen the focus and improve the quality of the RC’s research**

**ASPECTS:** Scientific quality, scientific significance, societal impact, innovativeness

PARTICLE, composed of 45 researchers plus 10 licentiate candidates for industrial pharmacy, with 3 PIs including Professor Juppo who was appointed to the new chair of Industrial Pharmacy in 2007, is based in the Faculty of Pharmacy. The research focuses of the three groups in the RC are distinctly different with some overlap of areas of study which enables collaboration and doctoral co-supervision. Current research is focussed on solid dosage forms of medicines with specific activity in solid state materials science and formulation design and functionalized nanotechnological controlled release forms, targeting studies at the molecular level to provide mechanistic understanding of material behaviour during formulation and processing. Such understanding is important in the optimisation of the design and processing of solid dosage forms for therapeutic performance, the work is distinct from other RCs activities, and the researchers are making important contributions in this field. With the immanent contributions to new research field, a higher participation in IP protection (mostly patents) should be envisaged.

Trends and field-averaged publication figures from the bibliographic analyses show a creditable annual publication record (averaging approximately 25 papers/year) with average values for MNCS and MNJS. Whilst 10 of the 142 papers were published in RC regarded high impact value journals, this aspect of publication policy should be addressed by the RC, with discussion and planned action to increase this number and proportion. The RC has a strong record of output of PhD theses (22 during the evaluation period) with 6 doctoral graduates gaining professorships in Finland and overseas.

Future research plans propose additional collaboration with top universities and EU consortia, and a newly formed international cluster in the focussed field of study of the RC. As mentioned above, the targeting of appropriate journals with high impact for publishing outputs is, and should be, reviewed to raise the international profile and reputation of the RC.

Overall, the RC operates at a high standard nationally with a focused research agenda with impressive doctoral programme and output. Attention needs to be given to elevating the international standing. Appropriate plans are outlined which will help to address this requirement.

**Numeric evaluation:** 3 (Very good)

2.2 Practises and quality of doctoral training

- **Organising of the doctoral training in the RC. Description of the RC’s principles for:**
  - recruitment and selection of doctoral candidates
  - supervision of doctoral candidates
  - collaboration with faculties, departments/institutes, and potential graduate schools/doctoral programmes
  - good practises and quality assurance in doctoral training
  - assuring of good career perspectives for the doctoral candidates/fresh doctorates
- **Identification of the RC’s strengths and challenges related to the practises and quality of doctoral training, and the actions planned for their development.**
Additional material: TUHAT compilation of the RC's other scientific activities/supervision of doctoral dissertations

ASPECTS: Processes and good practices related to leadership and management

The recruitment and supervisory processes for doctoral students are in accord with good practice and sound procedures. All doctoral students are closely mentored and their progress is monitored during studies via a supervisory panel headed by a professor. Most students are members of the Graduate School of Pharmaceutical Research, and training complies with high quality Graduate School instructions and governance.

The RC has participated in numerous research and training programmes with academia in Helsinki and other universities in Finland, and the international collaborations of RC staff provide opportunities for periods of overseas study for students which is encouraged, as is participation at international conferences.

The number of completed PhD theses during the period of evaluation (22) is impressive and the RC should be congratulated on this figure. Nevertheless attention should be given promptly to several identified challenges, especially to greater interaction between students and research staff in the three groups in the RC and in initiating joint doctoral training programmes.

Some general problem-oriented teaching studies based on theoretical or practical components with large overlap within the different groups of this RC may help to increase the information exchange and cross-interactions.

**Numeric evaluation: 3 (Very good)**

### 2.3 The societal impact of research and doctoral training

- **Description on how the RC interacts with and contributes to the society (collaboration with public, private and/or 3rd sector).**
- **Identification of the ways to strengthen the societal impact of the RC’s research and doctoral training.**
- **Additional material: TUHAT compilation of the RC’s other scientific activities.**

ASPECTS: Societal impact, national and international collaboration, innovativeness

The major societal impact as identified by the RC is the development, formulation and manufacturing of medicines, together with industrial collaboration and the education of postgraduate students (PhD and MSc). With the RC providing the major source of training and academic know-how in the field of pharmaceutical development in Finland, it is important that this facility and resource is recognised and supported.

Through careful pre-evaluation of suitable research programmes, the industrial links can augment relevance and timeliness to the RC research activity and an appropriate balance between fundamental and applied work is necessary. However, it is not clear how decisions on how this balance is debated, agreed and reached across the RC, and clear guidelines should be established if not already in place. Despite the clearly seen need of pharmaceutical industry for IP protection some new models should be tested, e.g. open innovation, and then may be taken as new examples for effective and productive co-operations.

The RC has communicated their findings and knowledge gained via the regular and appropriate channels – publications, conference participation, and a number of invited and plenary lectures at international symposia. Increasing the frequency of such invited presentations would also help to raise the international profile of the RC. Contributions have also been made to other media formats, as well as participation in national and international professional and scientific committees, and editorial and reviewing activity for a range of scientific journals.

The RC also comments correctly to the need to incorporate ethical aspects, such as environmental impact, into account in research and educational strategies.

**Numeric evaluation: 3 (Very good)**
2.4 International and national (incl. intersectoral) research collaboration and researcher mobility

- **Description of**
  - the RC’s research collaborations and joint doctoral training activities
  - how the RC has promoted researcher mobility
- **Identification of the RC’s strengths and challenges related to research collaboration and researcher mobility, and the actions planned for their development.**

**ASPECTS: Scientific quality, national and international collaboration**

The RC has an extensive portfolio of national and international collaboration in research and doctoral training including multidisciplinary projects. Funding is generally via TEKES, Academy of Finland, EU and industry. The RC benefits from a large number of international exchanges for researchers and students and has attracted numerous postgraduate students and researchers from overseas during the period of assessment. These exchanges are encouraged and will add to the overall reputation of the RC. The RC’s membership of the newly formed international Pharmaceutical Solid State Research Cluster will undoubtedly aid this process. With this additional vehicle for exchange, the RC may wish to consider the introduction of a requirement for a period of overseas study during the doctoral training programme, given the major benefits likely to result for students and the RC from such experiences. Within the leadership some European network or EU grant would greatly help on the international visibility and the further co-operations with smaller European biotech companies.

**Numeric evaluation: 4 (Excellent)**

2.5 Operational conditions

- **Description of the operational conditions in the RC’s research environment (e.g. research infrastructure, balance between research and teaching duties).**
- **Identification of the RC’s strengths and challenges related to operational conditions, and the actions planned for their development.**

**ASPECTS: Processes and good practices related to leadership and management**

The research infrastructure is regarded as of high quality and extensive and impressive resources are available to cover the most of the experimental demands of the RC’s research activities. Other specialised equipment is available via collaborations. RC members are involved in teaching, including provision of advanced courses related to research topics.

Challenges are the continuing maintenance of research facilities and resource, and due to the turnover of researchers’ maintenance of know-how for existing equipment. The plan to minimise this issue by increasing collaboration with alumni is sound, as is the proposed hiring of a laboratory engineer by the Faculty of Pharmacy.

2.6 Leadership and management in the researcher community

- **Description of**
  - the execution and processes of leadership in the RC
  - how the management-related responsibilities and roles are distributed in the RC
  - how the leadership- and management-related processes support
    - high quality research
    - collaboration between principal investigators and other researchers in the RC
    - the RC’s research focus
strengthening of the RC's know-how
• Identification of the RC's strengths and challenges related to leadership and management, and the actions planned for developing the processes
ASPECTS: Processes and good practices related to leadership and management

The procedures outlined are appropriate, with the professorial PIs taking leadership and mentoring roles. The detailed well-functioning management team could also be used to address the identified need for greater inter-group and inter-Faculty collaborations, as well as providing a means to promote inter-group information flow.

2.7 External competitive funding of the RC

- The RCs were asked to provide information of such external competitive funding, where:
  - the funding decisions have been made during 1.1.2005–31.12.2010, and
  - the administrator of the funding is/has been the University of Helsinki
- On the e-form the RCs were asked to provide:
  1) The relevant funding source(s) from a given list (Academy of Finland/Research Council, TEKES/The Finnish Funding Agency for Technology and Innovation, EU, ERC, foundations, other national funding organisations, other international funding organizations), and
  2) The total sum of funding which the organisation in question had decided to allocate to the RCs members during 1.1.2005–31.12.2010.

Competitive funding reported in the text is also to be considered when evaluating this point.
ASPECTS: Scientific quality, scientific significance, societal impact, innovativeness and future significance

The overall external funding approximates to €8m which indicates a high level of success with peer-reviewed and competitive grant applications. Increased applications for EU supported activities and funding would help in strengthening international standing of the RC.

2.8 The RC’s strategic action plan for 2011–2013

- RC’s description of their future perspectives in relation to research and doctoral training.
ASPECTS: Scientific quality, scientific significance, societal Impact, processes and good practices related to leadership and management, national and international collaboration, innovativeness, future significance

The RC aims to build upon its current strengths of multidisciplinarity in its research focus, especially for preclinical formulation and mechanistic understanding of material and processing behaviour in the design and manufacture of solid dosage medicines.

Additional cooperation and collaboration between the three groups in the RC is encouraged, as well as forging links with other RCs researching in complimentary areas of the pharmaceutical sciences (e.g. DePoNa, MAC).

2.9 Evaluation of the category of the RC in the context of entity of the evaluation material (1-8)

The RC’s fitness to the chosen participation category.
Category 1. The research of the participating community represents the international cutting edge in its field.

The focused research agenda of the PARTICLE RC delivered through the three groups brings forward a quality research output and doctoral training programme and understanding and knowledge regarding the
materials and processes used when preparing solid dosage medicines. The evidence for societal impact and innovation at the national level and international level is clear, although progress needs to be made to register and extend the performance at the international level. The overall assessment, and numerical assessment, lead to the view that the activities and performance of the RC at this stage of its development are more in line with participation category 2 (The research of the participating community is of high quality, but the community in its present composition has yet to achieve strong international recognition or a clear break-through), rather than the proposed participation category 1.

**Numeric evaluation: 3 (Very good)**

### 2.10 Short description of how the RC members contributed the compilation of the stage 2 material

Satisfactory and appropriate with broad based consultation prior to final compilation of the documents.

### 2.11 How the UH’s focus areas are presented in the RC’s research

The RC has not selected a specific UH focus area under background information stage 2 documentation, but highlights their work in applied material science. The RC should be asked to indicate which UH focus group they wish to select.

### 2.12 RC-specific main recommendations

The collaborative and distinct research work of the RC, and its particular value to the Finnish community, is recognized and especially the quality and numerical output of the doctoral training programme. However the self-identified need for additional inter-group collaboration within the RC should receive the attention of the PIs and be resolved.

An important aspect for the RC is to address the recommendation to increase the number of publications submitted to high ranking and impact journals. Achieving some success in this arena will provide much strength and add reputation to the RC’s current standing, especially on the international stage.

The membership of the RC in the IPSSRC is seen as important, and a recommendation is for the RC to take a leading role in this cluster. Such investment of time and effort would bear fruit in strengthening collaborative opportunities and facilitate further the exchange, short term and long term, of both researchers and doctoral students across the EU.

### 2.13 RC-specific conclusions

The Panel were encouraged to note the strengths of the multidisciplinary research and doctoral training programmes undertaken by the RC. The Panel also recognized the importance of the areas of study of the RC in their societal contribution, especially in providing the major source of trained personnel to support the development sector of the pharmaceutical industry in Finland.

A key recommendation for the RC is to focus attention on their publication strategy, and seek to secure more of their work being published in leading and high impact journals. Success in this area will add to the growing standing of the RC and help in building a stronger international reputation.
3 Appendices

A. Original evaluation material
   a. Registration material – Stage 1
   b. Answers to evaluation questions – Stage 2
   c. List of publications
   d. List of other scientific activities

B. Bibliometric analyses
   a. Analysis provided by CWTS/University of Leiden
   b. Analysis provided by Helsinki University Library (66 RCs)
NAME OF THE RESEARCHER COMMUNITY:
Pharmaceutical Technology and Industrial Pharmacy (PARTICLE)

LEADER OF THE RESEARCHER COMMUNITY:
Professor Jouko Yliruusi, Faculty of Pharmacy

RC-SPECIFIC MATERIAL FOR THE PEER REVIEW:

- Material submitted by the RC at stages 1 and 2 of the evaluation
- STAGE 1 material: RC’s registration form (incl. list of RC participants in an excel table)
- STAGE 2 material: RC’s answers to evaluation questions
- TUHAT compilations of the RC members’ other scientific activities 1.1.2005-31.12.2010
  (analysis carried out by CWTS, Leiden University)

NB! Since Web of Science(WoS)-based bibliometrics does not provide representative results for most RCs representing humanities, social sciences and computer sciences, the publications of these RCs will be analyzed by the UH Library
(results available by the end of June, 2011)
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RC-SPECIFIC STAGE 1 MATERIAL (registration form)

1 RESPONSIBLE PERSON

Name: Yliruusi, Jouko
E-mail: jouko.yliruusi@helsinki.fi
Phone: 09-19159145
Affiliation: Faculty of Pharmacy
Street address: Viikinkaari 5 E

2 DESCRIPTION OF THE PARTICIPATING RESEARCHER COMMUNITY (RC)

Name of the participating RC (max. 30 characters): Pharmaceutical Technology and Industrial Pharmacy
Acronym for the participating RC (max. 10 characters): PARTICLE
Description of the operational basis in 2005-2010 (eg. research collaboration, joint doctoral training activities) on which the RC was formed (MAX. 2200 characters with spaces): The Pharmaceutical Technology and Industrial Pharmacy research community (PARTICLE) forms a coherent administrative and research unit in the Faculty of Pharmacy, University of Helsinki. This group uses the same facilities and equipment and organizes common post graduate courses and seminars. We have strategically planned so that the research areas of three professors (PIs) in this RC (Yliruusi, Hirvonen and Juppo) are different, but there is some overlap and close collaboration and thesis supervision. By covering a coherent and supportive area of expertise we are able to give a good, versatile and up-to-date doctoral training for our PhD students. Prof. Yliruusi’s area of research is solid state research and pharmaceutical processes. Prof. Hirvonen is focusing in nanotechnologies, nanomaterials, poorly water soluble drugs and controlled release drug delivery systems. Prof. Juppo is responsible for a novel discipline, Industrial Pharmacy, which covers, e.g., pharmaceutical product development, manufacturing, marketing, whole sale trade and quality assurance, paediatric and veterinary drug formulations and protein drug formulations. Thus, there is a clear synergy between the research topics of all members, as the research of this PARTICLE RC is focussed mainly on solid dosage forms. It should be noted that this particular RC evaluated here, unlike most Pharmaceutics units in many Universities, does not include primary biopharmaceutical research focus, since in the Faculty of Pharmacy there is a strong Division on Biopharmaceutics and CDR research unit separately.

3 SCIENTIFIC FIELDS OF THE RC

Main scientific field of the RC’s research: medicine, biomedicine and healt sciences
RC’s scientific subfield 1: Pharmacology and Pharmacy
RC’s scientific subfield 2: TECHNOLOGY AND ENGINEERING
RC’s scientific subfield 3: Engineering, Manufacturing
RC’s scientific subfield 4: Materials Science, Multidisciplinary
Other, if not in the list: Pharmaceutical Technology
PARTICIPATION CATEGORY

Justification for the selected participation category (MAX. 2200 characters with spaces): PARTICLE unit participates in category 1. Our research is highly focused in 1. Solid state materials and drug development processes/formulations, 2. Development of functionalized nanotechnological controlled release systems and their drug delivery and safety studies, and 3. Protein drug formulations research. The unit has long tradition of exceptionally productive doctoral education with numerous international awards for the supervisors and the Ph. D. graduates. During 2005-2010, the 3-4 principal investigators and 6-8 senior researchers and post-docs at a time produced more than 100 peer reviewed original research articles and 22 Ph. D. theses (more than 1/3 of the six disciplines in the Faculty). Two theses (J. Aaltonen, S. Mirza) were awarded international AAPS Awards and one (S. Hirsjärvi) national Albert Wuokko Prize as the best theses in pharmaceutical sciences that year. Professor J. Yliruusi received also the prestigious Albert Wuokko Award for his solid state drug research and excellent researcher education (2009), while Prof. J. Hirvonen was awarded the CRS/Eurand Grand Prize in 2007 (Novel Approaches in Oral Drug Delivery), post-doc T. Laaksonen the national Komppa Prize for the best thesis in Chemistry (2008), and post-doc H. Santos the Talent Award in Science by the Portuguese Government, Ministry of Foreigner Affairs (2010). A. Juppo from AstraZeneca was nominated as the first Professor of Industrial Pharmacy in 2006, which further strengthened the collaboration with pharmaceutical industry. Of the former PARTICLE members, 7 professors were nominated during the evaluation period (J. Rantanen in Copenhagen, N. Sandler in Åbo Akademi, J. Heinämäki in Tartu, H. Guo in Shangdon, H.A. Rashid in Bangladesh, Meike Römer in Münster and M. Cerveza in Habana). Collegial and collaborative leadership and management practices in PARTICLE, together with challenging yet encouraging examples of the unit leaders and senior members, have created an excellent atmosphere and motivation for self-development of the younger scientists for academic drug research and research-based education, with excellent prospects for the future careers also in national and international.

DESCRIPTION OF THE RC’S RESEARCH AND DOCTORAL TRAINING

Public description of the RC’s research and doctoral training (MAX. 2200 characters with spaces): The goal of the oral solid state drug research oriented PARTICLE RC and the researchers involved is to promote scientific excellence in the fields of drug formulations and applied materials sciences. To accomplish this, the unit will identify and promote multidisciplinary research on essential areas in pharmaceutical technology and industrial pharmacy: Development of novel drug delivery systems, drug formulation studies, pharmaceutical materials research, physical process research and selected research topics in industrial pharmacy.

The research in the PARTICLE RC has been organised in few smaller research groups. Oral drug delivery route (the most common way to administer drugs) is the main focus area in the drug delivery systems and formulations. The solid state research project topics range from crystallization, polymorph screening.
particle formation, process induced transformations, process analytical technologies (PAT), nanotechnological materials and drug formulations, protein pharmaceuticals, and veterinary and paediatric formulations.

The main training objectives of the RC are:

- to educate a top-level specialists within the field of selected research topics
- to motivate young researchers in the present fields of research by promoting the mobility and internationalisation
- to give possibilities to cross-utilize advanced methodologies and equipment in the laboratories of partner institutions
- to acquire skills and ability to build up new competitive research and training also in the future.

By careful design of research projects, and complementary career development plans, the young researchers will acquire multidisciplinary and interdisciplinary skills, yet approaching increased independence during the process towards the thesis and post doctoral training.

The PARTICLE RC believes in the training-through-research combined with high level ethics, social and management skills. Mainly these are taught and learned by setting examples, in every-day practical research and communication.

Significance of the RC's research and doctoral training for the University of Helsinki (MAX. 2200 characters with spaces): PARTICLE RC doctoral productivity has been very high for years. Still we have been able to keep up good and often excellent scientific level. The well organized and effective doctoral training produces continuously better researchers and better teachers for the University. The societal impact of our research is mostly due to the research results which can easily be adapted to the benefit of pharmaceutical academic and industry research. Many research projects are done in collaboration with the pharmaceutical industry.

Integration of research and teaching is essential part of our training program. In every day teaching practice it is important that knowledge is quickly transferred also for undergraduate level students.

So far all our finalised Ph.D. students (totally 22 during the evaluation period) have received permanent positions or are continuing their research as post doctoral researchers. PARTICLE RC is multinational and we have lot of connections to various materials science and other groups world-widely. This keeps our research items up-to-date and also supports students visits abroad.

During the evaluation period the RC has been able to get a lot of external funding. Practically all research and in some years also about 50% of teaching hours have been paid by external funding.
INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

RC-SPECIFIC STAGE 1 MATERIAL (registration form)

The RC believes in the training-through-research combined with high level ethics, social and management skills. In practice, ethical issues and social and management skills are mainly taught and learned by setting examples, in every-day practical research and communication. In successful research training one of the most important issue is real commitment of both teachers and students. When a young researchers starts as a new member in our RC, he/she in practice invests his/her whole life – in return the RC honestly takes care of the new-comer by all measures in its power.

Keywords: pharmaceutical technology, industrial pharmacy, drug, drug product, formulation, drug delivery system, materials research, crystallization, polymorph screening, particle design, process induced transformations, nanotechnology, nanomaterials, PAT, protein pharmaceuticals, veterinary formulations, paediatric formulations.

6 QUALITY OF RC'S RESEARCH AND DOCTORAL TRAINING

Justified estimate of the quality of the RC's research and doctoral training at national and international level during 2005-2010 (MAX. 2200 characters with spaces): Number of original publications during the evaluation period is over 100. Majority of the publications are published in high impact peer-reviewed journals.

Totally seven of our earlier students and researchers have obtained Professorship outside the University of Helsinki (Jukka Rantanen, Denmark/Copenhagen; Jyrki Heinämäki, Estonia/Tartu; Niklas Sandler, Finland/Åbo Akademi; Hongxia Guo, Shandong/China; Harun Rashid Ar, Northern University/Bangladesh; Meike Römer, Munster/Germany; Mirna Cervera Havana/Cuba)

Many of our post doctoral researchers have spent one or more years abroad at various high level research teams. For example, currently Ph.D. Mirza Sabiruddin is on his post-doctoral year at Harvard University/USA, Ph.D. Samuli Hirsjärvi at University of Angers/France and Ph.D. Sanna Siissalo at Groningen University/Netherlands. At the end of this year, Ph.D. Inna Miroshnyk, is starting her post doctoral year at Massachusetts Institute of Technology/USA.

During the years, four of our students Ph.D. Theses have been awarded by the American Association of Pharmaceutical Sciences Outstanding Graduate Student Research Award (Jukka Rantanen, Niklas Sandler, Jaakko Aaltonen, Sabiruddin Mirza), In 2008 Samuli Hirsjärvi obtained Albert Wuokko Award of his distinguished doctoral thesis. In 2010 professor Yliruusi obtained Albert Wuokko award especially on his contribution to improve the quality of postgraduate studies and Ph.D. Theses made in Finland.

In Europe there are currently numerous small bio- and drug companies, which are mainly focusing in the high-risk drug discovery research. It is foreseen, that there is also an increasing need for drug formulation and manufacturing research. That's why the Faculty of Pharmacy has taken the step towards Industrial Pharmacy research and teaching within the Division of Pharmaceutical Technology (PARTICLE).
Finnish Higher Education Evaluation Council (FINHEEC) has designated the Faculty of Pharmacy, UH as one of the ten National Centres of Excellence in University Education units for 2010-2012. Earlier the Faculty of Pharmacy has obtained University’s Teaching Quality awards in 2007-2009 and also in 2005.

**Comments on how the RC’s scientific productivity and doctoral training should be evaluated (MAX. 2200 characters with spaces):** We suggest that the next methods (and or criteria) could be used:

1. **Comparison RC’s scientific productivity**
   - Number of peer-reviewed publications
   - Number of peer-reviewed publications per person in the RC
   - Amount of money needed on average for one peer-reviewed publication
   - Amount of money needed on average for one PhD
   - Governmental (University) money per person in the RC on average
   - External funding per person in the RC on average

2. **Assessing of the RC’s doctoral training**
   - Number of Ph.D. studies completed during the evaluation period
   - Average age of new doctors
   - Average time in months needed to obtain the doctoral degree
   - Gender balance
   - Number of foreign students in the RC’s environment
   - Ph.D. Theses awards obtained
   - Employment in Academia and industry

3. **Publishing strategy**
   The RC has its own written publishing strategy. We have listed Scientific Journals in two main categories. The idea is that the publications will be published in the highest category journals.

   **Category 1:** The most preferable journals in Pharmaceutical Technology and Industrial Pharmacy. This group also includes special scientific journals as Nature and Science. The target is to publish in this category journals.

   **Category 2:** Good, acceptable journals in Pharmaceutical Technology and Industrial Pharmacy. These journals can be used, but they are not actually suggested.
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RC-SPECIFIC STAGE 1 MATERIAL (registration form)

In addition, there is a third (not precisely determined) category, which includes other good journals, which however, are not representing our own main research fields. These journals may be, for example, focused in chemical, physical, colloidal and surface sciences, polymer sciences, and food sciences.

4. Benchmarking and comparison with similar type units within Europe: Comparable with the similar high-class Pharmaceutical Technology oriented units in Europe: University of Ghent, Belgium and University of Heinrich Heine, Düsseldorf, Germany.
**LIST OF RC MEMBERS**

**NAME OF THE RESEARCHER COMMUNITY:** PHARMACEUTICAL TECHNOLOGY AND INDUSTRIAL PHARMACY (PARTICLE)

**RC-LEADER:** J. Yliruusi

**CATEGORY:** 1

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**Industrial pharmacy (licentiate thesis)**

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Name of the RC's responsible person: Yliruusi, Jouko

E-mail of the RC's responsible person: jouko.yliruusi@helsinki.fi

Name and acronym of the participating RC: PHARMACEUTICAL TECHNOLOGY AND INDUSTRIAL PHARMACY, PARTICLE

The RC's research represents the following key focus area of UH: -- Select --

Comments for selecting/not selecting the key focus area: The goal of the RC is to promote scientific excellence in the fields of applied materials sciences. To accomplish this, the RC promotes multidisciplinary research on essential areas in pharmaceutical technology and industrial pharmacy.

Key research questions are related to all phenomena that occur in drugs during processing and phenomena that determine drugs' properties and physical and chemical stability and performance.

1 FOCUS AND QUALITY OF RC'S RESEARCH (MAX. 8800 CHARACTERS WITH SPACES)

- Description of the RC’s research focus, the quality of the RC’s research (incl. key research questions and results) and the scientific significance of the RC’s research for the research field(s).

The Pharmaceutical Technology and Industrial Pharmacy research community (PARTICLE) forms a coherent administrative and research unit in the Faculty of Pharmacy, University of Helsinki. This group uses the same facilities and equipment and organizes common postgraduate courses and seminars. We have strategically planned that the research areas of the three professors (PIs) in this RC (Yliruusi, Hirvonen and Juppo) are different, but with some overlap to enable close collaboration and thesis co-supervision. By covering supportive areas of expertise we are able to give a good, versatile and up-to-date doctoral training for our Ph.D. students. There is a clear synergy between the research topics of all members, as the research of this PARTICLE RC is focussed mainly on solid dosage forms. Our research is at the moment highly focussed in 1. Solid state materials and drug development processes and formulations and 2. Development of functionalized nanotechnological controlled release systems and their drug delivery and safety studies.

Key research questions are related to the fundamental approach that all relevant phenomena that occur in drugs during processing and phenomena that determine drug products’ mechanical properties and physical and chemical stability should be explained and understood at the molecular level. This is what the RC means with "Molecular based pharmaceutical technology". In most of our research it is also essential to know how to exploit experimental design and data analysis techniques in studying multivariate pharmaceutical formulation and processing systems.

Key past and on-going research questions are e.g.:

1) How ideal drug crystals, cocrystals and polymorphic forms are formed, what are the mechanisms that stabilize amorphous drugs and how to process amorphous drugs with low glass transition temperature. The processing technology has been patented. These findings are utilized in formulation of poorly soluble drugs in solid dispersions, nanocrystals or therapeutical proteins in freeze-dried and spray-dried formulations.
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2) Mixed crystal design based on integration of molecular modeling and laboratory work. To date few new mixed crystals of active APIs have been developed.

3) Powder technology: New in-line methods to determine granule size during granulation, and a totally new technique to determine flow properties of cohesive powders have been designed. No other research group has succeeded in this. These technologies have been patented.

4) Particle and surface engineering research to control particle size and morphology in a wide range. This enables better drug material processability and general functionality.

5) Novel film coating techniques and development of new coating materials and formulations. Stable films have been developed from cellulose derivatives, chitosan, chitin, modified whey proteins, zein and native starches.

6) Poorly soluble drugs: Successful improvements of dissolution rate by nanosizing or by entrapping the drug compounds into mesoporous silicon and silica structures have been done for many different drugs and drug formulations.

7) Toxicity of novel biocompatible nanomaterials: We have shown that mesoporous silicon particles and surface-modified nanomaterials can be safely used in pharmaceutical applications and have studied their biodistributions.

8) Enabling pharmaceutical formulations of nanomaterials: We have studied and prepared formulations of such diverse materials as mesoporous silicon, nanofibrillar cellulose and amphiphilic proteins in the context of tableting and/or controlled release of poorly soluble compounds.

9) Method development on drug dissolution and solubility determinations with high-throughput screening methods.

During 2005–2010, the 3-4 principal investigators and 6-8 senior researchers and post-docs of the RC produced more than 100 peer-reviewed original research articles. Most of these have been published in high impact peer-reviewed journals. Publication media varies from general pharmaceutical journals (e.g. Int.J.Pharm, Eur.J.Pharm.Sci., J. Control. Release) to specialized journals in adjacent fields such as nanotechnology (e.g. Small, ACS Nano), chemistry and materials science (e.g. Biomaterials). More than 10 of the publications have been published in journals with impact factor > 5, signifying the overall quality of the publications.

The unit has a long tradition of exceptionally productive doctoral education with numerous international awards for the supervisors and the Ph. D. graduates. During the evaluation period, 22 Ph.D. theses were completed in the RC (more than 1/3 of the six disciplines in the Faculty). Two theses (Jaakko Aaltonen, Sabiruddin Mirza) were awarded international AAPS Awards and one (Samuli Hirsjärvi) national Albert Wuokko Prize as the best theses in pharmaceutical sciences that year. Professor J. Yliruusi received also the prestigious Albert Wuokko Award for his solid state drug research and excellent researcher education (2009), while Prof. J. Hirvonen was awarded the CRS/Eurand Grand Prize in 2007 (Novel Approaches in Oral Drug Delivery), post-doc Timo Laaksonen the national Komppa Prize for the best doctoral thesis in Chemistry (2008), and post-doc Helder Santos the Talent Award in Science by the Portuguese Government, Ministry of Foreigner Affairs (2010). Of the former PARTICLE members, six have obtained Professorships outside the University of Helsinki (Jukka Rantanen, Denmark/Copenhagen;
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Jyrki Heinämäki, Estonia/Tartu; Niklas Sandler, Finland/Åbo Akademi; Hongxia Guo, Shandong/China; Harun Rashid Ar, Northern University/Bangladesh; Mirna Cervera Havana/Cuba.

In addition to the research awards, Finnish Higher Education Evaluation Council (FINHEEC) has designated the Faculty of Pharmacy as one of the ten National Centres of Excellence in University Education for 2010-2012. Earlier the Faculty of Pharmacy has obtained University's Teaching Quality awards in 2007-2009 and also in 2005.

Ways to strengthen the focus and improve the quality of the RC’s research.

International collaboration with the top universities should be further increased. More participation in EU consortia should be encouraged and reached in addition to the LIINTOP (Liver Intestine Optimisation) FP6 research consortium in 2007-2010. The PSSRC cluster (www.pssrc.org) offers a great opportunity to utilise the equipment and knowledge of several top universities.

The criteria of the appropriate peer-reviewed journals could be tightened even further. The RC should perhaps also adopt more challenging and risky research topics, produce publications (in collaboration with multidisciplinary research partners) with even wider application potential after careful identification of current hot topics in the field.

In graduate education, research-based learning and a research-focused study path for selected top students including practice periods in research projects during the studies would improve the starting level of future Ph.D. students and further improve the quality of the research.

2 PRACTICES AND QUALITY OF DOCTORAL TRAINING (MAX. 8800 CHARACTERS WITH SPACES)

How is doctoral training organised in the RC? Description of the RC’s principles for recruitment and selection of doctoral candidates, supervision of doctoral candidates, collaboration with faculties, departments/institutes, and potential graduate schools/doctoral programmes, good practises and quality assurance in doctoral training, and assuring good career perspectives for the doctoral candidates/fresh doctorates.

The multidisciplinary nature of RC’s research means that students in RC have variable backgrounds. Ph.D. students have masters e.g. in pharmacy, physics, chemistry or biotechnology.

The recruitment is based on individual assessments of the students. Personal experience of working with the new doctoral candidates is highly valued before making recruitment decisions. The intake of new students has been quite stable on the long run, averaging at approx. 5/year.

International candidates are very welcome to join the RC, both at M.Sc. and Ph.D. student level. Foreign students are mainly from European countries, but also from China, Russia, and Bangladesh. Approx. 25% of the RC’s Ph.D. students (between 2005-2010) are from abroad.

Each Ph.D. student has a professor as the main supervisor and one or two post-doctoral supervisors, who are working closely with the students on their Ph.D. thesis and laboratory work. During Ph.D. studies, most of the students also work at least some time in externally funded projects that have their own steering groups and regular meetings. These meetings are used to set goals for the students and to track their progress.

The progress of the Ph.D. students is monitored by each supervisor, and officially in their mandatory research plan defense, which takes place at mid-point of the Ph.D. thesis project. In the defense, the
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RC-SPECIFIC STAGE 2 MATERIAL

student presents the results from the first half of the thesis project (usually 2 articles) and outlines the plan to finalize the thesis. The defense is evaluated by three external referees.

Through regular meetings and evaluations, an open interaction between the supervisors and doctoral candidates is encouraged. The hierarchy of the RC is very low, and students can easily get help from all RC members.

RC has extensive collaboration inside the University of Helsinki and with groups from other Finnish/International Universities/Institutions, as well as with national/international industrial and other non-academic partners (several private companies, hospitals), mainly within the EU, but also in the USA, New Zealand, India, Japan and China. The collaborations include many multidisciplinary fields of research, e.g., pharmacy, physics, engineering, medicine, chemistry, biotechnology and food technology. Most of the M.Sc. and Ph.D. degrees taken in our RC are a result of joint doctoral training and research activities, involving these collaborations.

Our RC has participated as a member or as a main coordinator in several national/international research projects and networks. These projects have been funded mainly by the Finnish Funding Agency for Technology and Innovation (TEKES), Academy of Finland, European Union and domestic/international drug industry.

The RC has had numerous joint research and doctoral training projects within the University of Helsinki (including the Centre for Drug Research, CDR) and with many national universities and private research organizations in Finland. The RC is involved in the national Graduate School in Pharmaceutical Research and National Doctoral Programme in Nanoscience.

On the international level, the RC has established research collaboration with an extensive number of academic units and private sector companies. This cooperation has supported numerous Ph.D. theses and resulted in several appointments of our earlier Ph.D. students as professors.

Collaboration is also promoted through National Graduate School networks with travel grants. International collaboration is also promoted through former RC members appointed as Professors or University Lecturers in Universities/Institutions both in Finland and abroad. External collaboration is supported by the supervisors from the very beginning of the Ph.D. studies, e.g., through participation in several international scientific conferences every year and encouraging people to spend time abroad in different laboratories.

The RC is a founding member of Pharmaceutical Solid State Research Cluster (PSSRC), which is composed of eight academic research centers in the pharmaceutical sciences all over the world (http://www.pssrc.org). The PSSRC network gives a possibility to send Ph.D. students to the member Universities for utilization of equipment and for collaborative projects, and PSSRC annual symposium gives good forum for Ph.D. students to present their results.

Most Ph.D. students in the Faculty of Pharmacy are members of the national Graduate School in Pharmaceutical Research, and have to submit a research plan before initiating the doctoral training. Doctoral training complies with the Graduate School instructions. A compulsory preliminary exam ensures sufficient scientific knowledge and a compulsory defense of the research plan ensures that the student has sufficient theoretical knowledge, adequate insight into the quality of the research, and gives the tools and recommendations by the evaluation board needed for successful completion of the degree.
All Ph.D students are members of (at least) one research group. The aim is to involve the students in external projects. This gives insights into the fundamentals of scientific work and scientific project management, preparing them also for the more independent post-doctoral research. The projects are driven by schedules, requiring systematic research according to research plans. Quality of Ph.D. students’ own research plans are reviewed by independent reviewers. Assigned grants and external projects can also be seen as quality descriptors of the achieved results as well as merits supporting future applications.

The quality of the doctoral research is monitored by the supervisors and co-authors. All students are met as individuals. The quality of the work is reviewed and instructions for improvements are given in annual development discussions with the RC’s principal investigators. The theses are article-based with an emphasis on articles published in international high-quality peer-reviewed journals determined by a list of the most preferred publication journals identified for the RC.

The RC has weekly divisional research seminars held by M.Sc./Ph.D. students or Postdocs/PIs. In addition, there are regular group meetings in which the research of the doctoral candidates is discussed regularly. The RC has biannual Divisional development days, in which the status of the studies of all doctoral candidates is presented, and other research-related relevant issues are discussed. The goal is to have a public follow-up of the studies and to encourage the students to complete their studies. RC’s Professors also have one-day planning meetings four times a year.

The RC is participating actively and responsibly for the annual events and meetings of the Finnish Society of Physical Pharmacy. The Society is driven by the doctoral candidates representing both academia and industry.

During the past five years all researchers of the RC have been fully employed after obtaining their Ph.D. degree. University career opportunities include post-doctoral years abroad, special scientists’ posts and professorships, working in industry and in national regulatory authorities (FIMEA). In total six former RC members have obtained Professorships and almost all Ph.D.s have spent a post-doctoral period abroad.

- RC’s strengths and challenges related to the practises and quality of doctoral training, and the actions planned for their development.

Strengths
- Efficacy of doctoral training: 22 high-level Ph.D. degrees obtained in 2005-2010
- Awards for excellent doctoral theses (2 AAPS awards, 1 Albert Wuokko award)
- Research plan defense
- Good supervision system, low number of Ph.D. drop-outs
- International doctoral candidates

Challenges
- Clear quality indicators are not listed
- Cross-interaction between the Ph.D. students inside the RC is too limited
- The RC has no joint doctoral training programs
- Too limited participation in EU projects
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Action plans

Important fields in the doctoral training to be developed are:

- Arrange a standard 6-month training period abroad for the RC’s Ph.D. students
- More EU funding needed, e.g. Marie Curie funding, to improve doctoral training, organise joint courses and increase mobility
- Industrial pharmacy licentiate students will be incorporated more tightly into the RC
- Ph.D. and M.Sc. student seminars will be developed further.

3 SOCIETAL IMPACT OF RESEARCH AND DOCTORAL TRAINING (MAX. 4400 CHARACTERS WITH SPACES)

• Description of how the RC interacts with and contributes to the society (collaboration with public, private and/or 3rd sector).

The research of RC PARTICLE is closely related to drug development, formulation and manufacturing. Therefore the societal impact is closely related to these topics. Most of our societal impact comes through industrial collaboration and student (M.Sc., Ph.D.) education. We have had several short- or long-term industrial research projects assisting pharmaceutical material research and product development. These industrial collaborations guarantee that our research is relevant and highly interesting for the pharmaceutical industry. These projects have resulted in numerous publications and theses. So far all our finalised Ph.D. students (22 during the evaluation period) have received permanent positions. Many of them are continuing their research at post-doctoral or even professor level. The RC has collaborated with the public sector, for example by assisting the Helsinki University Hospital in development of paediatric formulations. We believe that it is ethically important to give help in these areas. Prof. Yliuruusi has also acted as a scientific expert on pharmaceutical patent conflict trials.

Currently, there are numerous small bio- and drug development companies in Europe, which are mainly focusing in high-risk drug discovery research. It is foreseen, that ever more drug formulation and manufacturing research is needed. To strengthen Finnish drug development knowledge, the Faculty of Pharmacy has started Industrial Pharmacy research and teaching (Prof. Juppo). These specialized studies are meant for persons with B.Sc. or M.Sc. in pharmacy and working in the pharmaceutical industry.

Since we believe that it is important to spread the knowledge obtained in the research projects, the RC members have given several popular oral presentations and lectures for professional and non-professional audiences in general open education, together with professional seminars and meetings and alumni get-togethers. The RC members have also been interviewed for the newspapers, professional magazines and for TV.

RC members have participated in several different expert groups for health care politics, industrial project development, pharmaceutical continuous education, doctoral training development, and in national and international planning committees e.g. for specialized studies in pharmacy and education in veterinary formulations. Prof. Hirvonen is a member of EDQM drug formulations section to develop the European Pharmacopoeia on these subjects. The principal investigators in the group have also evaluated grant proposals (FWO-Vlaanderen, Belgium, EAS-Enterprise Estonia) and given input for the forthcoming EU calls (IMI, Innovative Medicines Initiatives).
Ways to strengthen the societal impact of the RC’s research and doctoral training.

Industrial collaborations are crucial for the RC also in the future. Not only because of research funding, but also to keep on the track of front-line research topics that are truly beneficial to the pharmaceutical industry. The RC should be better in proactive planning of collaborations and forming strategic partnerships.

The doctoral and licentiate training is currently well connected with the pharmaceutical industry. However, the collaboration with former students (alumni) could be utilised better since they form an excellent network and a group of “critical friends” in the private sector.

In the future, the ethical aspects of research will have an even more important status, e.g., environmental aspects of drug manufacturing and packaging, development of drugs for the developing countries, and development of paediatric and geriatric formulations. These should be carefully evaluated and, when feasible, taken into account in the RC’s research and education strategies.

Description of the RC’s research collaborations and joint doctoral training activities and how the RC has promoted researcher mobility.

The RC has an extensive national and international collaboration in research and doctoral training: several research groups at the University of Helsinki, research groups form other universities and research institutions worldwide, and national and international industrial partners ranging from small local to large global companies. The multidisciplinary collaboration projects cover the fields of, e.g., pharmaceutical sciences, physics, engineering, medicine, and chemistry. Research projects are typically funded by various funding elements including TEKES (the Finnish Funding Agency for Technology and Innovation), Academy of Finland, European Union (EU) and industrial funding from domestic and international private companies.

The total number of students and researchers participated in international exchange programmes in 2007-2010 were 54 and 13, respectively. RC has attracted many undergraduate and postgraduate students, and researchers from all over the world (EU, Russia, China, Cuba, Bangladesh, Chile, New Zealand). Over 40 international M.Sc. and Ph.D. students or postdoctoral researchers visited the RC during 2005-2010. The number of long-term visits (over 12 months) was 6. Five Ph.D. students from abroad obtained their Ph.D. degrees between 2005 and 2010. The RC has also participated in the supervision of two Ph.D. students that obtained their Ph.D. degrees abroad. A total number of short-term visits (less than 12 months) was 29 in 2005-2010. Research visits abroad during 2005-2010 include 7 long-term visits, most of which were post-doctoral research periods.

The skilled staff and modern infrastructure enable high-quality training and research visits for international researchers. International collaboration has also been promoted by a substantial number of RC alumni currently located at other universities/institutions. RC is an active (charter) member in the international Pharmaceutical Solid State Research Cluster (PSSRC). The aim of PSSRC is to initiate and foster academic and industrial research collaboration between its members in the field of solid-state pharmaceutics, provide a discussion forum, and exchange members of the cluster through student and staff research visits. Staff recruitment policy of the RC embraces people from different countries.
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RC’s own Ph.D. students are encouraged to make short-term research visits (3–12 months) to partner laboratories. The aims of these visits are joint publications, to widen the students’ scientific perspectives and strengthen the basis of research collaboration. Researchers are also encouraged and supported to attend scientific meetings since the very beginning of the Ph.D. studies. In addition, the RC has promoted researcher mobility by maintaining the existing networks, increasing the research interactions within the networks, and using them to find new interesting collaboration partners.

The research collaboration and researcher mobility can be developed in the future by participating more in the EU Marie Curie ITN and/or RTN projects making new transnational collaboration initiatives, developing web-based visibility and information of the RC.

• RC’s strengths and challenges related to research collaboration and researcher mobility, and the actions planned for their development.

Strengths:
• PSSRC membership enables ‘an open invitation’ to any Cluster centre
• Vast number of international and national contacts
• RC encourages Ph.D. students to establish their own networks
• RC has a good reputation abroad and research facilities are excellent
• RC is highly multidisciplinary and multicultural

Challenges:
• More joint research within the RC needs to be developed.
• To motivate the RC members to participate even more actively in international mobility
• Difficulties to create research positions for incoming/returning researchers

Actions for further development

Building partnerships is increasingly important. Funding applications through national and international funding institutions should allocate more funds for researcher mobility. Overall, new ways are needed in order to allow the researchers to visit abroad faster and with minimum bureaucratic load.

5 OPERATIONAL CONDITIONS (MAX. 4400 CHARACTERS WITH SPACES)

• Description of the operational conditions in the RC’s research environment (e.g. research infrastructure, balance between research and teaching duties).

RC’s research infrastructure at the Division of Pharmaceutical Technology is of high international quality. The Division has a broad range of essential preparative and analytical equipment suited for RC’s focused research activities in solid dosage forms.

The RC has versatile equipment from molecule crystallization to final dosage form processing (from miniature to lab-scale and pilot-scale). Formulation techniques for traditional (e.g. granulation, tableting, coating, freeze-drying) as well as newer (e.g. proteins, nanoparticulate and transdermal) drug delivery systems are available. RC has an extensive array of advanced tools for physical and chemical analysis (HTS and larger scale). RC has also several (commercialized) in-house techniques for physical characterization of pharmaceutical solids and process analytical technologies (PAT). RC has facilities and
expertise also for cellular toxicity and permeability studies including aseptic laboratories for cell
culturing and cell monolayer preparations, toxicity assays and permeability testing platforms. The RC’s
research topics also require specialized equipment not feasible or financially possible to own by the RC
itself, but these are all achievable through existing collaborations.

RC members are involved in teaching on several courses. Most of the advanced courses are directly
related to the RC’s research topics and require that the teacher is also actively involved in research and
has up-to-date knowledge of the field. All RC members participate in teaching. Externally funded
employees are sometimes limited in their teaching responsibilities by the rules given by the funding
source. Balancing these issues is a continuing challenge for the RC and educational development
towards research-based courses.

• RC’s strengths and challenges related to operational conditions, and the actions planned for their
development.

A major strength of the RC is the high-level infrastructure at its disposal, both in-house and through the
high-level national and international collaborations. Also researchers in the RC with wide variety of
backgrounds (e.g. pharmaceutics, physical chemistry, engineering, physics, biochemistry) increase the
in-house possibilities for efficient utilization of the existing research methodologies and the novel
process and analytical techniques.

A future challenge and concern related to the operational conditions is the maintenance of the research
infrastructure. The importance of fruitful collaboration will further increase. Faculty of Pharmacy will
hire a new laboratory engineer in 2011.

Another challenge is the turnover of researchers and, related to that, maintenance of the know-how for
the existing equipment and laboratory facilities in the RC. By continuing the co-working with the alumni
afterwards, this is a possibility to further increase the collaborative actions. Also the role of in-house
training and mentoring should be further emphasized in the RC.

6 LEADERSHIP AND MANAGEMENT IN THE RESEARCHER COMMUNITY (MAX. 4400 CHARACTERS WITH SPACES)

• Description of the execution and processes of leadership in the RC, how the management-related
responsibilities and roles are distributed in the RC and how the leadership- and management-related
processes support high quality research, collaboration between principal investigators and other
researchers in the RC, the RC’s research focus and strengthening of the RC’s know-how.

The RC is a Division within the Faculty of Pharmacy with disciplines of pharmaceutical technology
and industrial pharmacy. We have monthly division meetings where administration, infrastructure, teaching,
research, visitor and ex-patriate and safety issues are handled. This meeting is chaired by a University
Lecturer and the whole staff participates. Also 1-2 Division days are organized outside the University for
development of specific topics. The agenda of these are planned and chaired by the Professors, but
initiatives come from all RC members and staff. Three Professors of the Division have strategic one-day
meetings 5-6 times per year, where the strategic issues, future development and common topics are
discussed. Senior scientist meetings (Professors and University Lecturers) are monthly meetings to
discuss research, administrative and teaching issues. University Lecturers have also their own meetings
to discuss the laboratory facilities 3 times/year. The laboratory facility responsibilities are divided
amongst the University Lecturers and the meeting is chaired by one of the Lecturers. Two of the RCs
research groups (Prof. Hirvonen and Prof. Juppo) have regular group meetings every month where the
focus is on research projects and scientific results. The third group (Prof. Yliiruusi) does not have joint
INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

RC-SPECIFIC STAGE 2 MATERIAL

group meetings, but managing is more personal in minor groups according to the various projects and topics. For confidentiality reasons due to industrial collaborations, these discussions are limited to smaller groups and project teams. However, there is a weekly seminar where all the RC members, Ph.D. students and M.Sc. students are giving scientific presentations on their results. This seminar series is chaired by a post-doctoral researcher. The Ph.D. students have also regular meetings with their supervisors, approximately every second week and ad-hoc when requested. Prof. Yliruusi is the Head of the Division having the administrative responsibility of the Division including the personnel, facilities and budget. The quality, health and safety group has meetings 4-5 times/year. This group is chaired by the Head of the Division and it performs internal inspections 1-2 times/year. Once a year the RC has a cleaning day organized by the University Lecturers and the whole staff participates. All these regular meetings and activities guarantee, we believe, that the facilities, equipment, instructions and safety level of the laboratories are on an excellent level. This is a necessity for high-quality research. The group and project meetings and seminars are meant mainly for sharing information from the scientific problems and results, but also function as an excellent arena to practice presentation skills.

- RC’s strengths and challenges related to leadership and management, and the actions planned for developing the processes.
- In order to better share knowledge and assist each other within the RC, there is also a plan to start a knowledge data bank, where the areas of expertise of all RC members are presented. In a recent external evaluation the RC got very positive feedback on our structured and well-functioning management and good and open atmosphere that ensures successful research projects. The pointed-out area to improve was that the RC is very good in making decisions, but poor in acting as decided. This concerns the whole staff. The information delivery between the groups could be better.

### 7 EXTERNAL COMPETITIVE FUNDING OF THE RC

- **Listing of the RCs external competitive funding, where:**
  - the funding decisions have been made during 1.1.2005-31.12.2010, and
  - the administrator of the funding is/has been the University of Helsinki

- **Academy of Finland (AF)** - total amount of funding (in euros) AF has decided to allocate to the RC members during 1.1.2005-31.12.2010: **1300000**

- **Finnish Funding Agency for Technology and Innovation (TEKES)** - total amount of funding (in euros) TEKES has decided to allocate to the RC members during 1.1.2005-31.12.2010: **3340000**

- **European Union (EU)** - total amount of funding (in euros) EU has decided to allocate to the RC members during 1.1.2005-31.12.2010: **350000**

- **European Research Council (ERC)** - total amount of funding (in euros) ERC has decided to allocate to the RC members during 1.1.2005-31.12.2010: **0**

- **International and national foundations** – names of international and national foundations which have decided to allocate funding to the RC members during 1.1.2005-31.12.2010, and the amount of their funding (in euros).
  - names of the foundations: **Alfred Kordelin Foundation**
  - **Center for International Mobility (CIMO)**
  - **Eemil Aaltosen säätiö**

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INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

RC-SPECIFIC STAGE 2 MATERIAL

- Finnish Concordia Fund
- Finnish Cultural Foundation
- Finnish Pharmaceutical Society
- Foundation for Finnish Inventions
- Fulbright Center
- Jenny ja Antti Wihuri Foundation
- New Zealand Pharmacy Education and Research Foundation
- Nordforsk
- Research Foundation of the University of Helsinki
- Suomalais-ranskalainen teknistieteellinen seura
- University of Helsinki / Chancelor (travel grant)
- Yliopiston apteekin 250-vuotisjuhlarahasto
- total amount of funding (in euros) from the above-mentioned foundations: 630000

Other international funding - names of other international funding organizations which have decided to allocate funding to the RC members during 1.1.2005-31.12.2010, and the amount of their funding (in euros).
- names of the funding organizations: American Association of Pharmaceutical Scientists (AAPS)
- Astra Zeneca
- Bayer Schering Pharma
- Boehringer-Ingelheim
- China Scholarship Council
- University of Kentucky, USA
- total amount of funding (in euros) from the above-mentioned funding organizations: 390000

Other national funding (incl. EVO funding and Ministry of Education and Culture funded doctoral programme positions) - names of other national funding organizations which have decided to allocate funding to the RC members during 1.1.2005-31.12.2010, and the amount of their funding (in euros).
- names of the funding organizations: Graduate School in Pharmaceutical Research
- Novagent Oy
- Orion Pharma
- University of Helsinki / Chancelor (travel grant)
- Åbo Akademi
- total amount of funding (in euros) from the above-mentioned funding organizations: 1950000

B RC’S STRATEGIC ACTION PLAN FOR 2011–2013 (MAX. 4400 CHARACTERS WITH SPACES)

- Description of the RC’s future perspectives in respect to research and doctoral training.
  RC’s future perspectives in research:
  The goal of the RC is to promote scientific excellence in the fields of applied materials sciences and solid dosage forms. To accomplish this, the RC will identify and promote multidisciplinary research on essential topics in pharmaceutical technology.
INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

RC-SPECIFIC STAGE 2 MATERIAL

It is foreseen, that preclinical formulation research should continue to be the essential part of our research. Development of new formulation technologies can lead to faster and higher-quality pharmaceutical formulation design and deeper molecular-level understanding of the relevant formulation issues. This will assure that all theoretical therapeutic potential of new drug candidates can be effectively exploited.

PARTICLE RC’s research fields will be: Development of novel drug delivery systems, Pediatric and veterinary drug formulations, Early ADME, Pharmaceutical materials research, and Physical process research including Process analytical technologies. Important, underlying, aim will be continuous development towards nanotechnological approaches and individual medication.

In the coming years the RC aims to maintain high productivity and educate annually four Ph.D. theses, file for three patents and/or patent applications, and twenty original high level scientific publications. Special attention will be paid in the publishing forums and research quality.

Since practically all the research in the RC is done by short-midterm external funding, it is necessary to find ways to strengthen the long-term funding. Especially the RC should cooperate more with its current EU partners and get more research funding together with them. The total amount of external funding should be increased by twenty percent in the coming three years period.

Collaboration with our own earlier students (for example six professors abroad) should be strengthened. It would be beneficial to select high-level international prime partners with whom the future research and students mobility will be mainly developed. These negotiations will be started within the Pharmaceutical Solid State Research Cluster.

Today the research in the RC is based on the three research areas (the three Professors’ groups). Cooperation between these groups has been too much based in Professors’ steering meetings. In future, direct cooperation between the researchers will be encouraged.

RC’s future perspectives in doctoral training:

Our doctoral training has been successful. During the evaluation period totally 22 Ph.D. degrees were achieved. However, there are still great challenges in the future in doctoral training; especially the Ph.D. student’s mobility and security of long-term funding should be improved. However, we believe that with individual care taking of the students, more clear leadership based on high ethics and our own specific scientific expertise and international networking, the challenges can be turned to the RC’s progress and welfare.

Important fields in the doctoral training to be developed are:

- Arrange a standard six-month training period abroad for the RC’s Ph.D. students
- The RC is aiming at getting EU’s funding, e.g. Marie Curie funding to improve doctoral training, which increases joint courses and students mobility
- The RC will build its employment follow-up system for recently graduated students
- RC will build its own alumni program
- Industrial pharmacy licentiate students will be incorporated more tightly into the RC
- Ph.D. and M.Sc. student seminars will be developed further
A special evaluation team consisting of two Professors and four University Lecturers was made. The responsible person, Professor Jouko Ylihuisi, was the team leader. In the first project evaluation team meeting, discussion and draft writing responsibilities were divided amongst all the participants. Also an information manager was named to keep the whole division up-to-date during the data collection phase.

In the beginning of the actual application text production, the separate subgroups worked quite independently. However, throughout the compiling of the evaluation documentation the groups were recommended to take into account researchers' opinions and help as widely as reasonable. When the individual parts were almost finished, they were cross-commented by numerous researchers and Ph.D. students in the RC.

The final compiling of the evaluation documents was made by the three Professors in the RC. After final corrections and suggestions the documentation was submitted.
INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

RC-SPECIFIC TUHAT COMPILATIONS OF PUBLICATIONS DATA 2005-2010

PARTICLE/Yliruusi

1 Analysis of publications

- Associated person is one of Sari Airaksinen, Sari.Airaksinen@helsinki.fi, Hélder A. Santos, helder.santos@helsinki.fi, Osmo Antikainen, Osmo.Antikainen@helsinki.fi, Jaakko Aaltonen, jaakko.aaltonen@helsinki.fi, Samuli Hirsjärvi, Samuli.Hirsjarvi@helsinki.fi, Inna Miroshnyk, inna.miroshnyk@helsinki.fi, Maria Tahvanainen, Maria.Tahvanainen@helsinki.fi, Henna Vihola, Henna.Vihola@helsinki.fi, Pierre-Paul Viscusi, pierre-paul.viscusi@helsinki.fi, and Jouko Yliruusi, Jouko.Yliruusi@helsinki.fi.

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<th>Publication type</th>
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<td>D3 Article in professional conference proceedings</td>
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2 Listing of publications

A1 Refereed journal article

2005

2005


2006

PARTICLE/Yliruusi


2007


INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI: PARTICLE/Yliruusi


PARTICLE/Yliruusi


2008


PARTICLE/Yliruusi


Sissalto, S, Zhang, H, Stilgenbauer, E, Kauppinen, AM, Hirvonen, J, Fidel, M 2008, "The expression of most UDP-glucuronosyltransferases (UGTs) is increased significantly during Caco-2 cell differentiation, whereas UGT1A6 is highly expressed also in undifferentiated cells", Drug Metabolism and Disposition, vol 36, no. 11, pp. 2331-2336.


2009


PARTICLE/Yliruusi


2010


PARTICLE/Yliruusi

INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

RC-SPECIFIC TUHAT COMPILATIONS OF PUBLICATIONS DATA 2005-2010


A2 Review in scientific journal

2005


2007


2008


2009


2010

Miroshnyk, I, Mirza, S 2010, 'Capturing the advantages of co-crystals', *Pharmaceutical Technology Europe*, vol 22, no. 7, pp. 31-34.

PARTICLE/Yliruusi


A3 Contribution to book/other compilations (referred)

2005

2007

2008


2009


A4 Article in conference publication (referred)

2005

2007

2008


PARTICLE/Yliruusi


2006


Aaltonen, J., Peltonen, L., Hirvonen, J., Rantanen, J. 2006. 'Can solid-state analysis solve the problem of anomalous dissolution profiles?', in 5rd World Meeting on pharmaceutics, biopharmaceutics and pharmaceutical technology.


2007

PARTICLE/Yliruusi


2008


PARTICLE/Yliruusi


B1 Unrefereed journal article

2005

2008

2010

B3 Unrefereed article in conference proceedings

2009

C1 Published scientific monograph

2005
Raiman, J 2005, Evaluation of intestinal absorption properties of clodronate using Caco-2 cell culture model, Kuopion yliopisto, Kuopio.

D1 Article in professional journal

2007

2010

D3 Article in professional conference proceedings

2005

E1 Popular article, newspaper article

2005
RC-SPECIFIC TUHAT COMPILATIONS OF OTHER SCIENTIFIC ACTIVITIES 2005-2010

PARTICLE/Yliruusi

1 Analysis of activities 2005-2010

- Associated person is one of Sari Airaksinen, Sari.Airaksinen@helsinki.fi, Hélder A. Santos, helder.santos@helsinki.fi, Osmo Antikainen, Osmo.Antikainen@helsinki.fi, Leena Christiansen, Jyrki Heinämäki, Jyrki.Heinamaki@helsinki.fi, Jouni Hirvonen, Jouni.Hirvonen@helsinki.fi, Anne Juppo, anna.juppo@helsinki.fi, Nina Kivistö, Nina.Kivisto@helsinki.fi, Timo Laaksonen, timo.laaksonen@helsinki.fi, Satu Lakio, satu.lakio@helsinki.fi, Leena Peltonen, Leena.Peltonen@helsinki.fi, Jukka Rantanen, Jukka.Rantanen@helsinki.fi, Nélia Sandor, nelia.sandor@helsinki.fi, Mia Siven, Mia.Siven@helsinki.fi, Clare Strachan, clare.strachan@helsinki.fi, Jouko Yliruusi, Jouko.Yliruusi@helsinki.fi, Jaakko Aalto, jaakko.aalto@helsinki.fi, Samuli Hinghofer, Samuli.Hinghofer@helsinki.fi, Inna Miroshnyk, inna.miroshnyk@helsinki.fi, Malle Römer, Hanna Vihola, luis.m.romer@helsinki.fi, Perniki Ehtera, perniki.ehtera@helsinki.fi, Janne Katrine Hautala, jaanne.hautala@helsinki.fi, Petteri Heljo, petteri.heljo@helsinki.fi, Ruzica Kolakovic, ruzica.kolakovic@helsinki.fi, Johanna Rahmen, Johanna.Rahmen@helsinki.fi, Kirsi Rosenqvist, kirsi.rosenqvist@helsinki.fi, Anna Shevchenko, anna.shevchenko@helsinki.fi, Anne Soikkeli, anne.soikkeli@helsinki.fi, Ira Soppela, ira.soppela@helsinki.fi, Maria Tahvanainen, maria.tahvanainen@helsinki.fi, Hanna Katrine Valo, Hanna.Valo@helsinki.fi

<table>
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<th>Activity type</th>
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<td>Membership or other role in public Finnish or international organization</td>
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<td>Participation in interview for web based media</td>
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</table>
PARTICLE/Yliruusi

2 Listing of activities 2005-2010

Supervisor or co-supervisor of doctoral thesis
Sari Airaksinen, Sari.Airaksinen@helsinki.fi
Supervision of Doctoral thesis: Kirsu Rosenqvist, Sari Airaksinen, 2009 → ..., Finland
Supervision of Doctoral thesis: Jaana Hautala, Sari Airaksinen, 2010 → ..., Finland

Hélder A. Santos, helder.santos@helsinki.fi
PhD Thesis Supervision, Hélder A. Santos, 2007 → ..., Finland
PhD Thesis Supervision, Hélder A. Santos, 2008 → ..., Finland
PhD Thesis Supervision, Hélder A. Santos, 2009 → ..., Finland

Osmo Antikainen, Osmo.Antikainen@helsinki.fi
Supervision of Doctoral thesis: Satu Lakio, Osmo Antikainen, 01.01.2005 → 06.11.2010, Finland

Jyrki Heinämäki, Jyrki.Heinamaki@helsinki.fi
Supervisor for PhD studies: Viviana Garcia Mir, Jyrki Heinämäki, 2006, Cuba
Supervisor for PhD studies: Sabir Uddin Mirza, Jyrki Heinämäki, 2007, Finland
Supervisor for PhD studies, Jyrki Heinämäki, 2008, Finland
Supervisor for PhD studies: Karin Kogermann, Jyrki Heinämäki, 2008, Finland
Supervisor for PhD studies: Meike Römer, Jyrki Heinämäki, 2008, Finland
Supervisor for PhD studies: Natalja Genina, Jyrki Heinämäki, 2010, Finland
Supervisor for PhD studies: Satu Lakio, Jyrki Heinämäki, 2010, Finland

Jouni Hirvonen, Jouni.Hirvonen@helsinki.fi
Free the captured knowledge – Expertise and its development in the field of pharmacy, Jouni Hirvonen, 2005
Caco-2 cell cultures in the assessment of intestinal absorption: Effects of some co-administered drugs and natural compounds in biological matrices, Jouni Hirvonen, 2006
Studies on thermosensitive poly(N-vinylcaprolactam) based polymers for pharmaceutical applications, Jouni Hirvonen, 2007
Characterization of ion-exchange fibers for controlled drug delivery, Jouni Hirvonen, 2008
Preparation and characterization of poly(lactic acid) nanoparticles for pharmaceutical use, Jouni Hirvonen, 2008
The Caco-2 cell line in studies of drug metabolism and efflux, Jouni Hirvonen, 2009
Mechanistic Studies of Drug Dissolution Testing - Implications of solid phase properties and in vivo prognostic media, Jouni Hirvonen, 2010
Miniaturization of drug solubility and dissolution testing, Jouni Hirvonen, 2010

Anne Juppo, anne.juppo@helsinki.fi
Ph.D. supervision: Characterisation and processing of amorphous binary mixtures with low glass transition temperature, Anne Juppo, 2004 → 2008
PhD supervision: Granulation in miniaturised fluid bed using electrostatic atomisation, Anne Juppo, 2006 → 2010, Finland
Melt behaviour and quantification of low amorphous levels in sugars and sugar alcohols with DSC techniques, Anne Juppo, 2010

INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

RC-SPECIFIC TUHAT COMPILATIONS OF OTHER SCIENTIFIC ACTIVITIES 2005-2010

PARTICLE/Yliruusi

2 Listing of activities 2005-2010

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PhD Thesis Supervision, Hélder A. Santos, 2009 → ..., Finland

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Supervision of Doctoral thesis: Satu Lakio, Osmo Antikainen, 01.01.2005 → 06.11.2010, Finland

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Supervisor for PhD studies: Sabir Uddin Mirza, Jyrki Heinämäki, 2007, Finland
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Supervisor for PhD studies: Meike Römer, Jyrki Heinämäki, 2008, Finland
Supervisor for PhD studies: Natalja Genina, Jyrki Heinämäki, 2010, Finland
Supervisor for PhD studies: Satu Lakio, Jyrki Heinämäki, 2010, Finland

Jouni Hirvonen, Jouni.Hirvonen@helsinki.fi
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Miniaturization of drug solubility and dissolution testing, Jouni Hirvonen, 2010

Anne Juppo, anne.juppo@helsinki.fi
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2
INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

PARTICLE/Yliruusi

Leena Peltonen, Leena.Peltonen@helsinki.fi
Supervisor for PhD studies, Leena Peltonen, 02.2008, Finland
Supervisor for PhD studies, Leena Peltonen, 02.2010, Finland
Supervisor for PhD student, Leena Peltonen, 06.2010, Finland

Jukka Tapio Rantanen, Jukka.Rantanen@helsinki.fi
Supervision of Doctoral thesis: Anna von Bonsdorff-Nikander, Jukka Tapio Rantanen, 2005
Supervision of Doctoral thesis: Sari Arnaksinen, Jukka Tapio Rantanen, 2005

Niklas Sandler, niklas.sandler@helsinki.fi
Supervision of Doctoral thesis: Kivikero Niina, Niklas Sandler, 2010

Mia Siven, Mia.Siven@helsinki.fi
Supervision for Doctoral thesis, Mia Siven, 2006 → …, Finland
Supervisor for Doctoral thesis: Rosenqvist Kirsi, Mia Siven, 2007 → …

Clare Strachan
PhD supervision, Clare Strachan, 2005 → 2008
PhD supervision, Clare Strachan, 2006 → 2009
PhD supervision, Clare Strachan, 2008 → 2008, New Zealand
PhD supervision, Clare Strachan, 2006 → 2008

Jouko Yliruusi, Jouko.Yliruusi@helsinki.fi
Supervision of Doctoral Thesis, Jouko Yliruusi, 2005
Supervision of Doctoral Thesis, Jouko Yliruusi, 2005
Supervision of PhD thesis, Jouko Yliruusi, 2010

Prizes and awards
Hélder A. Santos, helder.santos@helsinki.fi
Stipends for accelerated completion of all postgraduate courses, Licentiate and Doctoral degrees (cum laude), Hélder A. Santos, 2003 → 2007, Finland
Chancellor’s Travel grant, Hélder A. Santos, 2008, Finland
Travel grant, Hélder A. Santos, 2008, Germany

Formal tribute of Câmara Munícipal de Tarouca to Dr. Hélder A. Santos for the Award in the “Prémio Talento 2009” (Science Talent Award 2009), Hélder A. Santos, 29.07.2010, Portugal
Talent Award 2009 in Science, Hélder A. Santos, 23.07.2010, Portugal
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Top Reviewer in Pharmaceutical Sciences 2010 - ELSEVIER, Hélder A. Santos, 2010
Travel grant, Hélder A. Santos, 2010, Finland

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University of Helsinki Quality Teaching Unit, Faculty of Pharmacy, Jouni Hirvonen, 2005, Finland
CRS/Eurand Grand Prize Award on Innovations in Oral Drug Delivery Technologies, Jouni Hirvonen, 07.2007 → ..., United States
University of Helsinki Quality Teaching Unit, Faculty of Pharmacy, Jouni Hirvonen, 2007 → 2009, Finland
National Centre of Excellence in University Education, Faculty of Pharmacy, Jouni Hirvonen, 2010 → 2012, Finland

Timo Laaksonen , timo.laaksonen@helsinki.fi
Gust. Komppa Award, Timo Laaksonen, 01.12.2008

Satu Lakkio , satu.lakio@helsinki.fi
Young Investigator Award, Satu Lakkio, 08.06.2009, France

Leena Peltonen , leena.peltonen@helsinki.fi
Marques who’s who in science and engineering, Leena Peltonen, 2008 → ...
Top Reviewer in Pharmaceutical Sciences 2010, Elsevier, Leena Peltonen, 2010

Jukka Tapio Rantanen , jukka.rantanen@helsinki.fi
Prizes, Jukka Tapio Rantanen, 2005

Niklas Sandler , niklas.sandler@helsinki.fi
AstraZeneca UK/US innovation award, Niklas Sandler, 2008

Jouko Yliruusi , jouko.yliruusi@helsinki.fi
Invited Professor, Jouko Yliruusi, 2005
EUFEPIS research award, Jouko Yliruusi, 2008, Switzerland
Albert Wuolko award, Jouko Yliruusi, 2009
Honorary Member of Finnish Society of Physical Pharmacy, Jouko Yliruusi, 2009

Jaakko Aaltonen , jaakko.aaltonen@helsinki.fi
PhD Research Award, Jaakko Aaltonen, 2007

Inna Miroshnyk , inna.miroshnyk@helsinki.fi
Travel Grant, Inna Miroshnyk, 2005, Finland
Chancellor's Travel Grant, Inna Miroshnyk, 2008, Finland
Doctoral Dissertation Grant, Inna Miroshnyk, 2008, Finland
Doctoral Dissertation Grant, Inna Miroshnyk, 2008, Finland
The Best Poster Award, Inna Miroshnyk, 11.06.2008, Finland
Doctoral Dissertation Grant, Inna Miroshnyk, 2009, Finland
Chancellor's Travel Grant, Inna Miroshnyk, 2010, Finland
Postdoctoral Grant for Research Abroad, Inna Miroshnyk, 16.03.2010, Finland

Anne Soikkeli , anne.soikkeli@helsinki.fi
Young Investigator Poster Award, Anne Soikkeli, 20.04.2007, Netherlands

Editor of research journal
Jyrki Heinämäki , jyrki.heinamaki@helsinki.fi
AAPS Journal, Jyrki Heinämäki, 01.01.2005 → 31.12.2005
Biopolymers, Jyrki Heinämäki, 01.01.2005 → 31.12.2005
Carbohydrate Research, Jyrki Heinämäki, 01.01.2005 → 31.12.2005
INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

RC-SPECIFIC TUHAT COMPILATIONS OF OTHER SCIENTIFIC ACTIVITIES 2005-2010

PARTICLE/Yliruusi

Colloids and Surfaces B: Biointerfaces, Jyrki Heinämäki, 01.01.2005 → 31.12.2005
Polymer International, Jyrki Heinämäki, 01.01.2005 → 31.12.2005
AAPS Journal, Jyrki Heinämäki, 01.01.2006 → 31.12.2006
Acta Pharmacuetica, Jyrki Heinämäki, 01.01.2007 → 31.12.2007, Croatia

Jouni Hirvonen, Jouni.Hirvonen@helsinki.fi

DOSIS, Jouni Hirvonen, 01.01.2006 → 31.12.2006, Finland
Journal of Controlled Release, Jouni Hirvonen, 01.01.2006 → 31.12.2006
DOSIS, Jouni Hirvonen, 01.01.2007 → 31.12.2007, Finland
European Journal of Pharmaceutical Sciences, Jouni Hirvonen, 01.01.2007 → 31.12.2007
International Journal of Pharmaceutics, Jouni Hirvonen, 01.01.2007 → 31.12.2007
Journal of Cosmetic Dermatology, Jouni Hirvonen, 01.01.2007 → 31.12.2007
Journal of Pharmaceutical Sciences, Jouni Hirvonen, 01.01.2007 → 31.12.2007
Pharmaceutical Research, Jouni Hirvonen, 01.01.2007 → 31.12.2007
Bioanalysis, Jouni Hirvonen, 01.01.2008 → 31.12.2008
DOSIS, Jouni Hirvonen, 01.01.2008 → 31.12.2008, Finland
Journal of Controlled Release, Jouni Hirvonen, 01.01.2008 → 31.12.2008
PARTICLE/Yliruusi

Pharmaceutical Research, Jouni Hirvonen, 01.01.2008 → 31.12.2008

Leena Peltonen, Leena.Peltonen@helsinki.fi
Pharma Technology, Leena Peltonen, 01.01.2005 → ...
Journal of Drug Delivery Science and Technology, Leena Peltonen, 01.01.2008 → ...

Jukka Tapio Rantanen, Jukka.Rantanen@helsinki.fi
Member of the editorial board, Jukka Tapio Rantanen, 2005 → ...

Niklas Sandler, niklas.sandler@helsinki.fi
Member of the Editorial Board for Journal of Excipients and Food Chemicals, Niklas Sandler, 2009 → ...

Peer review of manuscripts

Sari Airaksinen, Sari.Airaksinen@helsinki.fi
Review of manuscripts, Sari Airaksinen, 2005 → 2007

Hélder A. Santos, helder.santos@helsinki.fi
Journal of Physical Chemistry B, Hélder A. Santos, 2005 → ...
Langmuir, Hélder A. Santos, 2005 → ...
Drug Discovery Today, Hélder A. Santos, 2008 → ...
Journal of Nano Research, Hélder A. Santos, 2008 → ...
European Journal of Pharmaceutical Sciences, Hélder A. Santos, 2009 → ...
Journal of Biomedical Chromatography, Hélder A. Santos, 2009 → ...
Journal of Controlled Release, Hélder A. Santos, 2009 → ...
The Leverhulme Trust, UK, Hélder A. Santos, 2009 → ...
Colloids and Surfaces B: Biointerfaces, Hélder A. Santos, 2010 → ...
International Journal of Pharmaceutics, Hélder A. Santos, 2010 → ...
Particle and Fibre Toxicology, Hélder A. Santos, 2010 → ...

Jyrki Heinämäki, Jyrki.Heinamaki@helsinki.fi
Reviewer in AAPS Journal, Jyrki Heinämäki, 1991 → ...
Reviewer in Journal of Pharmaceutical Sciences, Jyrki Heinämäki, 1991 → ...
Reviewer in AAPS PharmSciTech, Jyrki Heinämäki, 1999 → ...
Reviewer in AAPS PharmSciTech, Jyrki Heinämäki, 1999 → ...
Reviewer in AAPS journal, Jyrki Heinämäki, 1999 → ...
Reviewer in Acta Pharmaceutica, Jyrki Heinämäki, 1999 → ...
Reviewer in Agricultural and Food Science, Jyrki Heinämäki, 1999 → ...
Reviewer in Biopolymers, Jyrki Heinämäki, 1999 → ...
Reviewer in Carbohydrate Research, Jyrki Heinämäki, 1999 → ...
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Reviewer in Colloids and Surfaces: Biointerfaces, Jyrki Heinämäki, 1999 → ...
Reviewer in Drug Development and Industrial Pharmacy, Jyrki Heinämäki, 1999 → ...
Reviewer in European Journal of Pharmaceutical Sciences, Jyrki Heinämäki, 1999 → ...
Reviewer in European Journal of Pharmaceutical Sciences, Jyrki Heinämäki, 1999 → ...
PARTICLE/Yliruusi

Reviewer in International Journal of Pharmaceutics, Jyrki Heinämäki, 1999 → ...
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Reviewer in Journal of Food Engineering, Jyrki Heinämäki, 1999 → ...
Reviewer in Journal of Pharmaceutical Sciences, Jyrki Heinämäki, 1999 → ...
Reviewer in Journal of Pharmaceutical and Biomedical Analysis, Jyrki Heinämäki, 1999 → ...
Reviewer in STP Pharma Sciences, Jyrki Heinämäki, 1999 → ...
Reviewer in Polymer International, Jyrki Heinämäki, 1999 → ...
Reviewer in International Journal of Pharmaceutics, Jyrki Heinämäki, 1999 → ...

Anne Juppo, anne.juppo@helsinki.fi
Drug Development and Industrial Pharmacy, Anne Juppo, 1996 → 2010
European Journal of Pharmaceutics and Biopharmaceutics, Anne Juppo, 1996 → 2010
European Journal of Pharmaceutical Sciences, Anne Juppo, 1999 → 2010
Powder Technology, Anne Juppo, 2003 → 2010
Journal of Controlled Release, Anne Juppo, 2004 → 2010
Handbook of Pharmaceutical Excipients, Anne Juppo, 2007 → 2010

Timo Laaksonen, timo.laaksonen@helsinki.fi
Powder Technology, Timo Laaksonen, 2008 → ...
Biomaterials, Timo Laaksonen, 2009 → ...
Journal of the American Chemical Society, Timo Laaksonen, 2009 → ...
The Journal of Physical Chemistry, Timo Laaksonen, 2009 → ...
European Journal of Pharmaceutical Sciences, Timo Laaksonen, 2010 → ...

Satu Lakio, satu.lakio@helsinki.fi
Käsikirjoitusten vertaisarviointi International Journal of Pharmaceutics -julkaisussa, Satu Lakio, 01.01.2007 → 31.12.2010

Leena Peltonen, leena.peltonen@helsinki.fi
European journal of pharmaceutical sciences, Leena Peltonen, 2001 → ...
Journal of controlled release, Leena Peltonen, 2004 → ...
Colloid and polymer science, Leena Peltonen, 2006
European journal of pharmaceutics and biopharmaceutics, Leena Peltonen, 2006 → ...
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Nanomedicine, Leena Peltonen, 2007
Cyclodextrins in the pharmaceutical and biomedical fields, Leena Peltonen, 2008
Journal of pharmaceutical and biomedical analysis, Leena Peltonen, 2008
Asian journal of pharmaceutics, Leena Peltonen, 2009 → ...
Journal of drug delivery science and technology, Leena Peltonen, 2009 → ...
African journal of biotechnology, Leena Peltonen, 2010 → ...
BioDrugs, Leena Peltonen, 2010 → ...
Chemical engineering journal, Leena Peltonen, 2010 → ...
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Niklas Sandler, niklas.sandler@helsinki.fi
Review of manuscripts, Niklas Sandler, 2003 → ...

Mia Siven, Mia.Siven@helsinki.fi
European Journal of Pharmaceutical Sciences, Mia Siven, 2004 → 2011
Journal of Controlled Release, Mia Siven, 2004 → 2011
Journal of Pharmacy and Pharmacology, Mia Siven, 2004 → 2005
Reviewer in scientific journals, Mia Siven, 2004 → ...
Journal of Applied Polymer Science, Mia Siven, 2005 → ...
Pharmaceutical Research, Mia Siven, 2006 → ...

Clare Strachan
AAPS Journal, Clare Strachan, 2006 → ...
AAPS PharmSciTech, Clare Strachan, 2006 → ...
Analytica Chimica Acta, Clare Strachan, 2006 → ...
Analytical Chemistry, Clare Strachan, 2006 → ...
Applied Spectroscopy, Clare Strachan, 2006 → ...
Energy and Fuels, Clare Strachan, 2006 → ...
European Journal of Pharmaceutical Sciences, Clare Strachan, 2006 → ...
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Journal of Raman Spectroscopy, Clare Strachan, 2006 → ...
Molecular Pharmaceutics, Clare Strachan, 2006 → ...
Pharmaceutical Research, Clare Strachan, 2006 → ...
Talanta, Clare Strachan, 2006 → ...

Jaakkko Aaltoinen, jaakko.aaltoinen@helsinki.fi
European Journal of Pharmaceutical Sciences, Jaakko Aaltoton, 2007 → ...
European Journal of Pharmaceutics and Biopharmaceutics, Jaakko Aaltoton, 2007 → ...
Instrumentation Science & Technology, Jaakko Aaltoton, 2007 → ...
International Journal of Pharmaceutics, Jaakko Aaltoton, 2007 → ...
Journal of Chemometrics, Jaakko Aaltoton, 2007 → ...
Journal of Pharmaceutical Sciences, Jaakko Aaltoton, 2007 → ...
Journal of Pharmaceutical and Biomedical Analysis, Jaakko Aaltoton, 2007 → ...
Journal of Pharmacy and Pharmacology, Jaakko Aaltoton, 2007 → ...
Pharmaceutical Development and Technology, Jaakko Aaltoton, 2007 → ...

Inna Miroshnyk, inna.miroshnyk@helsinki.fi
Pharmaceutical Research, Inna Miroshnyk, 2004 → ...
PARTICLE/Yliruusi

Crystal Growth & Design, Inna Miroshnyk, 2006 → …
Journal of Pharmaceutical Sciences, Inna Miroshnyk, 2007 → …
Bioorganic and Medicinal Chemistry, Inna Miroshnyk, 2008 → …
Journal of Pharmaceutical and Biomedical Analysis, Inna Miroshnyk, 2008 → …
Molecular Pharmaceutics, Inna Miroshnyk, 2008 → …
Pharmaceutical Development and Technology, Inna Miroshnyk, 2008 → …
Chemical Engineering Research and Design, Inna Miroshnyk, 2009 → …
International Journal of Pharmaceutics, Inna Miroshnyk, 2009 → …

Editor of series
Clare Strachan
Editorial board member, Clare Strachan, 2007 → …

Editor of special theme number
Hélder A. Santos , helder.santos@helsinki.fi
In Vitro Models Used in Drug Discovery: Drug Absorption and Metabolism, Hélder A. Santos, 09.2010 → 12.2011
Innovative Technology for Drug Delivery Applications: From Nanocapsules and Biopolymers to Inorganic Materials, Hélder A. Santos, 05.2010 → 04.2011
Anne Juppo , anne.juppo@helsinki.fi
Dosis: Diversity of dosage form research - molecular, nano, micro and macro perspective, Anne Juppo, 2008, Finland
Jaakko Aaltonen , jaakko.aaltonen@helsinki.fi
Special Issue Editor, Jaakko Aaltonen, 2010 → 2011

Membership or other role in review committee
Anne Juppo , anne.juppo@helsinki.fi
Referee of research project grant proposal in FWO-Vlaanderen, Anne Juppo, 2009, Belgium
Jouko Yliruusi , Jouko.Yliruusi@helsinki.fi
Evaluation of the Undergraduate Program at the Aristotle University of Thessaloniki, Jouko Yliruusi, 2008, Greece
Evaluation of a company’s research funding application, Jouko Yliruusi, 2010, Estonia

Membership or other role in research network
Jouni Hirvonen , Jouni.Hirvonen@helsinki.fi
Head of the early ADME group, Vikki Drug Discovery Technology Center, Jouni Hirvonen, 2000 → 2005, Finland
Anne Juppo , anne.juppo@helsinki.fi
Sinpharma/Nordpharma, Anne Juppo, 2007 → 2008
Director of Pharmaceutical Solid State Research Cluster, Anne Juppo, 2010 → 2012
Jouko Yliruusi , Jouko.Yliruusi@helsinki.fi
Head of Division, Jouko Yliruusi, 1993 → …
National Graduate School in Natural Polymers, Jouko Yliruusi, 2008 → …

Membership or other role in national/international committee, council, board
Hélder A. Santos , helder.santos@helsinki.fi
Editorial Advisory Board Member, Hélder A. Santos, 2010 → …, United States
INTRODUCTION TO THE UNIVERSITY OF HELSINKI

PARTICLE/Yliruusi

Jyrki Heinämäki , Jyrki.Heinamaki@helsinki.fi
Board member, Finnish Pharmaceutical Society, Jyrki Heinämäki, 2002 → ...
Suomen farmaseutinen yhdistys (SFY), Jyrki Heinämäki, 01.01.2005 → 31.12.2005
Suomen farmaseutinen yhdistys (SFY), Jyrki Heinämäki, 01.01.2006 → 31.12.2006
Invited reviewer, Jyrki Heinämäki, 2009, Belgium

Jouni Hirvonen , Jouni.Hirvonen@helsinki.fi
AAPS, Jouni Hirvonen, 1990 → 2011, United States
Physical Pharmacy Federation, Jouni Hirvonen, 1996 → 2011, Finland
European Pharmaceutical Federation, Jouni Hirvonen, 2001 → 2011, Sweden
National ADME Cluster in Finland, Jouni Hirvonen, 2001 → 2007, Finland
European Association of the Faculties of Pharmacy, Jouni Hirvonen, 2004 → 2011, Belgium
Viikki Learning Centre, Jouni Hirvonen, 2004 → 2005, Finland
Controlled Release Society, Nordic Chapter, Jouni Hirvonen, 01.01.2005 → 31.12.2005
Finnish Pharmaceutical Association, Jouni Hirvonen, 2005 → 2011, Finland
Controlled Release Society, Jouni Hirvonen, 2007 → 2011, United States
Controlled Release Society Nordic Chapter, Jouni Hirvonen, 01.01.2007 → 31.12.2007, United States
Controlled Release Society Nordic Chapter, Jouni Hirvonen, 01.01.2008 → 31.12.2008, United States
Federation Pharmaceutische International, Jouni Hirvonen, 2008 → 2011, Netherlands
Board, Drug Policy 2020 in Finland, Ministry of Health, Jouni Hirvonen, 2010, Finland
Pharmacopoeia Committee, Finnish Medicines Agency FIMEA, Jouni Hirvonen, 2010 → 2013, Finland

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Representative in European Federation of Chemical Engineering (EFCE), Working Party on Agglomeration, Anne Juppo, 2001 → 2011
Inspector (inspehtori) of Pharmacy Students Organisation in University of Helsinki, Anne Juppo, 2006 → 2012, Finland
Member of the national committee on planning of specialising studies on Industrial Pharmacy, Retail Pharmacy and Hospital Pharmacy, Anne Juppo, 2006 → ..., Finland
Member of the APV Focus Group in Veterinary Formulations, Anne Juppo, 2010 → ...

Leena Peltonen, Leena.Peltonen@helsinki.fi
Finnish Pharmaceutical Association, Leena Peltonen, 01.04.2004 → ...
Slovenian Research Agency, Leena Peltonen, 01.01.2007 → 31.12.2007, Slovenia

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Member of the Board of Viikki Drug Discovery Technology Center, Jouko Yliruusi, 2000 → 2005
Member of the Faculty Board, Jouko Yliruusi, 2004 → 2006
Innovative Medicines Initiative, Contact Group Member, Jouko Yliruusi, 2005 → 2007
Member of the Faculty Board, Jouko Yliruusi, 2010 → ...

Membership or other role in public Finnish or international organization

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Scientific advisor and consultant, Sari Airaksinen, 2006 → ..., Finland

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INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

PARTICLE/Yliruusi

Membership, Hélder A. Santos, 2007 → ..., Switzerland
Membership, Hélder A. Santos, 2008 → ..., United States
Membership, Hélder A. Santos, 2008 → ..., Finland
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Membership, Hélder A. Santos, 2010 → ..., Finland
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Jyrki Heinämäki, Jyrki.Heinamaki@helsinki.fi
Scientific advisor, Jyrki Heinämäki, 1995 → ..., Finland
Scientific advisor, Jyrki Heinämäki, 1995 → ...
Scientific advisor and consultant, Jyrki Heinämäki, 1995 → ..., Finland
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Scientific advisor and consultant, Jyrki Heinämäki, 1995 → ..., Finland
Lääketaitos, Jyrki Heinämäki, 01.01.2005 → 31.12.2005, Finland
Lääketaitos, Jyrki Heinämäki, 01.01.2006 → 31.12.2006, Finland
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Opiskelijapalautejärjestelmän kehittämistyöryhmä, Jouni Hirvonen, 01.01.2007 → 31.12.2007, Finland
Opiskelijavointajärjestelmän kehittämistyöryhmä, Jouni Hirvonen, 01.01.2007 → 31.12.2007, Finland
HUS Apteekin johtokunta, Jouni Hirvonen, 01.01.2008 → 31.12.2008, Finland
HY:n opiskelijapalautejärjestelmän kehittämistyöryhmä, Jouni Hirvonen, 01.01.2008 → 31.12.2008, Finland

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Member of Finnish Society for Natural Philosophy, Jouko Yliruusi, 1990 → ...
Member of AAPS, American Association of Pharmaceutical Sciences, Jouko Yliruusi, 1993 → ...
Member of AAAS, American Association for the Advancement of Science, Jouko Yliruusi, 2000 → ...
Founder Member of Pharmaceutical Solid State Research Cluster (PSSRC), Jouko Yliruusi, 2006
Member of Finnish Pharmaceutical Society, Jouko Yliruusi, 2007 → ...

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Membership, Inna Miroshnyk, 2001 → ..., Finland
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Membership, Inna Miroshnyk, 2002 → ..., Canada
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Other tasks of an expert in private sector
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Consultant, Inna Miroshnyk, 2009 → ..., Finland
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**Participation in interview for written media**
Hélder A. Santos, helder.santos@helsinki.fi
Homenagem da Câmara de Tarouca a um Ilustre Jovem Tarouquense (in Portuguese), Hélder A. Santos, 04.08.2010, Portugal
Hélder Santos Homenageado na Terra Natal (in Portuguese), Hélder A. Santos, 04.08.2010, Portugal
Tarouca Projectada Mundialmente no Campo da Ciência (in Portuguese), Hélder A. Santos, 31.07.2010, Portugal
Jyrki Heinämäki, Jyrki.Heinamaki@helsinki.fi
Lääkevalmistus apteekissa -kurssi, Lääkäruhollon täydennyskoulutuskeskus, Jyrki Heinämäki, 22.05.2002 → 31.12.2011, Finland
Anne Juppo, anne.juppo@helsinki.fi
Kuljetuksen aikana jäätyneet lääkkeet voivat olla vaarallisia, Anne Juppo, 05.04.2007
Lääkkeiden vaikutusten tutkiminen lapsilla tulee pakolliseksi, Anne Juppo, 10.01.2007, Finland
Lääkkeitä lapsille, Anne Juppo, 2009, Finland

**Participation in TV programme**
Hélder A. Santos, helder.santos@helsinki.fi
“Prémio Talento 2009” (Science Talent Award 2009), in Portuguese, Hélder A. Santos, 23.07.2010, Portugal

**Participation in interview for web based media**
Hélder A. Santos, helder.santos@helsinki.fi
Portugal awards a citizen who is creating a science career in Finland, Hélder A. Santos, 29.09.2010, Finland
Anne Juppo, anne.juppo@helsinki.fi
Yhteisellä asiailta: Lääkkeitä lapsille, Anne Juppo, 2009, Finland
Research Group: Yliruusi J

**Basic statistics**

- Number of publications (P): 142
- Number of citations (TCS): 759
- Number of citations per publication (MCS): 5.35
- Percentage of uncited publications: 28%
- Field-normalized number of citations per publication (MNCS): 0.93
- Field-normalized average journal impact (MNJS): 1.14
- Field-normalized proportion highly cited publications (top 10%): 0.74
- Internal coverage: 0.79

**Trend analyses**

- MNCS
- THCP10
- MNJS

**Collaboration**

Performance (MNCS) by collaboration type