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"PRODUCT INNOVATION PROJECT" – A NOVEL INTERDISCIPLINARY STUDENT PROJECT

Fallast, M. * & Oberschmid, H. **
* Technology Transfer, Graz University of Technology,
Schloegelgasse 9/III, A-8010 Graz, Austria
E-mail: mario.fallast@tugraz.at
** Institute of Industrial Management and Innovation Research,
Graz University of Technology, Kopernikusgasse 24/II, A-8010 Graz, Austria

Abstract:
The paper presents a student project on the topic of "Production innovation", which is carried out in collaboration between student teams, enterprises and universities. Interdisciplinary, intercultural and international student teams are working on a task given by an industrial sponsor. It shall impart the holistic view on the product innovation process, from idea generation until market introduction, whereas the focus is put on the stages until the realisation of a product concept and a working prototype. The benefits of the collaboration for the three stakeholders (students, enterprises, universities) are diverse; some of the most important ones are shown in this paper – as well as a qualitative comparison of contributions to a common project.

"Product innovation project" covers certain stages of the company's innovation process where external support from teams of skilled, creative and motivated student is most suitable. The stages of the adapted innovation process are explained in the paper.

Key Words: Engineering Education, Interdisciplinary Student Project, Product Innovation

1. INTRODUCTION

The Commission of the European Communities stated the following in September 2006: "Our future depends on innovation" [i]. A comprehensive description of the term "innovation" was given by Myers and Marquis in 1969:

Innovation is not a single action but a total process of interrelated sub processes. It is not just the conception of a new idea, nor the invention of a new device, nor the development of a new market. The process is all these things acting in an integrated fashion. [ii]

The Commission of the European Union summarizes the present economic situation as follows:

"In a remarkably short period of time, economic globalization has changed the world economic order, bringing new opportunities and new challenges. In this new economic order, Europe cannot compete unless it becomes more inventive, reacts better to consumer needs and preferences and innovates more." [iii].

In the same statement, the importance of adequate education as a pre-condition for the actions mentioned was stressed:

"First and foremost, without education as a core policy, innovation will remain unsupported. It must promote talent and creativity from an early stage. In its Communication of 10 November 2005, the Commission has already identified the key competences necessary for living and working in a modern innovation-oriented society. These include entrepreneurial skills in the wider sense, as well as literacy, scientific and mathematical competence, languages, learning-to-learn skills and social and cultural competences" [iv].

What is mentioned in the quotation above is a short summary describing the changed environment Economy is currently facing? Increased mobility (of both goods and people) and the development in telecommunications changed the economic world. The market place

became global and competitors do not only come from the same geographic region, country, or even continent.

Two main challenges:

- The ability to innovate has to be increased
- The tools for innovators have to be taught and provided; both from a physical (infrastructure) and mental (education, mind-setting) point of view.

Our experience shows, that a close collaboration between enterprises, students and universities plays an important role and is a suitable tool to address the needs of nowadays European economy.

As stated by the EU commission, besides having profound scientific education also entrepreneurial skills in the wider sense, languages, learning-to-learn skills and social and cultural competences are key competences necessary for living and working in a modern innovation-oriented society. [v]

Practical experience and “soft skills” are requirements for a successful career entry, as well as a short duration of study. As universities as well as society in general are interested in shorter study durations, it is seldom mentioned that also the required “soft skills” need to be developed somehow and cannot be “taught” only in theory and school-like courses. This leads automatically to the approach of working on real business cases. If selected carefully, the use of case studies based on actual problems can be a successful tool for efficient teaching. It is one way to teach certain models and processes and to impart knowledge of the application of it in the economy.

Beginning of 2006, the Institute of Industrial Management an Innovation Research at Graz University of Technology started a pilot project to teach practical experience in a new way, in cooperation with Graz University and Helsinki University of Technology. “Production innovation project” was born.

Within “Production innovation project”, a holistic view on the complex and highly interdependent sub-processes within an innovation process shall be taught.

2. THREE STAKEHOLDER GROUPS

“Production innovation project” aims to serve as a platform for effective collaboration between three main stakeholder groups:

- Students
- Enterprises and
- University

For all of these stakeholders the cost-benefit-calculation has to show a positive balance.

In a project which is commonly carried out between these actors, each of them offers different contributions.

Table I: Contributions to a common project [vi].

	enterprise	students	university
money to spend	5		3
marketing - know how	5	1	3
experience in the application of new technologies, existing business case	5	1	3
specific technological knowledge	3	2	5
experts for specific knowledge	3	2	5
laboratories and infrastructure for specific experiments	2		5
existing legal framework for technology transfer	3		5
time to spend for a project	1	5	3
flexibility in time	2	4	3
openness to a broad view to new technologies	2	5	3

Table I shall compare their strengths and contributions in a common project: Points from 1 to 5 are given according to the degree of performance:

2.1 Students

University graduates play an important role in society. They often fulfil jobs of big responsibility – economically, but also from a social and ecological point of view. Having a profound knowledge and understanding of a specific field is a basis to “do the job”. But in a world that is getting more and more complex, the view “beyond one’s own nose” becomes more and more important. But someone’s potential key role for society is not directly a motivation for students to do anything extra to the minimum required education to (formally) being able to be qualified for a certain profession. [vii]

In case of the “Production innovation project”, the following points shall (and do) attract students to participate:

- Working on a product from idea generation until the realisation of a working prototype. In the course of study, usually only very few details of long processes or bigger projects are viewed. The “Production innovation project” shows the contribution embedded in a wider field. It leads to a better understanding of constraints and interdependencies, which cannot easily be taught in theory.
- See one’s own ideas grow - “Production innovation project” enables students to develop ideas until tangible results are achieved.
- ECTS-Credits/compulsory courses – ”Production innovation project” enables students to combine attending compulsory courses with gaining practical experience.
- “Professional” working environment – in the course of the project, professional infrastructure enables students to act as they would in their later profession.
- Team experience – Students have the opportunity to develop soft skills.
- Contact to a potential employer – during the 7-8 months of project duration, students receive an insight into a company’s corporate culture, its values, and it’s working methods – important influence factors when choosing a job after graduation.

2.2 Enterprises

From the point of view of enterprises, the following reasons can also be mentioned as reasons for cooperation with external partners:

- **New Ideas from Outside*:*** In a company, often much time is spent on daily business keeping the company running or slightly growing. Approved technical solutions are in use, there are only little resources to try experiments for different solutions. Working on a regular basis on developing, producing, or selling similar products, having in mind similar markets, similar user profiles, facing similar technological challenges, and working on similar tasks has several advantages. Experienced employers as well as organisations sometimes have an outstanding repertoire of solutions.
- **Identifying External Technology** – is necessary for knowledge-based and technology-oriented organisations to constantly search for and acquire technical information. [viii] Therefore, the technological environment has to be scanned, which can effectively be achieved either by working through scientific literature or through interacting with other people – in a formal or informal way. Organisations are constantly surprised by the amount of technology around about which they do not know anything about. [ix] It is important to ensure that the personnel are aware of technological development – on a general level but also in terms of specific knowledge.
- **Access to specific knowledge** – contact to universities provides access to the newest finding on research topics and – much more important in practice – easy and sometimes non-bureaucratic contact to experts of a certain topic.
- **Recruiting** – Enterprises are seeking for skilled employees – very often they focus on potential employees who graduate from university soon. This is exemplified through different kinds of activities going on at universities (e. g. recruiting fairs, company

presentations, the interest in carrying out final theses …). To get to know potential employees before their actual entry in the enterprise is one benefit. According to HOFER [x], for more than 85% of enterprises working together with universities, the access to potential new employers is one motivation for the collaboration. As the experiences at the “product development project” at TKK, Helsinki show, several student project participants end up working for their sponsor companies – often after having continued their project work in the framework of a diploma thesis. Especially these employees – coming from university and therefore knowing the organisational particularities and having a personal network – act as contact persons for further projects between university and enterprises. This is shown by HOFER [xi], but is also a result from the interviews carried out with representatives of regularly participating sponsor companies of the “Production development project” at HUT.

- **To place the brand** – One important first step towards being chosen as an employee is often simply to be known by potential employers. Especially small companies, focussing on niche products maybe even on the B2B-sector or not having premises in university cities often have the problem of not being known by students at all. Cooperating with universities – e. g. by carrying out student projects – is one possible and suitable tool to place the "brand" into the mind of high potentials.
- **Lack of Time and/or Resources inside the Company** – In case of limited resources inside the company – which is the usual case – not all necessary or desired project proposals can be realised. Even if a project proposal might be successful in the far future, it is often necessary for companies to choose the project which has moderate success in the near future instead. Interviews with sponsor companies at HUT "Production development project" as well as experiences at TU Graz show that student projects are often carried out for risky projects, “nice-to-have”-features, and as “test-balloons”, to investigate the (technical or market) feasibility of a project idea. Especially small and medium-sized enterprises often do not have sufficient resources to innovate. Cooperating with external organisations and building up a network of enterprises and research institutions enables them to access the necessary resources [xii].

2.3 University

Close collaboration with an industrial partner is not only of advantage for students, but also for universities. A significant change in the Austrian state financial support for universities is only one reason for the intention to commit to partnerships with industry on strategic, but also on selective (projects) bases.

Additionally to the opportunity to “sell” the results of the knowledge-generation-process, for universities, the collaboration with external partners offers several other opportunities:

The following examples can be given:

- It **facilitates the continuous evaluation** of the quality of education. Once a student finishes his/her academic education, it is difficult to obtain feedback about the usefulness and practicability of the learned skills. If student projects are carried out in the industrial environment, the practicability of the taught content is proved immediately, and “missing” contents can be identified. This helps to keep education up-to-date and react to changed requirements in the industrial environment (always keeping in mind the values of higher education).
- The intensified **contact between teaching personnel and students** during collaborative industrial project works frequently enforces this effect.
- Established partnerships and maintaining a lively network with company representatives facilitate their **involvement in other forms of teaching**, for example guest lectures. In many cases, guest lectures form a useful link between theory and its application in the world outside of university.
- Common projects facilitate the **exchange of experience**. Universities need to stay in contact with external organisations to remain “up to date” and not to lose track of technological trends or changed trends in management culture.

- Offering a platform to **prove the theoretical knowledge.** Universities are often seen as ivory-tower. Common projects can show that they can provide real-world-solutions. They present the university as a capable partner not only for theoretical research but for practical development.
- In case of the TU Graz, the “Production innovation project” in combination with the exchange of corresponding lectures and seminars turns out to be the basis for a **long-term collaboration** with an international partner university (HUT). Unlike a partnership based on a common research goal (where the partnership ends with the achievement of it) or defined project works (e. g. EU-projects), a partnership based on a common teaching goal has no predefined end. Especially for organisations where personnel fluctuation is high, it is a feasible way to realise an international partnership on a long-term basis.

“Product innovation project” in the innovation process

“Production innovation project” splits up the innovation process in a way that the process steps are carried out by different executing parties according to their strengths and weaknesses.

Whereas University acts as a “host” for the project preparation and organisation and contributes its specific technical know-how (when support for the students is needed), the main actors in the actual innovation process are the industrial sponsor and the student team.

The industrial sponsor covers the very first (the strategic decision of “what and how to innovate”) as well as the very last phase in the process (refinement, production, and market introduction).

The team of students (within the organisational framework of the “Production innovation project”) intermediate carries out the phases from idea generation until the preparation of a working prototype and a product concept.

In Figure 1, the integration of the “Production innovation project” into the innovation process as well as the important handovers are described. It shall give an overview of the responsibilities of both parties – student team and the industrial sponsor – preparatory actions and supporting activities from the universities are not described:

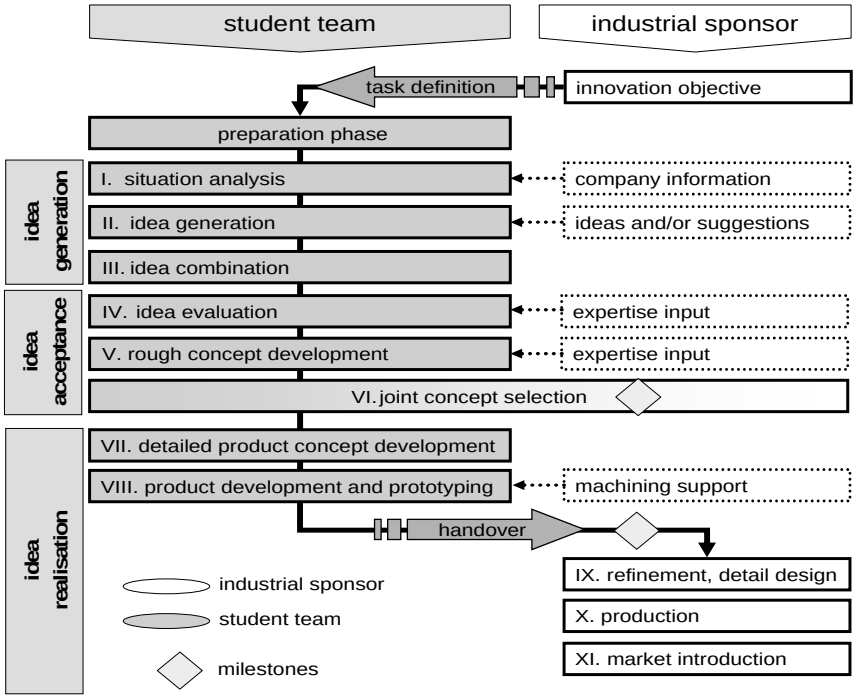

Figure 1: The position of “Production innovation project” in an enterprises´ Production innovation process [xiii].

Before handing over a detailed task description to the student team, the company has to be sure about its innovation objective. The position of the product to be developed in the company’s strategy should be also clear for the student team. This is of special importance for the development of the product concept including a business plan which is also part of the project result and shall be handed over with the working prototype.

A first introductory meeting, where company representatives and students meet and the task is described in detail should preferably take place at the company’s premises. Besides the exchange of basic information, this meeting is important to set up personal contacts between the main acting persons inside the company. Available machining facilities (for prototyping) and existing production methods (for high volume products) should be shown to the student team.

After the company visit, the student team starts to work autonomously on the project task and on important group-dynamic and preparatory actions. Especially for the remote collaboration in a virtual team, the team building phase can be stated as a main success factor that all team members get to know each other personally in the very beginning of the project. Experience shows, that students are eager to start working on the actual task very soon.

One of the first process steps is the collection of spontaneous solutions to the task. Following, a detailed situation analysis is done. Existing patents are investigated and information – from different sources (company, WWW, suppliers ...) – is collected.

In phase II a more specific and structured idea generation is done. Students generate a pool of ideas by using different creativity techniques. After screening the collected ideas, they are put together and combined in phase III (e. g. by using a morphological box).

In phase IV the combinations of ideas are evaluated and refined. In this phase external experts are contacted by the students – both at universities and in the industrial surrounding. A vital network of experts is of special importance in this phase.

In phase V rough product concepts are developed. First mock-ups are built to do first functional tests of single (potential) product functions. Virtual 3D models are useful in this stage, but the importance of prototyping shall be highlighted at this point. Experience shows that often only physically existing prototypes allow proper evaluation of product size, materials and other important product attributes.

Early prototyping as well as detailed research on the available solutions, their advantages and possible problems, their stage of maturity (research stage or available on the market) are the bases to prepare for an important phase in the process:

Phase VI ends with an important milestone – the concept selection. A consensual decision on the product concept to be further developed has to be made. Company representatives as well as the student team have to decide on one concept which is developed to the further stages, whereas the other concepts are skipped.

In phases VII and VIII, all the effort of the student team is put on the development of this single product concept both on the technical as well as on business side. Whereas some team members are working on the realisation of the working prototype, others are focussing on the development of the business plan, including e.g. marketing strategy, estimated ramp-up costs, market prices.

The project work of the students closes with handing over of the project results to the company and final, public presentations at the partner universities in Helsinki and Graz. After the transfer of the project results to the industrial sponsor, the main responsibility over the further proceeding is at the sponsor company. Even if students are asked to document the results of their work carefully and detailed, the final report can only cover a small percentage of collected knowledge and experience. Students usually generate significant project-related implicit knowledge, which cannot be made available for further project activities easily.

It is highly recommended to collaborate with the active members of the student team also after the closure of “Production innovation project”.

Deliverables of the student team

A defined set of deliverables guides the student teams. The following deliverables are part of the project task; they are mainly intended to ensure a proper documentation for the industrial sponsor:

- Project plan (project manager) at the very beginning of the project
- Progress reports every two weeks (project manager)
- Project folder (including a corporate design and logo)
- Project website
- Two preliminary reports
- Final report (digital + printed version),
    - Describing the team members and their responsibilities
    - Task description (including its position in the company’s strategy)
    - Initial situation (existing information, pre-development, competitive products, existing patents,…)
    - Documentation of ideas (the raw material of the idea generation phase – it might be helpful for the company-internal further development of the product or similar and alternative products)
    - Concept development, selection criteria catalogue (the selection of the concepts shall easily be comprehensible and traceable)
    - Technical documentation (It shall include sketches, workshop drawings, electronic circuitries, and physical measures to enable a technically skilled person to reproduce the prototype, information to understand the main working principles)
    - Business plan (which can be used as a separate document to act as a basis for the decision about the further company-internal project continuation)

The following deliverables shall support the activities of the organising university (documentation, internal marketing, external marketing …):

- One-page project summary
- Press release (prepared in collaboration with TU Graz press office)
- Press pictures (suitable pictures facilitate the communication of the project results)
- Pictures of the team and prototype
- A working prototype of the product

Apart from the deliverables, it is part of the project task to give the following presentations:

- Final presentation at HUT in April (in the framework of the “product development Gala, organised by the organising institute of machine design at TKK) including a multimedia-presentation of about ten minutes to the audience and the presentation of the prototype (if the transport to Finland is possible) at an information stand
- Final presentation at TU Graz in May
- Final presentation inside the sponsor company

Legal Framework

Collaboration needs to have clearly defined legal interfaces. Clearly defined responsibilities, deliverables, rights, and liabilities are the basis to avoid disappointments during and after the project. Between the triangle (Figure 2) students – university – industrial partner, the following contracts exist:

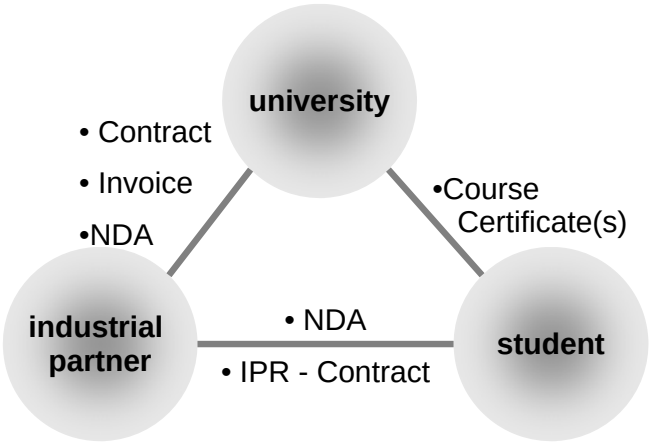

Figure 2: Existing contracts between project partners [xiv].

Legal basis of the collaboration between the university and an industrial partner is a contract, which places the order for a specific R&D-Assignment. It regulates:

- Total costs for the industrial partner
- Conditions of payment
- Scope of included supply and services
- Dedication of the budget
- Contact persons both on University’s and Industrial Partner’s side

A key point is the assumption that knowledge generated during the project is basically generated by students and not by university staff. Therefore, according to existing TU Graz internal policy [xv], any result achieved by students (having no active employment contract) is their own property and thus, open to any other kind of agreement.

Intellectual Property Rights (IPR)

The future use of project results is uncertain. If the worst comes to the worst, the project leads to a path which is not viable and no one will ever ask *who* has contributed *what*. At the best, any result generated by (a) members(s) of the student team (“project participants”) has to be protected by any means (patent, utility patent, trademark, copyright) and also worth to be protected. The industrial sponsor usually aims to take over the intellectual property rights of the intellectual project results. The contract between TU Graz and the industrial partner includes the following sections covering IP-rights:

- The handling of existing intellectual property rights
- The handling of the intellectual property rights if the industrial partner does not want to file in an intellectual property right
- A notice of intent for a bilateral contract between the industrial sponsor and every participating student including the following:
    - All intellectual property rights generated during the project by project participants are handed over to the Industrial Partner,
    - Project participants neglect to do anything that can harm a patent-application
    - Project participants notify the industrial sponsor about an invention immediately
    - In return the industrial partner treats the project participants like a company’s employee, including the rights concerning an inventor’s bonus pointed out in the Austrian patent act [xvi] § 8.

Nondisclosure agreement

For the execution of the project task, students usually have access to confidential information of the industrial partner. It is necessary to regulate the handling of this internal information. While in an employment status between a corporation and an employee confidentiality is

regulated in the working contract, the handling of confidential information has to be covered with a separate bilateral contract between the project participants and the industrial partner.

In addition to that, the project plan, which is developed at the very beginning of the project and signed by all student team members, can act as an agreement with the project’s objectives between the student team and the industrial sponsor

3. CONCLUSION

The experience of the pilot project showed, that the chosen approach is suitable to generate a win-win-win-situation between the three main stakeholder groups. Students showed significant improvements of their soft skills, it can be said that a correlation between learning effects and dedication to the project work was highly visible. The results of the student team in the pilot project – a working prototype and detailed reporting – were accompanied by remarkable publicity for the industrial sponsor. The university wins in form of a new cooperation between different universities. Starting from the academic year 2007/08 – the university is also able to offer a new university course called “Production innovation project”. For teaching the theoretical background of innovation management the course “Production innovation management” is established.

We can also say that the chosen approach of the innovation process – together with the industrial company is working and suitable for the implementation.

REFERENCES

[1] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions (2006) – *Putting knowledge into practice: A broad-based innovation strategy for the EU,* Brussels, 2

[2] Myers, S.; Marquis, D.G. (2005). Successful industrial innovation: *a study of factors underlying innovation in selected firms, National Science Foundation, NSF 69-17, Washington DC 1969 quoted in TROTT, P.: Innovation Management and New Product Development, 3rd edition, Prentice Hall,* Harlow, 15

[3] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions (2006) – *Putting knowledge into practice: A broad-based innovation strategy for the EU,* Brussels, 2

[4] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions (2006) – *Putting knowledge into practice: A broad-based innovation strategy for the EU,* Brussels, 2

[5] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions (2006) – *Putting knowledge into practice: A broad-based innovation strategy for the EU,* Brussels, 2f.cp. Fallast, M. (2007). Success Factors in the Implementation of an Interdisciplinary Product Innovation Project, Diploma Thesis, Graz, 27

[6] Fallast, M. (2007). Success Factors in the Implementation of an Interdisciplinary Product Innovation Project, Diploma Thesis, Graz, 27

[7] Johnson, S. C.; Jones, C. (2005). How to organise for new products, Harvard Business Review, Vol. 35, pp 49 – 62, May-June 1957 quoted in *Trott, P.: Innovation Management and New Product Development, 3rd edition, Prentice Hall,* Harlow, 325

[8] Trott, P. (2005). Innovation Management and New Product Development, 3rd edition, Prentice Hall, Harlow, 325

[9] Hofer, F. (2005). „Final Report of an Empirical Study of Styrian Enterprises and Researchers at Graz University of Technology“ *for the doctoral thesis „Technology Transfer Between Universities and Industry: Recommendations to Improve Technology Transfer Activities with Empirical Data for Styria (Austria)“, Graz University of Technology, Faculty of Mechanical Engineering and Economics,* Graz, 49

[10] Hofer, F. (2005). „Final Report of an Empirical Study of Styrian Enterprises and Researchers at Graz University of Technology“ *for the doctoral thesis „Technology Transfer Between Universities and Industry: Recommendations to Improve Technology Transfer Activities with Empirical Data for Styria (Austria)“, Graz University of Technology, Faculty of Mechanical Engineering and Economics,* Graz, 14 cp.: Berghoff, H.; Sydow, J. (2007). Unternehmerische Netzwerke, Kohlhammer, Stuttgart, 136

[11]Fallast, M.; Oberschmid, H.; Winkler, R. (2007). The implementation of an interdisciplinary product innovation project at Graz University of Technology*, Proceedings INTED IATED* Valencia
[12]Fallast, M. (2007). Success Factors in the Implementation of an Interdisciplinary Product Innovation Project, Diploma Thesis, Graz, 53
[13]Guideline at Graz University of Technology for business application of Results from Research and Development (2007).
[14]Austrian Patent Act (PatG 1970)