# AUSTRIAN HIGHER EDUCATION INSTITUTIONS' IDIOSYNCRASIES AND TECHNOLOGY TRANSFER SYSTEM

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Abstract

*The aim of this paper is to present the findings of a PhD research (Heinzl, 2007) conducted on the Universities of Applied Sciences in Austria. Four of the models that emerge from this research are: Generic Technology Transfer Model (Section 5.1); Idiosyncrasies Model for the Austrian Universities of Applied Sciences (Section 5.2); Idiosyncrasies-Technology Transfer Effects Model (Section 5.3) ; Idiosyncrasies-Technology Transfer Cumulated Effects Model (Section 5.3). The primary and secondary research methods employed for this study are: literature survey, focus groups, participant observation, and interviews. The findings of the research contribute to a conceptual design of a technology transfer system which aims to enhance the higher education institutions' technology transfer performance.*

*Keywords: Idiosyncrasies, Technology Transfer, Cumulated Effects.*

## 1 INTRODUCTION

Both innovation and technological change are considered drivers of economic growth (OECD, 2002). However, the stimulation of innovation is largely dependent on an effective management of scientific knowledge (European Commission, 2001a). An analysis of the European Trend Chart on Innovation (European Commission, 2002) reveals that the Austrian innovation performance lags behind other European countries (Fletcher, 2003). One of the suggested reasons for such an innovation gap is a weak linkage between universities conducted research and the industry (European Commission, 2001b). Consequently, a strong interaction between the science base and industry has been identified as a pivotal measure for the enhancement of Austria's innovation system performance. Such a science base may reside within universities, public sector research laboratories, or in independent research and technology organisations (European Commission, 2000). Higher education institutions, being initiators of scientific knowledge flows, could be considered a key stimulant to socio-economic development. However, higher education institutions differ vastly in terms of organisational structure, legal environment, strategy, mission, etc. However, there is little work done to investigate the relationships between such idiosyncrasies and technology transfer. The primary aim of this paper is to present findings on the effects of the idiosyncrasies of Austrian Universities of Applied Sciences on their technology transfer performance. Two of the deliverables, *Idiosyncrasies-Technology Transfer Effects and Cumulated Effects Models* (see Section 5), will provide deeper insights into the complex relationships that are prevalent in this context. Additionally, these models contribute to a set of recommendations for the implementation of a technology transfer system involving Austrian Universities of Applied Sciences which aims to enhance their technology transfer performance. Such enhancement has been identified by the Austrian Council (2002) as a core element in a generic strategy for narrowing the Austrian innovation gap.

# 2 LITERATURE REVIEW

## 2.1 Innovation System

The innovation system approach forms the basis of the European Trend Chart on innovation (European Commission, 2002) which provides a framework for research and innovation policy advice for member states. However, the innovation system is a complex system where innovation, technological change, and knowledge management are addressed (Lundvall, 1992). It also encompasses the interaction among multiple actors being: private enterprises, universities, public research institutes, industries, knowledge centres, government, and etc. (Saez et al, 2002; van Looy et. al, 2003).

The National Innovation System concept is widely popularised by Freeman (1987) and it is depicted in Figure 1. It is defined as a network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies (Freeman, 1987 as cited in OECD, 1997) as well as use new and economically useful knowledge which is either located within or rooted inside the border of a nation state (Lundvall, 1992 as cited in OECD, 1997). Such a system could foster successful innovation through the generation, diffusion, and implementation of scientific knowledge (European Commission 2000, 2001) and strong linkages among its actors facilitated through joint research, secondments, cross patenting, and etc. (OECD, 1997).

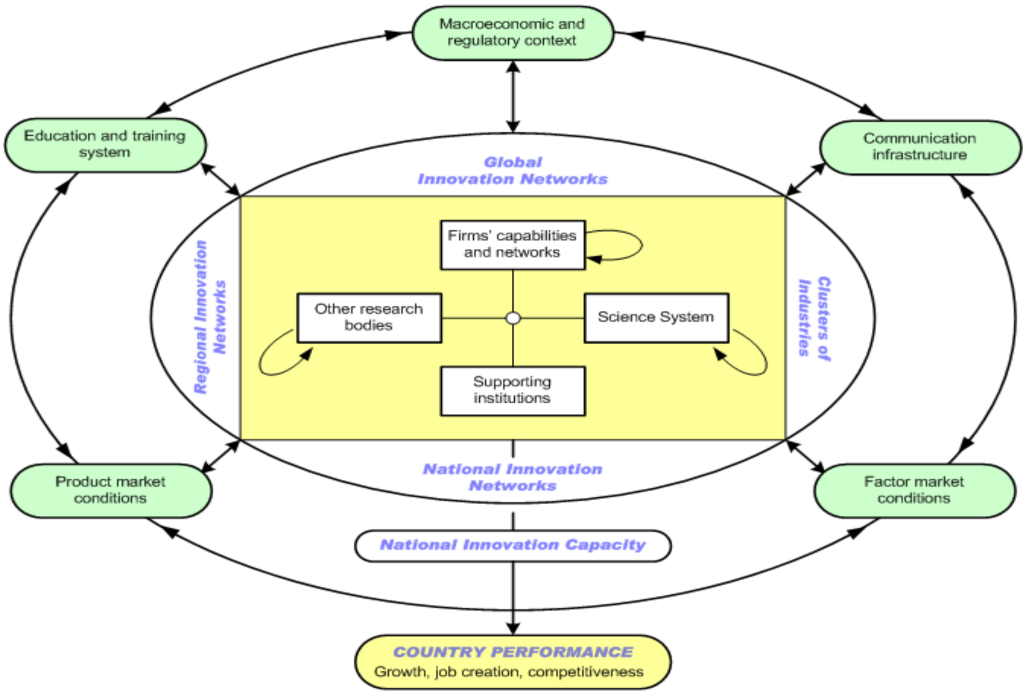


Figure 1: General Model Describing a National Innovation System (OECD, 1997)

### 2.2 Role of Higher Education Institutions in the Innovation System

As shown in Figure 1, higher education institutions play a pivotal role in the National Innovation System. According to the OECD (1999), academics act as problem solvers, and become innovators by creating new firms while research laboratories become important sources of innovation. The knowledge-related roles of higher education institutions are listed below:

- A provider of diverse and high quality knowledge base through the creation of scientific knowledge (Polt et al., 2000; Jacobsson, 2002; Gornitzka and Maassen, 2000; Jones-Evans et al., 1999; Doloreux, 2002);
- A disseminator of good practice and know-how including competency as well as capability building which is essential for successful problem solving (Polt et al., 2000; Jones-Evans et al., 1999; OECD, 2002);

Inevitably, collaboration among the industries and higher education institutions has to be fostered in order to exploit the latter's rich knowledge, science and technology bases. Through this, the industries will be able to remain competitive (Pyka, 2002).

### 2.3 Technology Transfer Concepts

When industries and higher education industries collaborate, technology transfer is expected to occur and this involves the movement of know-how, technical and scientific knowledge or technology from one organisational unit to another (Bozeman, 2000). However, technology transfer entails an intentional interaction made possible by different mechanisms (Amessa and Cohendet, 2001) such as: joint labs between academia and business, spin-offs, licensing of intellectual property, research contracts, mobility of researchers, co-publications, conferences, expos and special media, informal contact with professional networks, and the flow of graduates to the industry (OECD, 2002).

## 3 RESEARCH AIM

The overall aim of this study is to develop a model describing the effect of the idiosyncrasies of Universities of Applied Sciences in Austria on the technology transfer capabilities of this particular higher education sector. The research objectives of this study are listed as below:

- **Research Objective 1:** The identification of factors influencing the technology transfer performance for Austrian scientific institutions
- **Research Objective 2:** The conceptualisation of a technology transfer model for the Universities of Applied Sciences.
- **Research Objective 3:** The development of an idiosyncrasy-technology transfer effects model for the Universities of Applied Sciences.

## 4 RESEARCH METHODOLOGY

The research methodology as depicted in Figure 2 consists of three phases:

**Phase 1**: This phase is primarily a secondary research which comprises a survey of relevant literature and document analysis. A total of more than 300 literature sources has been analysed and has led to the abstraction of factors influencing Austrian Higher Education Institutions' technology transfer performance (collated and presented as a technology transfer model in

Section 5) as well as the identification of the idiosyncrasies of the Universities of Applied Sciences.

**Phase 2**: The ethnographic research conducted in this phase consists of a focus group followed by a participant observation. The goal of this phase is for triangulation purposes and also to refine the factors abstracted in **Phase 1** (or in other words, the technology transfer model). The participants of this phase are involved in the *Tech-Trans-V-Project* commissioned by the federal government in Vorarlberg, which aims to enhance the overall technology transfer performance of the Vorarlberg state.

**Phase 3**: This phase is preceded by conducting explorative interviews with experts in both the field of technology transfer and Universities of Applied Sciences. This is followed by focused interviews with stakeholders in Universities of Applied Sciences' sector (e.g. industry, intermediary organisation, an Austrian University of Applied Sciences, public funded research laboratory, etc.). The objectives of this phase are to validate and refine the technology transfer model (in **Phase 2**), idiosyncrasies of Universities of Applied Sciences (in **Phase 1**), and finally, explore the relationships between them and presented as an idiosyncrasy model.


Figure 2: Overview of Research Methodology (Heinzl, 2007, p.125)

The empirical research methods employed in this study have been summarised in Table 1.

| | Phase 2 | | Phase 3 | |
|---|---|---|---|---|
| | **Focus Group** | **Participant Observation** | **Explorative Interviews** | **Focussed Interviews** |
| **Purpose** | Theory building for behavioural aspects in the TT context | In-depth theory building for behavioural aspects in the TT context; validation of previous findings | Validation of previous findings in the Austrian context; further theory building for TT factors and idiosyncrasies; conceptualisation of idiosyncrasy model | Theory building for idiosyncrasy model |
| **Approach** | Inductive-deductive | Deductive | Deductive-inductive | Inductive |
| **Research Objective/s (from Section 3)** | 1 | 1 | 1,2,3 | 3 |
| **Sampling strategy** | Predefined by the *Tech-Trans-V-project* | Predefined by the *Tech-Trans-V-project* | Purposive Sampling | Snowball Sampling (Controlled by developing theory) |
| **Sampling Size** | 3 | 27 companies, 24 observation events | 8 | 12 |
| **Data Collection** | Group Discussion | Participant Observation | Semi-structured problem-centred interviews | Semi-structured focused interviews |
| **Data Recording** | Note Taking | Research Diary, Observation Records | Electronic recording | Electronic Recording |
| **Interview Guide** | yes | -- | yes | yes |
| **Pre-Testing** | -- | -- | yes | yes |
| **Analysis** | Content Analysis | Analytic Induction | Content Analysis | Content Analysis, Frequency Analysis |

**Note**: TT stands for Technology Transfer

Table 1: Overview of Research Techniques Applied during Empirical Research (Heinzl, 2007, p.128)

# 5 RESEARCH FINDINGS

## 5.1 Technology Transfer factors

The survey of relevant literature contributes to the identification of important technology transfer related concepts. These concepts are presented in an initial technology transfer model which is then validated and refined by empirical results of conducted focus groups, participant observation, and interviews. The final technology transfer model is shown in Table 2 while the refinement of the factors is depicted in Table 3. The factors influencing technology transfer performance are coded into three categories namely: providing agent-related factors; receiving agent-related factors; environment and transaction-related factors. The first category concerns institutions which provide the technology while the second, institutions which are at the receiving end. As for the third category, it involves the environment they are in as well as the interface between them.

The discussion on the technology factors will be across the various research methods and also, it will only highlight several key findings:

a. ***Providing agent-related factors***

***Strategy and Mission*** - relates to the institution's technology transfer strategy and research mission. The interviewees perceive that thematically focused research (as implemented in research centres) which pools together technical infrastructure, resources, and expertise, would better facilitate technology transfer. Additionally, it is suggested that a research strategy would clearly define the thematic focus, and look into the relevant equipment as well resources.

*R&D Orientation* - technology transfer crucially depends on *R&D Orientation* which is either applied or basic research orientation (note: the former involves the application of scientific or engineering knowledge to solve a defined problem). The following are excerpts of interviews conducted:

> "…*a higher education institution has to focus on applied research for establishing technology transfer*…" (A higher education support structure manager)

> "…*one has to be prepared that technology transfer is hardly possible if focusing merely on basic research*…" (A managing director of an intermediary organisation)

There has been a general consensus among the interviewees that strategic decisions concerning the thematic focus and applied research orientation are insufficient to stimulate technology transfer. Another vital dimension to be considered would be the institution's research mission that is formulated by the stakeholders.

***Infrastructure and Resources*** - the dimensions of the *Infrastructure and Resources* factor are: financial resources, technical infrastructure, and size of the research teams. There is a general consensus among the interviewees that these factors affect the technology transfer of higher education institutions. However, the effect of technical infrastructure on technology transfer performance is perceived as very trivial because it has not been considered a mandatory requirement for all technology-transfer projects.

***Scientific and Technological (S&T) Human Capital*** - based on the survey of literature and ethnographic research findings, the *Scientific and Technological Human Capital* factor is identified as essential for the enhancement of technology transfer performance. *Application Awareness* focuses on the customers - e.g. customer segmentation, customer needs, customer requirements, etc while *Business Excellence* encompasses more generic business skills such as: project management, grant application, communication, business appreciation, etc. The following interview excerpt confirms the need to prioritise the business aspect of technology transfer.

> "…*the activities of researchers change. Whereas formerly the researchers conducted research within the department or the laboratory only, today the researcher has to enter the market as he relies on selling his services…*" (A director of a public funded research laboratory)

*Personal Networks* and contacts are essential for gathering business intelligence which could facilitate a more successful market entry through increased technology transfer opportunities. Such networks are established through events, employment in the industry, communities of practice, conferences, etc. An interview excerpt to highlight the importance of such networks in technology transfer is as follows:

> "…*personal contacts are crucial for technology transfer and technology transfer rests on personal relationships as the facilitation of technology transfer always has to be seen in the context of acting persons…*" (A managing director of an intermediary organisation)

The interviewees unanimously agree that *Motivation* is vital for the enhancement of technology transfer. However, motivation iss largely dependent on the availability of a proper incentive and reward scheme within the institution.

***Research Organisational Design*** – the *Research Organisational Structure* dimension of this factor is necessary for a successful technology transfer. The interviewees perceive it as the composition of research teams as well as the overall structural organisation of research within the institution which is either full time versus part-time, or discipline specific versus interdisciplinary. The following excerpt highlights the emphasis of individual researcher's role in technology transfer.

> "*…the organisation is only of minor importance for technology transfer. A well-designed organisation is not responsible for the initiation of technology transfer projects. Technology transfer is initiated by persons. The organisation should not prevent the researcher in conducting technology transfer…*" (A managing director of a public funded research laboratory)

*Processes* in this context refer to workflows and information flows. Though *Processes* are highly relevant for technology transfer, they could be a barrier when caught in a bureaucratic web.

> "*…the definition of formal processes is certainly important for a properly working technology transfer. Proper communication is required for informing the relevant authorities. After project completion, customer feedback is important for identifying potential for improvement (like quality controlling). However, these formal processes must not become too complicated for not hindering technology transfer…*" (A manager of a higher education research centre)

*Support Structures* are responsible for providing a range of supporting services to the institutions as well as industry for the purpose of successful technology transfer. Such services relate to technology marketing, competencies building, business incubation, public funding related consultation, Intellectual Property Rights (IPR), Knowledge Transfer Partnership between Higher Education Institutions and the industry, etc. A positive *R&D Image* crucially affects the demand for technology-related services which in turn, stimulates technology transfer. However, specific mechanisms are necessary to build a reputable research image. These relate to research projects, publications, online dissemination, conference presentations etc.

> "*…most important are scientific publications followed by reference projects and internet presentations. Also the participation in scientific conferences belongs to the presentation. As a result, brand development activities regarding the technology-related services are specific compared to other products…*" (A managing director of a public funded research laboratory)

b. ***Receiving agent-related factors***

***Industrial Demand*** – this refers to the demand for scientific knowledge and technology. It is perceived that a high industrial demand for technology does not automatically lead to technology transfer. However, the demand has to be articulated by the industry (*Articulated Demand*) in order to initiate the transfer process. On the other hand, the *Latent Demand* phenomenon is thought to exist when an industry: is not aware of its need for technology; deliberately ignores its need for technology; lacks the appreciation for new technology; is reluctant to embark on knowledge transfer partnership programmes. However, such a demand poses to be a great potential for technology transfer and consequently, has to be stimulated through the following mechanisms: joint universities and industry events, informal meetings, talks, conferences, etc.

***Utilisation Capability*** – it encompasses two concepts being *Absorptive Capacity* and *Commercialisation Capability*. The former refers to the appreciation and absorption of technology into the industry. It is observed that companies with high absorptive capacity regularly assimilate new technology from its environment particularly scientific institutions, which thus result in long-standing collaborative relations with them. However, such a company is likely to be more critical of the reputation of its technology providers and also the quality of their technology. *Commercialisation Capability* is defined as the ability of companies to exploit the technology for commercial use (e.g. development of innovative products and services) and this step is considered the final action in the technology transfer process. The following excerpts highlight the importance of absorptive capacity and technology exploitation.

> "*…a company has to have qualified employees that are capable to absorb and process scientific knowledge. Knowledge does not only mean to grasp something from a cognitive perspective, but also to direct future behaviour and activities for the sake of the transformation of knowledge into financial assets…*" (An Interviewee)
>
> "*…companies have to be capable of transforming technology, which has been delivered to them, into products…*" (A manager of a higher education research centre)

### c. *Environment and Transaction-related factors*

***Transaction Modalities*** – the *Transfer Conditions* dimension is an amalgam of three sub-factors being: costs, distance, and IPR handling. The first concerns the costs of technology projects where portion would have to be borne and viewed as investments by the receiving companies. However, some companies are reluctant to invest in such strategic research endeavours due to uncertain commercial returns and long payback time. Geographical distance is considered an important sub-factor for the success of technology transfer. Stronger collaboration between both providing and receiving agents, is observed when they are geographically nearer to each other. Findings suggest that technology transfer performance would be enhanced when IPR regulations could better meet the requirements of the industry.

*Transfer Mechanisms* to facilitate technology transfer between higher education institutions and the industry encompass the following: patent licensing, collaborative research, contract research, and mobility schemes (for staff). Findings suggest that easy accessibility to such mechanisms would potentially effect a more successful technology transfer. *Supply-Demand-Matching* is considered a basic requirement for successful technology transfer since technology has to be commercially relevant to companies and their business needs. This sub-factor is defined as the coincidence of the technology-related services provided by the higher education institutions and the demand of the industry.

> "*…it does not make sense to build up competencies in thematic fields, in which no demand from the perspective of the regional innovation system is given and which, therefore cannot be commercially utilised…the technology transfer performance depends on the matching of supply and demand. To my mind, this represents the very core of successful technology transfer…this represents a pre-condition for properly working technology transfer…*" (A higher education consultant)

As mentioned earlier, the main reason for collaborative research projects between higher education institutions and the industry is for competitive advantage purposes. Thus, if *Confidentiality* could not be guaranteed by higher education institutions then technology transfer projects could neither start nor resume for ongoing ones. As for the sub-factor *Social Cohesion*, it includes shared language, shared understanding, mutual sympathy and trust. The following excerpts will provide some valuable insights.

> "*…basically, persons play a dominating role in technology transfer including both, higher education research staff and persons from industry. The interaction between*

> *these persons is of central importance…*" (A managing director of an intermediary organisation)
>
> "*…a common language between actors from the science base and the industry is required. This means a mutual understanding in a way that the industry feels that their demand is properly understood by the professor or research department in charge…*" (An interviewee)

***Framework Conditions*** – the sub-factors *Funding Programmes*, *Intermediary Structures*, as well as *Regulation and Legislation* are abstracted from a survey of relevant literature, and are subsequently confirmed by the findings in the explorative interviews. The first sub-factor represents the public funding system while the second includes institutions which provide value-added networking services. As for the third one, it encompasses rules of the game in the technology transfer market. The *Collaboration Culture* influences the behaviour of companies in technology transfer projects, and it is closely associated with trust, confidentiality, and etc. It is imperative that companies be made aware of the potential benefits when embarking on collaborative R&D endeavours. This is highlighted in the following excerpts:

> "*…what influences the technology transfer performance substantially is the collaboration culture. It is all about cultural staff, which hinders co-operation for us like the missing willingness for co-operation…*" (A higher education support structure manager)
>
> "*…from a macro-economic perspective a climate conducive to innovation belongs to the framework conditions. In this context, the economic policy has to become active for sensitising companies for the importance of technology transfer…*" (A higher education consultant)

| **Categories** | **Factors Affecting Technology Transfer Performance** | **Key Dimensions** |
|---|---|---|
| Providing agent-related factors | Mission and Strategy | R&D Thematic focus<br>R&D Orientation<br>Research Mission |
| | Infrastructure and Resources | Financial Resources<br>Technical Infrastructure<br>Size of R&D Team |
| | Scientific and Technological (S&T) Human Capital | Scientific Excellence<br>Application Awareness<br>Business Excellence<br>Personal Networks<br>Motivation |
| | Research Organisational Design | Research Organisational Structure<br>Processes<br>Support Structures<br>Incentive Schemes<br>R&D Image |
| Receiving agent-related factors | Industrial Demand | Articulated Demand<br>Latent Demand |
| | Utilisation Capability | Absorptive Capacity<br>Commercialisation Capability |
| Environment and transaction-related factors | Transaction Modalities | Transfer Conditions<br>Transfer Mechanisms<br>Supply-Demand-Matching<br>Confidentiality<br>Social Cohesion |
| | Framework Conditions | Funding Programmes<br>Intermediary Structures<br>Regulation & Legislation<br>Collaboration Culture |

Table 2: Generic Technology Transfer Model (Heinzl, 2007)

| | SR | FG | PO | EI | Comments |
|---|---|---|---|---|---|
| **Mission & Strategy** | | | | | |
| R&D Thematic Focus | E | -- | -- | D | The explorative interviews contribute to the elaboration of *R&D Thematic Focus* and *R&D Orientation* |
| R&D Orientation | E | -- | -- | D | |
| Research Mission | E | -- | -- | N | |
| **Infrastructure & Resources** | | | | | |
| Financial Resources | E | -- | -- | C | The initial conceptualisation iss retained throughout the study |
| Technical Infrastructure | E | -- | -- | C | |
| Size of R&D Team | E | -- | -- | C | |
| **S&T Human Capital** | | | | | |
| Scientific Excellence | E | -- | -- | C | The factors (except for *Application Awareness* and *Personal networks*) are abstracted from a survey of relevant literature |
| Application Awareness | -- | E | C | C | |
| Business Excellence | E | C | C | C | |
| Personal Networks | -- | -- | -- | E | |
| Motivation | E | -- | -- | N | |
| **Research Organisational Design** | | | | | |
| Research Organisational Structure | E | -- | -- | N | The interviews contribute to the *R&D Image* factor while *Research Organisational Structure* and *Processes* are revised terms |
| Processes | E | -- | -- | N | |
| Support Structures | E | -- | -- | C | |
| Incentive Schemes | E | -- | -- | C | |
| R&D Image | -- | -- | -- | E | |
| **Industrial Demand** | | | | | |
| Articulated Demand | E | N | C | C | The focus group contributes to these revised terms which are initially abstracted from a survey of relevant literature |
| Latent Demand | E | N | C | C | |
| **Utilisation Capability** | | | | | |
| Absorptive Capacity | E | C | C | C | The term *Commercialisation* encompasses market utilisation related factors |
| Commercialisation Capability | E | -- | -- | R | |
| **Transaction Modalities** | | | | | |
| Transfer Conditions | E | -- | C | R | The factor *Conditions* is the amalgam of the following factors: *Costs*, *Distance*, and the handling of *Intellectual Property Rights* (*IPR*) |
| Transfer Mechanisms | E | -- | -- | C | |
| Supply-Demand-Matching | -- | -- | -- | E | |
| Confidentiality | -- | E | C | C | |
| Social Cohesion | -- | E | C | R | |
| **Framework Conditions** | | | | | |
| Funding programmes | E | -- | -- | C | The interviews contributed to the *Collaboration Culture* while the rest of the factors remained unchanged throughout the study |
| Intermediary Structures | E | -- | -- | C | |
| Regulation and Legislation | E | -- | -- | C | |
| Collaboration Culture | -- | -- | -- | E | |

**Note:** C – Confirmed; D – Elaborated Concept; E – Establish factors; N – Revised term; R – Reconceptualisation;
EI – Explorative Interview; FG – Focus Group; PO – Participant Observation; SR - Secondary Research

Table 3: Refinement of the Factors in the Generic Technology Transfer Model (Heinzl, 2007)

### 5.2 Idiosyncrasies of Universities of Applied Sciences

The idiosyncrasies of the Universities of Applied Sciences are abstracted from document analysis (e.g. Austrian Ministry of Education official reports, the University Applied Sciences Council official reports, audit reports, statistics reviews, etc.). The idiosyncrasies of Austrian Universities have been coded into the following dimensions: study programmes, legal environment, funding structure, institutional setting, and research activities. These dimensions and their related idiosyncrasies are depicted in Table 4.

| Categories | Idiosyncrasies |
|---|---|
| Study Programmes | Mandatory internship during study<br>Entrance procedure for study enrolment<br>No automatic enrolment into a PhD programme<br>Focus on applied education |
| Legal Environment | Lax regulation (higher autonomy)<br>Private/regional ownership<br>No right to award PhDs<br>Legal structure |
| Funding Structure | No block-grant funding for research<br>Mixed funding structure (public and private funding) |
| Institutional Setting | Smaller in size compared to public universities<br>Recently formed<br>High teaching commitment of staff |
| Research Activities | Main focus being on applied research |

Table 4: Idiosyncrasies of the Universities of Applied Sciences (Heinzl, 2007, p.166)

### 5.3 Effects of Idiosyncrasies on Technology Transfer

The effects of idiosyncrasies on technology transfer are abstracted from the analysis of qualitative data collected from the focused interviews. A total of 75 positive or negative effects established in this study are depicted in Figure 3. The intensity of the effects is rated by the interviewees according to the following scale: *3* for high impact, *2* for medium impact, *1* for low impact, and *0* for no impact. Together with the direction of impact (i.e. positive or negative), a seven-step rating scale is employed: [*-3*, *-2*, *-1*, *0*, *1*, *2*, *3*]. As shown in the findings, not all technology transfer factors are affected by the idiosyncrasies. They are: *Research Mission*, *Business Excellence*, *Incentive Schemes*, *Social Glue*, and *Confidentiality* with regard to the outcome of collaborative research. Further discussion of the positive and negative effects is found in Heinzl (2007, Chapter 5).

| | IDIOSYNCRASIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Technology Transfer factors** | No PhD Award | Higher Autonomy | Block Grant Funding | Applied Research | R&D Image | Teaching Commitment | Small Size | Recently Formed | External Lecturers |
| **Mission and Strategy** | | | | | | | | | |
| R&D Thematic Focus | | + | -- | | | -- | + | -- | |
| R&D Orientation | | + | + | + | | | | | |
| Research Mission | | | | | | | | | |
| **Infrastructure and Resources** | | | | | | | | | |
| Financial Resources | -- | | -- | + | -- | | | | |
| Technical Infrastructure | | | -- | + | | | -- | -- | |
| Size of R&D Team | -- | | -- | | | -- | -- | -- | -- |
| **Scientific and Technological Human Capital** | | | | | | | | | |
| Scientific Excellence | -- | + | -- | -- | -- | -- | -- | -- | |
| Application Awareness | | | | + | | | | | + |
| Business Excellence | | | | | | | | | |
| Personal Networks | -- | | -- | + | -- | -- | -- | -- | + |
| Motivation | | + | -- | + | | -- | | + | |
| **Research Organisational Design** | | | | | | | | | |
| Research Organisational Structure | | + | | | | | + | | |
| Processes | | | | + | | | | | |
| Support Structures | | | -- | + | | | -- | -- | |
| Incentive Schemes | | | | | | | | | |
| R&D Image | -- | | | + | -- | -- | -- | -- | + |
| **Industrial Demand** | | | | | | | | | |
| Combined Articulated and Latent Demands | | | -- | + | -- | -- | -- | -- | + |
| **Transaction Modalities** | | | | | | | | | |
| Transfer Conditions | -- | + | -- | | -- | | | | |
| Transfer Mechanisms | | | | + | | | | -- | |
| Supply-Demand-Matching | | + | | + | | | | | + |
| Confidentiality | | | | | | | | | |
| Social Cohesion | | | | | | | | | |

Key: High Intensity Effect; Medium Intensity Effect; Low Intensity Effect

+ or -- : positive or negative effect      Empty Cell : no effect

Figure 3: Idiosyncrasies-Technology Transfer Effects Model (Heinzl, 2007)

**Cumulated Idiosyncrasies Effects for Each Technology Transfer Factor**

In this section the rating of each idiosyncrasy-technology transfer effect is extracted from the focussed interviews followed by an analysis of the cumulated effects of the idiosyncrasies per individual factor influencing the technology transfer performance. The results of this analysis reveal the advantages as well as the disadvantages for the Universities of Applied Sciences technology transfer system. This section introduces the formulae for the calculation of the cumulative effects. The mean cumulated effect of each idiosyncrasy on technology transfer is calculated and represented by $S_{ij}$ (see first equation in Figure 4). As a result, the cumulated idiosyncrasy effect, $S_j$, for each technology transfer factor is derived (see second equation in Figure 4).

$$s_{ij} = \frac{\sum_{m=1}^{12} v_{ij}^{\ m}}{12}$$

$$s_j = \sum_{i=1}^{9} s_{ij}$$

$$s_j^{\ *} = \left( \frac{s_j}{\left| \max\left(s_j\right) \right|} \right) * 3$$

| | |
|---|---|
| $s_{ij}$ | *arithmetic mean of individual ratings* |
| $v_{ij}$ | *individual rating value* |
| *m* | *interview number index (1..12)* |
| $s_j$ | *cumulated ratings per technology transfer factor* |
| *j* | *technology transfer factor index (1..22)* |
| *i* | *idiosyncrasy factor index (1..9)* |
| $s_j^*$ | *standardised cumulated ratings* |
| $max(s_j)$ | *maximum value of cumulated rating* |

Figure 4: Formulae for the Calculation of the Idiosyncrasy-Technology Transfer Cumulated Effect (Heinzl, 2007, p.253)

For analysing the standardised cumulated effects of the idiosyncrasies, the third formula in Figure 4 is applied. The standardised cumulated rating, $S_j$*, is calculated by dividing each corresponding $S_j$ by the maximum value of the set of $S_j$ values ($S_1$ to $S_{22}$) as represented by (max($S_j$)) multiplied by 3 (which correlates to the maximum value of the rating scheme). This standardisation is conducted for every cumulated rating factor and shown in Figure 4.

**Impact of the Cumulated Idiosyncrasies on the Technology Transfer Factors**

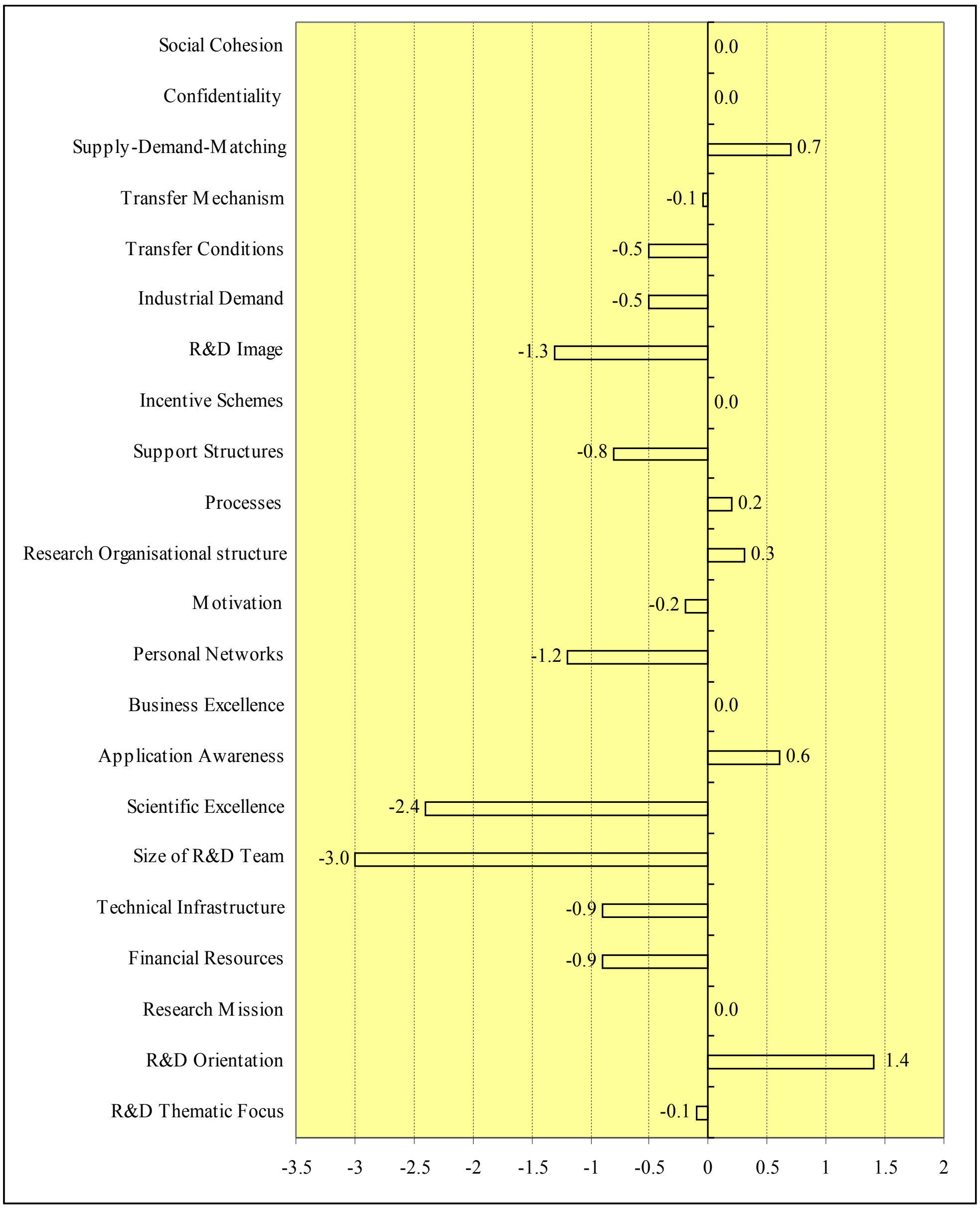


Figure 5: Idiosyncrasies-Technology Transfer Cumulated Effects Model

Based on the findings shown in Figure 5, the idiosyncrasy-technology transfer null cumulated effects seem to be true for the following technology transfer factors: *Transfer Mechanism*, *Confidentiality*, *Incentive Schemes*, *Business Excellence*, and *Research Mission*. The findings suggest that idiosyncrasies have very great negative cumulated effects on the *Size of R&D* as well as *Scientific Excellence*. It is also noted that there are more and generally greater negative idiosyncrasy-technology transfer cumulated effects than the positive ones.

# 6 DISCUSSION AND CONCLUSION

Both the *Idiosyncrasies-Technology Transfer Effects* and *Cumulated Effects Models* have been developed based on the Austrian Universities of Applied Sciences context. Consequently, they cannot be applied directly to other European countries. However, the three-phase research methodology could be replicated in other contexts in order come up with their respective *Effects Models*. These models have provided valuable insights into the higher education institutions' idiosyncratic factors which affect their technology transfer performance.

The findings in this research contribute to a conceptual design of the Universities of Applied Sciences technology transfer system as depicted in Figure 6. The strategies embedded in this system primarily aim at reducing the negative effects of idiosyncrasies in technology transfer. Some of the recommendations for the Universities of Applied Sciences are to: create strategic partnerships with other institutions in the science base through research networks; establish consortia to build a better research image; increase research funding; effect research structural changes relating to research staff, groups, centres, and etc.; exploit the services of intermediary institutions (e.g. regional development agencies, patent offices, funding consultancy agencies, etc.).

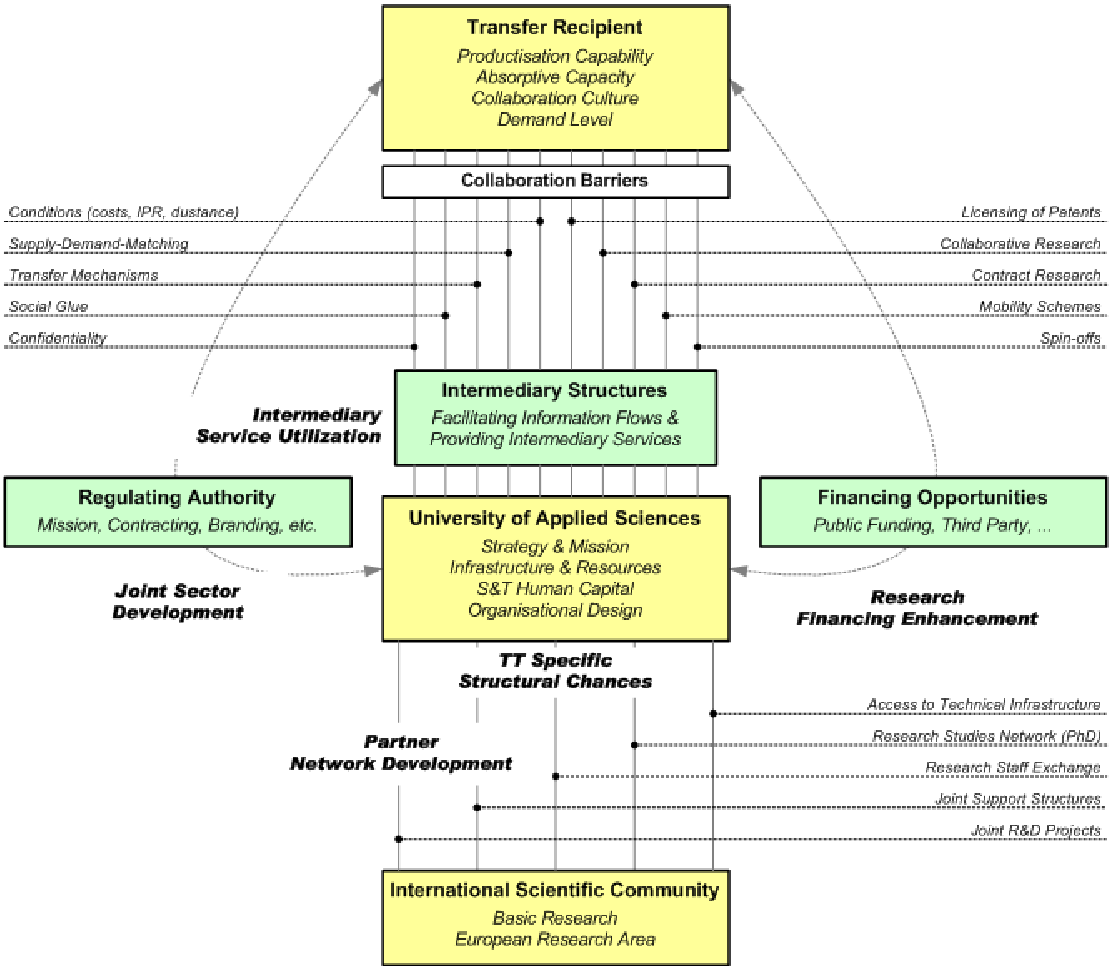


Figure 6: Conceptual Design of the Universities of Applied Sciences Technology Transfer System (Heinzl, 2007, p.284).

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