Creating Attractive Job Environments in Nepal through Industry-University Collaborations and University Partnerships

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Abstract

Providing an environment that fosters the creation of attractive jobs is a challenge shared by all countries educating young people. Even European countries report a continuous movement of young researchers to the US and other countries. However, it is particularly challenging for developing nations who frequently face severe brain drain problems caused by more attractive jobs abroad. In this paper we present an example of an industry-university collaboration in Austria and discuss whether a similar approach could succeed in Nepal. We also discuss partnerships between universities in Nepal and Austria as a means to cater national and international collaborations for facilitating research and educational developments in Nepal.

In our research laboratory on "Automated Software Engineering"[1] three industry partners collaborate with the Johannes Kepler University Linz to promote talented young scientists and to achieve high-quality research results. The collaboration particularly emphasizes the transfer of knowledge to the industry partners in the laboratory. The lab is funded and supported by the Christian Doppler Research Society (CDG), a non-profit organization promoting research in the areas of natural sciences, technology, and economics. In the presentation we will give a survey about our ongoing research activities in the areas of product line engineering, domain-specific languages, and component-based software development.

The focus of this paper lies on the discussion of a potential application of the CDG funding instrument to the Nepali software industry and higher education institutions. In the long-term, setting up similar labs for technology transfer in Nepal could reduce the current brain drain. A short-term step to foster the transfer of experiences between Austria and Nepal is to establish partnerships between Austrian and Nepali universities. Such partnerships are essential to promote exchange of teaching and research staff.

[1] http://ase.jku.at

1 Introduction

When referring to Nepal, many people use phrases such as "*one of the poorest countries in the world*", or (if on the positive side) "*a beautiful country of mountains, with friendly people…*". However, Nepal needs other catch-phrases providing a different perspective on the country. For instance, the boom of information-communication technology (ICT) could be beneficial for a developing country like Nepal if Nepal manages to become visible on the global ICT map.

The first step towards such an endeavour is the development of high-quality manpower in the country. Year after year, Nepal loses a high number of graduates to other countries. It is therefore very important to minimize the migration of qualified personnel by supporting the human resources available in the country. The social structure of Nepalese families is very close. With adequate opportunities at home, most Nepalese would not choose to leave their families and migrate.

The "Foreign Investment and Technology Act of Nepal (1992)" aims to attract foreign investors to invest in Nepal, which can serve as an instrument to transfer technology from developed countries to Nepal. This was one of the most important steps towards enhancing the production capacity and providing good employment opportunities in the country [Nepal, Karki 2001]. However, security issues and Nepal's political problems often prevent foreign investors from getting into the country.

One of the aims of the "Information Technology Policy (2000)" is to establish Nepal in the global market through the use of information technology. In order to work towards the fulfilment of that goal, it is important to make information technology accessible to the public and increase employment through this means [Shakya, Rauniar 2000]. This is particularly important for meeting the growing needs of academic and research communities in Nepal.

To increase the visibility of Nepal as an ICT destination, it is inevitable to equip Nepalese manpower with marketable skills, including an exposure to international standards and the latest technologies. It is equally important to cooperate with the private sector in Nepal to allow commercialisation. Facilitating technology transfer between academia and the local industry can be a milestone in creating attractive job environments in Nepal. Furthermore, partnerships between universities in Nepal and academic institutions abroad can expedite knowledge transfer from and to Nepal.

The development and employment of highly qualified manpower in the country is essential to reduce brain drain problems. The diffusion of knowledge from qualified personnel to students and to the general public will contribute to a brighter future of Nepal. Innovation and creativity cannot be taught but are the result of challenges faced and experiences gained when solving practical problems. In this sense, collaboration between industry and academia allows students to gain insights into practical problems and fosters their creativity to come up with innovative solutions.

2 Industry-University Collaborations

According to [Brussels 2003], European universities as the centres of education, research and innovation employ 34% of the total number of researchers, and are responsible for 80% of the funda-

mental research pursued. As public funding of universities tends to become scarce universities increasingly seek to transfer their expertise to the industry in order to acquire funding and to trigger innovative research based on lessons learned from real-world challenges. It is often not cost-effective, particularly for small and medium-sized enterprises (SMEs), to run their own research departments. Companies find it attractive to outsource research activities to universities. Such an approach also allows universities to employ young researchers and improve their infrastructure and equipment.

Considering the situation of universities and SMEs, it is obvious that a win-win situation can be created with mutual benefits for both sides. The main goals of such collaborations are the optimal usage of resources between university and industry by fostering talents and promoting networks of knowledge exchange. Industry learns about the state-of-the-art in research and technology and academics become aware of practical problems and constraints in real-world projects. Applying results in industry also provides an excellent test bed to validate research results.

Depending on the availability of financial resources and the problem at hand different kinds of collaborations between industry and academia are possible.

- The easiest way of collaboration are student projects carried out in the form of master theses and PhD projects. Funding is cheap and there is almost no administrative overhead.
- Another promising approach is bilateral research agreements between a company and a university institute. Such agreements are driven by mutual interests of the partners and avoid most of the bureaucracy that often comes with public funding bodies. For example, our institute runs a very successful cooperation with Sun Microsystems in the area of compiler optimization.
- Finally, there are opportunities for publicly-funded research cooperations both on the national and the international scale. In these cooperations a certain percentage of the project costs is funded by the government and the rest comes from the industrial partners. In this paper we will concentrate on national funding instruments. As an example we will describe the Austrian *Christian Doppler Research Society* [CDG], but there are also similar associations in other countries, for example the *Fraunhofer-Gesellschaft* in Germany [Fraunhofer].

2.1 The Christian Doppler Research Society in Austria

The Christian Doppler Research Association (CDG) is a non-profit association promoting “development in the areas of natural sciences, technology and economy as well as their economic implementation and utilization” [CDG]. The CDG runs several so-called *CD labs* (see Fig.1) in which universities and industrial partners work on applied basic research problems. In contrast to large research centres (such as the INRIA centres in France) CD labs are of small or medium scale and are associated with existing university institutes. This makes them focused on the expertise of these institutes and keeps the administrative overhead low. Companies can apply for membership in the CDG, which entitles them to participate in a CD lab and to take advantage of research results tailored to their particular business area. At least one company with a concrete research need is required to start a new lab. Lab proposals are developed by researchers and are thoroughly evaluated by the CDG with

the help of international experts. The funds for a CD lab are provided by the member companies and are doubled by the CDG; the financial contribution of SMEs can even be reduced for an initial period of up to two years. CD labs are established for up to seven years. After two years an evaluation is carried out to ensure the scientific quality of their work. Labs are evaluated against their scientific contributions as well as the usefulness and applicability of results for the companies.

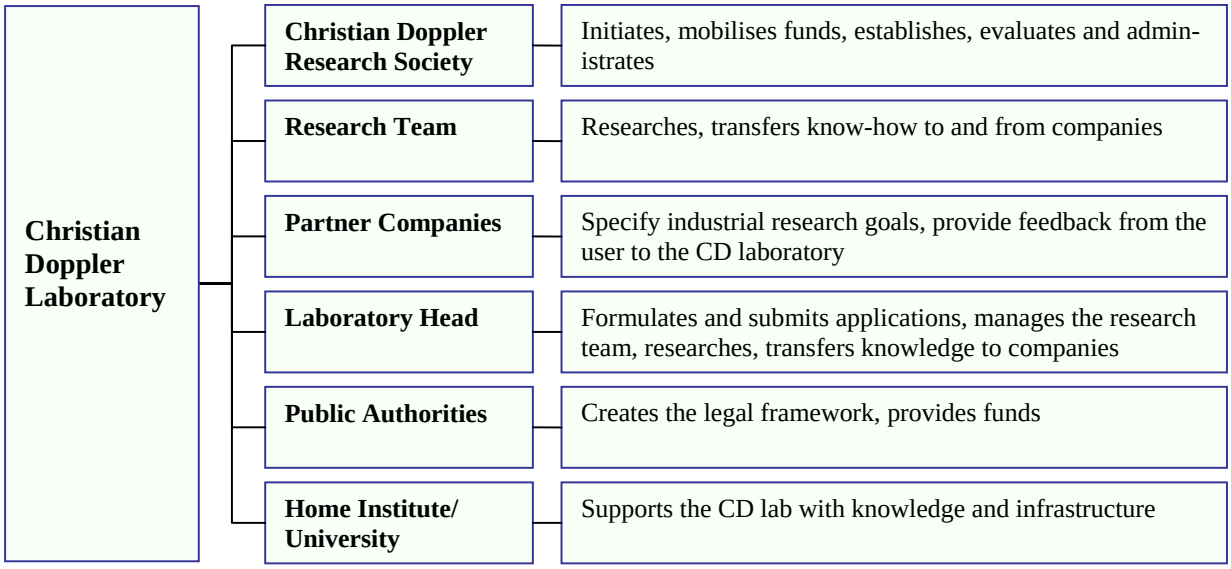

Fig. 1 Different stakeholders of a Christian Doppler Laboratory and their contributions [CDG]

There are currently 38 CD labs established by the CDG in Austria and funded by 84 member companies. Here, we briefly describe our laboratory for Automated Software Engineering.

2.2 The CD Lab for Automated Software Engineering

The CD lab for Automated Software Engineering [ASE] has been funded in February 2006 and is associated with the Institute for System Software at the Johannes Kepler University Linz (Austria). It consists of three senior researchers, 4 PhD students and a couple of undergraduate students. With an annual budget of about 300.000 € it cooperates with three industrial partners doing applied basic research for automating essential software engineering tasks in typical industrial settings.

Although software is an essential asset in almost every business branch today, systematic software development methods still lag behind on what is expected from a mature industry. Research results need to be put into practice more quickly and new software research needs to be performed in industrial settings. Automated software engineering (ASE) applies computation to software engineering activities [ASE journal; ASE conference]. The goal of ASE is to partially or fully automate software engineering activities by appropriate methods and tools, thereby significantly increasing both quality and productivity. This includes the study of techniques for constructing, understanding, modelling, and adapting both software artefacts and processes. Automatic and collaborative systems are impor-

tant areas of ASE, as are computational models of human software engineering activities. Model-based approaches and knowledge representations applicable in this field are of particular interest, as are formal techniques that support or provide theoretical foundations.

The mission of the CD lab for Automated Software Engineering is the research and development of concepts, methods, and tools for the automation of success-critical software engineering tasks such as software analysis, software architecting and composition, software reuse, and software generation. The work plan during the first three years is divided into three project modules, each of which is being pursued together with one industrial partner. The topics of the three modules are connected with each other in that they all emphasize automation in important areas of software development:

In module 1 (Product-line engineering for automation software systems) we apply a product-line approach in cooperation with Siemens VAI [VAI] to automatically generate software from feature specifications that characterise individual members of the product line. As a result, both software engineers and sales people of our partner are supported in planning and developing new product line instances and thereby maximising productivity and minimising defects and economic risks. The novelty of our research lies in the combination of approaches for modelling stakeholder needs, product features, architectural elements, and variability, in introducing business decision making in product line engineering, and in an innovative approach for making feature-based product configuration accessible to non-software-experts.

The goal of module 2 (Domain-specific languages for industrial automation) in cooperation with KEBA AG [KEBA] is to develop new notations and tools for the specification and translation of domain-specific languages in the automation domain. We are devising novel features for such languages, e.g. hierarchical structuring, extensibility, exception handling, constraints and safety. As a result, our partner and its clients are able to define and apply custom-specific languages in which the concepts of a specific problem domain can be described in a concise and intuitive way.

Module 3 (Component architectures for next-generation business computing systems) in cooperation with BMD Systemhaus GmbH [BMD] deals with the conception and architectural design of a next generation business computing framework. Our main contribution is the adoption of the ideas of plug-in component systems to design flexible architectures, design approaches, development methods, and tools that will alleviate the composition of business computing systems.

2.3 Experiences

The experiences with our CD lab are very encouraging so far. The motivation of both university researchers (mostly young PhD students) and industrial partners is high while the overhead imposed by the CDG is kept to a minimum. All we need is an agreement with our partners on the annual budget as well as quarterly financial reports to the CDG.

As an example of the processes in our lab we discuss module 1, in which we collaborate with Siemens VAI, the world's leading engineering and plant-building company for the iron, steel and aluminium industries. The research collaboration focuses on the automation software for the continuous

casting technology of Siemens VAI providing capabilities like material tracking, process supervision, and process optimization. The size of the code base is about 1,3 million lines of code. Siemens VAI delivers 20+ software solutions per year customized to the needs of individual customers with a technical staff of about 35 software engineers.

Improving existing methods for product-line engineering in the context of automation software systems is a challenging task. Due to the size and complexity of the existing software solution and the highly specialised domain it is essential to establish and maintain a continuous dialog between university and industry to ensure progress. This is only possible in a highly iterative process with frequent meetings and contributions from both parties. Research results are made available to our industry partner using software prototypes. Such prototypes are then applied by engineers of our partner to validate the research and to receive valuable feedback. Feedback also triggers new research directions not stated in the original proposal.

Two young researchers find an interesting and highly challenging job environment in this module. Via travel funds the lab also allows young researchers to present research results to the scientific community at international conferences and workshops.

3 University Partnerships

Another interesting opportunity to embed young Nepalese researchers into the international scientific community are university partnerships. Such partnerships can range from informal contacts between professors or institutes to formal agreements between university management boards, often supported by international partnership programmes.

The goals of such partnerships are manifold: Most often they include the exchange of students, postdocs or staff members. Sometimes they also aim at a closer cooperation in curriculum development and even in joint degrees awarded by two or more partner universities. As a general benefit, university partnerships make national institutions visible outside their country and contribute to the internationalization and professionalism of research, teaching and university administration.

Europe has an extensive programme for supporting the cooperation of universities in the field of higher education, known as *Erasmus* (more specifically, *Socrates* from 2000 to 2006 [Socrates] and *Lifelong Learning* from 2007 to 2013 [Lifelong Learning]). From 1987 to 2004, more than 1 million university students spent an Erasmus period abroad and 2,199 universities (or other Higher Education institutions) are presently participating in the programme. The EU budget of Socrates/Erasmus for 2000-2006 amounts to around 950 Mio € (of which approximately 750 Mio € are spent for students grants). Additional funds are provided in each country by public authorities, by the universities themselves and by other organisations. Erasmus grants are mobility grants destined to cover the additional costs of a study period abroad rather than the entire cost of the stay.

A similar programme has been established for countries of central and eastern Europe under the name *CEEPUS* (Central European Exchange Programme for University Studies) [CEEPUS]. Its goal is to bring former eastern countries like Bulgaria, Hungary or Romania into the European network of

university collaborations. The legal basis for CEEPUS is an agreement signed by the individual member states. CEEPUS is based on lean management. Coordination, evaluation and program development are handled by the central CEEPUS office (consisting of only two persons). Each country has a national CEEPUS office in charge of the national implementation. With CEEPUS, there is no transfer of funds: Each country pays its incoming students and teachers and has to pledge at least 100 scholarship months per academic year.

Our home university, the Johannes Kepler University Linz, runs about 150 Erasmus and CEEPUS partnerships, as well as about 120 partnerships based on bilateral agreements between universities from all over the world. Typically, such bilateral contracts just agree on waiving tuition fees for incoming students and providing the partners with the necessary information about curricula, housing, visa regulations, health insurance, etc. Outgoing students and teachers are supported by scholarships offered by their home universities or by local authorities.

Our personal experience with university partnerships is very positive. Our students happily take the opportunity to study abroad for one or two semesters, getting to know the language and the culture of their host countries and learning about technical areas which are not available or less developed at our own university. Credits earned at a host university are transferred to the students' regular study programme when they come back. Since incoming students often have a limited mastery of the German language we are challenged to give more courses in English, which we consider to be a positive side-effect of such partnerships contributing to the internationalization of our university. As another positive effect incoming teachers add to our curriculum by offering courses in their area of specialization. In return, outgoing teachers from our university spread their expertise to other universities. All this contributes to building an international academic network from which all partners benefit.

4 Conclusions

In this paper, we discussed the challenge of creating attractive jobs to reduce brain drain problems. We illustrated our discussion using two examples from Austria: Industry-University collaborations and university partnerships. Although a direct transfer of such experiences from one country to another is neither possible nor desirable, we believe that some of the presented experiences could contribute to more attractive jobs in Nepal. Scientific leadership and investment in research institutions both by government and private sectors are required and it is essential to integrate enterprise-research institutions, universities, and industry. One of the first steps towards this goal is therefore to increase the percentage of the GNP that is to be devoted to universities and research institutions. In conclusion, Nepal should be committed to retaining high-level scientists, stimulating them, and providing funds and other support to encourage and maintain their productivity. With the increase of scientific popularity, visibility and recognition of the researchers in Nepal the country will become more attractive for foreign investors. This increases employment in the country, thereby reducing the current brain drain. It will contribute to making Nepal an interesting ICT-destination. Advances in the ICT

sector are a big hope for this landlocked mountainous country. We hope that "*An interesting ICT-Destination*" can be the next catch-phrase describing Nepal.

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