Science2Society

Best Practices for Open Innovation

A selection of cases representative of Open Innovation in Europe.

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Editorial

Science2Society is a EU-funded project that aims to boost innovation efficiency across Europe. To improve the efficiency of the innovation system, this project analyzes the ways it creates new businesses, turns technology into products and services, attracts financing and generally creates value from academic research. Science2Society brings together practitioners and system experts, including universities, industries, research and technology organizations and SMEs, with the common goal of increasing the throughput capacity of the European innovation system. The project is endorsed by large networks of peers (EU-level) and the innovation ecosystem.

This brochure includes "real life" experiences from practitioners in science and industry that illustrate best practices in the field of Open Innovation. These case studies exemplify key lessons in relevant University-Industry-Society interfacing schemes, which cover a wide range of approaches and advances far beyond the traditional role of the interface as a facilitator of knowledge transfer from university to business.

Content

ProVIL – Product development in a Virtual Idea Laboratory

A co-creation project to develop highly innovative product concepts through excellent master students

CO-CREATION

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Main actors

- IPEK – Institute of Product Engineering at Karlsruhe Institute of Technology (KIT)
- Karlsruhe University of Applied Sciences
- Master students from mechanical engineering
- Master students from industrial engineering
- Porsche AG

ProVIL – product development in a Virtual Idea Laboratory (2016) was a product development project with 32 Mechanical Engineering students and 10 Industrial Engineering students held at the IPEK – Institute of Product Engineering. The project was conducted in cooperation with Porsche over a period of 4 month, during the summer of 2016.

In ProVIL, the students worked in 8 teams on a product development challenge from Porsche in the field of "digital services for the customer of tomorrow". The main objective was to generate viable product concepts for Porsche.

During the whole project all participants (students, IPEK, Porsche) mainly worked together using an online innovation platform form SAP (SAP innovation Management). The innovation platform included a visualisation of the whole process of ProVIL and provided activity-specific descriptions, templates, and supportive video tutorials. Additionally, the platform provided functionalities like ideas for campaigns, ideas for evaluation modes, and a personal inbox for every participant. That allowed an intense collaboration between the students groups and co-creation between the students, the project partner and IPEK.

As an innovation project, ProVIL supported a master course of mechanical engineering. Additionally, IPEK and its partners use ProVIL as a yearly research platform, which is used for the investigation of new methods and process with virtual teams in the field of new product development.

Process Main Stages

STAGE 1 – RESEARCH
In the research stage the students acquired market and technology knowledge in so-called research fields. The research fields were predefined by IPEK and Porsche to ensure relevance for the project.

STAGE 2 – DEFINITION
In this stage the students conducted customer interviews and defined a desirable customer and producer value by defining product profiles. A commonly conducted online survey with international participants helped to evaluate these product profiles.

STAGE 3 – IDEATION
Based on this, the students created product ideas, which presented technical solutions meeting the aspects from the product profiles.

STAGE 4 – SOLUTIONS
In the last stage, all teams generated product concepts. They used virtual mock-ups on mobile tablets to allow for experiencing the later products (digital services) from a customer's perspective. After every phase, all participants met for a milestone. The students presented their results and all partners discussed together the development focus, the timeline and the next steps for each team.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – PROVIL INNOVATION PLATFORM
The main touchpoint in ProVIL is the innovation platform, which is used for collaboration and co-creation. Possible bottlenecks can occur here if the project process is not visualized in a detailed but still simple way.

TOUCHPOINT 2 – FACE-TO-FACE MEETINGS
Further touchpoints are the project kickoff and milestones where all project actors regularly meet as well as customer contact during the interviews in phase 2.

TOUCHPOINT 3 – EXTERNAL PRESENTATIONS
The most visible touchpoint to external parties is the project closeout where students pitch their concepts and present it at booths. For the project closeout, IPEK invites usually between 150 – 250 people from different enterprises.

Success Factors / Barriers

The main success factors of ProVIL are the motivation of the students and a trustful relationship between all parties. To motivate students it is essential that the project partner coming from the industry presents itself in an attractive way and brings in a challenging task assignment as well as regular support and appreciation for the performance of the students. For example, it helps a lot if the project partner defines a colleague per team to function as a contact person, supporter and motivator.

As the majority of the activities within ProVIL are conducted online within virtual team, it is of great importance that people have the chance to get to know each other better (face-to-face) at the project kickoff and in the milestone meetings.

Additionally, all task descriptions should be very clear and transparent, as people do not have the chance to clarify problems of understanding as in the case of collocated teams.

To improve the development process itself the students from industrial engineering functioned as innovation coaches. In this role they accompanied the students teams from a methodical and process oriented point of view and provided early feedback about the quality of deliverables before the milestones.

Conclusion

To ensure project success it is helpful to acquire highly motivated and excellent students. As virtual student teams cannot solve any product development challenge, it is helpful to arrange for early workshops between the institute and the project partner to define the product development challenge precisely and to harmonize the expected outcome with the student's competence. From the institute's side it is necessary to find a good balance between guiding the students and allowing them for free thinking which often turns out to be a consideration between systematic approaches and creative development. The most important aspect is to avoid anything, which could undermine the student's motivation.

Due to the great project success and very positive feedback from the students as well as from Porsche IPEK will include ProVIL as practical course into the regular curriculum that it can be offered on a yearly basis with changing project partner. The ProVIL concept is defined broad enough to allow for adaption to other fields of engineering as well as to other universities.

DO
- Acquire highly motivated students
- Organize workshops between the institute and the project partner early on.
- From the institute side, find a good balanced approach between guidance and creativity.

DON'T
- Do anything that could undermine students' motivation

Dual-Desk PhD researchers

An open innovation approach implemented between KU Leuven and Siemens Industry Software

INTER-SECTORAL STAFF MOBILITY

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Main actors

- KU Leuven hosting research group (main professor and peer-researchers)
- Siemens Industry Software research group (main supervisor and peer-researchers)
- KU Leuven and SISW administrative and legal support
- KU Leuven Arenberg Doctoral School
- PhD researcher in question

To boost realization of Siemens Industry Software's and KU Leuven's complementary ambitions to advance, respectively, the industrial state-of-the-use and scientific state-of-the-art in mechanic and mechatronic system design and analysis, both organizations co-developed a concept they label "Dual Desk PhD".

A steering team, composed out of the corporate RTD Director of Siemens and the head of the KU Leuven Noise and Vibration research group, discuss on a regular basis cross-fertilization opportunities between the industrial product and service roadmap and the academic research roadmap. After identifying such opportunities, it is investigated if it makes sense to recruit/host a co-supervised researcher to develop the opportunity towards PhD-level scientific innovation with an industrial valorization target. Once the research objectives are defined and funding is agreed, an appropriate candidate is selected from within either organization or recruited as new researcher. The process is strongly enabled by dedicated industry-university funding schemes such as VLAIO Baekeland (Flanders) and H2020 Marie Sklodowska Curie Industrial Doctorates, but can also take the form of a bilateral PhD programme.

The researcher has two desks, one at KU Leuven and one at Siemens and divides his/her time between both, hence benefitting from being submerged in an academically inspiring environment, while at the same time gaining experience on what it means to bring innovation into an industrial context. The researcher can fall back on the fundamental knowledge base of KU Leuven while he/she can at the same time be challenged by full-scale industrial application studies with end-users through the network of Siemens Industry Software.

Over the past years, several such Dual Desk PhD's have successfully defended their degree and are now continuing their career at KU Leuven, Siemens and other organizations worldwide. KU Leuven and Siemens Industry Software highly appreciate the scheme and are continuously updating and further improving it learning from do's and don'ts experienced, expanding lessons learned to and streamlining processes in legal, financial and doctoral school administrations.

Process Main Stages

STAGE 1 – IDENTIFICATION OF A RESEARCH TOPIC
Identification of a suitable research topic based on roadmap cross-fertilization analysis and agreement on the corresponding funding scheme to be used.

STAGE 2 – PHD CANDIDATE SELECTION
Selection of a suitable PhD candidate (internal or external recruitment)

STAGE 3 – BUILDING A SOCIAL NETWORK
The first 3 months of the PhD are crucial as during this start-up phase, the researcher should get embedded in both the academic and industry environment and build up a social network with his/her peers.

STAGE 4 – MONITORING AND STEERING RESEARCH
Monitoring the progress and steering the research during the main part of the PhD research execution by the joint supervision team.

STAGE 5 – PHD DEFENSE
Wrap up of the work and defense of the PhD. During this phase, both the academic and industrial output KPI's need to be respected.

STAGE 6 – EVALUATION
After completion of the PhD, an important phase is the evaluation of the whole process by the steering group to update and improve the process based on lessons learned.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – MEETINGS OF JOINT RESEARCH INTEREST
Periodic roadmap exchange meetings to identify topics of joint research interest (at least yearly). Identifying where academic research tracks and industrial needs meet is the starting point for a joint endeavor. This exchange takes the form of a workshop chaired by the steering team and involving the senior researchers of both parties.

TOUCHPOINT 2 – PERIODIC SYNCHRONISATION MEETINGS WITH STEERING TEAM MEMBERS
Periodic synchronization meetings between the steering team members to review the global process and the set of joint projects and programs:(at least bi-monthly). This allows to assess the overall process as well as the global status of the individual research tracks. It is important to timely identify problems with any of the researchers, their supervision, the operational circumstances or practical needs, financing etc. Where needed, extra individual progress meetings can be scheduled.

TOUCHPOINT 3 – REGULAR PROGRESS MEETINGS WITH SUPERVISORS
Per Dual Desk PhD hold regular progress meetings where both supervisors are present. This allows to assess progress according to each party's priorities, update the work plan, confirm next period targets and solve any operational issue of joint relevance (test setups, use cases, investments, research visits, publications, IP, …). Where identified by the Synchronization meeting, additional ad-hoc progress meetings can be scheduled.

Success Factors / Barriers

Success factors driving the growing interest of both KU Leuven and Siemens Industry Software in the Dual Desk PhD scheme are a clear win-win leverage between scientific research advancement and industrial product and process innovation. The combination of academic research being pushed and inspired by industrial problem statements and industrial products and processes being fed with unique and truly revolutionary technologies yields extremely interesting and attractive PhD projects. Key requirement here is the open mindset and attitude of the members of the steering group, respecting each other's organization DNA and KPI's. The fact that logistically and culturally the barriers between both organizations are rather low, also contributes to the success of the scheme.

Typical barriers hindering Dual Desk PhD schemes are dual in nature. First of all, ownership and access rights to results achieved are subject to often tedious discussions with legal departments, yet, based on a level of mutual trust built up and past success stories which are used as template model, a good understanding continuously grows and substantially lowers this barrier. Secondly, the alignment of formal procedures at both organization administrations takes time and needs to be monitored and iterated on the fly.

Conclusion

Overall, KU Leuven and Siemens Industry Software are very positive about the Dual Desk PhD scheme, realizing that the success of the programme is strongly driven by the long history of joined research and cooperation, by the willingness to work together on key technologies and by the fact that the steering group members are both missionaries of the scheme within their organizations.

DO
- Respect each other's DNA and KPI's
- Be sufficiently transparent and open on roadmap cross-fertilization

DON'T
- Be afraid to attempt new HR and administrative routes within your organization
- Follow the temptation of profile dilution
- Forget that the project is a PhD project, needing to advance the international state-of-the-art
- Forget that the project is driven also by an industrial need, requiring to assess the added value for industrial challenges
- Go for short term success; PhD research is by definition a mid-term activity

New equipment to Collect Recycling Bins

Collaboration to develop a more efficient, robust mobile equipment to collect bins

UNIVERSITY KNOWLEDGE TRANSFER

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Main actors

- UPC Technology Center, CIT UPC: commercial interface between the company and the research group.
- Industrial Equipment Design Center (CDEI UPC): the research team actually transferring the knowledge to the company.
- PALVI, S.L: company hiring CIT UPC to solve the technical challenge.

The UPC Technology Center (CIT UPC) and its industrial Equipment Design Centre (CDEI UPC) have worked with the company PALVI, S.L to develop new equipment for collecting recycling bins. The result greatly improves efficacy and cuts the cost of the recycling process.

The mechanical arm in this system has hydraulic axes and can move to either side of the vehicle. It improves efficiency and cuts the time required to collect this kind of containers. Using the old system, operators took between 4 and 5 minutes to complete the collection cycle for each container. Now, this time is reduced to one minute, partly due to the fact that the computer vision system can be used to accurately calculate the path to the container and memorize the movement to put the bin back in the right place once it has been emptied.

The new equipment weighs 20 % less than the old system, which means that less energy is used to transport it. As bins are handled precisely and their path to the lorry calculated accurately, they are moved without being knocked, which extends their useful life.

The technology has led to various patents. It forms part of the DULE system, patented by PALVI, S.L and made up of several pieces of equipment including bins and collection and washing systems.

Process Main Stages

STAGE 1 – IDENTIFYING THE TECHNOLOGY
The first main stage was the identification of the technology needs between PALVI, S.L and CIT UPC.

STAGE 2 – PARTNERSHIP ACTIVITIES
Then CIT UPC identified the main research group to do R&D to solve the issue. CIT UPC and CDEI UPC worked together to present the budget. With the acceptance of the budget of PALVI, S.L, the starting point in the development was the state of the art and analyzes the conceptual design of the existing mechanism. During the following 2 years, a team of ten people, including company specialists and researchers from the center, have worked on the design and fabrication of the new device. PALVI, S.L. was highly satisfied with the results of the project.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – FIRST FORMAL MEETINGS BETWEEN ACTORS
On the first stages of the project (identification of the challenge, expertise required, budget, negotiation) several appointments were fixed in order to understand the company's environment, to analyze the issue and define the technical expectations.

BOTTLENECK 1 – REGULAR FACE-2-FACE MEETINGS WITH THE PARTNERS
During the execution phase, face-2-face meetings were held every 15 days between both parties.

BOTTLENECK 2 – VIRTUAL AND DIGITAL COMMUNICATION
Regular e-mail and phone communication was also established between the partners during the whole project.

Success Factors / Barriers

The result of the project was an automated mechanical arm designed to be supported on a lorry. It can collect top-loading recycling bins from the ground on both sides of the street, as well as underground containers. The solution delivered provided substantial reduction in time, weight and costs.

The success factors of this project are: track record (historical relationship of the applied research from CDEI UPC into industrial customers) of CDEI working with industrial clients similar to PALVI. Fluent relationship between both parties during the project. Early definition of the collaborative team from both entities and maintain it throughout the project lifecycle (2 years). Early involvement of design aspects (aligned with company's marketing design strategy) into the project development to avoid later disagreements. Detailed project schedule to close monitoring of project development.

Conclusion

On the identification of the challenge, CIT UPC normally analyzes the lead and customizes the presentation and targets the speech for the specific client and its particular field/technology needs. This involves explaining similar use cases that could be relevant in the company identified. Once it is identified the research team and the budget is presented, CIT UPC usually sets as meetings as needed to convince PALVI, S.L of the success on the proposal. In order to ensure the success, the project may be split in different stages with their associated budgets. After the end of each stage both partners agree on the technical expectations of the following stage, facilitating the monitoring of the whole project. The company may do research on the market environment to calculate the increase in sales and estimate the VAN, TIR, PAYBACK of the investment. Both parties shall agree on the economic conditions, lead times and IPR.

To succeed on the implementation of the project the company specialists and researchers from the center should work together on the project from the very beginning. They must share all the expertise, from the staff of PALVI, S.L: knowledge on the old system and from the research team: knowledge on industrial equipment design).

During the execution phase, face-2-face meetings must be scheduled regularly between both parts. Fluent communication and expectations management is key for establishing successful long-term bilateral relationship between the partners.

DO

- Customize your speech and relevant cases for the target company.
- Make sure both partners agree on the technical expectations, economic conditions, lead times and IPR.
- Schedule regular face-2-face meetings between both parties during the execution phase.
- Communicate fluently and especially about expectations for the collaboration.

DON'T

- Do not keep the expertise and knowledge for yourselves (mechanical, industrial equipment design, etc), parties should work together from the beginning and share their experiences.

CH4PA – The multipurpose vehicle for developing countries fueled by biomethane

A frugal innovation for 1,5 billion small farmers to enhance their productivity, meet the raising food demand, save 95% of CO_2 emissions and reduce fuel costs by more than 50%.

COLLABORATIVE R&D PROJECTS

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Main actors

- Innovator and Lead Company: Spirit Design
- Funding: aws, WKO/go International, WAW, FFG
- Development Agency: Austrian Development Agency
- NGO: ICEP
- Universities: Technical University of Vienna, University of Agriculture
- Research Organizations: Virtual Vehicle, China, Brazil: CIBiogas
- SME: Tobias
- Industry: AVL, Voest

Spirit Design developed this market innovation as a concept and a prototype for the CH4PA (chapa = Portuguese for "buddy"). Its name is derived from using biomethane (=CH4) as fuel. This environmentally compatible and affordable multifunctional vehicle increases the productivity of small farmers. The project is a cooperation with many different stakeholders aiming at puting the CH4PA in series production in Brazil.

Process Main Stages

STAGE 1 – IDEA
The idea of developing a vehicle combining a quad and a tractor for small farmers came up after first client projects in the agricultural field. The project OX was born. It was build-up to a design concept and then rested for a while.

STAGE 2 – FEASABILITY AND MARKET RESEARCH
By the means of funded feasibility studies, the OX was taken to the next stage, where the design concept and the technology of CNG (compressed natural gas) were reflected upon. In cooperation with the Technical University of Vienna, it was determined if a CNG engine would work for a tractor. Furthermore, a market research was conducted in China to identify competitors and market potentials. Due to IP issues in China, Brazil was selected as target market. Based on a local study on the needs of the small farmers, the concept evolved from OX to CH4PA.

STAGE 3 – DESIGN DEVELOPMENT AND PROTOTYPE
A crucial part was the raising of the money for the design and prototype development. After organizing the funding provision, a search for partners for the prototype build-up was conducted. The offers of large, well-known companies turned out to be out of reach. But the Virtual Vehicle in Graz aided to find cheaper approaches and by chance an expert in building special cars as well as a SME with a tool shop. There the CH4PA could be built at reasonable costs. Due to the height of the external costs, the Brazilian partner agreed to pay 50% of the IP costs.

STAGE 4 – TESTING AND COMMUNICATION
At this point the testing of the prototype has been started, during which a few necessary improvements and some points for further development were detected. Additionally, increased communication activities took place. Those included a.o. a website, conferences and PR activities in specific media and on television. Finally, the CH4PA was transferred to Brazil for further testing and promotion.

STAGE 5 – COST PLANNING FOR SERIES PROTOTYPES, BUSINESS PLAN
Due to the PR activities, industrial attention and contact to AVLBrazil, who supported the development of a roadmap and supplied fundamental numbers for a business plan, was obtained. This business plan will serve as an acquisition tool for industrial partners as licensees. Concrete negotiations have already started with the company Agrale.

STAGE 6 – INVESTOR AND/OR LICENSE AGREEMENTS WITH INDUSTRY, FOUNDING OF A NEW COMPANY
Currently, a new company specialized in the development of biogas regions is under planning. This company will provide products and services connected to biomethane upgrading in developing countries.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – TECHNOLOGY LEARNING STAGE
Throughout three client projects, first contacts to the field agricultural vehicles were made. The projects gave insight into the strategies of big tractor producers and allowed to set up own know-how. Furthermore, they pointed out the big market segment of small farmers in developing countries that has not yet been targeted by established companies.

TOUCHPOINT 2 – USER NEEDS AND REQUIREMENTS
The nex important touch points were scientific and cluster conferences, where personal contacts to experts of development assistance were built. Those pointed out that the fuel costs (which count up to nearly 50% of small farmers' expenses) are as important as the price of the whole vehicle. This process led to the idea of using biogas as vehicle fuel, which the farmers can produce themselves from agricultural residues.

TOUCHPOINT 3 – PERSONAL CONTACT TO THE BRAZILIAN MANAGER OF ITAIPU
A professor of the University of Agriculture provided the contact to the environmental manager of Itaipu, the world's biggest hydro power plant. which signed a MOU (memorandum of understanding) with Spirit Design to define a long-term cooperative relationship. This cooperation still lasts.

TOUCHPOINT 4 – CONFERENCE ON MOBILITY FROM THE AUTOMOTIVE CLUSTER OF VIENNA
By chance, the acquaintance of Peter Kainz, a former builder of special vehicles, was made during the search for a supporting partner for the prototyping. He introduced Spirit Design to a tractor distributor and service company, which also offers workshops. In this way, the road was prepared for the fastest and cheapest way of the prototype production.

TOUCHPOINT 5 – PERSONAL CONTACT TO A MANAGER OF THE AUTOMOTIVE INDUSTRY
AVL organized the contact between Spirit Design and their Brazilian representative, who became enthusiastic about the project. After the finishing of the prototype, AVL was hired to organize workshops for the development of two series near.

BOTTLENECK 1 – INDUSTRIAL MANAGERS OF THE AUTOMOTIVE INDUSTRY
Though, the contacted industrial managers of the automotive industry were initially interested in the idea, they only saw reasons, why it could not work. Also their market focus was on the big, developed markets instead of poor, small farmers in developing countries, a market segment that - they believed - would disappear in a while.

BOTTLENECK 2 – TRANSATLANTIC BUSINESS AND BUREAUCRACY
The development of the MOU, the transfer of half of the IP rights as well as the technology import were very costly, time consuming and stressful due to the crossing of international boarders, Brazilian bureaucracy and (at the beginning) language barriers.

BOTTLENECK 3 – INTERNAL RESISTANCE
Not everybody working at Spirit Design supported the project from the beginning. Though, funding could cover the direct costs, the risks as well as the opportunity costs seemed to high. Therefore, the development was internally fought instead of backed-up.

Success Factors / Barriers

SUCCESS FACTORS
A clear but also adaptable idea and a well-developed strategy are the basic success factors for the implementation of an innovation. These require money, time and a fitting network. Money was provided by various funding agencies and the Brazilian partner. Know-how was delivered by the partners and from research of the local market. Further important success factors are cost efficiency as well as, entrepreneurship and good communication, which will keep the project successful even in times of profit driven innovation from multinational companies.

BARRIERS
Throughout the project, money stayed the limiting factor of the process. Also, the organizational structure of Spirit Design is unsuited for in-house developments. For the next steps, development of small series prototypes, production and launch, a Brazilian tractor company as license partner and funding from big investors will be needed. Furthermore, building-up of the infrastructure in Brazil with open and reliable partners (research, industry, etc.) that are willing to contribute to the same goal is necessary.

Conclusion

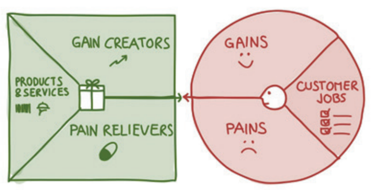
One of the most important parts of a project is the research (about i.a. market, its driving forces, technology, industry, potentials). Hereby, the best approach is to see the target market as a holistic system. The users and their needs play a major role in this system. Therefore, it is of importance to involve them directly and ask the right questions (done by i.a. workshops and feasibility studies) It can also be helpful to show them visual concepts as people have problems to think more abstract. Beside the users, partners are of importance especially ones in other fields, as no one has all the know-how. So while waiting for the right time and instead of being afraid of other people stealing the idea, one should communicate and already build-up the fitting network.

In the beginning, it is also necessary to develop a long-term funding strategy, as it will take time until investors will join. Another lesson learned is that an idea might needs some evolvement before a successful implementation. Therefore one should keep the initial idea flexible and check the strategy carefully. But the most important message is to simply not give up. Even if other experts discourage you. But many people can just not think outside their boxes.

Nanocapsule applications in dermo-cosmetics

Market research as part of the academic course "Strategy Fieldwork"

CO-CREATION



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Main actors

- Students
- University staff
- Client Company

This case study is the course work of a group of four students done as part of a course called "Strategy Fieldwork" at Aalto University, Department of Industrial Engineering and Management. During the course the group did the project in collaboration with a Nordic consulting company to validate nanocapsules as a skin care product in the current Finnish market. The group conducted a market research in the form of a survey to potential customers and produced a report as well as presented it at the end of the course. In the reports, they summarised the results of the market research and provided recommendations and future considerations for their client company. The case fits the Co-creation scheme as it combines the efforts of University, students and Industry to work on new projects. Strategy-orientated projects emphasise the assessment of market potential in relative established settings, while entrepreneurship-orientated projects emphasise identification of customer value with novel products and in new settings.

Process Main Stages

STAGE 1 – COURSE STARTS

The course states its learning outcomes are for the course students will develop skills in the following areas: problem solving, working in groups, writing a business solution report for a company, and presenting ideas and findings in a clear way.

The course starts with lectures to have students informed on the practicalities and expectations of the course. The course instructors also introduce the concepts of qualitative and quantitative interview methods with the expectation that students will use at least one of them. The goal of the course is to conduct a practical project in a group of 3 or 4 students. There were in total four lectures during the first four weeks of the course. The whole course lasts one semester (roughly four months).

STAGE 2 – FORMING GROUPS, FINDING CLIENT

The students were encouraged even before the course started to form groups and start searching for potential client companies. During this stage groups find a company and start communicating to each other their respective expectations on the project in general as well as drafting a project plan. The course instructors also provided guidance sessions at this stage to help the group.

STAGE 3 – WORKING ON THE PROJECT

The group is assigned an opponent group to critically review the assignments (project plan, reports, presentations etc.) they return to the course. The group gets all necessary information from the client company to start mostly working independently on the project. They conduct their work by first reviewing relevant literature in the field of nanocapsule appliances in dermo-cosmetics. Then they decided to conduct preliminary interviews for directional purposes before launching the mass questionnaire to collect both quantitative and qualitative data (232 answers).

STAGE 4 – FINALISING

The group assess their collected data and start working on the report. This is done largely by identifying its different parts and delegating each team member to work on. The different parts include: introduction and background, literature review, the used analytical frameworks, the research strategy, the results from the surveys and conclusions and recommendations. Then combining these together to make a coherent written report. The group also prepares a final presentation to deliver at the end of the course before presenting to their client company.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – ONLINE INTERACTIONS

The first touchpoint is the online workspace website for all university courses at Aalto University (mycourses.aalto.fi) This platform is used to inform all attendees of a course regarding news and where all of the course materials can be found. The website is fairly easy to use and students are highly familiar with it. However, personal guidance for the group is not done very effective through merely the website. The group also maintained communication through digital means by using Whatsapp, Google Drive as well as Google Hangouts. Whatsapp and Google Hangouts were used for direct internal communication through text and audio. A Google Drive was set up to document and manage all the work that was done. The group regularly communicated with their client company via e-mail and phone calls.

TOUCHPOINT 2 – PHYSICAL INTERACTIONS

Physical interactions with the course included four lectures, multiple guidance sessions (minimum of three per group over the duration of the course) and one mandatory seminar attendance for each group. Lectures held by course instructors worked as a way to inform in a direct manner regarding what the course demands as well as teach aspects of conducting market research to all course students. Lectures did not require mandatory attendance and students were not motivated enough to attend all lectures. This prompts the question whether the lectures were necessary at all. Guidance sessions were highly effective with groups receiving direct feedback for their work by the course instructors in a one-on-one setting. During seminars groups delivered their final presentations to the rest of the students and received feedback from a chosen opponent group.

The group held weekly meetings to review their own work and define the next steps in their project. The frequent meetings were largely helpful, however due to different time schedules they were difficult to plan. The group set up physical meetings with their contact person from the client company to discuss issues regarding the project at the company office. The group also maintained communication through digital means by using Whatsapp, Google Drive as well as Google Hangouts. Whatsapp and Google Hangouts were used for direct internal communication through text and audio. A Google Drive was set up to document and manage all the work that was done. The group regularly communicated with their client company via e-mail and phone calls.

Success Factors / Barriers

The success factors for this case study were the availability of both course staff and contact person at the client company to assist students out with needs at the beginning of the project. Their help was crucial in the making of the final report and having results that were actually impactful. The group of four students already knew each other from the same major programme at the university. This proved to be beneficial as they were used to working with each other. Getting over 200 survey answers was quite high for the relative scarce resources they were working with.

The group noted that information regarding the project from the company sometimes came slow. This was due to confidentiality issues that had to be solved beforehand. These could have dragged on and affected the project results negatively, as the group was trying to meet course deadlines before getting the necessary background information from the company. At first finding the client company, for whom they conducted a practical project for, was rather difficult. They could have started working a project sooner had they found one before the eventual one.

Conclusion

These kind of projects should be done in a group of three to five. That way the team stays well glued together while having the benefits of being able to exchange opinions. On another hand, working with a real company on a concrete issue is very helpful for learning actual applicable skills stated in the course's learning outcomes. Letting students find a client themselves is a very good way to practice communication in the business world. This can be a quite valuable leaning experience. Personal guidance sessions are very effective in setting direction when students have relative little experience working in a similar environment. Also, set deadlines help guide the work forward. This means having a project plan ready then a first and second draft of the project report and finally the final report delivered.

On the contrary, for the success of these type of project, the university should not give lectures to frequently, the idea is to something practical, by giving lectures valuable time is taken from students to focus on the actual work.

The client company provided feedback from their side in the form of a signed statement. However, more thorough follow-up on the implantation of the students' recommendations was not conducted. Thus the actual effectiveness of the project is actually difficult to track.

DO

- Arrange student groups of 3-5 members
- Arrange personal guiding sessions
- Set deadlines and have a project plan in advance
- Let students find a client themselves.

DON'T

- Give lectures too frequently

PAE course – Applied Engineering Project

A university course where students are introduced to innovation in business, Agile and LEAN principles through the development of an applied engineering project motivated by companies' technical challenges.

CO-LOCATION

Contact

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Main actors

- UPC – Universitat Politècnica de Catalunya
- Undergraduate students from Computer Science School
- Companies (i.e. CA Technologies)

PAE is an optional course of the Computer Science Bachelor at the Universitat Politècnica de Catalunya (UPC) with two main objectives: training students to build their own solutions to real industrial/societal challenges, and narrowing the gap between industry and students.
Students improve their soft-skills, technological stack and business vision through the development of an innovative project in close collaboration with a co-located company. To foster entrepreneurship, companies act as consumers of the solution, providing regular feedback and helping them to shape their proposal with a business-oriented vision.

Process Main Stages

STAGE 1 – TEAM FORMATION
In the team formation stage, the companies independently decide which problem will be proposed to PAE's students. During the first class of PAE, companies introduce their businesses and explained their industrial/societal challenges. Students then choose the project in which they would like to participate per their own motivations and interests. At the end of the second week, students and companies are already paired and then they can proceed with the project definition and execution.

STAGE 2 – PROJECT IDEATION AND IMPLEMENTATION
The project ideation and implementation stage comprise several regular face-2-face meetings between students and the company they chose in stage 1. During the first meetings, students and companies may reshape their projects to better-fit students and business goals, as well as set a preliminary, reasonable roadmap of implementation. Once the project is coined, team members are free to organize work among themselves. Besides, periodical meetings are scheduled so students would get constant feedback from the company and coaching on how to add business value to their proposals.

Parallel to the students-company meetings, PAE's teachers help the students to define their solution, roadmap and find the most optimal technical stack for its implementation.

STAGE 3 – EVALUATION
During the last week of PAE, an evaluation of all the projects is conducted. Students show their solution and business proposal to the rest of the classroom and companies' representatives. Students are mainly assessed on this presentation, and not only based on the quality and maturity of the solution. Hence, PAE's students are expected to show a clear alignment of the solution and the industrial problem, as well as provide a business vision. The results of PAE's projects may be exploited and disseminated by both companies and students.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – FACE2FACE MEETINGS DUE TO CO-LOCATION
The main touch point of PAE are the regular face-2-face meetings between companies and the students. Every two weeks, students visit the company office and discuss about the status of the project. As mandated by Agile and LEAN principles, these meetings have also the purpose of evaluating the progress, providing feedback from customers, prioritizing the work to be done in the following two weeks, and reshaping the project's scope or ambition if necessary.

Thanks to the co-location of the company research team in the University, informal meetings may occur any time during the project execution, which reinforce communication and facilitate the removal of project's roadblocks. Students feel more integrated in the business world and company culture.

There are only two plenary meetings in which all stakeholders are present: the kickoff meeting and the closure of PAE. Nevertheless, interaction between industrial stakeholders is minimal. During the kickoff meeting, companies present their problems to the students, and they choose the project in which they want to participate. In the closure of PAE, the students present their projects and solutions, whereas companies act as spectators that might give feedback to any project.

During PAE, teams may meet with PAE's teacher to ask for technical assistance. During the first weeks of PAE these meetings are mandatory to provide an initial guidance, but it is expected that guidance is reduced as the project progresses.

Success Factors / Barriers

SUCCESS FACTORS
The main success factors of PAE are the motivation of the students, a trustful relationship between students and company's representatives, and a continuous coaching from PAE's teachers and companies driven by the co-location of companies in the university.

From the company side, it is important to align the outcomes of the students' project with their business goals. In general, companies use this opportunity for validating early-stage ideas or assessing viability of the project.

BARRIERS
As for the barriers, students may feel overwhelmed with the definition of the project as companies propose problems not broadly discussed in the academia, but the continuous collaboration help in shaping the project to satisfy stakeholders' goals. Besides, PAE is conducted in combination with other subjects of the Computer Science Bachelor and, hence, time is very limited and efforts are significantly impacted by student's motivation.

Conclusion

We have run PAE during the first quarter of the academic year 2016 – 2017, and the feedback provided by the students highlighted the lessons learnt thanks to the close collaboration with companies, especially in the case of CA Technolgies, co-located in UPC. In particular, students appreciated learning how to collaborate in a business environment and not only in new technological stack. Besides, all students commented that they felt they produced an outcome useful for the company. Unfortunately, one of the teams felt a bit alone as the people chosen by the company to interact with them did not have enough technological knowledge in the topic.

DO
- Project must attract students' attention and be aligned to business and societal needs.
- The project scope must be feasible for undergraduate students and doable during its limited time.
- Project scope should be broad enough to give students space for shaping the project to their own objectives and interests.
- Companies must choose representatives motivated by the subject and project scope, with interest in coaching students.
- Foster innovation and leadership among students by providing them with minimal technical guidance.
- Companies should commit to PAE and be reachable to students.

DON'T
- Don't leave students alone.
- Don't make a very generic project proposal, as students may feel overwhelmed by the uncertainty and the broad spectrum of possibilities.
- Don't use students as an extra resource of the company.

Nimble Bee: the co-creating community

Assistance in solving R&D design challenges with an international community of young potentials.

CO-CREATION

Contact

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Main actors

- Universities (Professors and students)
- Sponsor
- Customers
- Toluna (Consumer panel)
- CogniStreamer (Nimble Bee host)

The Nimble Bee project is an example of co-creation on multiple levels. First of all, the students work on a design challenge of a sponsor. The sponsor gives feedback on the designs and the students should take this into account when refining for the submission deadline at the end of the first round. The co-creation occurs also during the second round: the consumer feedback round. The consumers tell the students what they like/dislike or how the design can be improved. After that, students can ask questions to the consumers during a Q&A-session. With this information, together with the sponsor's jury feedback, they can redesign their idea for the final submission deadline. So for this consumer phase, there is a cooperation with end-users. The overall objectives are different according to the actors.

- The universities get the chance to work on a real case from an existing company. They gather real life experience with feedback from international companies and end-users.
- For the sponsor, the objective is to get a load of new, fresh ideas from different parts of the world, in a fast, efficient and effective way.
- For CogniStreamer, Nimble Bee profiles us as an experienced provider in design crowdsourcing and facilitates a fully managed co-creation program.

Process Main Stages

STAGE 1 – ONBOARDING

The search for participating schools starts, once a brief abstract of the challenge is drawn up. An email is sent out to a list of global universities, followed by personal calls to the respective professors. The professors decide whether the challenge fits their curriculum or not and if the timeline matches the duration of the semester. When they decide to participate in the competition, we ask them to send a list of the participating students. With these data, we can make every student a profile on the platform. Once the private drawing boards and the official challenge are ready and the full brief is on the platform, we can send out an invitation to the participating students.

STAGE 2 – STUDENT IDEATION

The students receive an invite to the platform. There, they can read the full brief of the challenge. To be able to read the full brief, the students have to sign the Terms & Conditions via a click-wrap agreement on the login page of the portal. It might happen that not everything is clear to them. Therefore, we host a webinar (about two weeks after the launch of the competition). During the webinar, the sponsor explains the challenge and the students get the opportunity to ask questions they might have. After that the Nimble Bee consultants explain the Nimble Bee process. Then the students can start the ideation process. They can work individually or in group on their designs.

STAGE 3 – IDEA REFINEMENT

Halfway through the first round, the students can upload their designs in the 'Private Drawing Board' of their school. They get feedback from the sponsor on the 'Deadline for Feedback' and can redesign their idea if necessary. On the 'Final Submission Deadline for Ideas', the students need to submit their final designs in the 'Official Challenge' on the platform. The company jury of the sponsor reviews every design based on a few criteria and decides which designs go to the second round. (The second round is only for the finalists)

STAGE 4: CONSUMER FEEDBACK ROUND

The designs which were chosen as finalists (usually 10 designs) get the chance to present their ideas to a consumer panel. The consumers comment on the ideas and tell the designers what they like/dislike about the designs. In a second phase, the students can start the conversation and ask the consumers questions about the designs or specific habits regarding the product they are designing. During the feedback round, the students also get feedback from the sponsor's jury at the end of stage 3. With this information, they can redesign their idea which they have to submit on the 'Final Design Submission Deadline for Finalists'.

STAGE 5: WINNER SELECTION

The 10 final designs get reviewed once more by the company jury of the sponsor. The jury chooses the three winning designs and the Nimble Bee team makes the announcement to the professors and the students. After that, we start the communication for the certificates of participation and the administration to pay the prize money.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – SPONSOR MEETINGS WITH STUDENTS

The sponsor has a few meetings with the Nimble Bee consultants. During these meetings, a brief abstract is drawn up and the elements for the full brief are discussed. Once the competition has started, the sponsor needs to prepare a presentation for the webinar. During this online meeting, CogniStreamer and the sponsor explain the process and the full brief in detail. After the presentation, the students get the chance to ask questions. Another touchpoint is when the deadline for feedback is reached. The sponsor takes a look at the designs in the private drawing boards of the school and gives feedback on the. Once the final submissions are in, the jury team of the sponsor reviews the designs and selects the 10 best ideas. They also pick the 3 winning designs.

TOUCHPOINT 2 – MAILINGS TO PROFESSORS

The professors are approached via an email with a link to the brief abstract. If they are interested in the competition they receive more information about the competition, timeline, challenge, etc. To be able to make a profile for the students on the platform, CogniStreamer needs to receive a list with the names and email addresses of the participating students. The Nimble Bee consultants communicate the date of the Webinar to the professors. They decide if they join the online meeting with the class or if the students join individually. After that, the professors are kept informed of the finalist and winner announcement via an email.

TOUCHPOINT 3 – MAILINGS TO STUDENTS

The Nimble Bee experience starts for the students with an invitation to the platform. The students receive their username and password via email and with this data they can log in on the Nimble Bee platform. During the competition they get emails when a milestone is getting closer. The students get the chance to ask their questions directly to the sponsor during a webinar. They also receive emails with the announcement of the finalists and the winners. In addition, the students are approached via several posts on social media. Once the winners are known, the students receive an email with a link to request a certificate. The Nimble Bee consultants create a personal certificate for every participant and send it to the student via email. The winners also need to sign documents via email to receive their prize money.

TOUCHPOINT 4 – CONSUMERS ON THE NIMBLE BEE PLATFORM

The Nimble Bee consultants work with Toluna to find suitable consumers that meet the target group. These consumers receive an invitation to the platform with their username and password and an explanation of what is expected from them. They can comment on the ideas via the comment function on the platform and answer questions of designers in the Q&A section. Once the finalists upload their final design, the consumers give one more time feedback.

Success Factors / Barriers

SUCCESS FACTORS

One of the success factors is the fact that it is held online. This implies that students from all over the world can participate in the competition. Which means that the sponsor gets different visions from different parts of the world. Another success factor is the online iteration between the students and the sponsor. For the students it is educative to work with/for a big company. For the company it might be refreshing to see all the innovative ideas of the students. Besides the feedback from the sponsor, the student also gets consumer feedback. During the second round, the consumers will comment on the designs of the finalists. The consumers tell the designer what they like/dislike and how the design might be improved. After the comments, the students can ask questions.

BARRIERS

A first barrier is definitely the embedment into the curriculum. The Nimble Bee team decided that the competition should be embedded into the curriculum and that the professor should be a mentor who guides the students. This leads to more qualitative designs. Because of this, it is hard to engage the universities to join in our Nimble Bee competition. The standard legal framework which is the same for all schools, may also be a barrier. This implies that we can not allow adjustments for specific schools.

Conclusion

DO

- Keep the brief as wide as possible
- The sponsor provides enough context to the students and that the framework within which the design should function is outlined well
- Create a visual platform
- Have good communication and moderation

DON'T

- Send out 1 bulk email to the universities
- Change the competition model and the timeline Ad Hoc
- Put too much effort in small groups
- Give people too much information (it can lead to uncertainties)

MO.Point

Mobility services in front of the door

COLLABORATIVE R&D PROJECTS

Contact

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Main actors

- Spirit Design Innovation and Brand GmbH
- raum & kommunikation GmbH
- private Co-founders

This case study represents collaborative innovation best, because from the first ideas untill the foundation of a company, best know practices were used. The results led to the foundation of the company MO.Point. During the applied R&D project, phases of open innovation were combined with cocreation and closed innovation. Any research only creates value, if it solves a real-life problem. This implies, that the quality of the R&D can only measured afterwards, when the research results were transferred and applied to the market. This is, why the use case of MO.Point is worth a best practice case study: The company is planning and operating Mobility Points in buildings and city districts. Residents can rent a wide range of eco-friendly sharing-vehicles such as e-bikes, electric cars or electric cargo-bikes at convenient prices. The vehicles and supplementary services are easily accessible just around the corner and can be used around the clock. The appropriate vehicle can be reserved via app or website. Users have access to the vehicles during the booking period with their digital access card and can lock and unlock the vehicles. The billing of the consumed journeys takes place at the end of the month. Project developers, cities, municipalities and companies benefit from a customized mobility solution, which MO.Point implements as one-stop shop with selected partners. The local mobility services add value to real estates.

Process Main Stages

STAGE 1 – RESEARCH PROJECT WOMO – WOHNEN UND MOBILITÄT

The companies raum & kommunikation GmbH and Spirit Design GmbH got to know each other, wrote a proposal and applied for a grant on the topics of mobility and housing. The proposal was successful and the project was funded by the Austrian Ministry of Transport, Innovation and Technology (BmVIT) in the scheme "mobility of the future" The companies carried out the project and investigated how to integrate smart mobility services into the planning and construction process of housing. (see: http://www2.ffg.at/verkehr/projekte.php?id=1154) During the project, a multi-stakeholder process was conducted, including representatives of municipalities, urban planning, real estate developer, mobility service operator and end consumer. Visualizations of the project results were very helpful to develop a common vision and share the ideas.

STAGE 2 – INCUBATION PHASE

Due to the huge interests of the stakeholder, especially besides real estate developer, the cooperation partner decided to bring the ideas, that were developed in the research project, to the market. In 2015, the companies led preliminary talks with organisations interested in realization of local mobility services. The offer "mobility point" was developed. The consortium decided to hive the project and fund a spin off. During this process, main persons involved remained the same and even decided to engage personally in the spin-off. The consortium got another grant offered by Austrian Wirtschafts-services. Within this project, the consortium developed a business plan, a clear offer for the market. In parallel talks on the realisation of a first pilot project were conducted.

STAGE 3 – START-UP AND PROTOTYPE PLANNING

Subsequently to the previous phase the transformation from a project organization to a separated organizational entity took place. Design thinking eased the establishment of an own corporate identity. During this stage, the team defined a steering committee and an operational team, and distributed roles and duties. Besides the corporate design, legal and financial issues played a major role. Processes and tools, needed to start the prototype were developed. Pre-contracts with supplier were arranged. Over all, the contract for the first pilot project was negotiated and budgeting was done.

STAGE 4 – FOUNDATION OF THE COMPANY

MO.Point Mobilitätsservices GmbH was founded in May 2016. Since June 2016, the company has been operating the first pilot project at the residential building Perfektastraße 58, 1230 Vienna. MO.Point was awarded the VCÖ mobility prize Austria 2016 for this pilot project, and attracted attention. (see: https://www.vcoe.at/projekte/vcoe-mobilitaetspreis). In 2016 MO.Point started to generate revenues and was alredy contracted by real estate developers to plan additional mobility points in Vienna. The realisation of further sites in the bigger cities in Austria and Germany is planned.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – STEERING-COMMITTEE MEETINGS

At the beginning of the research project, the project organization, timing, roles and duties were defined. In the steering-committee the manager of the co-operating organizations were present and responsible for strategic decisions.

TOUCHPOINT 2 – TEAM MEETINGS

Team meetings involved 3-6 persons, that elaborated the project content. Amongst them, two project leader were defined, that cared for operational decisions and managed the project on a weekly basis.

TOUCHPOINT 3 – JOUR-FIX MEETINGS

Once the project organization was defined, regular jour-fix meetings helped to structure the project. At the beginning the meetings took place on a monthly basis. Later at a weekly basis. Important was, that the two project leaders were present.

TOUCHPOINT 4 – INTERNAL WORKSHOPS

Selected members amongst the team prepared the workshops and set the agenda. At workshops, it was important that the needed knowledge was represented.

TOUCHPOINT 5 – FTP-SERVER, WIKI, E-MAIL

It was intended to establish a structured knowledge exchange and knowledge management. Although diverse tools such as a wiki and a FTP-server was provided, most information exchange happened spontaneously via E-Mail or telephone.

TOUCHPOINT 6 – STAKEHOLDER-WORKSHOP

One stakeholder workshop was held, where selected experts were invited. The exclusive format led to a strong interest besides all participants. The workshop was announced 2 months earlier, and participants were selected carefully.

TOUCHPOINT 7 – FOCUS GROUPS

As soon as the team came up with solutions, these were visualized and presented to selected people, representing end user. The solutions were discussed in the setting of focus groups. Independent of the setting we recommend in any case to involve user in the project!

Success Factors / Barriers

SUCCESS FACTORS

The success factors of the project were, that the consortium was kept small from the beginning. This is why is was lean and efficient to manage. Processes and knowledge exchange was direct, effective and quick between the two companies. Concerning the competences, the project team had a diverse knowledge background (e.g. urban planning, innovation management, design, mobility, …), but diversity amongst the team members was not to huge. An important factor during the forming of the project team and even more important for the spin-off was the development of a common vision with all founders. Design thinking and visualization facilitated this process. Important was a multi-stakeholder approach in the early stages of the project; but also a small, closed-innovation approach in the elaboration of solutions. We can recommend a short time to market, to test the solution as early as possible (it could even be shorter!). Helpful was the integration of end-consumers (via focus groups) in this process. Essential was the early spin-off and the foundation of a completely separated organizational entity. In this context it is important, to keep the team tight and do not exchange team members, if the team once works fine.

BARRIERS

Of course, resources were limited during the start-up phase. Although limited resources are helpful to keep projects lean and effective, the search for funding can be time-consuming and slow the processes. Another issue was, that the consortium did not cover all knowledge, especially IT competences. We recommend to thoroughly check the needed competences with those available and cover missing ones.

Conclusion

DO

Form a small team or project consortium. Tackle a real-life problem, instead of writing project proposals according to calls. A diverse team that covers all competences needed is necessary. It is essential to development of a common vision amongst all stakeholders. Therfor design thinking and visualization is a facilitator. A combination of open-innovation in the idea generation phases, followed by close-innovation, for the elaboration is recommended. Most important is to test, as soon as solutions have been elaborated. Once, the team performs, do not change it and let it form a separated organizational unit.

DON'T

Avoid complex consortia, that do not share a common vision. Do not develop projects for the sake of a research call and don't lose the contact to real-life problems.

Braingaze – Measuring cognitive processing using eye-tracker technology

From scientific research to a startup

UNIVERSITY KNOWLEDGE TRANSFER

Contact

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Main actors

- University and the Office of Technology Transfer
- Entrepreneurs
- External experts
- Children suffering from ADHD and their parents
- Investors
- People concerned who participated in crowd-funding

The Braingaze case exemplifies a very effective way to get innovation (new technologies) to the market by creating a science-based market oriented startup. In his research, a neurobiologist discovered a technique that could potentially enable the diagnosis of ADHD using existing eye-tracking devices. He tested this new technology, named mind-tracking, and validated its effectiveness with psychiatrists (who are the potential end-users of the solution). The scientist contacted a business expert, and together they co-founded the spin-off company. The approach followed to get this new technology to the market was to create a startup. Several parties were involved in this process, including researchers, psychiatrists, investors, patent attorneys and the Office of Technology Transfer.

After 1,5 years of business feasibility analysis and tech transfer negotiations, Braingaze was formed with the aim of commercialize eye-tracking technology to health care professionals. The first commercial application of the Braingaze technology is a solution to diagnose ADHD in children.

Process Main Stages

STAGE 1 – RESEARCH
In the research stage, scientists discovered and developed a new technology with potential for commercialization.

STAGE 2 – VALIDATION
In the validation stage, scientists validated the feasibility of the commercialization of the new technology with end users (psychiatrists).

STAGE 3 – KNOWLEDGE TRANSFER AND PATENT
In the knowledge transfer stage, scientists contacted with Bosch i Gimpera Foundation to get the technology generated at the University of Barcelona to the market. Also, patent for the mind tracking technology was filed.

STAGE 4 – CREATION OF THE STARTUP AND DEVELOPMENT OF MINIMAL VIABLE PRODUCT (MVP)
In the creation of the startup stage, both partners registered the company and proceeded to attract investors to raise funds. Braingaze went through two crowd-funding campaigns using an online platform and personal network.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – CREATION OF THE COMPANY AND INITIAL FUNDING
This touchpoint involved mainly scientists and investors. The interactions included face-to-face meetings, entrepreneur presentations (competitions), and an online platform for crowd-funding. It is critical to have a well-elaborate plan to attract investors. Also, this process would be more efficient if investors were more clear and transparent about their interests, investment timing preferences and revenue expectations.

TOUCHPOINT 2 – TECH TRANSFER NEGOTIATION
This touchpoint involved scientists, the Office of Technology Transfer, lawyers and investors. This is a critical touchpoint because there are a lot of parties involved and no standard procedures exist which tends to drag out proposal - response cycles especially involving also lawyers on both sides.

TOUCHPOINT 3 – BUSINESS-RELATED DOCUMENTS
These documents (the typical pitch deck presented to potential investors) hardly ever convey all the information that the entrepreneurs would like to transmit, nor does it contain all the information that an investor needs to digest in order to shape a good opinion on the fit of the proposed investment in the strategic investment scope of the fund (or the investor itself). Possible a multi-layered and structured approach of slide decks covering various aspects of an investment opportunity could reduce the mismatch between information offered and information sought.

TOUCHPOINT 4 – INTERACTION WITH POTENTIAL USERS
This touchpoint involved scientists, investors and psychiatrists (potential users). This interaction was very difficult due to the limited availability of medical doctors who need to carve out time of their very busy schedules to discuss innovations. This is something that could be improved by building a network including healthcare professionals, investors, scientists and universities.

Success Factors / Barriers

SUCCESS FACTORS
A main milestone for Braingaze is the development and market-launch of its first new product: the ADHD diagnosis test for children. The success factor behind this key milestone was a clear and stringent focus on getting the first feasible application of the technology really market ready, rather than exploring a lot of different potential applications but not pushing any single one of them actually into a marketplace. Another success factor was the collaboration between the scientist and the entrepreneur due to their complementary knowledge and experience in their respective fields.

BARRIERS
The main barrier in the very initial stages was the lengthy negotiation process with the Office of Technology Transfer. The negotiations to commercially exploit scientific research are not yet fully standardized, and thus, they take a long time. This was an important issue because the negotiations needed to be done before the patent could be expanded to the quite costly phase where it goes from a single (PCT or national) application to a world patent applied for in a large amount of countries (which must be initiated and paid for within 30 months after regional patent application).

At a later stage, another barrier is the tight agenda of potential customers, in this case medical doctors; since they have very little time to participate in the development and testing of new technologies, actual deep dialogue with future clients is not easy to accomplish, something that add risk to the product development process.

Regarding funding, it is worth mentioning that raising money from private investors (business angels, formal VC's or crowd-funding platforms) takes a lot of hard work. The quite innovative approach taken by Braingaze in successfully completing two crowd-funding rounds has definitely helped them to cross the typical valley of death that occurs between the lab-scale "proof of principle" and getting into the actual market.

Conclusion

Creating a science-oriented startup can be a very effective method to get science and technology innovation to the market. In this process, it is important to study business feasibility and market to make sure that the new technology can be successfully commercialized. It is recommended to remain in the research stage as long as possible and create the startup once there is a well-developed plan. To create the startup it is worthwhile to consider crowd-funding besides other types of funding. Crowd-funding allows potential users to invest in getting innovation to the market. To some extent, crowd-funding platforms are a tool to allow society to get involved in this process, and decide which technology/science innovations they want to see in their lives.

DO

- Keep research (academia) profile as long as possible.
- Standardize template for technology transfer deals.
- Have conversations with end users early on in the process and find out whether they would be willing to pay for the technology-derived product.
- Explore different business scenarios thoroughly.

DON'T

- Create a startup to soon. Wait until having created a product with what you can have leverage and get a good deal with investors.
- Assume that only because a new technology is adding value and/or interesting, it is going to be commercially viable and successful.
- Engage investors too soon.

Co-location of a multinational company research team in a University Campus

Using co-location to improve collaboration and knowledge sharing between a multinational company with distributed R&D labs and a University

CO-LOCATION

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Main actors

- CA Technologies
- Universitat Politècnica de Catalunya (UPC)
- Technology Center of the UPC (CIT-UPC)

In 2011, CA Technologies (ca.com) established a co-located office at UPC (www.upc.edu), a university specialized in architecture, engineering and technology. Since then, professors, researchers and students have worked jointly with CA research staff in several projects. This relationship continues, and this co-located team participates in many research and innovation activities with UPC, such as collaboration with students, organization of events, joint preparation EU project proposals, etc.

Process Main Stages

STAGE 1 – PREPARING
In the approach stage, management of both the company (CA) and the University (UPC) started conversations to build the long-term collaboration. The University involved its Technology Center (CIT-UPC) to deal with the relationship on the administrative side. The success factor is the willingness to foster a long-term and strong relationship.

STAGE 2 – NEGOTIATION
In the negotiation stage, both CA and UPC involved their legal departments to agree on the terms and conditions of the Master Collaboration Agreement. The success factor in this phase is the negotiation of the intellectual property and exploitation rights from the beginning, setting clear expectations on both sides.

STAGE 3 – IMPLEMENTATION
In the implementation stage, which started after the Master Collaboration Agreement was signed, there were several substages, implemented for each single research project:

- In substage 3.1., the research director of the company co-located team approached CIT-UPC to indicate which research topics were more relevant for the company.
- In substage 3.2., CIT-UPC proposed a research team at UPC with expertise in those topics presented by CA.
- In substage 3.3, the research director of the company co-located team and the research lead of the specific UPC research team agreed on the research topics and the specific projects to be performed.
- In substage 3.4., the specific agreements for those projects were written and signed.
- In substage 3.5., research was performed.
- In substage 3.6., research results were communicated to CA management.

The are some success factors in this stage and substages, such as:

- the ability of the co-located team to understand the company strategy as well as the expertise from the University when defining the areas to explore;
- the ability of the Technology Center to find the proper experts inside the University;
- the ability of the University research team leader to understand the needs and the tempos of the company;
- the motivation of the research teams on both organizations to join efforts, knowledge and expertise;
- the strong background of the research teams on both organizations.

As a result of the abovementioned project collaborations, other opportunities for collaboration between CA and UPC emerged, many focused in education and training activities addressed to students, but also collaborative projects (EU funded projects, industrial doctorates) and ideas on how to join efforts between Universities and companies to foster excellence in research and innovative ways for collaboration between industry and academia.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – FACE2FACE MEETINGS
Provided that this approach relies on proximity and lack of intermediaries in knowledge transfer, the main touchpoints in this relationship are face-2-face meetings (kick-off, milestones, regular meetings).

TOUCHPOINT 2 – INFORMAL CALLS
Other means of communication are informal calls between the company and the university professors, as well as informal meetings taking place at the University cafeteria or other common areas.

TOUCHPOINT 3 – PITCHES
These documents (the typical pitch deck presented to potential investors) hardly ever convey all the information that the entrepreneurs would like to transmit, nor does it contain all the information that an investor needs to digest in order to shape a good opinion on the fit of the proposed investment in the strategic investment scope of the fund (or the investor itself). Possible a multi-layered and structured approach of slide decks covering various aspects of an investment opportunity could reduce the mismatch between information offered and information sought.

Being the touchpoints face-2-face meetings, the success factors and the barriers are related to communication and personal soft skills. The success factors rely on the ability of team leaders (both from the University and the company) to effectively communicate the expectations of the collaboration and the specific project, the roles of the team members and to set an environment of trust and collaboration.

The main barriers are also related to personal skills:

- From the company: lack of understanding of the University way of performing research and tempos;
- From the University: lack of understanding of the company strategy, tempos and priorities;
- From both: not being able to effectively communicate the roles and the expectations to the team members, or to set an environment of collaboration.

Success Factors / Barriers

The main success factors of this experience are the motivation and engagement from research teams and building an environment of trust and long-term relationship, as well as setting clear expectations, objectives and ownership of results.

From the company perspective, it is essential to make the process from research to market agile, and to build a strong relationship with the research communities and experts in relevant topics. Detecting and acquiring talent is also a strong reason for companies to co-locate their teams at the university.

From the Technology Center of the University point of view, it is important to exploit the results of its research. As for the University, it is essential to impact the market and society and to expose its research staff and students to the business side of research.

The main barriers are lack of understanding of the expectations and exploitation of the results from both organizations.

Conclusion

Co-location of multinational company research teams in Universities has many advantages that other types of collaboration cannot offer, as it removes physical separation and intermediaries: being at the campus originates informal meetings that lead to new research opportunities, close physical collaboration allows to work through the potential differences (cultural, interests, understanding of the expectations) much more quickly, it creates stronger relationships and it has an appealing international dimension.

DO

- Engage Legal Departments as soon as possible, as they need time to understand the relationship and agree on the legal aspects of the co-location experience.
- Involve a team at the University that has a business mindset, and a team at the company that understands how University research works, as well as the company strategy.
- Find research topics that are aligned both with the University's research interests and the company commercial strategy.
- Work together to attract best students.
- Communicate and train the co-located teams so that they understand the policies related to the process, IP protection and expectations.
- Work on joint events (workshops, presentations) as well as joint research collaborations (project proposals, industrial doctorates, teaching classes).

DON'T

- Base the relationship on a single person at the University and/or the company.
- Appoint a leader of the relationship at the company that does not understand how research is done at the University.
- Appoint a leader of the relationship at the University that does not understand how companies approach research.
- Be inflexible on intellectual property aspects.

Joint doctoral degree of the research group SAM of Technische Universität Darmstadt and BMW Group

Open innovation collaboration between the Technische Universität Darmstadt and the automotive company BMW Group

COLLABORATIVE R&D PROJECTS

Contact

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Main actors

- Technische Universität Darmstadt
- SAM Research Group
- BMW Group
- Phd Candidate

A member of the research group System Reliability, Adaptive Structures, and Machine Acoustics SAM of Technische Universität Darmstadt is doing research at the automotive company BMW Group in Munich. In this open science environment, high-class research is performed at the interface between university and industry. This type of OI collaboration initiative probably fits best into UISIS #4 mentioned in the proposal (Collaborative R&D&I projects between universities, RTOs, industries, SMEs and public sector entities).

This collaboration initiative relates to open science by the open nature of a doctoral degree. All scientific results gathered, both at the university and industry, will be published in a way that it is accessible by scientific community and society.

Process Main Stages

STAGE 1 – AGREEMENT AND SHAPING OF THE RESEARCH TOPIC
Firstly, the Technische Universität Darmstadt and BMW have to agree on a research topic of common interest. Therefore, a cooperation contract is signed between both partners to ensure a good cooperation. And finally, the doctoral student candidate for the job has to be recruited at either the Technische Universität Darmstadt or at BMW Group.

STAGE 2 – ENSURING A CONTINUOUS ALIGNMENT OF THE RESEARCH
While the doctoral student does research on the defined topic, a continuous communication between all three actors has to be ensured. Simultaneously, a permanent alignment of the research with the expectations of the university and the industry must be safeguarded as well. Finally, the specific parts of the research results are published.

STAGE 3 – CONFIMATION AND PUBLICATION OF RESULTS
Once the research phase has been completed, the doctoral student presents the outcomes to both, university and industry. Therefore, after a final review, the results are published within the scientific community and among society. At this point, the doctoral student finally graduates.

STAGE 4 – STRENGTHTENING TIES
Ultimately, the university and the industry agree on future works and projects in order to intensify their relationship and, thus, their mutual benefit.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – UNIVERSITY-INDUSTRY INTERACTION
The interface science-industry that takes place at the company between the doctoral student and the industry employees supporting his work, in addition to the supervisors of both entities, who continuously oversee the process.

BOTTLENECK 1 – DIFFERENT EXPECTATIONS
The main bottleneck is the different expectation of the university and the industry towards the research process and the research outcomes. The university is expecting very accurate and detailed research on fundamental questions, while the industry expects ready-to-use outcomes, with which can be monetarized. The doctoral student, who is in between these different expectations, must serve both interests. He is employed at the industry, but is evaluated and graded by the university.

BOTTLENECK 2 – COMMUNICATION BETWEEN ACTORS
Another bottleneck is the communication between all three actors. The doctoral student is doing research at the industry. Hence, the communication between the doctoral student and the industry is much more intense than the communication between the doctoral student and the university. This easily leads to misunderstandings. A regular communication between the doctoral student and the University is necessary in order to avoid problems and to agree upon shared goals.

Success Factors / Barriers

The main objective of Technische Universität Darmstadt is to have a strong and intense cooperation with the industry to learn about the industry's needs in research. The knowledge transfer from university to industry is as direct as possible, but also the knowledge and skills from the industry directly influence the university's research activities. The main success factor is the open and intense communication between the university and the industry.

The main objective of BMW is to have excellent research done in-house. Hence, BMW can profit as much as possible from the high-class research done at the university. With the continuous and intense communication between the company and the university, BMW can stay on track with the newest results in research achieved at the university. The main success factor is to have a motivated and capable researcher as an employee. Additionally, the direct link to the university providing newest research outcomes is an important point.

The main objective of the doctoral student is to graduate as a doctor. To achieve this target, he will do excellent research in a highly motivated way. At the interface between science and industry, he can experience both, the university's and the industry's way of research. With this double experience, he is better prepared for a job in the industry than a doctoral student who has graduated at university only. The main success factor is to have good and reliable supervisors, both at the university and the industry. A good relationship between both supervisors is very important since the doctoral student is right in between.

A clear agreement on the publication of the research results is necessary to allow the university to publish the results within the scientific community and the society. Furthermore, the doctoral student's responsibilities must be clearly defined to ensure that he has enough time to finish his research and will not work too much on daily business.

Conclusion

The overall experience is very positive for all three actors, who all profit of the cooperation. The University gains knowledge about the needs of the industry, the industry gains knowledge about newest research outcomes of the university and the doctoral student can do high-class research right at the interface between university and industry to graduate as a doctor.

DO

- Detailed definition of the doctoral student's field of research,
- Doctoral student should be motivated and open minded towards innovative research outcomes,
- Formulation of a clear collaboration agreement between the university and the industry,
- Agreement on a mutual publication policy,
- Regular communication between university, industry, and the doctoral student.

DON'T

- Doctoral student must not be integrated too much into the daily business,
- Task should not be too detailed in order to not prevent innovation,
- Research outcomes must not be kept secret.

InnoLab – Innovating Future Mobility with talented students

A co-creation project to identify future visions and new concepts for mobility through the direct involvement of students participating in the Talent programmes at the Politecnico di Torino and the University of Torino

CO-CREATION

Contact

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Main actors

- The Innovation Team of the Vehicles Research & Innovation Dept. at Centro Ricerche Fiat (CRF)
- Technical specialists from CRF
- Innovation Director at CRF (involved in the drawing of the final conclusions)
- Students on the Talent programme at the Politecnico di Torino (www.polito.it)
- Students on the Talent programme at the Università di Torino (www.unito.it)

InnoLab – a case study focused on defining a feasible and viable vision for future mobility, conducted by specialists at CRF (the research & innovation centre of Fiat-Chrysler Automobiles) which, when run in mid-2016, was characterised by the direct involvement of 33 students from diverse faculties and disciplines including Mechanical, Electrical, Electronic, Aerospace Engineering, Management, Economics and Business Administration, Philosophy, Sociology and Psychology.

The students worked in different groups of 6-8, and the activities involved expressing their personal perspectives regarding different options and concepts aimed at addressing the issues facing society with respect to future mobility. The result of the activities was a series of future mobility scenarios that involved the assessment of critical factors including financial and economic considerations in addition to the technical perspective.

The activities were conducted over a one-week period.

Process Main Stages

STAGE 1 – IDENTIFICATION OF TRENDS
In the first phase, experts and concept vehicle specialists from CRF collected and conveyed to the students a series of technology development forecasts and roadmaps in order to identify possible future trends and scenarios with respect to mobility and transportation by road.

STAGE 2 – TECHNICAL SEMINARS
In the second phase, the students were given the possibility to participate in technical seminars run by experts in FCA to provide information regarding specific technological solutions currently under development.

STAGE 3 – INNOLAB SESSIONS
The third phase related to the running of the InnoLab sessions which were conducted in distinct stages: Introduction, Ice-breaking & Warm-up, Initial vision creation, Vision dissemination, comparison & discussion, Vision development, Vision evaluation & assessment, Conclusions

STAGE 4 – FOLLOW-UP & FEEDBACK
The fourth and final phase was devoted to a follow-up, providing feedback to the students following an evaluation by the Innovation Director at CRF.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – WORKSHOPS AND FACE-TO-FACE MEETINGS
The InnoLab process which has been defined utilizes extensively workshops and face-to-face meetings as the key touchpoints. Previous experience has demonstrated that direct communication between participants is the most effective means, although effective communication also depends heavily on personal skills and experience.

TOUCHPOINT 2 – DIGITAL COMMUNICATION
Websites and other forms of communication are used exclusively within the information gathering phases, but during the InnoLab workshops Internet access in not permitted in order to encourage free-thinking by those involved.

Success Factors / Barriers

The principal success factors of InnoLab can be considered to fall into two distinct categories:

The first category concerns the personal and professional development of the students involved. In particular the participation in the InnoLab exercise provided the students with the opportunity to gain first-hand experience of working in the context of a Research Centre of an Industrial Company for several days, and for developing and applying a series of 'soft skills' such as working in multi-disciplinary teams and articulating and presenting the results of the activities to a wider audience. Furthermore, the students also gained access to and experience of working with various methods and tools, which have been developed and consolidated at CRF for the purpose of new concept generation and Innovation support including:

- Role Play, in which a group of participants performs a hypothetical service experience in front of a small audience of other participants
- Brainstorming, which is a group problem-solving technique that involves gathering spontaneously contributed ideas from all members of the group to find a conclusion for a specific problem, which is particularly useful for generating many initial ideas to choose from for further development.

The second category regards the positive contribution received by CRF in terms of both helping to appraise the suitability of individual students with respect to the professional working environment and from the direct interaction with the students that helped to provide new points of view and specific opinions regarding the relatively familiar discussion on future mobility. Indeed the aim was to conduct "co-creation" by involving the students themselves as current and future users of mobility. In this context, the students were able to provide a new and potentially completely different perspective on the development of mobility solutions with respect to more experienced vehicle designers of FCA, a number of whom were also involved in the process to provide answers to the students, particularly as regards specific technical issues, if and when requested.

The main barrier, which was encountered, was related to the difficulty to be able to come up with original ideas and concepts in an age in which everyone is effectively bombarded with information and opinions. Consequently it will be necessary to develop and refine the tools to address and overcome this hurdle in future editions of InnoLab.

Conclusion

Naturally, the quality of the result is directly dependent on the abilities, skills and level of interest and motivation of the participants, in this case students on the Talent programmes at the Politecnico and University of Torino. Through the process, it of fundamental importance for those running InnoLab to try to keep the levels of motivation and interest as high as possible by continually setting new assignments. The direct involvement also of key specialists and the Innovation Director can also help to provide motivation.

In general it is essential to find an appropriate equilibrium between providing the participants with clear instructions and guidance on one hand, while encouraging and supporting free and inventive thinking on the other.

DO

- Keep the levels of motivation and interest as high as possible
- Direct involvement also of key specialists
- Provide guidance and support free thinking

DON'T

- Avoid anything which could undermine the students' motivation.

Women-up

Development of a solution for the home treatment of urinary incontinence.

COLLABORATIVE R&D PROJECTS

Contact

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Main actors

- CREB UPC – Project coordinator
- Hospital Clínic – Clinical leader
- Mega Electroincs Ltd – Medical Technology Company
- Academic Medical Center – Obstetrics/ Gynecology and Clinical Research Unit
- Kuopio University Hospital – Gynecology and Rehabilitation Services
- Babes-Bolyai University – Health Psychology Research
- YouRehab Ltd – Training Software Company
- European Urogynaecological Association (EUGA) – Results dissemination
- UPC Technology Center (CIT UPC) – High-level support in the definition of the concept, approach and consortium for the H2020 proposal

WOMEN-UP is the first European collaborative R&D project in the field of urinary incontinence, a disorder that affects 56 million Europeans, most of whom are women. High performance technology patented by the UPC and Hospital Clínic is being used to carry out pelvic floor rehabilitation at home. During the project, the technology will be improved and tested in three European hospitals, with the collaboration of some of the top European specialists in urinary incontinence, and the support of the European Urogynaecological Association (EUGA). The project has a budget of 3.5 million euros and a duration of 3,5 years.

Project video (recently launched): https://www.youtube.com/watch?v=PCiH2YKEfuQ

Process Main Stages

STAGE 1 – LONG-TERM COLLABORATION IN THE FIELD OF PELVIC FLOOR TRAINING
In 2010 CREB UPC and Hospital Clínic initiated a research collaboration in the field of urinary incontinence, which resulted in a prototype of a biofeedback system for the training of pelvic floor. By the end of 2012 they had developed and successfully tested a high-performance device for rehabilitating the pelvic floor at home, which offered advanced features, similar to those used in clinical practice. The solution was protected with a joint patent.

STAGE 2 – IDENTIFYING AND CONTACTING A SUITABLE INDUSTRIAL PARTNER FOR MARKET EXPLOITATION
After that, both partners wanted to transfer these results to the market and started to explore the possibilities of creating a European collaborative project in this field. To do so, the first step was to identify a suitable company to join the consortium and lead the industrial aspects. The company selected was Mega Electronics, a Finnish SME with experience in advanced technology for EMG, ECG and EEG monitoring applications, both in hospital laboratory and field conditions.

STAGE 3 – SETTING UP A EUROPEAN COLLABORATIVE PROJECT PROPOSAL
The creation of a European collaborative project proposal required expanding the core group with the participation of other complementary partners. It was decided that the proposal should involve a multicenter clinical study in 3 EU hospitals, so two additional hospital were invited to the consortium. Additional complementary partners were selected based on their expertise in aspects such as e.g. health psychology or adherence to treatments.

STAGE 4 – APPROVAL AND EXECUTION OF THE WOMEN-UP PROJECT
After submission to the H2020 call, the proposal was approved for funding and WOMEN-UP became the first project of its kind to be financed in Europe. The proposal was evaluated with the highest score in the H2020 Health Call of 2014. The project started in February 2015 and is expected to finish by July 2018.

Touchpoints & Bottlenecks

The description below applies to stages 2-3, when the multilateral collaboration was established and the related technology transfer process consolidated.

TOUCHPOINT 1 – INTRODUCTORY E-MAIL COMMUNICATION
The first communication with the candidate partners was done by e-mail, explaining the background, introducing the opportunity (i.e. the H2020 call) and indicating the possible role of the candidate partner.

TOUCHPOINT 2 – REGULAR FACE-2-FACE COMMUNICATION WITH THE PARTNERS
During the execution phase, face-2-face meetings were held regularly, either bilateral or multilateral (with the participation of the whole consortium).

TOUCHPOINT 3 – VIRTUAL AND DIGITAL COMMUNICATION
Regular e-mail, phone and skype communication was established between the partners during the preparation of the project proposal. A web repository (dropbox) was also used in order to share relevant documentation.

Success Factors / Barriers

After a joint collaboration in the field of urinary incontinence, CREB UPC and Hospital Clínic decide to jointly apply for a H2020 project, with the support of the UPC Technology Center (CIT UPC). The first step was to find a suitable company interested in taking the product to the market. Several candidates were identified and contacted, resulting in the company Mega Electronics joining the consortium. A key decision factor was the fact that Mega Electronics already had a commercial product for pelvic floor training, which they wanted to improve with the WOMEN-UP project. The fact that the company was also familiar with EU projects contributed to a favorable decision.

Another key success factor for preparing a good proposal was the involvement of highly complementary partners, each of them providing the required expertise for the project (including research, clinical and industrialization capacities).

Finally, the execution of a multicenter clinical study in 3 hospitals (Spain, Finland, and The Netherlands) was also very positively perceived by the evaluators. The fact of involving patients from 3 different countries was important in order to provide a good solution, as urinary incontinence has very different connotations in different countries (e.g. social aspects, preferred treatments, available information, patients' behavior, etc.).

Conclusion

There is a fierce competition in H2020 programme nowadays, meaning that only the best projects are selected for funding. The call topics are increasingly more and more open, giving the applicants the freedom to propose a research of their interest and at the same time fitting with the expected impacts detailed in the respective call topic. For this reason, it is especially important to select the project topic very well. WOMEN-UP focuses on urinary incontinence, a disease that has a tremendous impact (social, quality of life, economic, etc.) for Europe but where no previous collaborative projects were funded at EU level. Carefully building of a consortium where each partner had a very clear and complementary role can also be considered a key success factor.

DO

- Strategically choose the partners to build the consortium based on the expertise they can bring to the project
- When choosing a topic for a H2020 project proposal, choose for original and high impactful topics.
- When addressing a challenge where different aspects (clinical, social, behavioral) aspects may vary significantly between countries, it is very important to involve communities from several complementary regions, so that they are well represented in the definition and delivering of the final solution.

DON'T

- Do not leave Intellectual Property Rights (IPR) discussion for the end; IPR rules should be clear from the project start, especially for those projects where the resulting technology is expected to be commercialized.
- For projects involving clinical studies: do not underestimate the efforts need in order to recruit the patients needed for the clinical trials.

Cooperation through Clusters and Strategic Research Centers

An open innovation approach implemented between Flemish universities, research centers, and industry

COLLABORATIVE R&D PROJECTS

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Main actors

- Flanders Make Strategic Research Center (as organizational entity bringing together the various research entities in the field of manufacturing and product engineering)
- KU Leuven as one of the leading academic partners in Flanders Make (together with the other Flemish universities)
- Siemens Industry Software research group (as one of the leading industrial partners in the Flanders Make programs (together with multiple other key industries in Flanders))
- KU Leuven and SISW administrative and legal support
- Project researchers in the various involved entities

To support the transformation of the manufacturing industry in Flanders required to fully embrace the opportunities and challenges offered by Digitization and the Industry 4.0 agenda, the Strategic Research Center "Flanders Make" was established in 2014, supported by the Flemish government. This physical Center brings together Academia, Research Centers and Industry to implement a jointly defined strategic roadmap for research, innovation and industrial uptake in the field of product design and product manufacturing. Flanders Make consists of a unique combination of an "Intra-Muros" capacity for applied and transformational research and a "Virtual Department" consisting of a number of leading Flemish academic laboratories, which together with industry partners execute projects of different types (including Strategic Basic and Industrial Cooperative).

The roadmap definition and the project implementation are supervised and validated by both an Industrial and a Scientific Advisory Board while IP principles are discussed and agreed in an IP board.

KU Leuven was one of the co-founding partners of Flanders Make and leads key roadmaps while Siemens Industry Software (SISW) has been a driving industry member from the first hour and involved in several of the identified strategic innovation lines. These two partners together create both a platform and bring own expertise.

Process Main Stages

STAGE 1 – STRATEGY
Definition/update of the global vision and strategy of the Research Centre. Validation by the International Scientific and Industrial Advisory Board.

STAGE 2 – DEFINITION OF MAIN TECHNOLOGY ROADMAPS
Definition/update – by all stakeholders – of the main technology roadmaps. Intensive consultations with all stakeholders take place and proposals are iterated and consolidated in joint workshops.

STAGE 3 – SELECTION OF RESEARCH TOPICS
Staged process to propose, develop and select concrete research topics for implementation in projects (with subsequent reviews by stakeholders, management board, funding agency). Dedicated consultations and workshops take place per roadmap and per gate in the Stage Gate process.

STAGE 4 – PROJECT EXECUTION
Execution of the selected research projects.

STAGE 5 – PROJECT FINALIZATION
Finalization of the research projects with specific attention on valorization perspectives and required follow-up actions.

STAGE 6 – PROJECT DISSEMINATION
Dissemination of the – open part of the – research results to the broader (industrial) community.

STAGE 7 – IMPROVEMENT
Evaluation of the processes as well as roadmaps in view of future improvement and adaption.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – PHYSICAL AND VIRTUAL CONSULTATIONS
Physical individual consultations with the involved stakeholders. Mainly physical; of course from time to time some virtual consultations take place (online surveys)

TOUCHPOINT 2 – WORKSHOPS
Research roadmap workshops. Project proposal workshops (per Gate in the Stage Gate process) to come to a common project definition endorsed by the involved academic, research and industry partners.

Success Factors / Barriers

SUCCESS FACTORS
The key success factors are the identification of common technology innovation needs for a whole industrial sector (Flemish Manufacturing Industry with all stakeholders) and the pooling of available innovation and research capacity among a variety of academic, RTO and industrial research laboratories to address these needs through a structured research roadmap. The complexity and multi-disciplinary nature of the problems posed by the manufacturing industry make it impossible for a single research team to address the required innovation challenges. Cooperation between complementary competences as well as along the value chain from basic research to industrial deployment allows to develop, implement and validate breakthrough solutions previously impossible.

BARRIERS
A first barrier challenging industry-academia cooperation is related to the different time horizon pursued by the various actors. This makes that the industrial support to generic long term basic research is often not easy to obtain as the outcome seems still too far away for solving the daily concerns while the need to extend research trajectories to address short term industrial deployment needs is not always put as a priority in the academic research. By being together in the intensive roadmapping and programme discussions and understanding each other's agenda's and concerns, this gap however gets narrowed down.

A second barrier concerns IP. Basic research targets general scientific progress and aims at widespread dissemination, industrial research on the other hand aims at proprietary solutions while research centers aim to build up expertise for future exploitation. Jointly agreed template agreements adapted to the specific nature of the various types of cooperation have therefore been established and an IP board governs the related issues.

Conclusion

Overall, the experiences of cooperating in the context of Strategic Research Centres or Advanced Research Clusters are very positive for KU Leuven and Siemens Industry Software. Pooling competencies across various complementary fields and sharing research needs between different companies, possibly also along the value chain, allow to unleash innovation power and realize innovations not possible standalone or by pure bilateral cooperation.

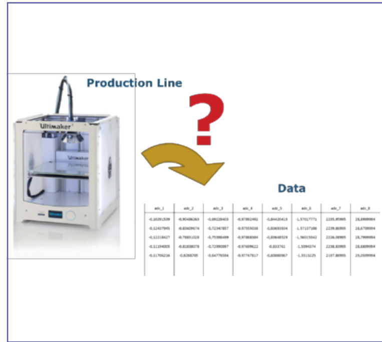
DO
- Respect each other's DNA and KPI's, including the IP concerns of the various stakeholders
- Be sufficiently open in sharing roadmaps and research needs as the leveraging power largely outweighs the potentially competitive concerns

DON'T
- Lose view on addressing the long term research needs by focusing too much on short term industrial deployments, the research partners should not become/be expected to become a service organization helping out in daily problems but have to enable the long term breakthroughs
- For the research partners: don't lose the view on the need to eventually realize socio-economic added value through the innovations

The 3DPrinterLivingLab@Virtual Vehicle

Exploring (big-)data-driven manufacturing innovations in a lightweight environment

BIG RESEARCH DATA TRANSFER



Contact

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Main actors

- Virtual Vehicle Research Center (operator of the 3DPrinterLivingLab)
- UNIs and/or RTOs (interested in manufacturing data analytics who want to replicate the 3DPrinterLivingLab concept)
- Industry partners (aiming to explore machine learning on non-sensitive production data)
- Researchers (who seek access to non-sensitive manufacturing data)

Thanks to paradigms such as Industry 4.0, Smart Factories, or Industrial Internet, manufacturing has become a prominent application domain for Big Data technologies. However the availability of high volumes of manufacturing data from real production lines as open data is a major challenge. The 3DPrinterLivingLab has been designed as a lightweight approach at Virtual Vehicle to support researchers in developing and demonstration data-driven manufacturing innovations, which can be summarized under the machine-learning umbrella. To achieve this, a 3D printer as a lightweight production machine has been equipped with multiple sensors and thereby transformed into a "big data generator". Being heavily used by other researchers at Virtual Vehicle the 3DPrinterLivingLab has already generated high volumes of manufacturing data, which has been used in a multitude of collaborative data science experiments together with another research organization, and even shared via zenodo.org in an open science like way.

Process Main Stages

The 3DPrinterLivingLab and the respective data-to-knowledge processes can be easily replicated by other research organizations to engage a wider number of researchers in applying and demonstrating big data technologies to solve industrial manufacturing challenges.

STAGE 1 – SET-UP A 3DPRINTERLIVINGLAB

First of all a low cost manufacturing process technology has to be identified, which is capable of generating a significant amount of process data. Second the selected manufacturing process technology has to be analyzed, and as a consequence the domain specific challenges have to be sufficiently understood by data scientists. Third computational access to input and output data of the manufacturing process has to be established via appropriate interfaces. Fourth the feasibility of integrating various sensors to monitor important events within the production process has to be investigated. Fifth, an appropriate state of the art information system for aggregating manufacturing process data and eventually corresponding quality data has to be set up to facilitate data-driven scientific discovery.

STAGE 2 – USE CASE DEVELOPMENT & DATA GENERATION

The 3DPrinterLivingLab has already been used to implement and demonstrate a broad spectrum of real industrial use cases ranging from the application of smart glasses, and industrial learning, to machine learning on manufacturing big data to deepen process understanding. Currently the amount of manufacturing process data generated in the 3DPrinterLivingLab is about 4GB / 12 hours of operation. This allows many different types of use cases to be investigated and experienced in the 3DPrinterLivingLab.

STAGE 3 – DATA ANALYTICS & KNOWLEDGE GAIN

Exploring correlations and causalities between process data and quality data is a current hot topic of data-driven innovations in factories. Manufacturing process experts expect to increase their knowledge on how machine and process parameters influence the quality of a produced part. They expect to receive better decision support and to detect possible problems already at an early stage. One already implemented use case involves detecting events which can have a negative influence on the production quality by assessing the generated process data. This includes e.g. the automatic detection of vibrations caused by people walking by printer or by a ringing smartphone placed near the printer by analyzing the accelerometer sensory data collected during a print job.

STAGE 4 – DATA SHARING WITH OTHER RESEARCHERS

To outline the full potential of the 3DPrinterLivingLab – the provision of manufacturing data as open research data for the scientific community – the corresponding data set of accelerometer sensory data collected during this experiment has already been published on zenodo.org (Zernig et al 2016: doi.org/10.5281/zenodo.54574) following the principles of open science promoted by the European Commission. This allows other researchers interested into manufacturing data analytics to easily replicate conducted experiments, evaluate their findings, and increase their knowledge. Moreover it will enable sustainable collaborations through Big Data and Science 2.0.

Touchpoints & Bottlenecks

TOUCHPOINT 1 – THE PHYSICAL 3DPRINTERLIVINGLAB

The physical 3DPrinterLivingLab it is a physical space, where researchers of different domains can meet with others (including representatives from industry) to discuss data-driven challenges as well as to explore the impact of applied data analytics and visualization technologies to the manufacturing domain.

TOUCHPOINT 2 – VIRTUAL ENVIRONMENT

The 3DPrinterLivingLab has also a virtual environment, which is the data repository containing all the captured sensor, process, and quality data. The captured process data is currently aggregated into a PostreSQL database running on a virtual server. Researchers can access the data though interfaces with their favorite analytic tools including e.g. MathLab or R to explore it and to develop prototypical implementations.

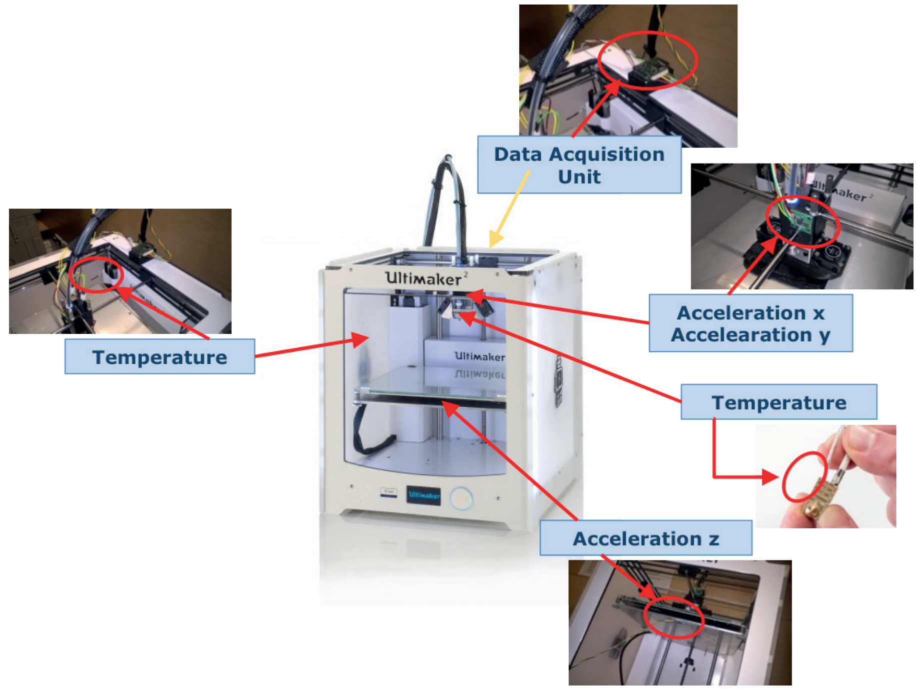
TOUCHPOINT 3 – DATA-SHARING PLATFORMS

The third touchpoint are data-sharing platforms, which are currently promoted on the European Level, including e.g. zenodo.org to name a renowned one, which uses technology developed by CERN for Big Data Management. Sharing generated research data on such platforms will allow other researchers to replicate experiments, which will enable them to learn quickly. Datasets shared on zenodo.org can be cited like a scientific paper. Thereby sharing data can increase the reputation of the sharer.

Success Factors / Barriers

SUCCESS FACTORS

- As a lightweight environment the 3DPrinterLivingLab is a relatively cost-effective way to generate huge amounts of manufacturing data. Both the costs of 3D printers and of wireless sensors are rapidly decreasing while their capabilities are increasing.
- The 3DPrinterLivingLab is a best practice, which can be taken up by other research organizations to allow their employees and/ or students taking on data-driven manufacturing challenges in a controlled environment, too.
- Publishing captured manufacturing data as open research data allows other researchers who do not own such a laboratory to benefit from open manufacturing research data so that they can tackle practical manufacturing challenges by applying data analytics and machine learning.
- If more research organizations follow this practice, the availability of manufacturing related data will be increased. This will overcome



the current lack of open manufacturing process data, allowing more researchers to engage in challenges related to smart factories.

- Since decision makers within factories can be hardly motivated to share their process data from a real production line to a wider scientific community in an open science-like way, this can be a feasible approach. It shows how an application of open science principles can lead to more data-driven (open) innovation.

BARRIERS

- The 3DPrinterLivingLab is currently heavily used for producing prototypical parts in other research projects. Achieving such an adoption is very important to generate enough process data from the 3Dprinter which can be used for data analytics in the latter. However, other researchers have to be motivated to include the feasibilities of a 3D printer for rapid prototyping into their work practices.
- Applying machine learning and data analytics has a high entry threshold. It is important to create a community-of-practice like collaboration between more experienced and less experienced data analytics researchers to quickly realize prototypical data-driven innovations.

Conclusion

Under the umbrella term 'machine learning', data analytics experiences a new renaissance in manufacturing. Exploring correlations and causalities between process data and quality data is a current topic of data-driven innovations in factories.

Two developments increase the pervasion of such digital technologies in manufacturing environments: The availability of more computational resources allows using more complex machine learning models, and new algorithmic approaches for predictive data analysis have been investigated, which can be applied in a broad palette of smart factory use cases ranging from predictive maintenance to advanced process decision support.

The 3DPrinterLivingLab is a lightweight approach, which can enable manufacturing practitioners to experience the adoption of novel ICT-solutions in a living lab environment. They can gain a better understanding on the potentials and pitfalls of implementing data-driven innovations into their factories. The 3DprinterLivingLab is the archetype of a small and flexible manufacturing living lab, which can be set-up very quickly to allow people from all over the world to take on practical data-driven innovation challenges.

The 3D printer has been equipped with sensors including e.g. heat sensors to measure the temperature at the printer head and plate, acceleration sensors to keep track of the printer head's movement, and a camera to have an additional optical inspection of the process. The captured manufacturing process data is aggregated into a PostreSQL database, which makes the 3D printer an archetype for a lightweight smart factory asset to be used in science2science and science2industry collaboration.

DO

- Set-up a community of researchers from different disciplines (i.e. computer scientists for software tasks, electrical engineers for sensor related tasks, data scientists for data analytic tasks, …) and provide them a physical and virtual space to effectively collaborate with each other.
- Engage others in using the 3Dprinter for rapid prototyping, which boosts manufacturing process data generation - a precondition for data analysis and knowledge generation
- Engage with industrial partners to elicit requirements for manufacturing data analytics, which can be explored in the 3DPrinterLivingLab
- Motivate researchers to share generated process data along with knowledge gained from analyzing this data via European data portals so that others can replicate the findings

DON'T

- Don't just focus on the technology, only
- Don't forget about installing a community manager, who will engage others with the new capabilities
- Don't forget about sharing the generated data with others using open standards and platforms to enable success cross-organizational collaborations

Science2Society Consortium

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