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MEETING THE CHALLENGES
OF USER-DRIVEN RESEARCH,
DEVELOPMENT, AND
INNOVATION IN
UNIVERSITIES OF APPLIED
SCIENCES





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REQUIREMENTS FOR THE RESEARCH, DEVELOPMENT AND INNOVATION PROCESS

INTEGRATION TO THE EDUCATION PROCESS

Universities of applied sciences (UASs) offer practice-oriented higher education resulting typically with a bachelor level degree. They play an important role in our society where jobs in all sectors have become more demanding due to global competition and the use of advanced ICT. Higher education is a common requirement even for operational level jobs. In Finland, a country of 5 million inhabitants, roughly 20.000 students graduate yearly from UASs.

It is important that UAS students have opportunities to get involved in the real activities of their future employers during their studies. They will then be better prepared for the challenges of their jobs when they get employed after graduation.

UASs should create such opportunities for their students by research, development and innovation (RDI) co-operation with companies and public organizations. This RDI co-operation differs from the traditional approach of universities because its objectives are more closely linked to daily operational challenges than scientific challenges. Involvement in RDI should be a natural part of studies and widely integrated to the contents of study courses.

REGIONAL DEVELOPMENT

UASs can be seen as regional centers of excellence due to their highly qualified multidisciplinary teaching staff, well-equipped laboratories and the high volume of students possessing latest know-how. The challenge is to make the expertise and facilities easily available to companies and public organizations of the region to improve their RDI capability. The UAS could take the role of the RDI department of the partner organization, providing access to multidisciplinary excellence and a variety of facilities in an extent which is not possible for a single company or public organization with limited resources for RDI.

SOLUTIONS FOR THE REAL LIFE

Because of the practice-driven nature of their education activities, UASs should have a continuous and intensive interaction with their partner companies and public organizations. When teaching staff and students are in daily contact with those partners, new problems and challenges from the real life come up all the time. We need to organize the activities of UAS staff and students in such a way that useful solutions

to those problems and challenges can be produced cost-efficiently. Integration of RDI and study courses should facilitate serious work on real problems and not just demonstration of ideas.

PARTNERSHIPS AND CUSTOMER ORIENTED ACTIVITIES

UNIVERSITY AS AN ACTIVE MEMBER OF COMPETENCE ECOSYSTEM

There are plenty of reasons and needs for dialogue and co-operation between the UAS the companies, public organizations and third sector organizations of the region. Firstly, it is important to ensure the relevance of the education given by the UAS by a constant dialogue with the future employers of the students. Secondly, one duty of the Finnish UAS's is to support regional development in their own regions. Thirdly, it is increasingly important for the UAS's to get external funding to complement the funding coming from the Finnish Ministry of Education and Culture.

UAS's are institutions with a high potential for working on multidisciplinary topics. This should be reflected in the partnerships between UAS's and their customers. Multidisciplinary approach is a way to look for better solutions and increased competitiveness.

All members of the teaching staff are in constant interaction with companies, public organizations and third sector organizations of their fields of expertise. In addition, the top

management and all members of the middle management are involved in various networks which lead to a lot of contacts and enquiries for co-operation. Furthermore, the RDI and services department staff are constantly in contact with potential partners and customers. It is very challenging to manage and coordinate all this and to develop the UAS to a customer-oriented direction.

There is a clear need for coordinated efforts and shared practices for the interaction with partners and customers. Their objective is to make sure that all contacts are done in a professional manner with good awareness of relevant earlier interactions with the same partner or customer organization.

KEY ACCOUNT APPROACH

Three types of partnerships can be recognized based on the level and content of cooperation: educational partnership, development partnership and strategic partnership. The largest group includes organizations that mainly cooperate with a single study programme and faculty. The importance of these educational partnerships is mainly seen in supporting learning process and it is based on agreement of mutual understanding between partners. Development partnerships are wider including cooperation with several faculties. They are based on customer needs and, at the same time, UAS's own strategic priorities. The core of these contract based partnerships is a jointly written development plan leading to cumulative learning for both parties. In strategic partnerships, the cooperation is seen essential from the perspective of the whole UAS with a mission targeting both the national and international levels.

As the result of this approach, the needs of clients can be taken into account better, long term development plans are easier to schedule, and satisfaction of all actors in cooperation is improved. However, certain arrangements are needed inside the UAS in order to make sure that all members of the staff follow this common approach. Distributed responsibility of marketing, sales and customer relationships needs to be facilitated and supported appropriately.

One solution is to have a key account teacher (KAT) in each educational unit who is responsible for the partner-oriented and customer-oriented activities of the unit. Together with other customer-oriented professionals from RDI, information, and recruitment services they form a larger team for customer-oriented work. The strategic management at the UAS level is done by the customer director together with the directors of educational departments. The KAT does not have to be involved in all interactions with partners and customers, but he or she should make sure that the common approach is always used. Once a month, the KAT's gather together to report, discuss and exchange experiences.

SHARING OF CUSTOMER INFORMATION

One essential step towards high quality customer oriented working culture is sharing customer information between university departments and staff members. When being in contact with a partner or customer organization, it is important to know about relevant earlier interactions with the organization. Otherwise, it could happen that many meetings or phone contacts take place with the same people from the partner or customer organization without the UAS participants knowing from each other. It could also happen that

the contact person in the partner or customer organization mentions an earlier co-operation which the UAS participants know nothing about.

A modern approach for the sharing of customer information is to use a customer information management system with social media features. An example of such a system is the Oiva system used by TAMK.

Oiva is an information system which gathers to one shared database all the information associated with partner and customer interactions. This makes the interactions transparent and visible to all staff members and makes the management of contact information more efficient. It also provides a shared workspace for the management of customer oriented work and the associated information.

IDENTIFICATION AND REFINEMENT OF PROJECT IDEAS

INTERACTION WITH COMPANIES, THE PUBLIC SECTOR AND THE THIRD SECTOR

Lots of problems and development needs are identified when UAS staff and students interact with companies, public organizations and the third sector as part of their daily activities. Providing valid and useful solutions to real problems often requires an RDI project approach. The identified need of the partner organization should be considered carefully to estimate the amount and complexity of the required RDI effort. Sometimes students can solve the problem within their

project-based study courses but often an RDI project with designated project funding is needed.

TOPICS EMERGING FROM THE EDUCATION PROCESS

Project ideas also emerge from the internal discussions of UAS staff and students. Those ideas are often related to the topics of study courses and the latest state-of-the-art and they are very well in line with the strategic priorities of the UAS. Many ideas deal with learning environments. However, there are also ideas which have no connection to the education process. They can just come “out of the clear blue sky” but often they emerge from the private lives and personal contacts of people.

THE PROJECT IDEA PROCESS

UASs are often big multidisciplinary organizations. A process is needed for the objective evaluation and ranking of the ideas dealing with very different topics. In TAMK, this evaluation and ranking is done by the so-called idea group composed of the vice presidents of TAMK who gather for this every second Friday.

Ideas are submitted for evaluation and ranking electronically by filling in a specific form. In addition to filling in basic information about the contents and size of the proposed project and proposed sources for external funding, the following questions dealing with the strategic importance of the proposed project have to be answered:

- * How does the project strengthen the strategic themes of the UAS?
- * How does the project make the UAS more international?
- * How is the project integrated to studies and teaching?
- * How does the project meet the needs of regional development and the UAS's partner organizations?
- * How does the project strengthen the UAS's strategic partnerships?

Based on the submitted information, the idea group decides if a project idea can proceed to the preparation stage. Negative decision means that there is no permission to go on with the project idea. Positive decision means that the person in charge of the project idea has the permission to proceed with the idea by following a standard sequence of steps. Those steps are necessary to ensure the availability of organizational support and the required time and resources to prepare a high quality project proposal for external funding.

Standard steps to facilitate the efforts leading from idea to proposal:

1. Read the comments and instructions given by the idea group from their memo and take them into account.
2. Make sure that all those who should participate in the project proposal preparation work get permission from their superiors for that.

3. Contact the head of RDI department to agree on the maximum budget and duration for the project proposal preparation work.
4. Fill in the excel sheet with budget and person hour information.
5. Send the excel sheet by email to all the recipients of the initial idea group decision.
6. The project office opens a work id for the recording and monitoring of the person hours spent in the project proposal preparation work.
7. Go on with the project proposal preparation work.
8. When the project proposal preparation work has been completed, the vice president of RDI makes the decision to send the funding proposal to the funding organization.

FORMATION OF MULTIDISCIPLINARY TEAMS FOR PROJECT PREPARATION

It is important to consider the multidisciplinary aspect of the project idea already in the early stages. Experts of different fields can be found in the different departments of the UAS, and it is possible to involve them in discussions on the project idea and in the actual proposal writing work. For example, a project idea on the improvement of health care services for the elderly might involve aspects dealing with technology, business and culture. The formation of multidisciplinary teams should be encouraged and made possible by practical arrangements.

CUMULATION OF EXPERTISE

TEACHING STAFF AND STUDENTS AS APPLICATION DOMAIN EXPERTS

It is necessary to consider the impact of RDI activities on the competencies and expertise at the level of individuals and at the organizational level. The strategic priorities of the university can be supported by RDI projects only if the topics of the projects are in line with the expertise and professional development goals of the teaching staff.

From this point of view, RDI projects should always be carried out in such a way that the application domain expertise comes from the participating members of teaching staff and their students. It might sometimes be easier just to hire a domain expert to work on the project as a member of the RDI service staff but that is not a sustainable solution. It is very difficult to secure continued project funding for such experts. As a result, they normally leave the university after some time and most of the expertise and knowledge resulting from the project is lost.

RESEARCH AND DEVELOPMENT SERVICES AS EXPERTS OF PROJECT WORK

Allocating the work to teaching staff and their students is still not the complete solution. It is very challenging to carry out a multi-partner RDI project in a professional manner. Teaching staff do not usually have the necessary RDI project experience and expertise for that. Furthermore, it is not useful

to train them to become project professionals because most of them participate in RDI activities only for a single project and shift their focus on other professional activities when the project ends.

Having a small group of RDI project professionals to run the projects is one way to deal with this problem. They have the skills to ensure that there is a work plan with realistic objectives, resources and timetables for each subtask. They also know good practices for project management and how to prepare materials and organize meetings and events for presenting the project and getting feedback and guidance. These RDI project professionals do not have to be experts of the domain but preferably individuals with a multi-disciplinary background and an ability to participate in discussions on the contents of the project from that point of view.

PROJECT OFFICE AS EXPERTS OF FUNDING AND FINANCIAL ASPECTS

Multi-partner projects are often funded by public funding organizations in the context of strategic research programs or regional development programs. Examples of such funding organizations and schemes are the Finnish Funding Agency for Technology and Innovation, the European Regional Development Fund (ERDF) and the EU Framework Programme for Research and Innovation (Horizon 2020).

Each funding scheme has its own specific rules for the administration and financial management of projects. One solution is to have designated personnel to deal with the administrative and financial details and practices of publicly funded projects. Their expertise cumulates gradually by being

involved in numerous projects dealing with different domains but similar administrative and financial rules.

KNOWLEDGE TRANSFER TO THE USERS IN THE PRIVATE AND PUBLIC SECTORS

INVOLVEMENT OF USERS AND USER ORGANIZATIONS

Universities of applied sciences have an important educational role in their regions. They serve as suppliers of skilled young graduates and re-educated professionals to the companies and public organizations of the region. This educational role leads to a natural close link between the UAS and these employer organizations. It is easy to carry out discussions with them about the challenges that they are facing now and in the future, and how those challenges could be tackled by joint RDI activities with the UAS.

The path to joint RDI activities can be such that the company or public organization is first invited to an event of a running project. It is very good from this point of view to include open events in the work plans of projects. After this kind of first exposure to the RDI side of the activities of the UAS, it is easier to be in touch again with deeper co-operation in mind.

THE LIVING LAB APPROACH

In order to reach better results in education and RDI, UASs have a clear need to get closer to the real needs of enterprises, public organizations and individual citizens. The best way to achieve that is to step out of the university building and start to teach and develop outside in the middle of the daily activities of businesses and people.

In the living lab approach, students learn by doing through participation in development projects which are carried out in locations outside the university in intensive interaction with the end users of the product or service under development. Even a short project of that kind can produce important and innovative results. Sometimes a need is identified for a bigger and more profound development project. In that case, it is easy to take the next steps towards such an externally funded project, typically involving the preparation of a joint proposal for external funding, because the basis for working together has already been established.

DISSEMINATION (PUBLICATIONS ETC.)

Traditionally, knowledge transfer was done by writing articles, conference presentations and books about the results of development projects. This is still important although the world has changed in many ways. A high quality publication is still the only way to explain in detail what was done and achieved. Publications are also important as evidence of excellence.

The university series of publications is a good forum for publishing RDI results. There are certain guidelines to be followed but the control of the editing process stays within the university. University publications are relatively easy to find using the different search tools available in the internet. However, scientific and professional publications have a wider audience of regular readers who are professionals of the field. Therefore, it is often worth the effort to propose an article to such a publication.

However, there are new ways of knowledge transfer which in many cases are more efficient than traditional publications. Project web pages are nowadays a standard practice. The results can be made available there in the form of downloadable documents or even as videos or interactive applications. In addition, social media can be used to spread the word about the web pages and the existence of new and interesting results there.

STUDENTS AS YOUNG PROFESSIONALS

We must not forget that knowledge transfer from universities to companies and society happens largely through the graduating young professionals who get jobs in all kinds of organizations and bring the latest knowledge with them. Therefore, it is important to arrange possibilities for the students to participate in RDI activities during their studies. In addition, the results should be integrated to teaching materials whenever possible.

INNOVATION PROCESS TO TURN IDEAS INTO BUSINESS

INVENTIONS AND BUSINESS IDEAS

Students of higher education institutions (HEI's) represent a big and weakly utilized innovation capacity. In 2009, there were 48 HEI's in Finland: 20 universities and 28 UAS's. The total number of HEI students in Finland was about 313 000. There is a need for an innovation-friendly atmosphere and a good selection of support services to take the innovation potential of HEI students into full use to develop new solutions for the society and organizations in the private and public sectors.

Some ideas are purely business ideas. In such cases, the product or service to be delivered is already well known and well defined, and the required activities are focused on business development.

However, many ideas deal with ways to improve current products, services and working practices, and what kind of completely new solutions could be useful. Then, preliminary steps need to be taken before business development can be started. These idea-refining steps should be appropriately integrated in the education and R&D processes of the HEI.

STUDY PROGRAMS AND IDEA REFINEMENT

It is not easy to modify study programs to fulfill the emerging competency requirements. In particular, engineering is

a domain where regulations on entities such as machines, bridges and buildings require that students gain a thorough understanding of the behavior of structures and materials. This takes a lot of time. Health care is also a domain with regulations and associated requirements on the content of study programs. It is hard to add new courses on R&D, innovation and entrepreneurship into the studies if none of the existing courses can be removed.

Looking at the contents of examples and exercises within each course might be a better approach. A student could be linked to a specific case study already in the first study period of his or her studies. The student would then use this case study as an environment for examples and exercises in all his or her study courses. The case study could be a specific joint theme of the university and a company, or it could be a product or business idea of the student himself or herself.

In the case of a product or business idea, each study course would then mean a small step forward as some aspect of the idea would get studied in detail. In the later stages of studies, bigger steps could be taken in the form of project courses and practical training periods. Finally, the student would be able to leave the university not only with a degree but also with a well-developed idea waiting to be turned into business.

The Finnish legislation on inventions requires that HEI's follow given practices in invention issues. The Act on the Rights in Inventions made at Higher Education Institutions 369/2006 came into force in 2007. The purpose of the act is to promote the identification, protection and exploitation of inventions created in Finnish HEI's in a way which is good for the inventor, the HEI, and society.

The legislation is one driving force when a HEI considers how to promote such activities of their students and staff which are dealing with innovations and entrepreneurship. Another driving force is the evaluation criteria set by the Finnish Ministry of Education for HEI's. The number of innovations is included in this criteria as well as the number of new companies. The underlying philosophy in both the legislation and the evaluation criteria is that a modern HEI should, in addition to educating professionals, also be a source of new innovations and businesses.

In order to efficiently deal with all the ideas coming from students and staff, standardized procedures are needed. The first step is to go through the idea with the inventor and to make sure that the idea is documented clearly and with sufficient detail to enable detailed technical discussions with specialists. A network of specialists can be formed from the teaching staff of the UAS to support the innovation process. Usually two or three specialists are selected from this network to participate in the technical discussions on the feasibility of the idea. If the discussions with the inventor and with the specialists indicate that the idea is worth further development, more detailed considerations on IPR, markets and commercialization can be initiated. The goal is to solve all the issues on the way towards a commercial product.

ROLE OF EXTERNAL EXPERTISE AND RELATED FUNDING INSTRUMENTS

When the idea is refined towards a credible product with realistic commercial perspectives, different kinds of technical expertise as well as business, marketing and legal expertise is needed. The students of a multidisciplinary HEI form a valu-

able source of “junior experts” to work on the refinement of the different aspects of an idea. However, external high-level expertise is also needed in order to make the correct choices and decisions from the viewpoint of global markets and latest technological developments.

Public funding instruments are necessary for bridging the gap between a refined idea and a commercial product. In Finland, various arrangements have been made during the years to make public funding available for this market-oriented work. For example, patenting expertise, market expertise on international markets and business planning expertise can be acquired. The following activities have been supported:

- * commercialization of publicly funded research results
- * establishment of commercialization services in universities and research institutes
- * promotion of cooperation between research organizations and companies
- * creation of successful and viable businesses through start-ups, spin-offs and technology transfer.

PATENTS AND AGREEMENTS

It is often very important to protect the IPR of the innovative product or service idea by patenting. In particular, technology and health are such domains where it is difficult to convince partners on the business potential of the idea if the patenting process has not been started.

In case of public organizations such as HEI's, it is necessary to consider what the policy of the organization on the ownership of IPR is. One solution is that the HEI owns the IPR. In that case, the HEI should also have plans and resources to work on the exploitation of its IPR portfolio. There should be more income than costs from the portfolio.

Another solution is that the HEI does not take the ownership of IPR. In this case, the inventor has the ownership and should also take care of the costs of protecting the IPR. It is likely that the inventor is more motivated to spend time on the necessary idea refinement and commercialization steps if he or she expects to get substantial financial benefit as the result of successful commercialization of the invention.

The HEI and the inventor can also co-operate and agree on sharing the costs and benefits associated with the IPR and its protection. An agreement needs to be prepared which deals with the rights and responsibilities of both parties. One possibility is that the HEI covers the IPR protection costs and gets its money back from the income after commercialization, licensing or sales of the IPR. It can be agreed that the HEI also gets a share of the benefits, for example 30% of the benefits for ten years.

UNIVERSITY AS SHAREHOLDER

Some HEI's have decided to join the ownership of spin-off companies. In this case, a company is set up jointly by the inventor and the HEI and possibly other partners. Covering the costs of IPR protection can be seen as an investment by the HEI to the company. It can also be agreed that the company can use the facilities of the HEI with favorable conditions.

Being a shareholder gives the HEI a possibility to participate in the decision making of the company. At some point, the HEI may decide to sell its shares in order to get its investment back and to gain some profit.

EVALUATION AND CONTINUOUS IMPROVEMENT OF THE RESEARCH, DEVELOPMENT AND INNOVATION ACTIVITY

MONITORING OF PROJECT PROGRESS

According to the Finnish law on higher education, the RDI activities of UASs should support the educational activities of the UAS and contribute to the development of the region where the UAS is located. In addition, the projects should fulfil the objectives of the source of funding which is typically a R&D funding programme of a public body with lots of societal objectives and themes for development.

Each project has a steering group which monitors and guides the project. The steering group looks at the project work plan and follows the progress of the activities described there and the use of the project budget. In addition, it can discuss about possible needs to make changes to the project work plan and the allocation of the budget to partners and tasks. The steering group has typically 2-4 meetings per year. It is composed of senior representatives of the partner organizations. Sometimes also external experts are included to bring a wider perspective.

The existence of a steering group does not fully cover the monitoring needs of the UAS. Separate monitoring and guidance is needed in relation to the strategic goals of the UAS. The criteria used on the project idea evaluation stage are a good starting point for this. They deal with the contribution of the project to the strategic R&D themes, strategic partnerships and internationalization of the UAS. In addition, attention is paid to efforts on integrating R&D with degree education.

One possible solution is to gather all project managers together for example once in every two months. They can be asked to fill in some information to a simple project monitoring table beforehand and to give a five minute speech on the importance of the project in the meeting.

FINAL EVALUATION

The final evaluation of the project should be a more thorough examination of the project and its results. It is not anymore possible to make changes on how the project was carried out and what results were produced. Therefore, the focus of the final evaluation should be on learning from the successes and failures of the project.

The same evaluation criteria can be applied as during the project but from a different point of view focusing on lessons learnt. In addition, archiving the project documentation should be discussed as well as plans for further work on the same topic or with the same partners in the form of a new RDI project.

CONTINUOUS IMPROVEMENT OF THE PROCESS

Issues requiring attention and further work on the improvement of the RDI process may arise in connection to project monitoring and evaluation activities. Whenever such issues are raised, they should be recorded in a list of process improvement needs. This list forms the basis for continuous improvement planning as part of RDI process quality assurance.

Feedback is another source of input for continuous improvement. Each project should collect feedback in the end of the project from project partners and stakeholders. A good way of collecting this feedback is a simple electronic form sent by email. The questions to be scored 1-4 should cover benefits, expertise, co-operation, timetable and quality of results.

At least once a year, a quality group formed of experienced RDI staff should go through all this input consisting of the collected feedback and the list of issues from project monitoring and evaluation. As a result, a yearly plan for improvements is made and its implementation started.

FINAL REMARKS

Management and strategic development of the RDI activities of an UAS is a complex task. This article is an attempt to cover all the different aspects which should be considered by the management of an UAS willing to develop its RDI activities in a professional manner. The author would be very happy to receive feedback and comments on the practices suggested in this article.