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Innovation intermediaries in university-industry collaboration: analysis of online platforms

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Abstract: The importance of intermediation in university-industry collaboration (UIC) has been widely acknowledged, however, the phenomenon of UIC online tools is not yet studied in detail. In this paper, we examine fifteen UIC online platforms, identify their functions and role that they play in UIC. By combining secondary data with interviews with platform developers and users, we identify five main archetypes of collaborative online platforms: education-focused, knowledge transfer platforms, crowdsourcing platforms, networking tools and platforms for innovation marketing. We also present a number of the benefits the platforms bring. These tools reduce the time and resources spent establishing and managing collaborations; they help to make networking more targeted; they help to reveal the value that university research has for business and increase the adoption of university education. Our findings suggest that whilst facing some challenges, the platforms analysed represent a scalable, rapidly growing and more importantly demand-led business opportunity.

Keywords: university-industry collaboration, innovation intermediary, online platform

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1 Introduction and research problem

Effective collaboration and knowledge exchange between universities and companies has been widely acknowledged by academics, practitioners and policy makers (Perkmann et al., 2013) to create sources of corporate innovation. Given the radical differences in the objectives and rationale of ‘profit-oriented enterprises’ when compared to ‘educational

institutions’ (Parker, 1992) the role of intermediary organizations, who help develop collaboration, has increased and now draws specific attention in the literature on knowledge and technology transfer (Wright et al., 2008; Kodama, 2008). Intermediaries are commonly understood to be bridging organizations, which help to develop bilateral or multilateral relationships (Dalziel, 2010). Although the academic research of innovation intermediaries is not yet focussing specifically on university-industry relations, it is readily acknowledged that many of the current challenges in university-industry collaboration (UIC) could be resolved by carefully designed intermediary services (Wright et al., 2008). Concurrently, in practice, such intermediaries are rapidly developing and bringing new forms of intermediation – one example of this is online platforms focussing on developing UIC.

The aim of this study is to identify the new or novel forms of online intermediation platforms in the UIC sphere; to analyse the role they fulfil and to identify what functions they offer for UIC. Therefore, the two underpinning research questions for this study are:

RQ1: What are the emerging types of online intermediaries in UIC?

RQ2: What are the roles and functions these different types of intermediaries have in UIC?

We hope that by undertaking an in-depth study of the role of online platforms as innovation intermediaries in university-industry collaboration, we will help in defining the phenomena and thus contribute to theory (Dalziel, 2010), which is still fragmented when it comes to intermediation in UIC (Korff & Kestingand, 2013) and particularly online platforms (Soendergaard et al., 2015). Therefore, our submission contributes to research in the field by (1) developing a theoretical basis for understanding rapidly emerging university-industry collaboration platforms and (2) beginning to categorize them by analysing their functions and role they fulfil in university-industry relationships.

This paper is structured as follows: first, we review the existing typologies of innovation intermediaries and compare these with intermediaries operating in UIC, before presenting the gaps in the literature. We then explain the research methodology of our study, after that we provide the results and we conclude by discussing our main findings and directions for future research.

2 Background

Barriers in UIC: why intermediating platforms are needed?

There are certain barriers in university-industry relationships, which are quite generic and close to ones identified for inter-firm relationships: lack of trust, mutual understanding and transparency (Barratt, 2004), IP issues (Bader, 2008). The principal difference in barriers to collaboration in firm-to-firm and firm-to-university relationships arises from the difference in primary objectives and motives of these two types of partners. Universities, as partners are more oriented to searching for new ideas and fundamental knowledge, while companies are more profit and practice-oriented (Parker, 1992). That is, in part, why a collaboration between academia and business can be difficult to

establish and manage. This is illustrated by different motivations (Siegel et al., 2003b), level of internal bureaucracy (Bruneel et al., 2010), the languages the parties speak, time horizons and day-to-day practices undertaken (Barnes et al., 2002; Plewa et al., 2005; Muscio & Pozzali, 2012). Frequently, university employees involved in collaboration lack marketing skills to communicate the university research results to industry (Siegel et al., 2003b), while business representatives could feel uncomfortable or simply do not have enough time to digest the relevant scientific papers. Thus, an intermediary able to speak both business and academia languages and capable of smoothing the differences between the two worlds is often required to make collaboration happening.

Additionally, a lack of resources on both sides inhibits UIC (Hughes, 2011), but also hinders the actual search for partners and awareness of collaboration opportunities (Muscio & Pozzali, 2012) forming a 'connection' barrier in UIC (Galán-Muros, & Plewa, 2016). Browsing through other organizations' websites to find a likely partner is to be an inefficient strategy and that is why tools, which help guide the search or build a connection could be highly valuable in solving the connection problem.

Typologies of innovation intermediaries in UIC

The phenomenon of intermediation is addressed from the different perspectives and units of analysis. Certain studies analyse exclusively particular type of intermediary, e.g. technology transfer offices (TTOs) (Alexander & Martin, 2013; Siegel et al., 2003a). A number of studies is devoted to analysing and classifying innovation intermediaries (Howells, 2006; Lopez-Vega & Vanhaverbeke, 2010). A particular group of research works analyse the phenomenon from the broader perspective looking at the National Innovation System, Triple Helix concept, institutional and network theories (e.g. Watkins et al., 2015; Dalziel, 2010; Klerkx & Leeuwis, 2008; Westergren & Holmström, 2012). Interestingly, one stream of the literature on open innovation and crowdsourcing platforms (Frey et al., 2011; Marjanovic et al., 2012) creates a foundation for the emerging topic on university-industry collaborative online platforms (Soendergaard et al., 2015).

When it comes to categorising intermediary organizations, Wright et al. (2008) divide intermediaries in UIC into two groups: internal intermediaries (as university TTOs) and external intermediate organizations (as Collective Research Centres, regional development agencies, etc.). Lopez-Vega & Vanhaverbeke (2009), looking at innovation intermediaries (but not specifically in UIC), define four archetypes of innovation intermediaries by their value proposition: innovation consultants, innovation traders, innovation incubators and innovation mediators. Howells (2006), again looking at general inter-organizational mediators, analyse intermediaries from the perspective of the functions they perform. They define ten functions: foresight and diagnostics, scanning and information processing, knowledge processing and combination/recombination, gatekeeping and brokering, testing and validation, accreditation, validation and regulation, protecting the results, commercialisation and evaluation of outcomes.

We suggest that the three typologies discussed above could be partly integrated and adopted for the UIC context (see Table 1). *Innovation mediators*, which manages a collaborative environment could be either internal (university-based Living Labs) or external - independent external organizations (as publically co-funded Living Labs or independent private initiatives) or corporate initiatives targeting particular company' interests in collaboration (Connect and Develop by P&G (Huston & Sakkab, 2006)). They can all be combined in one group by their main function – providing an

environment (physical or digital) for collaboration between companies, universities and authorities. *Innovation incubators* could be also university-based (as startup and business acceleration programmes launched by university), independent public/private initiatives (FinTech Innovation Labs) or corporate innovation incubators (Samsung Accelerator), but again, they share the main functions – transforming knowledge into innovation utilizing the expertise of academia and business. At the same time, independent (external) companies normally represent *innovation consultants* assisting corporates in detecting technological and innovation opportunities, technological foresight, advising on technology acquisition. However, university TTOs do provide assistance in similar functions, but for university employees – these are internal intermediaries. Finally, *innovation traders* (as NineSigma, InnoCentive, etc.) represent purely external intermediaries for UIC, which play the role of gatekeepers and brokers in between challenge holders (companies) and solution providers (universities).

Table 1 A summary of innovation intermediaries for UIC context

<i>Internal vs External for university (Wright et al., 2008)</i>	<i>Intermediaries by value proposition (Lopez-Vega & Vanhaverbeke, 2009)</i>	<i>Intermediaries by functions (Howells, 2006), (Lopez-Vega & Vanhaverbeke, 2009)</i>
Internal (External) UIC intermediaries	Innovation mediators	Creates spaces for knowledge processing, generation and combination; intermediaries between science policy and industry; demand articulation; testing and validation
	Innovation incubators	Knowledge processing and combination/recombination, Testing and validation, training, evaluation of outcomes
External (Internal) UIC intermediaries	Innovation consultants	Scanning and information processing, Protecting the results, Commercialisation, foresight and diagnostics
	Innovation traders	Gatekeeping and brokering; scanning and information processing, foresight and diagnostics, Commercialisation

Howells (2006) put an emphasis on the importance of the intermediaries’ ties with knowledge exchange actors, the building of long-term relationships and complexity of the network required for fruitful intermediation. An illustrative example of a complex knowledge exchange system for university-industry collaboration is the Knowledge Integration Community (KIC) model developed by Cambridge-MIT Institute and analysed by Acworth (2008). It highlights the importance of strong ties between research, education, industry and government meaning a number of stakeholders to be involved, and, as a result, – a need for a separate entity with an organizational structure enabling continuous knowledge exchange (Acworth, 2008).

Despite the fact that the literature examines many aspects of mediation in cooperation of universities and business, the theory is very fragmented and is lagging behind the practical development of online platforms playing an intermediation role in university-industry relationships (Soendergaard et al., 2015).

3 Research methodology

This study is qualitative and explorative by nature, since it aims at answering our open-ended research questions, which enable us to begin to understand the nature of the phenomenon.

The data collection process was broken into two phases, as follows. Firstly, we analysed 15* online platforms in total, by viewing their webpages and collecting all available secondary data on their aims, target audience, requisite functionality and performance. Based on this preliminary analysis, five distinct types of intermediary online platforms were identified. Secondly, data were then collected via a series of interviews with owners of UIC platforms, which represented one of each type. These data were then augmented, where possible, with interviews with a small number of their users. Finally, supplementary data were collected, which included additional secondary data (press releases, web-sites and platform users' public feedback). In total, seven interviews were conducted in February-April 2016. The duration of the interviews varied from 30 minutes to 70 minutes. Interviews were conducted via Skype or in person. The interviews were recorded. The interview guide consisted of 10-15 open-ended questions, tailored to the specific focus of each platform and/or respondent, which in turn was informed by the secondary data.

To ground the initial data further, one of the researchers participated in a subject-specific conference, where each of the platform developers were presenting their solution. Field notes were collected explaining how the platforms meet the needs of their current users and what might be attractive to new ones, who wish to exchange ideas or configure responses to specific challenges.

Finally, in order to test the interpretation of the results we applied a member check technique. We asked our interviewees to read and comment our results and we revised the paper in accordance with their comments. That decreases the chances of misrepresentation and thus, increases the validity of our study (Krefting, 1991).

* It is important to note that a large number of open innovation online platforms exist at present (e.g. InnoCentive, Yet2.com, NineSigma). However, we have limited the scope of our research only to those online platforms, which explicitly target collaboration between universities and businesses.

4 Results

Data arising from Phase 1

Based on the initial review of the literature coupled with the primary analysis of the secondary data devoted to web-based platforms serving university-industry relationships, we identified five archetypes of UIC online platforms. These are presented in table 2.

These are education-focussed platforms; platforms for knowledge or technology (via IP sales etc.); crowdsourcing platforms; networking platforms and innovation marketing platforms.

Education-based platforms are those online tools, which enable students to ‘learn by doing’ – running a project for a company (as EduSourced) or take a course designed by company (as those offered by Coursera).

Online platforms that aim to **transfer knowledge from universities to companies** exist in many forms. These ranged from the transfer of very tangible assets (as patents and licensing – i.e. easyaccessip.com or globalipexchange.co.uk) to a larger number of forms of knowledge sharing through establishing connection (e.g. [In-part.com](http://in-part.com)).

The platforms generally applying **crowdsourcing principles** collect ideas or problem solutions from any individual or any team globally, while the crowdsourcing platforms for university-industry collaboration aim specifically at sourcing ideas from students and university researchers to solve business challenges (e.g. nimblebee.eu or marblar.com) or also to jointly solve scientific challenges (e.g. challengeacademy.eu (Ventura et al., 2015 Rakitina-Qureshi, 2015)).

Table 2 A typology of university-industry collaboration online platforms

<i>Platform type</i>	<i>Platform Functions</i>	<i>Platform examples</i>
1. Education-focused platforms	Enabling project-based learning and students working on the real companies’ problems	www.edusourced.com www.coursera.org
2. Knowledge, technology and IP transfer focused	Enabling easier search for required knowledge, technology or IPR	www.in-part.com www.easyaccessip.com www.praxisunico.org.uk www.globalipexchange.co.uk
3. Crowdsourcing platforms	Collection and assessment of ideas and solutions for companies from students and university researchers	www.challengeacademy.eu www.nimblebee.eu www.marblar.com
4. Network building platforms	Mapping a network of valuable actors, enabling easy search for	www.uiin.org www.bridgelight.co.uk

	capabilities, competences and individuals, connecting individuals with complimentary assets	www.uidp.org www.connect.innovateuk.org
5. Innovation marketing platforms	Disseminating information about university innovation, provision of statistics analysis (clicks, downloads)	www.leadingedgeonly.com a number of open science platforms (e.g. www.sciworthy.com)

Network building platforms source social capital across a network and play a vitally important role in establishing valuable collaborations. Acknowledging this, a number of tools have appeared, and, in addition to the commonly used social media platforms such as Facebook, Twitter and LinkedIn that are applicable for any kind of collaboration, the platforms specifically designed to bridge experts from academia and business have been developed. Among those are University-Industry Interaction Network (UIIN.org), which in addition to online social network features provides both companies and university representative a chance to meet in person annually at the conference and discuss collaboration related issues. Another connector is the University-Industry Demonstration Partnership organization, which uses its website (UIDP.org) and the dedicated community on LinkedIn to build a network of academics and practitioners and assist in facilitating their collaboration on the project-level (UIDP, 2016). Another rapidly developing online tool for building a network is Bridgelight. This platform allows building a map of the actors with complementary assets (knowledge, technology, expertise) and common interests, based on the analytical algorithm that aggregates and examines all the the data available online, combining it with additional, specific data provided by participating organizations themselves. An umbrella type of platform for network building targeting particularly UK is Connect.Innovateuk.org, which aggregates information and data on different business and research areas at the national level, providing a basis for cross-disciplinary connections.

Innovation marketing platforms use a number of tools that help to disseminate information about academic research online and make it more accessible and understandable by business – in essence, to make science more open. Friesike et al. (2015) provide a comprehensive overview of the initiatives supporting open science, including online tools, such as Atlas Twiki Portal – an open-access platform that provides access to the results of the CERN lab. Another example is Sciworthy, which delivers easy-to-understand scientific news. A platform specifically dedicated to marketing university research has been developed by the UK-based start-up called Leading Edge Only. Using the principles of online marketing, Leading Edge Only provides a space for scientific discoveries to be presented, generates and analyses statistics concerning interest in particular technologies or ideas by tracking clicks and number of kits downloaded.

Data arising from Phase 2

As part of the phase 2 data collection we interviewed the owners of one platform of each type identified. Table 3 presents a summary of the results.

Education-focused platform: EduSourced

The EduSourced is a web-based platform developed for managing student-company collaborative projects. It’s run by a USA-based start-up founded in 2013. The platform enables the creation and management of new projects (using the functionality of traditional project management tools), whilst also collecting feedback from both students and clients (companies). Moreover, the platform provides a function for supervising a project by the university teacher or supervisor. Therefore, for universities the platform provides a digital space allowing centralized and efficient management and monitoring of collaborative projects. In addition to actual involvement into project-based learning, the students also learn about project management tools. The projects are funded by a company and run by a team of students, often with faculty oversight, in collaboration with a company manager. According to the interview with the EduSourced CEO, there are cases, when after working for the company the students were hired by the client organization. The main benefits of EduSourced for companies is that first, they get an easy access to low-cost skilled students, which through collaborative work could be evaluated and can lead to relationships where new employees could be discovered. The second benefit is that they use digital tools to manage difficult projects in a fast moving environment, with businesses that are used to working with (project management tools). EduSourced also runs a number of joint seminars and webinars on university-industry collaboration and project-based learning along with other topics involving both companies and universities. The main revenue streams for EduSourced are the fees paid by universities. According to EduSourced CEO, the demand and interest in EduSourced is growing and the current team ambition is to expand its presence globally.

Knowledge, technology or IP transfer platform: IN-PART

IN-PART is a three year old UK-based start-up. The main goal of their online platform is to match new university technology and opportunities for collaboration, directly to industry.

Initially started as a pilot with a small amount of funding, six universities and 40 companies became involved, now IN-PART has raised funds and grown into a network of 52 universities (mainly UK-based, but also leading institutions from the USA, Australia and Japan), with users from over 500 companies.

IN-PART strategically introduces university technology and/or opportunities for collaboration, to a curated network of users from industry. Opportunities range from very early-stage research with potential commercial application, to ready-to-licence technologies. Their approach is exclusively to company executives, with the goal of connecting them to the university for further discussion about an opportunity. If the company is not interested, IN-PART collects qualitative market feedback on the technology or solution, and shares this with the respective university TTO. This is also reported within regular Impact Reports, which also contain quantitative user interest metrics, and helps universities to better understand the commercial value of their solutions, and at the same time get a better picture of current industry needs. If a company is interested in the university opportunity, IN-PART personally introduces parties directly.

We interviewed two IN-PART users - representing an innovation and technology transfer office of the same university in the UK - and received very positive feedback

about the platform from both. One comments on the usefulness of the platform for collaboration (universities and companies):

“There are many of those platforms, but mostly it’s about IP. ... They [InPart] are quite useful for some companies, that have technology scouts and companies actively looking. ... The really good thing [for university] is the reports that come out, which detail the people that are interested...”

For companies, the platform helps in saving resources used to scout for new university technology or commercial research ideas, as they no longer need to browse individual university websites; instead receiving opportunities tailored to their interests via email. This links companies to applicable university opportunities on IN-PART, these consist of around 500 words, explaining the university technology/collaboration opportunity in a standardised format. Specifically this reviews: background to the technology, its benefit over existing technology, and the actual form of collaboration the university is looking for e.g. licencing, funding, collaborative research, etc.

When the university representative was asked about an ideal online platform, they admitted that university-industry relationships are all about people, noting that at the end the actual connection often happens offline, because it could be challenging to understand online if the people are able to collaborate or not - but the IN-PART tool provides an initial point of contact. The main revenue stream for IN-PART is an annual fee paid by universities.

Crowdsourcing platform: NimbleBee

NimbleBee is a crowdsourcing platform developed by a small Belgium company in 2013, where the main concept behind the platform is to engage students to solve industry challenges. These industry-led projects are undertaken within their university programme (as part of the curriculum) and take the form of a competition, where the best results are validated by the end-user. The platform currently operates across around 40 universities and 4 B2C companies and to date it is focussed on design and packaging challenges. As each project round must align with the university curriculum, NimbleBee runs two competitions each year, although the companies have an appetite for more frequent competitions. According to the NimbleBee programme manager, when comparing the quality of the outputs across other crowdsourcing initiatives open to the public, NimbleBee scores higher in terms of client satisfaction and quality.

Each NimbleBee cycle starts by scouting for industrial challenges among the companies, firstly within the NimbleBee network but then beyond it. The NimbleBee team works on designing the challenge to make sure that it fits the NimbleBee scope (design and packaging) and then sets out the scope to ensure the company expectations are clear to the universities and are applicable to the university study programme. If the university decides to join the competition, only at that point is it publicised to the students, who then in turn accept (electronically) the programme terms and conditions (responsibilities of the parties and overarching legal framework). Then the competition starts and runs over two rounds. The first is a three months design round. Each university gets a private space on the platform and cannot see the others’ work in progress, but the sponsor has an access to all the design solutions. Then experts representing the industrial sponsor of each competition evaluate the proposed designs and select 10 finalists out of an average of 50 submitted per challenge. The second round is a consumer-sparring

round, when 10 finalists submit their solutions and a panel of about 50 consumers representing the company’s target audience evaluate the proposed design solutions (again enabled by the online platform). The consumer panel votes and comments on the proposed designs and then volunteers from the consumer panel are invited to start working directly with the designer and through an iterative development process the designers improve their solutions and resubmit their final proposition. All the communication is via the platform. Finally, the sponsor selects three winners, who receive a monetary reward as well as the knowledge and experience gained from the process. In terms of IPRs, by default the IP created during the NimbleBee competition belongs to the student or to the university (depending on the conditions of university-student agreement). However, the company gets, by default, a non-exclusive right to use it for their purposes or they have a six-month time sterile period of non-disclosure, to decide if they wish to buy the exclusive IPRs from the student/university.

From a few month programme and for a relatively small fee the companies (sponsors) get a new design-concepts validated by end-users for relatively low costs and they also get access to jointly trained and developed potential employees (talents). The whole process happens via the closed and secure web-based platform. This keeps the development process protected from competitors and efficient, since it avoids the costs of all the actors (university teachers, students, corporates and end-users) travelling to meet each other, as has been the case in previous, similar projects. The universities in turn get a free access to real industrial challenges, receive direct inputs from industry in the curriculum development and get their students trained with real industrial experience and monetary reward.

In terms of why the NimbleBee platform has grown, the main competitive advantage, according to the programme director is:

“We are compared with existing crowdsourcing platforms, like 99Designs for instance, but we do not like this as we think we are an alternative to those programs. The main differentiator is that it [99Designs] is not linked with the curriculum. Another differentiator is that most programs, if not all, stop with the first round and they deliver only the ideas. I don’t think there is another program that also includes consumer-sparring”.

For more detailed analysis of NimbleBee in the crowdsourcing context see Still et al. (2015) and Still & Soens (2016).

Currently negotiations for expanding the tool towards engineering challenges, in addition to design and packaging, are ongoing. Also the NimbleBee team is intensively working on getting all the processes (including negotiations, achieving sign-up, company acceptance etc.) even more automated to increase the function and scalability of the business.

Network building platform: Bridgelight

Bridgelight is a UK-based start-up that offers a unique tool, which applies semantic textual analysis, to enable the construction of a visual map of organizations and linked individuals, based on their networks expertise and current interests. Currently, Bridgelight has more than 250 academic and industry users. Its client base includes universities, research centres, members of the UK Catapult network, trade associations and manufacturing organisations. The platform uses a combination of data available online and data provided by the organizations themselves (e.g. specific financial information, their own network of partners, or their interests in innovation and

collaboration challenges and requirements). The platform's main function is to dynamically interrogate the network map, refocussing it around keywords that could represent challenges, or funding calls or any other common opportunity for collaboration. Initially, Bridgelight started out focussed on a particular sector, the UK railway industry, but since the platform was launched it has received a growing interest from a number of other sectors. Another particular sector with rapidly developing potential at the present is university-industry collaboration, and the Bridgelight CEO has challenging targets for populating growth over the coming months. He describes the origins of the idea behind Bridgelight:

“If you look at one person's unique data profile, and then you compare it to thousands of other people's unique data profiles ..., you can begin to build clusters of people, who've have the same types of activities, interests and therefore problems, and perhaps who've all got the same sort of goals or aspirations and maybe who have the same type of skills or capabilities and expertise. Once you began to build up that map, you can then begin to apply your knowledge or your ability to use that map in a whole range of different ways. ... up until know, bridging the gap between the network's connections has been done manually, by people operating in a boundary-spanning role.”

The Bridgelight platform is a powerful tool, which enables the initial construction and visualisation of the network. Creation happens as an automated process and consequently, radically reduces the time and resource normally allocated by companies to try to understand their connections and market entry points. By using this platform, companies can rapidly find a new customer (or market), or identify collaboration and innovation opportunities, which otherwise were not visible.

Once the data sources are identified, the users begin by entering a set of keywords which dynamically generate the construction of the map of relevant nodes. Exploring a particular node within the map uncovers relevant themes where the user can drill into more information about the related organizations, individuals, and, eventually, the source data. The Bridgelight CEO describes the value his platform brings:

“I would say that a map or visualisation of who does what across any industry sector is useful at any level of business. In fact, it is one of the most valuable sources of business intelligence that you can possibly get hold of. ... The fundamental benefit that we offer is that we provide that map of who does what.”

As the platform analyses a university's skills, competencies and track record (including the UK Government Gateway to Research database), it is able to help companies in searching for university partners and likewise, for universities vice-versa. The Bridgelight map helps to identify the challenges that industry faces, who is working on these challenges and thus makes a partner / collaborator search both easier and more targeted.

Bridgelight's specific competitive advantage, when compared to such platforms such as LinkedIn etc., is that it aggregates not only the information provided by actors themselves, but also all the data provided by third parties – for example, it can analyse press releases, interviews, third party websites, etc., to generate a more comprehensive picture of the organization's true profile. The other main advantage is Bridgelight's ability to visualize the network of companies and actors surrounding a problem therefore giving a view into the sector structure. Unlike manual projects to map and analyse a capability network (typically costing organisations £50k-£250k, taking 3-6 months and

delivering a static picture), the Bridgelight platform provides a live asset that can grow and maintain itself on an ongoing basis.

Innovation marketing platform: LeadingEdgeOnly

LeadingEdgeOnly (LEO) was selected from a set of innovative marketing platforms as the platform is specifically designed to promote university research and lead to adoption by industry. The LEO platform was launched by the UK-based start-up in January 2014. LEO currently has about thirty universities (based in USA, UK, The Netherlands, Australia, Singapore and China) and over 80% of FTSE100 and over 60% of the Fortune 1000 companies as clients. In addition, a number of investors represent a part of the LEO network.

For thirty universities that LEO has on board, it prepares a brief digital profile of the university assets (it could be a ready for market prototype, or just an idea or even a research methodology), publishes it on the platform and supply the corporates interested in the relevant innovation with these profiles via emails. The LEO founder notes that the general problem that universities have is a lack of marketing skills to promote their innovation, which even puts them in a weak position compare to high-tech SMEs. LEO suggests it can help, according to their CEO:

“I think, where the universities suffer ... is while competing with the SMEs that do understand inter- degree marketing.”

For companies, LEO provides an access to description of university assets (knowledge, ideas or technologies) formulated in industry-oriented language. LEO also collects the challenges that industry search solutions for and provide universities an access to these challenges, so university researchers can better understand the industry needs and possibly address them in their research. As a result, the company gets a comprehensive description of the innovations available from all the universities on the platform or as a customized set – depending on the company request. This enables the process of searching for academic partners and reduces costs. The platform founder says, in respect to the benefits that companies get:

“If you are in America, you are not going to go and look at ... the Helsinki University innovation or Hong-Kong University... It is impractical. ... So, one big advantage that corporates like is they know they can come to our platform and see at the moment innovations from thirty universities. So, they don’t have to go to each university’s website, which they just will not do.”

The LEO platform is developing quite fast from a start-up, to a worldwide online tool. That illustrates a demand existing for such an intermediary as well as scalability of their platform. Having a real-time access to both the university knowledge assets and industry interests tracked by monitoring clicks and downloads of the university innovation profiles, LEO is able to identify the trends in certain areas both in science and in business. The CEO of the LEO platforms comments on its progress:

“Yes, we can track the sector. ... In 2014 we had 60.000 of these engagements (the number of times the innovations are open and read), now in April 2016 it got to 600.000 of these engagements... and yes, we have 15 employees... yes, it’s a good business model”.

In terms of the actual revenue streams, LEO's main stream are contracts with large corporate clients, while the universities get the innovation dissemination service for free.

Table 3 provides a summary overview of the five UIC online tools. In the following section we discuss our main findings.

5 Discussion

In our study of intermediation in the UIC field, we have considered a range of intermediation platforms and undertaken a two-stage evaluation of the platforms. We can note that the emerging forms of intermediation analysed in this study represent "external" type of intermediary (e.g. they are not university-based, but represent a separate organization) according to the classification proposed by Wright et al. (2008). Similarly, in terms of the key functions performed by intermediaries, as proposed by Howells (2006), our cohort of emerging intermediaries undertake scanning and information processing; knowledge processing and combination/recombination; testing and validation; evaluation of outcomes, although to differing degree for each platform. What is more noticeable, and constitutes a function not expressly identified by Howells is that all of our intermediaries in the UIC context focus on the derivation and solution of problems. Two of them utilise this problem focus to create a project-based learning opportunity as a supplementary outcome. This aligns with the concept that suggests that a problem-orientated focus is an important tool to galvanise stakeholders with diverse organisational goals and motivations (Krajcik & Blumenfeld, 2006; Hung et al., 2008). What is also evident from our cohort is that the emerging platforms also focus on enabling collaboration across the globe, thus, diminishing the importance of geographical proximity (studied precisely by Laursen et al., 2011 and D'Este et al, 2012).

From analysis of secondary sources, we were able to construct a primary typology. The key five types of intermediating platforms defined are: education-focused, knowledge and technology transfer focused, crowdsourcing platforms, network-building platforms, technical platforms supporting joint research. By mobilising our second phase of data collection, we confirmed that we can populate the emerging typology for online platforms which are playing an intermediation role in university-industry collaboration. This typology uses specific functions and forms of intermediation, types of stakeholders involved and also challenges observed in certain mediation type as differentiators. In terms of the benefits offered by the platforms we analysed, all of them focus on the facilitation of university-industry collaboration in a virtual space, which in turn offers resource savings on both sides. It also enables matching and networking to be more targeted. Only one of the platforms, however, used automated text recognition to automate data collection and comparison – with the remainder relying on more 'people' centred activities.

Table 3 Analysis of *university-industry collaboration online* platforms

<i>Platform</i>	<i>Platform Functions</i>	<i>Platform benefits for universities</i>	<i>Platform benefits for industry</i>	<i>Platform revenue stream(s)</i>
Education focused platform <i>EduSourced</i>	Supporting the transition in Higher Education toward real-world experience. 1) Creation, management and assessment of the learning projects 2) Internal communication between students, teacher/supervisor and company representative 3) Team dynamics monitoring and student impact assessment	1) Access to web-based tool, which integrates the teaching programme and collaborative project functionality 2) Possibility to facilitate and monitor online the collaboration between students and companies (clients) 3) Linking multiple experiential initiatives together for a more consistent student experience and better university records	1) An access to web-based tool, which allows collaboration with low cost problem solvers 2) An access to web-based tool, which allows collaboration in education and uses an interfaces and functionality that business is used to	Annual fees paid by universities
Knowledge transfer focused platform <i>INPART</i>	A platform connecting universities and companies: 1) continuous monitoring and analysis of the universities capabilities and companies’ needs 2) Preparing an introduction of university innovations 3) Putting companies and universities in direct contact based on their common interests	1) Access to up-to-date information on industrial needs in a target area 2) Access to companies executives interested in the university innovation via platform	1) An access to up-to-date information on university expertise in a target area 2) Minimized time and costs on search for the right people in academia	Annual fees paid by companies and universities
Crowdsourcing Platform <i>NimbleBee</i>	A competition-based platform for solving industrial challenges in a curriculum-integrated process	1) Access to real industrial challenges 2) Receiving an industrial guidelines in development of the curriculum 3) Competition as a motivational factor	1) New ideas and their validation by end-users for relatively low costs 2) The platform is closed and secure 3) Access to jointly trained and	Fees paid by companies

		for students (monetary benefits are not the main)	examined potential employees	
		4) Coaching and mentoring of students by industry representatives	4) It's a full-service program: the company only needs to bring a challenge and the fee. Everything else, including legal framework and IP-transfer, is taken care of by the intermediary	
		5) Real-life study projects to offer students: including collaborations with company and lead-users		
Network building platform <i>BridgeLight</i>	Builds a map of actors describing, who is doing what and who is currently interested in what based on both the data provided by third parties and by the companies themselves: 1) Mapping the networks based on the known relationships (supply chains, project dependencies and organizational structures) 2) Mapping the networks based on match in capabilities and expertise, technology and innovation, funding and investment	1) Access to industrial problems 2) Access to a dynamic visualised map of companies interested in particular areas and at the same time interested in collaboration with universities	1) Mapping the known relationships: supply chains, project dependences: better visualization of the entire network, better navigation, access to clients problems and better control over the sector 2) Mapping the network of existing expertise: discover new collaboration opportunities, discover new seed collaboration, identify new technology, find funding and investment opportunities	Annual fees paid by companies and universities
Innovation marketing platform <i>LeadingEdgeOnly</i>	Digital market place for university innovation: 1) Publishing digital profiles of the university innovations 2) Distribution of information among companies in the sector 3) Monthly reports on marketing performance of innovation 4) Collection and publishing of industry challenges 5) Putting universities and companies in direct contact	1) University innovations got promoted worldwide and also targeting specific companies – potential partners 2) Better understanding of the university innovation market position 3) Knowledge of the industry challenges in the field 4) Getting access to targeted and interested industrial partners' contacts	1) Free access to direct connection with university 2) Receiving a solid and clear picture of the university innovation in the area on a regular basis 3) For large corporate clients: targeted search for required partner or technology among universities	Fees paid by large companies

When considered from a policy perspective, all of the platforms offered a way to disseminate university research results and attempted to help industry to learn and gain value for the businesses concerned, while the provision of industry feedback helps universities to better understand industry problems and the value that university research has for industry (Wilson, 2012). This aligns well with policy drivers and research onto the triple and quadruple helix models of interaction (Etzkowitz, 2002; Carayannis, 2014).

At an organisational level, the platforms, which involve students in solving industrial challenges, help universities in developing a more industry-oriented curriculum and improves the image of the university delivering a more substantial amount of industry collaboration and impact achieved. For companies such platforms help in identifying talented potential employees.

Finally, our findings suggested that digital platforms for university-industry collaboration and networking are a rapidly growing market. Even though it is still at a development stage, the number of businesses focussed on breaking down UIC barriers are growing, with some platforms achieving scalability and expansion.

6 Conclusions

This paper contributes to the university-industry research field but helping to understanding how novel intermediaries in university-industry collaboration are forming, in terms of online platforms. We suggest this assists in closing the gap between the theory and rapidly evolving practices of intermediation in university-industry collaboration. Our research also attempts to augment the existing knowledge on UIC intermediaries, borrowing from the theory of inter-organizational relationships, to focus looking at the external ties that UIC intermediaries have (as per research gap addressed by Howells, 2006). More specifically, by defining the typology, role and function of online platforms as innovation intermediaries in UIC, we bridge the gap in understanding the involvement of these organisations in the collaboration process and their position in the collaboration value-chain accordingly. This is of importance for both the theory and practice around university-industry collaboration.

We also consider this study to have an additional practical value. First of all, it creates the awareness of existing UIC platforms and tools within the community of academics and practitioners – which in turn may influence their collaboration by using these tools, especially if they are attracted by the functions that make this activity easier and smoother. We know that collaboration of academia and industry is often problematic and we conclude that the involvement of the intermediary organisations we have studied eases the collaboration process and improves the outcomes.

Finally, we suggest that policy makers may find our typology useful for developing support for intermediary companies (outside of the internal classification) and thus fostering UIC, now that they are better able to identify the types of organisations that are coming forward. We suggest the typology proposed in this research can serve as a starting point.

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