COLLABORATION BETWEEN INDUSTRIAL DESIGN STUDENTS AND INDUSTRY: SHARING KNOWLEDGE AND INTELLECTUAL PROPERTY

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ABSTRACT
To optimize collaboration between industrial partners and students product development, specific agreements are needed for the protection and transfer of intellectual property created in e.g. master theses, including newly generated foreground know-how as well as existing background knowledge and confidential information. We have mapped the concerns of students, educational concerns and concerns from industry, and we have proposed a framework for collaboration and sharing knowledge and intellectual property between students, educational institute and industrial parties. The framework allows us to formulate particular agreements, which are applied now for several years at the Antwerp master of Product Development with regard to the master theses conducted by their students. The current paper describes the effect of using specific collaboration agreements by measuring the relative and absolute number of master theses that are being conducted in collaboration with industry and the relative and absolute number of projects which result in intellectual property being transferred to industry. Additionally, the master in product development aims to increase the amount of master theses in collaboration with academic research groups. Based on our analysis and first experiences, we formulate recommendations for collaboration agreements involving an academic partner that contributes to the master thesis through its scientific know-how. Importantly, all parties have an valorisation interest in the setting considered. Our findings might be useful for universities that host product development or related educational programs, to manage their contacts with industry and translate scientific knowledge to economic value and to optimize IP generation taking account concerns of all stakeholders. The methodology used in the paper can be transferred to other industrial design educational programs.

Keywords: Product development, foreground knowledge, intellectual property, valorisation, innovation

1 INTRODUCTION

The targets set by a university have traditionally been the organization of academic education and its related research, c.f. the von Humboldt concept [1]. A major outcome is academic publications. Academic research is thereby driven to acquire fundamental explanatory knowledge. This type of research can be complemented with a more applied driven approach, starting from and / or referring back to specific practical problems and opportunities. University educational programs with a practical orientation such as industrial design and product development, in turn, can enhance economic activity through translation of state of the art scientific knowledge. However, to stimulate optimal collaboration between academic and industrial partners as well as collaboration with students working on a design project, specific agreements are needed for the protection and transfer of intellectual property (IP), including newly generated foreground know-how as well as existing background knowledge and confidential information. In the second section we describe a methodology to pinpoint such agreement. Furthermore, we will focus on how the created added value or IP should be distributed between the stakeholders in relation to their own knowledge and investments in the particular project. The aim is to identify those forms of collaboration that are most stimulating for all stakeholders. In the third section we evaluate the effect of the arrangements on collaborations with industrial partners and IP transfer in the longitudinal comparison from the academic 2008-09 up to the academic 2012-2013. In the fourth section we discuss future trends.

2 BASIC FRAMEWORK FOR SHARING KNOWLEDGE AND IP

The collaboration with industrial partners is an added value for students, the educational program, and for the industrial partner. Thereby each party also brings in its specific concerns.

2.1 Educational program

Master students in product development learn to create new products with an added value. Integrated Product development at Artesis University College includes the entire process, staring from search fields and opportunities, to idea generation and product definition, followed by the new product design that consists of two phases: system design and product design, after [2], as illustrated in Figure 1.

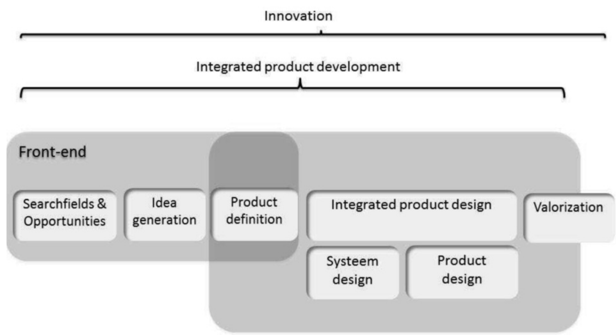

Figure 1. The process of innovation, derived from [2]

Thereby technological, economical and human factors are equally taken into account [3] and constrains imposed by the valorisation trajectory should be taken into account as well. New technology and state-of-the-art scientific know-how, shifts in market and socio-economic trends, changes in needs, value and demographic evolutions are all important resources for the referred innovation. Students should take account of these drivers that can be of rather abstract nature, compared to the final result of a student's master thesis, i.e. a product that might be viable in a real world context. The student should end with a product that is theoretically feasible, where all critical aspects including use, functionality, value chain, business strategy and business plan have been mapped and clarified to certain extent. The realization of the product concept is not imposed as a deliverable of the master theses due to several constraints and external factors including time, funding, scale, external support…

To enhance the feasibility towards effective implementation of valorisation of product concepts that have been created within the framework of a student's master thesis, collaboration with industry is stimulated, often originating from the knowhow of the industrial partner of its own market technology and distribution. The collaboration with industry also provides valuable knowledge for teachers to keep their courses up to date and keep track of trends and opportunities for innovation. On the other hand, many companies are not yet familiar with the process of new product development, often reasoning and acting according to their own tradition, internal knowledge, resources and skills, e.g. only thinking in terms of existing solutions or in terms of an already established product portfolio [4].

However, next to the added value of having an industrial partner that closely interacts with a student during its master thesis, several concerns have been raised. A major concern when involving an industrial partner is that this partner will steer the project and will narrow the scope of the project, e.g. striving for short term solutions or the lowest budget. As such the student's project would be limited, conflicting the educational mission, especially for the student to learn to master the entire process of product development including front end of innovation.

Another concern is that unrealistic expectations imposed by the industrial partner will put pressure on the students, e.g. the student might be assessed based on milestones or deliverables of which they do not control boundary conditions or success factors.
A final concern is proper price: added value for a company delivered by the institute should be rewarded at commercial prices to avoid unfair competition on one hand whereas on the other hand obligation of results can not be imposed for student's work.

2.2 Student

The merits for the student is that he/she gains experience in a real world industrial context and that he/she builds up a network and future references though contacts with relevant stakeholders enabling future valorisation of his/her ideas. The setting allows him/her to prove himself/herself as a professional thereby building up future references.
However, a concern is that the student becomes demotivated by working for the industrial partner with a tight agenda thereby narrowing his/her creativity and originality. Another concern is that the student is not or properly rewarded for his/her intellectual work and creativity. The concern of proper rewarding grows in case the product concept is picked up by the industrial party and brought to the market.

2.3 Companies

A merit for several companies is that broadening the view on possible solutions can increase the innovation potential of companies [5] e.g. involved in collaborations with the master in product development. Companies that are less familiar with the process of product development are supported by students and staff e.g. to broaden their view on innovation and their own resources. For the industrial partner the collaboration creates the opportunity to explore the possibilities of his resources and opportunities brought by external collaborations as well as to keep in touch with trends and opportunities for innovation, explore their innovation capacity and broaden their network. The collaboration in an educational project also offers companies the chance to explore the feasibilities of ideas for which no investment budget has been foreseen (yet).
A major concern for the company is that strategic internal know-how is brought into the public domain and that the company may lose rights on existing intellectual property.
Another concern is that the return is not in proportion to the investments made by the company. Added value might be created that strongly relies on the company's background knowledge and/or ideas and companies should be offered a mechanism for a proper rewarding.
A related concern is that the student or the institute might refer to the project for its own credits, which could be in conflict with the interests of the company.

2.4 Basic principles

To safeguard the abovementioned merits and take account of the said concerns, we formulate a set of basic principles. To the best of our experience, the list is exhaustive to set up clear arrangements between product development and industrial design for efficient collaboration in student's projects with large companies and SME's. A good general framework is found in e.g. [6].
In the further discussion in this paragraph, key concepts are denoted by initial capital letters.
The Agreement is entered into force between The Parties; The Institute, The Enterprise and The Student. IP is divided in *background IP* and *foreground IP*. Background IP is defined as the intellectual property that is owned by the company before the start of the mutual project or created independently of the project. Foreground IP is limited in the current paper to what the student and its supervisors add on top of already existing IP and trade information.

- The Enterprise Trade Information that should be kept secret can be declared confidential e.g. in an addendum to The Agreement.
- No Party acquires any rights on Background IP of any of the other Parties through the said collaboration.
- Foreground IP is assigned to The Institute. This can be set in The Agreement, if not already entailed, e.g. by the applicable Education Regulations.
- The Enterprise has *first right of refusal* on Foreground IP through payment of a fair and reasonable compensation. A time range is foreseen to consider the decision to acquire the

Foreground IP. When The Enterprise is not interested to acquire The Foreground IP, the ownership remains with The Institute.

- The compensation fee is redistributed among The Student and The Institute along a predefined allocation model.
- A confidentiality policy is set during the project which starts when the Agreement enters force.
- Confidentiality is guarantied after takeover of Foreground IP bound in time to allow for a legal protection of Foreground IP, e.g. 3-10 years from the start of the project.
- The student has at any time the right to refer to the said collaboration.

2.5 Drivers, starting conditions and time schedule

The effective collaboration regularly runs through an entire academic year, say 20X-20X+1. The process of new product development is spread over two academic years starting with the front end in the second half of the preceding academic year 20X-1-20X (see also Figure 1). It is an advantage to enrich the start with external know-how, e.g. brought in by companies that aim to collaborate in master theses. The following are important drivers for innovation, external to the knowledge of educational institute:

1. New needs entailed by e.g. trends, changes in society, economy, company strategy...
2. New technology that offers the possibility to meet existing needs or create future opportunities by means of new product concepts
3. An existing technology or system that could be applied to another market or another application, e.g. transformation of high tech business to consumer goods.
4. New scientific knowledge for which no market applications exist yet.
5. New market applications for which no proof of concept exists yet but could be achieved by combining scientific research with product development.

The first three drivers are usually brought in by an industrial partner. To post a topic, The Enterprise formulates its project idea and resources to contribute to possible solutions in a typical a4 pitch which is an excellent mean of communication between The Institute, The Enterprise and The student. Whether a project posted by The Enterprise is posted as a master these topics depends in the first place on whether the project fits in the Institute's mission. As such the following rules are considered by The Institute to evaluate the feasibility of the externally handed search fields and opportunities:

- There is enough room for improvements; i.e. sufficient amount of innovative solutions can be generated such that the final product concept is distinctive and has competitive advantages over the existing product(s).
- The final concept or initiating problem has the potential to create sufficient added value for the Enterprise as well as society, end user, economy and society. This condition implies that market potential is proved from the very beginning of the project. So it is an advantage to start from a broad setting.
- There are enough indications that the problem can be solved by technological resources at hand or within the Institute's network.
- The problem can be solved by a product, not depending or only to a small extend on factors that are exogenous to product development, e.g. factors of logistical, political, psychological nature.
- The project is large enough to be conducted in a full year master thesis and not too large, to be feasible.

Whether a project is effectively conducted evidently depends on whether the topic is chosen by one of the master students. The agreement is entered into force at the start e.g. the beginning of the academic year 20X-20X+1. This IP Milestone 1 is displayed in Figure 2 as IPM1. It might also occur that a student working on his/her own theme needs substantial support of an industrial partner. Such support might drastically increase his/her output. To that end and to motivate companies to participate in such a trajectory, another IP Milestone IPM2 is foreseen where The Enterprise can collaborate according to the same aforementioned conditions with regard to IP transfer, i.e. at IPM1 and IPM2 the same agreement mutatis mutandis is entered into force. At IPM3 the procedure for both cases collides when The Enterprise decides to adopt the foreground IP.

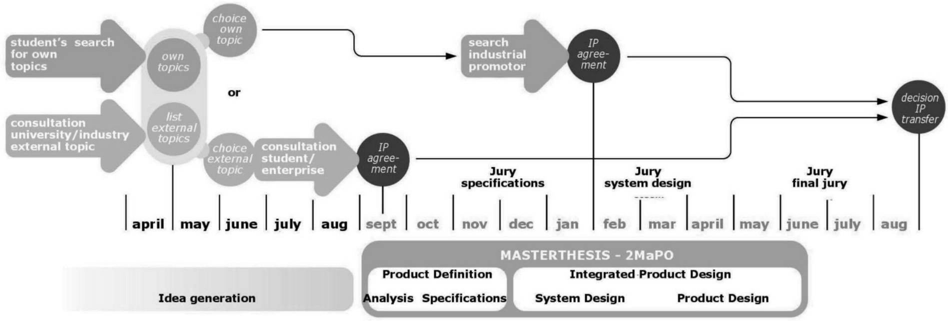

Figure 2. Master theses regular time schedule including idea generation and IP sharing milestones

3 RESULTS

The agreement is used as from the academic year 2008-09. It has led to an increasing number of master theses conducted in collaboration with an industrial partner, as seen in Figure 3.

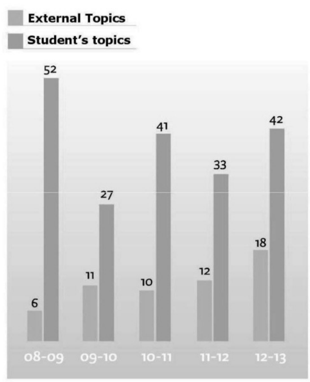

Figure 3. Number of master theses with internally and externally initiated topics, over the academics 2008-09 up to the academics 2012-2013

A relative small but important number of results from master theses has effectively been transferred to the industrial partners (Figure 4).

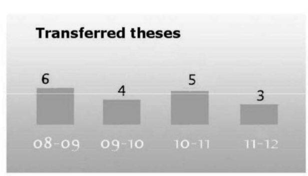

Figure 4. Number of externally initiated master theses of which IP is transferred to the company, over the academics 2008-09 up to the academics 2012-2013

These cases presumably complete the integrated product development with a valorisation trajectory and thus they lift the activity of integral product development to the level of innovation, as seen in Figure 1.

4 TRENDS AND FUTURE OPPORTUNITIES

It would be of great value to increase the number of IP transferred from master theses to industry (Figure 4).

Besides research, education and services, valorisation of research results is increasingly seen as an important driving force for innovation and economic and social value. In this regard, universities have been assigned a direct role towards society in many countries, through which valorisation of research not only means a better education but also serves society in a very direct way by creating economic value out of science. In most European countries, all activities that offer a direct return for the benefit of the economy and society, and, more specifically, those activities with a measurable output towards industry, are somehow rewarded by governments. Industrial-academic research contracts, fee-for-service research, the protection of IP by means of patenting, and the creation of spin-offs are typical examples of valorisation in an academic context. Academic research groups are increasingly interested in bringing their results to the market. This may be achieved by the activity integral product development starting from idea generation where the results are the basis to define new product concepts.

Educational programs aimed at industrial design activities such as a master educational program in product development could benefit in turn from valorisation-oriented research activities, for they may consolidate the link with their natural professional field and may at the same time enrich the process of integrated product development with a final valorisation phase (Figure 1). Within the education-research-industry collaborations, relevance of the education program can be safeguarded and the content can be kept up-to-date. Thus although product development within an educational setting in collaboration with industry might indeed generate revenues, it can be seen in the first place as a form of quality-control for education, e.g. a means to attract students.

Only three out of five drivers for conducting innovation through integral product development, identified in Section 2.5, are currently provided by industrial partners. The other two can be assessed through intensive collaboration in educational and research programs with other academic disciplines and research groups, driven to create economic added value out of their research results and/or willing to orientate their research lines towards results with direct market applications. Strong incentives, resources and opportunities for valorisation are found in the health care domain. About 20% of master theses in product development have been conducted in health care over the past five years. The master in product development has indeed opted to put a focus on that domain, due to inter alia a dense regional network of hospitals, ageing issues and potential research partners [7] and as such collaboration with biomedical research groups, engineering groups and university hospitals for validation are most appropriate. Such groups also have a strong interest in the valorisation of their expertise and research results due to their practical orientation. Valorisation can be organized at research level but also at master level in subsequent theses running over multiple academics, to constitute at the end an entire innovation trajectory.

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