

Transfer of Technology Between Universities and Enterprises as an Important Factor of Funding of Universities

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Abstract: The universities of applied sciences, especially those tied to a specific region, are responsible in both senses for developing their region: By recognizing future development trends and, together with partners in business and administration, reacting to these developments by implementing modern, tailor-made programmes in education and further training. By fulfilling their role as the region's motor with applied research and development and the closely-related transfer of knowledge and technology, as well as supporting entrepreneurs. The level of these two aspects represents the quality of innovation of a university of applied sciences in practical action

Keywords: technology transfer, university of applied sciences, teaching and research, external revenue, Bioinformatics, Biosystems Engineering, economic structure, Service Centre for International Knowledge and Technology Transfer – SeWiTec, EU affairs, Total Quality Management, Prize for Research, EU, InnoRegio, Telematics. Logistics, Aviation Engineering;

1 Introduction

In order to survive successfully every company and every institution involved in the market must be able to react quickly and flexibly to the new challenges its environment presents. Growing, ever more international competition, ever shorter innovation cycles, increasing customer demands and changing social conditions

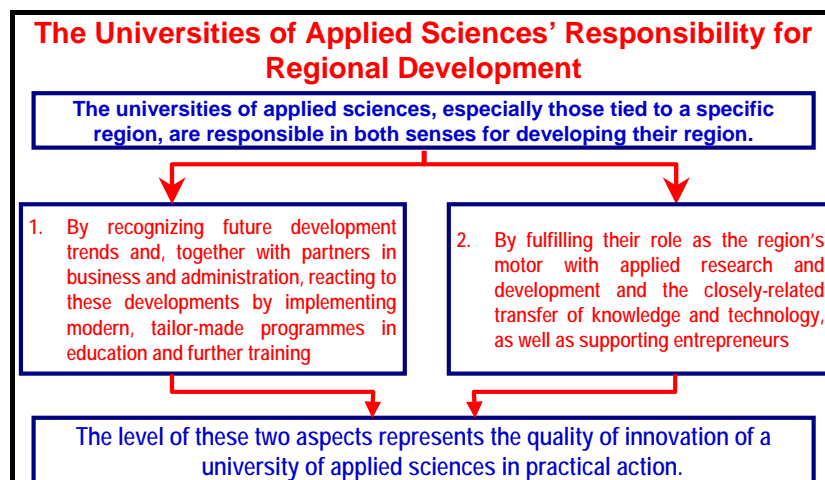
mean that small and medium-size enterprises must be constantly prepared to develop or adapt new ideas, processes and technologies.

The universities of applied sciences fulfil two important functions on account of their historical role. On the one hand, they are the institutions in society that store handed-down knowledge, analyse it critically and pass it on to future generations.

The universities of applied sciences are, on the other hand, society's workshops of the future. Their research creates new knowledge, which they pass on in their educational and further-training capacity and in other forms of knowledge transfer.

The ability of any society to survive in the future is largely dependent on its knowledge and abilities. There is an inestimable relationship between the performance which a society is able to achieve and its level of scientific advancement. The universities of applied sciences are the motors of economic development in any single region.

The universities of applied sciences, especially those tied to a specific region, are responsible in two senses for developing their region. Firstly, by recognizing future development trends in the regional economy and public administration, and together with partners in business and administration, reacting to these developments by implementing modern, tailor-made programmes in education and further training. Secondly, the universities of applied sciences fulfil their responsibility for the local economy through applied research and development and the related knowledge transfer. The level of these two aspects represents the quality of innovation of a university of applied sciences in practical action.



The Universities of Applied Sciences' Responsibility for Regional Development

In order for a university of applied sciences to be successful in the face of national and international competition, it has to continually strive to improve itself. This

competition includes competing for students, professors and mainly of course for budget financing and/ or private money in the form of knowledge and technology transfer.

The following study provides an overview of knowledge and technology transfer at universities, universities of applied sciences and research institutes in the Federal Republic of Germany. Special focus is on Brandenburg and the University of Applied Sciences Wildau following an account of the situation of knowledge and technology transfer all over Germany.

2 Technology and Knowledge Transfer – Explaining the Term

The Greek/ Latin term for knowledge transfer means to transfer (Latin *transfere*) knowledge that comes from handicraft or art (Greek *logos* and *techne*). Originally that meant transferring knowledge in the area of natural and engineering sciences as well as medicine to produce useful, marketable products. In a wider interpretation the term technology and knowledge transfer means providing industry and small and medium-sized companies with the results of teaching and research at universities of applied sciences and research institutes. There is a variety of forms of cooperation imaginable and possible between science and industry in the systematic search for marketable ideas. The forms can be listed as follows:

- Cooperation and contractual research
- Hiving off from scientific areas
- Personnel transfer
- Expertise concerning individual questions
- Further training activities
- Patent and licensing activities

The treatment of small and medium-sized enterprises (SME) is particularly important due to its special position in the German economy.

Publicly funded research in Germany is carried out within a highly differentiated system. This is based on a strict division of responsibility between various sectors. There are historical and intellectual reasons for this development. The different sectors of this system, comprising universities, universities of applied sciences and research organizations, pursue different tasks in their respective scientific work and consequently provide different amounts of technology and knowledge

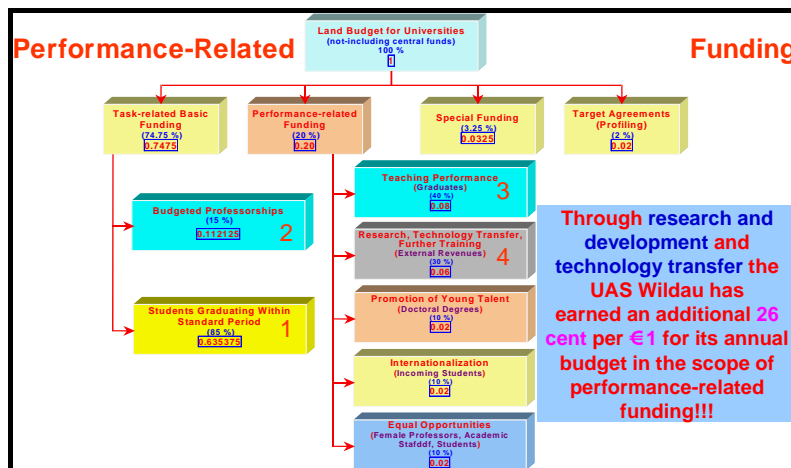
transfer. Therefore the above-mentioned forms of interaction have a different priority for technology and knowledge transfer from these sectors.

It is therefore advisable to look at the technology and knowledge transfer separately for universities, universities of applied sciences and research institutes outside the third-level system. The latter comprise the Max-Planck-Gesellschaft, Fraunhofer Gesellschaft, Leibniz-Gemeinschaft and Helmholtz Gemeinschaft.

3 Technology and Knowledge Transfer Must be Rewarded – the Promotion of Technology and Knowledge Transfer in the State of Brandenburg Using an Appropriate Political Framework

The state of Brandenburg has nine universities – three universities, five universities of applied sciences and the university for film and television. Additionally there are thirty research institutes outside the universities, among them the Max-Planck-Gesellschaft, the Fraunhofer Gesellschaft, the Leibniz-Gemeinschaft and the Helmholtz Gesellschaft deutscher Forschungszentren.

The subject “Technology and Knowledge Transfer must be rewarded – Incentives for the cooperation between Science and Industry” is important today since this cooperation is an essential requirement for innovation and competitiveness and, following the conviction of the State government, necessary for the well-being of both parties.



Representation of Performance in the area of Knowledge and Technology Transfer in University Financing

Consequently, the State government feels responsible for creating the framework to promote this cooperation. Within the Brandenburg University Law the regional government Science Department has declared technology transfer together with teaching and research to be an essential function of universities. Universities include universities of applied sciences. In so doing the ministry has made clear that both types of university are to a large degree equal in this respect.

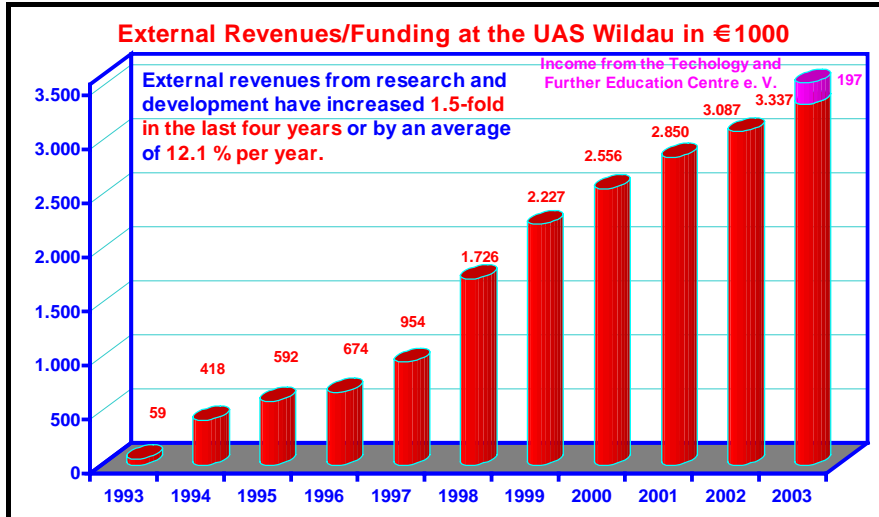
The importance of this issue demands that new forms of promotion should be considered and tried out. Experience to date shows that technology transfer can be successfully supported by

- setting up new businesses from the universities
- extending the technology centres
- extending the research network
- increasing patent and licensing activities of universities

Together with the transfer of personnel, new forms of technology transfer networking, building up technology transfer institutes at universities and the participation of universities at fairs have all proved successful. Additionally, various forms of public-private partnership have to be developed with the (regional) economy. Universities have to make their knowledge transfer to businesses more professional. The success to date can only be continued if additional incentive schemes are developed, which for example create a suitable framework for the acquisition of external revenues for the universities.

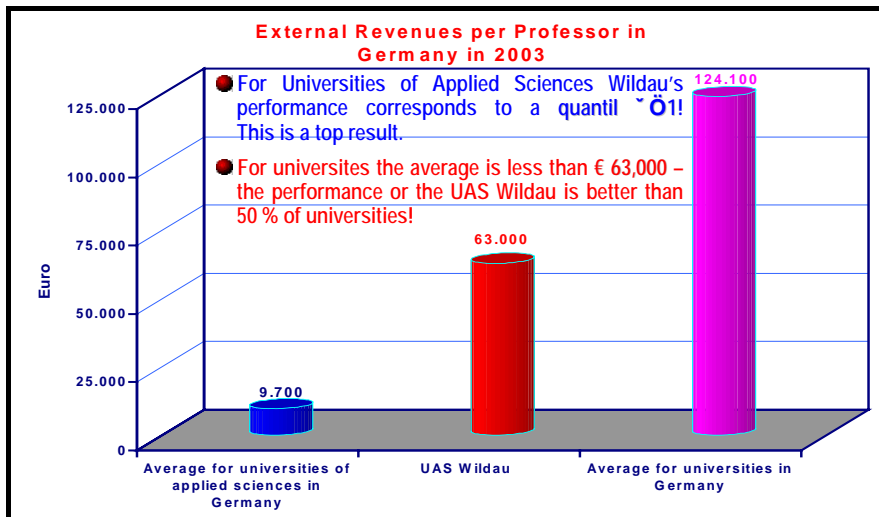
4 Technology und Knowledge Transfer at the University of Applied Sciences Wildau in Practice

In the area of applied research and development as well as technology and knowledge transfer the University of Applied Sciences Wildau has managed to maintain a superb position both in Brandenburg and across Germany. It continues to build on this base and extend it.



Development of revenue at the University of Applied Sciences Wildau from Knowledge and Technology Transfer

The pioneer role of the UAS Wildau in the area of technology transfer can be seen for example in the ratio of “external revenue effectiveness per Professor”. This means that each professor has acquired more than €55,000 in external revenue in recent years. For 2003 this increased to €63,000. On average approximately 60 staff are employed with these funds. In November 2003 this figure rose to 67.



External funding per professor

On account of its highly developed applied research and development the University of Applied Sciences Wildau has become an important player, both regionally and nationally. Moreover, it has also become a major employer in the region.

The University of Applied Sciences is working on two major projects funded by the Federal Ministry for Education and Research, supported by the InnoRegio promotion programme. These are the “Application Network Biohybrid Technologies” and “Networking Tourism, Innovative Technology, Closed Loop Economy and Living with Nature”. The University of Applied Sciences is the only university in Brandenburg to be involved in the InnoRegio promotion programme. The interesting aspect to this research is not only the leading role of the UAS Wildau, but that both projects are trying out and developing new degree courses for the UAS Wildau. In the context of the Application Network Biohybrid Technologies project, the UAS Wildau is developing the dual degree course Bioinformatics/ Biosystems Engineering, as a bachelor’s and master’s degree. In the winter semester 2001/2002 the first students registered for this new course. With the second project mentioned above, study modules, for example in the area of materials technologies, are being developed. These modules are due to be offered to students taking up new places in our engineering degrees.

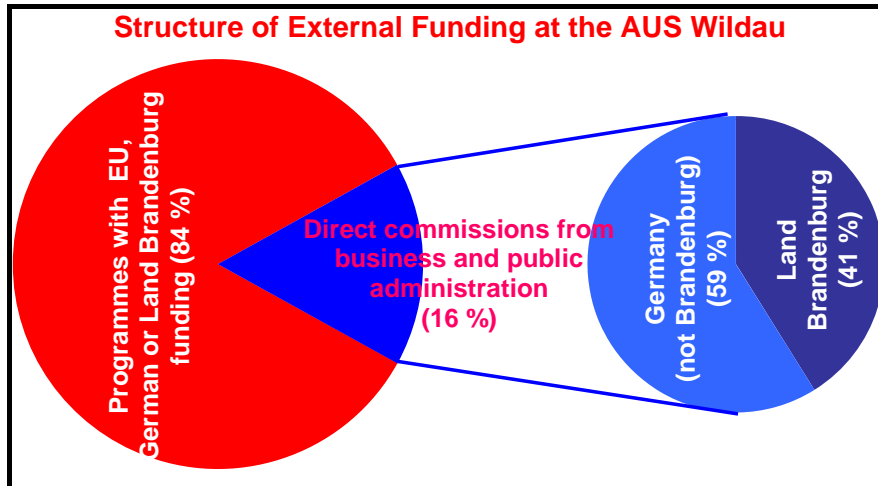
Main Areas of Applied Research and Development

In Wildau the emphasis is on technological developments related to the subjects we teach:

- **Logistics**
(Company logistics, transport logistics, airport logistics, ...)
 - **Material Sciences**
(Technology of new materials, also in connection with aviation engineering)
 - **Recycling**
 - **Surfaces Technology**
 - **Telematics**
(in particular traffic telematics)
 - **Process Engineering**
(Development and Implementation of “Beulrohr” technologies)
 - **Environmental Engineering**
 - **Information and Communications Technologies**
- and also further fields of research including
- **Innovation Management**
 - **Communal and Administrative Fields**

Main areas in Technology and Knowledge Transfer at the UAS Wildau

It is the goal of the university to integrate itself into the surrounding region. However, technology and knowledge transfer at the University of Applied Sciences Wildau is disadvantaged by the weak economic structure of the region. This is shown in the following representation.



Structure of External Funding at the UAS Wildau in 2003

This means that in the context of knowledge and technology transfer payments the percentage of direct (non-funded) business contracts from Brandenburg is merely 6.56%. The reason for this is not that companies in Brandenburg do not require knowledge and technology transfer (especially from UAS Wildau) since the percentage of funded and non-funded knowledge and technology transfer within Brandenburg is much greater; rather we have to examine the reason for the discrepancy between funded and non-funded knowledge and technology transfer. The simple reason is the relatively weak economic and business structure in Brandenburg, since most companies are medium-sized, small or very small. Over 90% of companies employ fewer than 20 people. Due to their limited economic strength, these companies cannot award contracts to universities which they themselves have to pay for. They continue to rely on promotion programmes of the regional state, the national government and the EU when cooperating with universities and research institutes.

The structure of technology and knowledge transfer at the UAS Wildau also reflects and describes the overall economic situation in the regional state of Brandenburg.

Mainly technology transfer means transferring knowledge from a technology producer via a possible technology mediator to a technology user. In a first approach this means that the university of applied sciences is a technology producer and the business is a technology user. In a second approach the university plays the role of catalyst in transferring knowledge between businesses.

The forms of knowledge transfer can be divided up into five variants. In reality, these are interlinked rather than distinct.

1. Implementing projects in the area of applied research and development having received a contract from a company.
2. Licence agreements between universities and companies.
3. Personnel transfer between science and business – even hiving off in the area of technology.
4. Tailor-made education and further training programmes at universities for companies.
5. Scientific and technical consultancy regarding concrete questions and problems.

These forms of knowledge transfer have been successful since they are based on mutual benefit. For business the benefit lies in the availability of advanced expertise in solving technical and business problems. The benefit for the university staff is the opportunity to make their research and teaching more relevant to the market and not least the financial transfer involved.

Technology transfer follows a certain structure:

The phases in a project's process within technology transfer

An "ideal" process within technology transfer at the UAS Wildau follows this route:

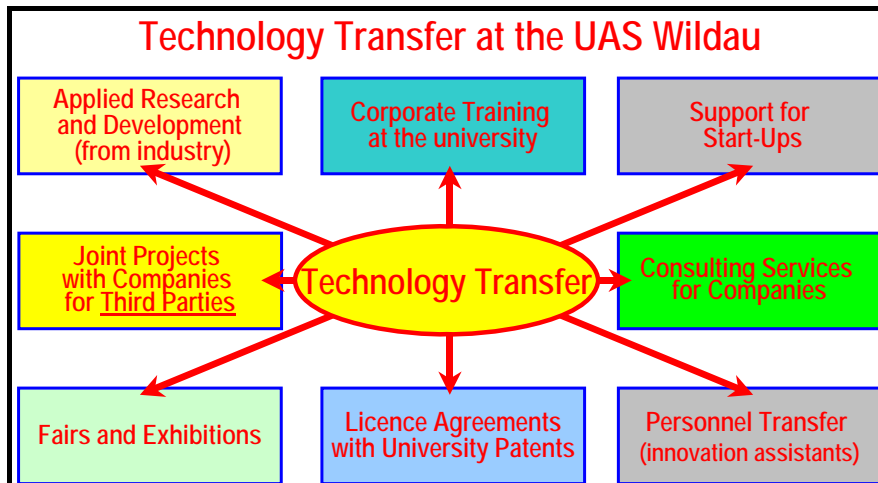
- **Phase 1: Information phase or informing phase**
Collecting data and presenting the offer to perform on behalf of potential transfer partners within the university (professor, institutes, laboratories, etc.)
- **Phase 2: Acquisition phase (searching ? "knocking on doors")**
The university becomes involved in the innovation process as a problem solver for business and administration
- **Phase 3: Contact and negotiating phase**
Defining the task on the basis of the problem and discussing its possible solution with financial support (funding programmes)
- **Phase 4: Realization phase**
Developing solutions and implementing them

Process of a technology transfer project

The strategic goal of technology transfer lies in making the University of Applied Sciences Wildau an ever-stronger anchor in the regional economy.

It is essential therefore that the transfer elements of the university have all the qualities of a brand product. Moreover, the university must act as a business entity, both internally and externally.

Following some introductory observations, the following pages present the goals of knowledge and technology transfer at the University of Applied Sciences Wildau.



Goal areas for Knowledge and Technology Transfer at the UAS Wildau

It is easy to describe the organizational structure at the UAS Wildau. The Technology Transfer and Innovation Consultancy service is directly responsible to the President of the University. The President takes personal responsibility for knowledge and technology transfer.

5 Development Plans for Technology and Knowledge Transfer and the Development of an Efficient Incentive System to Promote Applied Research and Development at the UAS Wildau

“Our university is committed to continually developing itself to remain a sought-after and reliable partner for business and a motor for growth in the region. We actively support small and medium-sized companies as well as public administration, seeking to assist their ecological, social and economic sustainable development”. This is a key goal of the UAS Wildau. We will have to set up efficient and sustainable structures to deal with new responsibilities in the area of dynamically changing networks. To this end we also have to consolidate the level reached in this area and promote the forecasted development tendencies, especially regarding EU responsibilities in the area of languages and other promotional activities. This is in the interest of the university and the regional and national economies. The expectations of external and internal partners can only be met if an efficient structural unit dealing with every aspect of a project is in place.

Professors at a university of applied science face the demands of teaching, looking after students writing their dissertations, publishing etc. Consequently it takes extraordinary commitment to acquire and realize wide-ranging research projects. Additionally, the procedure of filing an application and writing reports on the projects is taking up more and more time, especially because of the increasing number of EU projects.

In order to deal with these increasing demands it is essential to put a professional structure in place within the university which will deal with research/ acquisition, negotiations, administrative project demands (contracting) as well as support with compiling the report. It requires a professional service to maintain the level already achieved and to increase it.

In order to fulfil the above-mentioned tasks the University of Applied Sciences Wildau has set up the Service Centre for International Knowledge and Technology Transfer – SeWiTec. The centre began working on 1 May 2004. The staff comprises a manager and one employee, both highly skilled linguistically and in the area of EU affairs.

6 Technology Transfer Must Be Rewarded (Final Comments)

The transfer of knowledge and technology must be rewarded, for both sides involved. The direct benefit for the University of Applied Sciences Wildau can be represented in the following way:

The Mutual Benefits of Technology Transfer

Benefits and Advantages of Technology Transfer for the University

- **External funding for the university additional funds for the university's budget**
 - ✓ Performance ratio (for the UAS Wildau the level of external funding in the budget was 38.2%).
 - ✓ Improved procurement opportunities for the university, especially equipment replacement.
 - ✓ Institutional and individual incentives within the university.
- **Relevance of the teaching material.**
 - ✓ Making the content of courses more relevant to the working world with practical experiences and insights.
 - ✓ Increasing contacts to companies (future placements, dissertation placements).
- **Building up the image and reputation of the university.**

The mutual benefit of knowledge and technology transfer – benefits for the University

Businesses profit in the following way.

The Mutual Benefits of Technology Transfer

Benefits and Advantages of Technology Transfer for Business

- The universities, especially universities of applied sciences are the innovation reserve for small and medium-sized companies.
- ✓ The small and medium-sized companies are not in a position to create their own research and development potential. The universities of applied sciences are their strategic partners in the area of research and development.
- Solution to companies' problems.
- ✓ Companies obtain high-quality solutions at a good price.
- Personnel transfer in research projects.

An important advantage for both partners is the growing trust between businesses and universities of applied sciences.

The mutual benefits of technology transfer – benefits for business

Knowledge and technology transfer has to be worthwhile not only for the universities as institutions, but also for professors and staff as individuals. Given that state-wide solutions are not to be expected, this means that the UAS Wildau will gradually introduce a system of incentives for knowledge and technology transfer. The first step was taken in 2004, when the university presented its first research prize.

The *UAS Wildau Prize for Research, Development and Technology Transfer* was introduced as a result of the university's Total Quality Management procedures, and is presented to reinforce outstanding achievements by university staff in research, development and technology transfer. The € 3,000 prize is awarded every two years, beginning in 2003. It is presented on the occasion of the annual students' graduation ceremony in mid-July.

When it comes to knowledge and technology transfer universities of applied sciences are clearly disadvantaged in comparison to full scientific universities and non-university research institutions in Germany. The reason for this is that professors at universities of applied sciences normally have a heavy teaching load of 18 hours per week. This makes it important that incentives for knowledge and technology transfer for individuals (professors, academic staff) are created at universities of applied sciences. An incentives system for applied research and development and for knowledge and technology transfer at the UAS Wildau could be as follows, whereby professors receive staggered reductions in teaching commitments for R and D projects:

Position	Acquisition of External Funding or Standard Budget Funds	Reduction of teaching hours per semester
Successful acquisition of external funding		
1.	first €100,00	3
2.	second €100,000	2
3.	third €100,000	1
Successful acquisition of standard budget funding		
4.	first €100,000	1,5
5.	second €100,000	1
6.	third €100,000	0,5
Successful registration of Large Scientific Equipment		
7.	from €100,000	1
Leading a Research Area or a Competence Centre		
8.	from €200,000	2

Reductions in teaching commitments for R and D projects

Rules should be set up to regulate this incentives system, as follows for the UAS Wildau:

- It should be possible to collect fractions of one teaching hour (one hour = one teaching hour per week over one semester) until one hour is attained.
- In line with the Ministry of Science, Research and Culture of the state of Brandenburg regulations on teaching loads a maximum of 6 hours per week may be collected before the “stock” of hours has to be reduced. Further hours would otherwise be discounted.
- The basis for calculating the volume of knowledge and technology transfer work would be the funds booked in the accounts for one calendar year.

An incentives system like this would make knowledge and technology transfer more attractive in times of staffing shortages, and would further reinforce this key performance and quality feature of our university.