University-Business-Government Collaboration: From institutes to platforms and ecosystems

Nyman, Göte

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University-business-government collaboration: from institutes to platforms and ecosystems

Göte S Nyman

Correspondence:
gote.nyman@helsinki.fi
University of Helsinki, Helsinki, Finland

Abstract

An outline for a platform-based, bottom-up model, based on extensive project practices, is introduced for the university-business-government collaboration (UXC) analysis. Current internal incentive problems of UXC at universities especially in Europe are considered and guidelines introduced for a fast-lane platform model for building agile UXC knowledge engines. Experiences and learning lessons from small-scale, university-business-government collaboration cases are described and used as supporting knowledge for the hypothetical, bottom-up type of collaboration model. The practice experiences emphasize the role of the individual actors in opportunity pursuit and the value of the traditional academic capabilities as self-organizing elements in a successful UXC.

Keywords: University; Business; Collaboration; Triple Helix; Platform

Spanish: La colaboración entre universidad, industria y gobierno: de los institutos a las plataformas y los ecosistemas

Resumen: Se describe un modelo de abajo a arriba basado en una plataforma para el análisis de la colaboración universidad, industria y gobierno (UXC). Se toman en cuenta los actuales problemas de incentivo interno relacionados con la colaboración UXC en las universidades, especialmente en Europa, y se introducen pautas para un modelo de plataforma de vía rápida, así como para construir motores de conocimiento UXC eficientes. Se describen casos de experiencias de colaboración a pequeña escala entre universidad, industria y gobierno, los cuales se emplean como base de conocimiento para el modelo. El enfoque enfatiza el valor de las capacidades académicas tradicionales como elementos de auto-organización y factores de éxito para la colaboración UXC.

French: Collaboration Université-Entreprise-Gouvernement: des Instituts aux plates-formes et aux écosystèmes

Résumé: L'article décrit un modèle bottom-up basé sur une plate-forme, pour l'analyse de la collaboration Université-Entreprise-Gouvernement (UXC). Les problèmes actuels d'incitation interne liés aux UXC dans les universités en particulier en Europe sont analysés et des lignes directrices sont présentées pour un modèle de plate-forme de voie rapide et pour la construction de moteurs de connaissances.
UXC efficaces. Des cas de collaboration université-entreprise-gouvernement dans des expériences à petite échelle sont décrits et utilisés comme base de connaissance pour le modèle. L'approche souligne la valeur des capacités académiques traditionnelles en tant qu'éléments d'auto- organisation et facteurs de succès pour la collaboration UXC.

Chinese: 大学–企业–政府合作:从科研院所到平台和生态体系

摘 要**:** 为分析大学–企业–政府的合作(UXC),本文提出一个基于平台的自下而上的模型。目前人们 探究了关于UXC的大学内部激励问题,特别是在欧洲;并且引入指导方针(行动指南),形成快 车道平台模型和建成有效的UXC知识引擎。本文说明了由小规模大学–企业–政府合作案例而来 的经验,并用作我们的模型的支撑知识。这个观点强调传统学术能力的价值是UXC的自组织要 素和成功因素。

Russian: Сотрудничество между университетом, бизнесом и правительством: от институтов до платформ и экосистем

Абстракт: Модель платформы "Снизу вверх" описывается для анализа сотрудничества между университетом, бизнесом и государством. Рассмотрены актуальные проблемы стимулирования внутреннего сотрудничества в университетах, особенно в Европе. Предложены ведущие принципы построения модели платформы быстрого развития и построения эффективных двигателей знаний. Использованы несколько примеров взаимодействия между университетом и бизнесом в качестве доказательств модели. Этот подход подчеркивает ценность традиционных академических качеств, как самоорганизующихся элементов и факторов успеха сотрудничества.

Portuguese: Relações de colaboração Universidade-Negócios-Governo: das instituições para plataformas e ecossistemas

Resumo: Um modelo botton-up é descrito, para a análise da colaboração universidade-empresa-governo (UXC) baseado em plataforma. São abordados problemas de incentivos internos atuais nas universidades, especialmente na Europa, relacionados à UXC e são introduzidas diretrizes por um modelo de plataforma sendo construídos eficientes motores de conhecimento UXC. Em experiências de pequena escala, os casos de colaboração universidade-empresa-governo são descritos e utilizados como apoio de conhecimento ao modelo. A abordagem enfatiza o valor das capacidades acadêmicas tradicionais, como elementos de auto-organização e fatores de sucesso para UXC.

Multilingual abstract

Please see Additional file 1 for translation of the abstract into Arabic.

Background

Co-evolution of the universities with their societal environments has a thousand-year history, but a challenging near future. Historically, the University of Bologna, for example, was intimately connected with the church and the city in substance and lived by teaching the canon and civil law, but was able to remain relatively autonomous because of its income from wealthy foreign students who even had the power to hire and fire the professors. In this sense, the university was built from the bottom-up, as its independence was so natural that there was probably no need to consider the relationship of the university and the city as a 'collaboration' (cf. Pace 1907).

Today, such university relationships are indeed considered as 'collaboration', either according to the University-Business/Industry (UBC) models or more generally the Triple Helix of university-business-government (Etzkowitz 2008). Currently, at the European level, the institutional analysis framework dominates the UBC analysis. It is grounded

on the structures of the higher education systems, business organizations, and governmental base; the latter is described as the 'Action level' that drives the 'Factor level,' which then leads to the 'Result level' (cf. Davey et al. 2013a, b). Single actors, agents, and bottom-up developments do not have a strong role and position in these models.

However, because the university vs. private sector and public sector system is now seen as a major source of national competitiveness, there is also a trend to view it as an ecosystem where 'the multiple actors need to work cooperatively and in a coordinated manner' (Davey et al. 2013a; see also Nyman 2013). On the other hand, the innovation system analysis has extensively relied on entrepreneurial perspectives in both the USA and Europe (Etzkowitz 1983; Benner and Sandström 2000; Shane 2004; Wright et al. 2007; Etzkowitz and Ranga 2010; Ács et al. 2014). The ecosystem and entrepreneurial models share such properties as their basic economic and technological requirements, but their social and governance-related drivers, for example, can differ significantly.

While the institutionally oriented ecosystem model on UBC (Davey et al. 2013a) emphasizes its contribution to knowledge society and identifies the general ecosystem levels, an organization-cultural, practice-centric, and socially grounded approach is left rather open. It would be necessary to understand what, in addition to the institutional factors, actually leads to the emergence of vital interaction between universities and their partner organizations. It is no exaggeration to claim that the current Triple Helix development at universities is far from functional, and some of the obstacles are reviewed below.

Applying the ecosystem model to the university-business-government collaboration entity requires the knowledge of the vital forces that actually feed the emergence of such ecosystems and exist on the underlying platforms (cf. Cusumano and Gawer 2002). These forces can be economic, technological, social, policy-related, academic, cultural, and psychological in nature, but they require a functional platform, coupled with the ecosystem. Hence, the recognition of the relevant ecosystem platforms is especially valuable when choosing supporting policies concerning any ecosystem.

In the following, the term 'university-business-government collaboration (UXC)' is used to denote many of the university collaboration forms and sectors related to the industry, business, or government partners. For example, it may refer to research collaboration where the partners come from large university institutes and governmental offices with shared interests, or it can be a small university-based research team (fewer than ten researchers) working closely with a business unit of a private firm and sharing their specific research and development (R&D) goals. The collaboration itself can concern either single firms or their business units, specific sectors of industry, ministries, public offices, or business activities within a global business partner network. Only when relevant, a university-business (industry) collaboration is here denoted by 'UBC'.

A platform look

There is accumulating evidence on successful industrial, technological, social, and service platforms (e.g., Amazon, Cisco, Facebook, Google, Intel, Microsoft, SAP). Although run by these well-known firms, the platforms have grown to cover a spectrum of services and customers, often outside the original business area of the company (e.g., Amazon Cloud). The platform concept, as defined by Cusumano and Gawer (2002),

includes general elements that offer inspiration for the analysis of modern UXC platforms. For example, there are at least five relevant concepts: (i) *the scope* and extent of internal/external innovation work, (ii) *the openness* of the technology and other architectural elements underlying the innovation activities, (iii) the nature of *interaction* and complementary collaboration, (iv) *relationships* with external parties, and (v) *the structure* of internal organization and its alignment according to the platform strategy.

The concept of platform can be either wide or narrow, but typically, it does not refer to a closed system, or to a technology, organizational structure, or a function alone. In consumer businesses, for example, a platform can include social, cultural, and even political elements as has been demonstrated by the social media applications corresponding to Facebook, but used in China and Russia. Many of the platform elements are intimately connected with the ecosystems, and indeed, they can be seen as the necessary sources of ecosystem growth.

Here, the UXC platform concept is introduced to reframe the university-business-government relationships and identify its behavioral requirements. It is a bottom-up, practice-oriented complement to the institutional models, with the aim to help universities enter UXC platforms and speed up this development. The approach is somewhat similar to the entrepreneurial analysis of national innovation systems; the national perspective is described by Ács et al. (2014) using the framework of National Systems of Entrepreneurships (NSoE). They note: 'NSoEs…are fundamentally resource allocation systems that are driven by individual-level opportunity pursuit, through the creation of new ventures, with this activity and its outcomes regulated by country-specific institutional characteristics'. In other words, they not only emphasize the role of *individual-level pursuit* and the individual ability to create new ventures but they also look at institutional obstacles of NSoE, having influence on venture pursuing individuals. The individual is considered as an entrepreneurial actor, constrained by institutional regulations and other environmental factors controlling entrepreneurial behaviors (see also e.g., Lundvall (1992) and Nelson (1993) on the national innovation systems analysis).

The role and function of an individual actor in the modern UXC environment has become ambiguous. Traditionally, academics have been motivated by the ethos and culture of the scientific endeavor, but today, they are subject to the economic and competitive factors that constrain all forms of science including basic research. The question now arises of how to provide opportunities for academically motivated people to work in the UXC contexts, different from the traditional basic research environments *and* how to do this without sacrificing what is best in the academic ethos and value system.

The UXC platform can be considered as a functional base where individuals (university researchers and students with their collaborating partners) are encouraged to behave according to the UXC requirements and the academic values. Such platforms already exist, but they should be recognized. They emerge as a result of technological, economic, social-individual, and/or cultural and even regional factors, tightly coupled as different configurations constituting the de facto growth factors where profitable and productive UXC interaction is possible. If successful as systems, the platforms can feed a true ecosystem emergence (cf. Gawer and Cusumano 2008). However, the situation is complex for the current collaborating parties who are guided by the historical

institutional regulations, emerging new policies, the largely varying values, and incentives of different and sometimes even conflicting partnering organizations in the UXC.

A successful platform, which can also exist without explicit support from the institutional university regulations, is an invitation to partners from any segment of the society, including other universities, to join, but it cannot happen without a consensus and shared goals of the participants in adapting to the platform. An excellent example of the emerging Open-X activities is the development of Linux. In this case, Linus Thorvalds studied and worked at the University of Helsinki in the early 1990s and collaborated with the 'open' operating system development community, independent of the locations and institutional boundaries of its members (cf. Raymond 1999).

However, not all examples of Open-X activities are so strong. Typical examples of weak platforms in the UXC context are the institutionally driven, once-only or time-limited and program-driven research and service purchases by firms, ministries, or other organizations, which are conducted without a deeper, process-related, continued, or other entanglement of the UXC parties. While there is no explicit data on this, only practical experiences, there are good grounds to assume that this has happened in many of the EU calls where temporary research coalitions were formed, but they have not led to long-term collaboration platforms or ecosystems.

Who could take the lead? The general business trend is towards distributed, richly subcontracted and networked production and management. Straightforward, top-down control of UXC is becoming increasingly difficult and actually inefficient in this environment. Hence, involving the future generation of policymakers - the students - and academic management early at universities could itself be a means to facilitate the future university-society partnership culture and its institutional forms. However, the basic research-only governance system that does not prepare students for future academic positions with a UXC remit is a significant hindrance to this transformation. Early study alternatives, internships in firms, dynamic career alternatives, and other means could be considered as an effective solution if they were incentivized. Accordingly, Etzkowitz et al. (2012) have recently suggested a model, *Novum Trivium*, integrating education, innovation, and research in undergraduate studies, consisting of the components of academic specialization, innovation, and entrepreneurship studies and language and culture studies. They also list a number of examples from universities in Europe, US, UK, and South America, where some elements of this approach occur. Some best practices can also be found as described in the documents of University-Business Forum[a].

Changing business landscapes and UXC

Universities need to be aware of the ongoing renewal of the collaboration forms and models in businesses (cf. Samuel 2014): what is now called 'collaboration' is increasingly becoming knowledge sharing, partnering in ecosystems, and dynamic value-creating networking (Peltonen et al. 2013). This has already introduced new kinds of partnerships and public-private ventures, creating shared value by responding to human needs and social problems (Porter and Kramer 2011) and looking for business model innovations. Business giants like Intel, Wells Fargo, and General Electric have already launched services and business with such a motivation. WaterHealth[b] International is

another more specific example of a growing firm working on water purification business to offer pure water with minimum cost for people in poor countries. Universities could and should have a critical, new role, founded on academic values in making the two aims meet: advancing economically profitable businesses and promoting their beneficial societal impacts.

SMEs are known to have a significant national impact on growth, but most SMEs cannot afford the risky costs and bureaucracy of the traditional university collaboration. Furthermore, they do not have extensive experience in dealing with such activities and SME networks for university collaboration do not exist in abundance[c]. In the UK, for example, the university funding from SME collaboration in 2012 was about 1/6th of the investment in higher education relationships by the public sector, charities, and social enterprises (Docherty 2013).

As an example of their potential, SMEs in the US produce 13 times more patents per employee than large companies do and innovations in small firms are twice as closely connected with scientific research as they are in large firms[d]. Furthermore, they hire about 40% of the high-tech employees and have been responsible for creating approximately 65% of the new jobs over the last 20 years[e]. This is an exceptional opportunity for investments in UBC R&D platforms with SMEs.

The governmental sector has its own problems in fostering 'strategically valuable' UXC, especially given the current economic turmoil. One example of this can be seen in Finland, where some are returning to the 1970s policy of allocating a rather small but symbolically significant share of national research funding to be purely politically governed and aimed at what the politicians call 'strategic research,' to support national decision-making. This arrangement will certainly neglect the wider research community, especially research activities that could be valuable in the end but which do not immediately promise a solution to the political problems at hand. Certainly, the Finnish case is not an isolated one considering the complex and turbulent environment where governmental decisions are made today. In such conditions, there will be an increasing pressure to align some of the scientific and political views on what is valuable research for the society and its decision-making.

Another European trend for improving the UXC development has been to introduce external representatives especially from the private sector, to the university governing boards (EU 2011). However, a suspicion is already emerging (Pihlanto 2014) that this is actually leading to bureaucracy and 'measurement mania' due to the new demand by management for data and documentation on performance and other metrics - materials that have not been routinely produced earlier at the universities and that do not easily fit into academic work or its cultural climate. The complexities involved in the management and output evaluation of UXC will not make this situation easier in the future. If the relatively mechanical way of measuring academic performance is continued and extended to UXC as it is typically currently done, by using traditional scientific publication metrics, it will certainly make impossible a dynamic development in UXC. Typical UXC-related examples not rewarded at all in most classic academic environment are producing effective infrastructure for others to use, building collaboration consortiums, preparing high-quality reports for the partners in UXC, and the constructing novel research set-ups for specific purposes.

Although overall political support exists, the university system is extremely slow in re-shaping the UXC practices. Fast and efficient models are needed for renovating and

aligning UXC with the pressing societal and business needs. Fortunately, several simultaneous, although weak signs of this development seem to offer a chance to accomplish this: entrepreneurial, innovation-oriented, and cross-disciplinary education and research practices are already emerging globally in higher education. Furthermore, the emerging idea of the shared value production will change the way universities have traditionally seen their relationship with business organizations. In the following, we describe a platform-based, bottom-up approach aimed at solving these problems in UXC development by facilitating a smooth building of UXC.

Methods

Case findings and the approach

In the following, two general case examples are presented and analyzed, each with a relatively long UBC experience history (10 to 15 years), from the major scale global industries. Two basically different platform approaches are introduced to the UXC business model innovation. Qualitative observations are presented, and how they demonstrate the benefits of UXC platform-based collaboration is explained. The implications of the findings are then considered.

Results and discussion

Spanning a new UXC platform: a case example from the paper industry

The first case is *the spanning of a totally new platform for UXC when recognizing an opportunity for a mutually profitable partner relationship*. This is possible when identifying the economic, academic, and governance-related opportunities; their interdependencies include, then support, and incentivize the platform emergence.

The specific case example comes from a collaboration project in which our research team of experimental psychologists and one of the leading European paper mills, M-real Ltd in Finland, partnered with us. We started with five researchers, focusing on magazine and advert reading and visual quality experience research. For the business partner, the main aim was to attain a globally leading position as a provider of magazine reader experience and knowledge and to use this knowledge as a differentiating asset on the market to promote their future R&D and marketing activities. For the university team, the interest was in creating new models and methods for studying high-quality human quality perception, especially natural vision and experience, in the global paper media context. Due to the extensive international sales network of M-real Ltd. and its publishing house customers, the collaboration quickly spanned a rather wide contact and collaboration network in several European countries.

With the support from M-real and its business partners and by demonstrating the relevance of the collected research data on customer behavior knowledge, the collaboration soon extended from the publishing to the packaging industry and result-driven funding was found for it. Living on this *new platform* for international collaboration, the project lasted for 15 years, with highly successful and productive outcomes, including several spin-off awards in commercial publishing. For M-real, our research group and its novel data became an asset - in approaching the international publishing houses, for example - that their competitors did not have.

The emerging platform had all the chances to become a solid business and research ecosystem with a valuable position in and predictable support from the company.

However, universities, like companies, live their own independent lives. In our case, a direct hindrance to the incentive system plans for the project researchers was that the university salary system in Finland was renovated and applied to all employees, including the research team of this project, which froze our result-oriented pay system; this circumstance made it impossible to continue the ambitious and UBC-oriented incentive system. Nevertheless, this did not prevent the collaboration, but it was a game-changer in project management when it became impossible to aim at an entrepreneurial, independent, and economically rewarding work environment for the researchers in this exceptional UBC environment. The compensation system is an essential component of such platforms.

After 15 years of collaboration, the project was terminated when our partnering business unit at M-real was sold to another company, less interested and not prepared for this kind of UBC. This is a natural business development, and any UBC project must be prepared for such circumstances and build its long-term strategy and capabilities accordingly. In our case, the development work, especially in creating the new quality experience measuring methods, had already produced significant knowledge, capabilities, and competent personnel (about 15 to 20 researchers and research aides) so that the loss of a customer did not result in fatal problems. Other projects, first with Nokia and partly overlapping with the previous one, were launched, but now on mobile phone image quality development and the methodology and capabilities developed earlier. At this writing, the mobile phone image quality project has already continued for 10 years. Furthermore, another two-year multi-media behavior research project in Finland, China, and Turkey was run based on similar UBC capabilities.

The 'engine' of the UBC with M-real Ltd. was run by carefully managing the main sources of vitality (interests and benefits for the students, research ethics and knowledge, and the value for the firm) to feed the activity within the platform. At its best, our UBC network consisted of parties from our unit at the department of psychology, specialists from the partner firm, and their partners (e.g., subcontractors, global publishers, brand owners, and print houses). Typically, a network might consist of about 30 to 40 active people, excluding the customers. As such, the collaboration with M-real Ltd. was a rather exceptional combination of engineers and experimental psychologists and matched well with the definition of a platform (cf. Cusumano and Gawer 2002).

Joining an existing UXC platform: a case example

Our second case is an example of *joining an existing platform, with its own business, technology and R&D environment and history*: Nokia mobile phone camera production. The university team could now claim that it could offer the best available method and theory for very high image quality measurements. No similar methodology was available on the market or in research institutes at that time, and this became the flagship project that has now lasted for 10 years.

At Nokia, the interest in our image quality measurement methodology (cf. Nyman et al. 2005; Radun et al. 2010) was triggered by the novel and successful subjective approach we had from the paper industry, especially in evaluating very high image quality. We could show how our approach can offer guidance to their technical product development work, circuit selection, and competitor bench marking better than the standard

subjective or photometric methods. Seriously competing methods actually did not exist at that time, and even today, the best physical image quality measurement methods fail in differentiating vey high image qualities. In other words, we had a scientifically tested, valid approach, and working model to offer. Nokia on the other hand, had the increasingly challenging task of staying up-to-date in advancing the image quality of its products in a way that could lead to the best possible customer satisfaction. It was natural for them to first outsource the subjective methodology to us at University of Helsinki; then, after a couple of years of successful collaboration, they were ready to extend this by outsourcing the physical image measurement process to our collaborating, technical university. Thus, a new form of collaboration was generated between the two universities. In other words, the existing collaboration platform was transformed significantly, but there was an extra benefit for the partnering universities: a chance to build an effective new collaboration. The original UBC became a node facilitating the new university-university collaboration that otherwise would have been difficult to launch.

This was a case of an 'existing platform' because Nokia had conducted its camera research within its own team and in-house, and there was already a functional platform to join, consisting of Nokia's camera teams, other engineering teams, and their international circuit subcontractors. When we joined the platform, a significant process and method-related transformation began in the way subjective image quality studies and data were collected, shared, and used to support the camera development, bench marking, and camera circuit tuning processes.

The research model - actually a knowledge engine as it is described below - was based on the typical academic standards in terms of the set-ups, methods and analysis tools, number of subjects used, and the code in publishing the data. It was never necessary to question these requirements, and the shared aim was to produce highly reliable data using the best scientific methods and practices. Actually, it was obvious to everyone participating how important it was to produce trustworthy data: at its best, Nokia purchased perhaps 200 million image-processing circuits from a number of circuit manufacturers, relying on our data, and it also used the data as an operational guide in its camera development work. Some of the image quality data was also shared among selected circuit manufactures putting even more pressure on the research methods and their accuracy and control. It is no exaggeration to claim that the scientific and business interests were in a natural harmony there, and the young researchers running the studies could adopt these collaboration values and responsibilities on both sides across the collaboration boundary.

The Nokia collaboration network has typically consisted of at least 50 strong person-links including the university researchers. The number of weak links (cf. Granovetter 1973) may be of the order of 100 or more. Recently, our pure basic research project on Mind, Image, and Picture has joined this network, supported by the Finnish Academy, the leading and most competitive basic research funding organization in Finland and initiated as a spin-off[f]. By engaging several international partners and creating interest in the component industry and electronic imaging research forums, it is fair to say that the collaboration has grown from a platform to an ecosystem. R&D and basic research have been driven by both the value creation needs and the basic research ambitions shared by the university researchers and the image technology specialists. This genuine interest is reflected in a number of academic publications on subjective and physical image quality.

All this collaboration was driven by a complex network of economic dependencies related to the Nokia internal processes, sharing of the research data among international partners, and the internal performance measures at Nokia, which were naturally confidential and not shared with the university team. In summary, the Nokia collaboration with all of its extensions and academic and business drivers demonstrated the signs of a platform and can now be considered as a true ecosystem with economic, business-related, academic, and social drivers. A question remains about whether this kind of activity should lead towards the form of established centers of collaboration that could live on the well-tested ecosystem (cf. Etzkowitz and Kemelgor 1998) or would the dynamically changing ecosystem be a better alternative in the increasingly turbulent world and markets.

Interestingly, in this case, both the department and the faculty hosting us at the university have only had a secondary role, as institutes being mostly ignorant, somewhat reluctant to become involved or to directly support the work. There have been even underestimating and critical comments on our application work, but that criticism did not actually prevent the work and indeed the institutes benefitted economically from the significant overheads paid and the thesis produced over the years. Paradoxically, for the industrial world, the university brand has been seen as a significant trust factor on the market because it has guaranteed a certain level of scientific quality of the applied research work, especially when directly related to specific products.

Nokia was recently sold to Microsoft and the turbulent environment challenged the continuity of the university project. This is a realistic aspect of any UXC and should not be overlooked as a potential source of problems. The survival of the university project under these pressures is critically dependent on the competences, social capital, and knowledge base acquired over the course of the collaboration.

Platforms for UXC

Our case examples demonstrate a number of benefits in building UXC platforms or even ecosystems. The first and most obvious benefit is the speed - less than a year - in which UXC can be initiated and launched between relatively independent research units and the business partners. The slow pace of change in institutionally guided UXC programs is disturbing. Even the most radical policy decisions guiding the university-society interaction can be expected to take at least 10 years before the first signs of genuine and productive changes start to appear. Considering this, we see at least two general alternatives, although not excluding pathways for progress: firstly, *the slow lane*, long-term, institutional (currently dominating the EU-based approaches), where the focus is on restructuring the organization, support, and management of UXC systems. The second alternative concept, and further explained here, is *the fast lane*, the platform approach in which efficient UXC is sought by interfacing the university system with either a new or already existing collaboration platforms. When successful, the platforms can lead to the emergence of true UXC ecosystems. The two approaches can also be viewed as top-down and bottom-up models.

The institutional model (se e.g., levels of analysis by Davey et al. 2013a, b) can be formally ambitious, but it runs the risk of being bureaucratic and slow to build due to all the known obstacles within the university and faculty systems. In the platform approach, these hindrances can sometimes be partly avoided at universities by launching

UXC initiatives with an entrepreneurial ethos and behaviors, driven by business or governmental interests. The entrepreneurial-like activities in UCX differ from the purely institutional approaches in their self-organizing approach: they can be launched quickly and dynamically, driven by the perception of opportunities and pursued by motivated individuals or teams, often without an explicit institutional support framework and sometimes even in a hostile academic environment as described below. These activities can be rather similar to such start-up projects at universities as *startupsauna*[g] at Aalto University in Finland. There they have been building their collaboration networks partly independent on university governance constraints; that is they have been loose organizational units at the home university that can work actively with people and businesses with no direct connection to the university. They can arrange popular open-house networking, start-up, and other pitching events. Either commercial or non-commercial interests can be their value drivers, and their performance evaluations can be different from the hard-core publication metrics that are applied to the university researchers.

Here, we contrast the *fast lane* or bottom-up approaches against the dominating top-down or institutional approaches to the UXC challenge. The case examples and conclusions presented are based on the author's own experiences and experiments in a number of UXC contexts. Each is of a rather small scale, but it is informative; some university-pedagogical and project work aspects of them have been documented earlier (Marttiin et al. 2004; Muukkonen et al. 2010; Muukkonen et al. 2013). They typically demonstrate the value and efficiency of the bottom-up approach.

Our emphasis is on the main functional components of UXC: the dynamic, social, and academic-cultural factors underlying it and the value of easy and fast launching of UXC. The traditional academic ethos and values (research ethics, quality ambition, questioning of established paradigms, dynamic teamwork, and continuous method innovation) are seen as *the* success factors in UXC, especially under the demands of the emerging Knowledge Society. The single examples are given as demonstrations of how easy entrance, trust, and incentives for students and young researchers to join UXC can offer potential and speed up the progress of collaboration.

In summary, what we call the platform approach in building UXC has been based on the following functional elements and principles:

- Trusting in traditional academic values
- Building mutual understanding of the substance matter and its context
- Creating intellectual demand on both sides of UXC
- Finding ways to balance basic and applied research work and their requirements
- Looking for mutually optimal, strategic value of collaboration
- Learning to set mutually ambitious quality goals
- Creating and maintaining shared U-X processes
- Building awareness of the values and goals across the U-X boundary
- Facilitating bottom-up and lateral collaboration
- Advancing the purchasing practices of the collaborating organizations
- Surviving a potentially hostile university environment in doing all this

This is a complex and still hypothetical set of outlines, but over the years of collaboration projects in UXC contexts, we have repeatedly shown how these elements can

support the emergence of a new form of collaboration or feed an existing collaboration platform at both the university and its partner organizations. It may not be self-evident that the university work can have a significant impact on how the partnering firm will organize and tune its respective activities in R&D and marketing, for example. The partnership and working culture takes time to emerge, but it has been surprisingly smooth with young students and in our local technology and organizational context.

Constructing the knowledge engine

The case examples indicated how UXC can be the source of both the breadth and depth of knowledge expertise, which together are known to have an influence on the number of innovations produced and on their real impact (Boh et al. 2014). We have conceptualized the emergence of this kind of collaboration as the construction of a knowledge engine (KE) in which the basic research, applied research, and company functions like R&D, marketing, and management can live in balance (Nyman 2008). In this model, the 'academic depth' in the form and role of basic research is taken as a starting point of UXC. KE can then be built on an existing platform or by creating one. Our KE situations can be described by three examples: 1) the paper industry processes + print industry processes + magazine publishing houses + experience research, 2) mobile phone camera R&D + circuit manufacturers + visual perception research, and 3) not reported here: computer game development + game psychology research. A successful KE can contribute to further UXC platform development (Figure 1).

Teaching UXC project work and creating the knowledge engine with students

Along with the number of projects run, we have also studied and modeled UXC in student courses in order to learn about its management, strictly within the university curriculum and by teaching explicit UXC project work to the students. These courses have been an excellent way to recruit new student members for our UXC teams. We have experimented in half a dozen cases using the student run KE model having a distributed, virtual team organization (project teams, management team, research team),

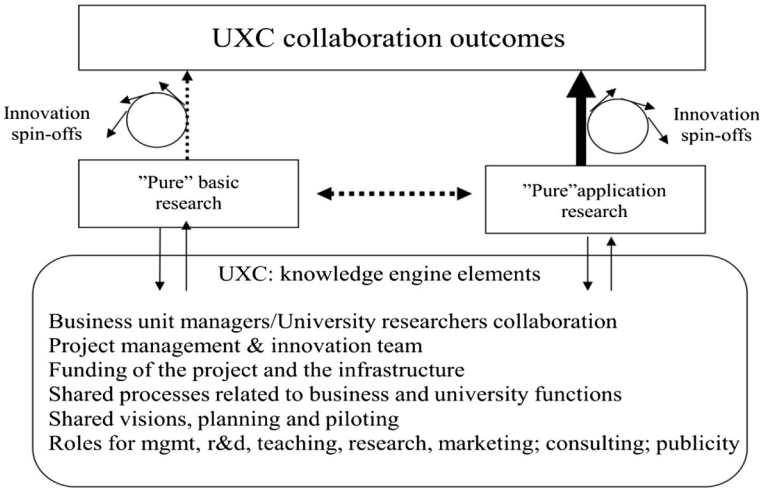

Figure 1 Outline for a UXC knowledge engine in the basic and applied research platform.

managed by the students at the university and consisting of second to fourth year students from three different universities (classic university, university of technology, and a business school).

Each 3-month project with students and a client (between 2000-2010), either from private (e.g., Nokia) or public sector (e.g., the Finnish National Tax Office), has been a genuine and result-oriented project, but configured to test the ways the knowledge engine can be maintained in collaboration. It was no surprise to find out how a productive KE requires a mix of psychological, economic, educational, technological, and organizational factors - a platform - where it can run on the energies and values of the *different* collaborating partners (Marttiin et al. 2004; Muukkonen et al. 2010; Muukkonen et al. 2013). We found it unwise to lock the UXC model, but instead experimented with it by iterating it every year along the dimensions we found useful for successful, step-by-step improvements in effective collaboration (e.g., the collaboration tools used, the management model applied, project scheduling). This was necessary since it is not possible to know what kind of functional structures and value-creating networks would evolve in our UXC context over time. This situation is probably typical in any new UXC initiative. Time and resources were invested for the UXC to self-organize - guided by the management model applied (cf. Muukkonen et al. 2010; Muukkonen et al. 2013) - in a way similar to the mature Triple Helix III 'regime' (Etzkowitz and Leydesdorff 2000; Etzkowitz 2008). Traditional academic values related to knowledge creation and research were emphasized and exercised.

In addition to learning about the best ways to prepare the students for the case and the study course and about the critical management activities necessary for systematic running of the project, a number of innovation spillovers, somewhat surprising, occurred because of our commercial and non-commercial KE projects. For example, we could generate spillover from the paper industry to the mobile phone industry or from the mobile phone industry to public (tax) services. This was the result of the business and R&D knowledge acquired during each course, the innovative working practices, and energy in the collaborating consortium of young generation, connected students and their teacher team.

There are a number of ways in which a knowledge engine can be created, ranging from the radical idea to mixing the academic institutions and campus life with industrial R&D units (cf. Nyman 2013) to UXC-related curriculum arrangements in collaboration with an existing UXC platform. However, the latter is not straightforward, and the universities need to become dynamic from the inside and offer motivating environments, especially positive academic atmosphere and support, realistic career potential, and relevant incentives to encourage the students and academics in UXC. New possibilities for KE networking open up almost every month in the domains of open x, massive open online courses (MOOCs), and crowdsourcing communities.

Prospects for UXC

Impetuses and hindrances

Most universities struggle in aiming at a mutually economical and scientifically profitable relationship with their business/industry/government partners. National variability

does exist, in the governance, academic culture, practices, and overall conditions, but as the EU data shows (EU 2011) at least in Europe, the overall variability is not extensive and no nationwide success stories exist. Typically, in Europe, the university bureaucracy and governance have been tuned to the management of basic research and teaching, which can hinder and even prevent dynamic alignment with commercial, industrial, and even public sector partner strategies. While a few positive exceptions may well exist, there is an abundance of anecdotal evidence related to the academician's fear of lack of openness in UXC-based research, in addition to other basic research ambitions and funding worries. These systemic factors preventing platform emergence can be traced to the dominant role of governmental funding, evaluation models and practices, and the inward-oriented incentive systems within academia.

Not surprisingly, there is an increasing lack of trust in governmental interventions to boost national innovation outcome. For example, Nightingale and Coad (2014) from the University of Sussex, UK, recently stated this bluntly in referring to the government-guided universities and start-up clusters to produce innovations: 'In Europe and the US, it is probably fair to say that there is not a single example of a successful cluster that has been created by government intervention'.

Preaching the benefits of UXC, but not rewarding it

There is visible political support for the higher education European policy aimed at strengthening the university-society link and for promoting the general competitiveness of the EU. This has been explicitly expressed in the EU Horizon 2020, the 80 billion-Euro program declaring, with backup from the leading European politicians: 'The goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation'. As a specific country example, the recent report by Sir Tim Wilson (2012) from the University of Hetfordshire, UK described '…how the business-university interaction, and its development, has enjoyed all-party support…'.

However, the reality and data on the internal (at universities) support and motivation at European universities remains far from this ideal, and the situation at UK universities is barely better than in Europe on average (Davey et al. 2013a). This conclusion is bluntly supported by the EU (2011) report, which monitors the maturity of UBC in European universities and shows the weak engagement of academics with serious business collaboration in general. It also notes unequivocally how academics do not see its benefits for themselves or their research. A recent report on US universities, with a balanced geographic coverage, including public and private institutions, is surprisingly similar in showing the problems of weak institutional incentives and significant faculty resistance to UBC (Ranga et al. 2013).

According to the EU (2011) report, the UBC consists of eight forms of collaboration between university and businesses: 1) collaboration in R&D, 2) mobility of academics, 3) mobility of students, 4) commercialization of R&D results, 5) curriculum development and delivery, 6) lifelong learning, 7) entrepreneurship, and 8) governance. Through this lens, the overall maturity of the UBC system and its potential to form collaboration platforms appears strikingly weak. The average grades given to the majority of the above factors - the data came from all European countries - only exceptionally reach the value 7.0, but typically lies within 5.0 to 6.0 on the scale 0 to 10.

There are alarming details in these data: to the item 'UB activities increase my chances of promotion,' university academicians give an *average* score of 4.4! (on a scale 0 to 10; it was the lowest of all in this questionnaire). The second lowest score 5.2 was given to 'UB activities improve my standing within the university'.

These disappointing findings resonate with the low scores on items measuring the weight European universities actually give to 'cooperation with business' in their assessments and incentive systems. To put it simply, a serious organizational support for UBC is practically nonexistent at universities, a finding in striking contrast to the public and political discourse. Even in the United States, data on faculty attitudes and appropriateness of the incentive systems, there is a similar although weaker negative demotivating impact for UBC as in EU (Ranga et al. 2013).

The strikingly slow development of the European UXC can be attributed to a number of traditional and modern hindrances. First, there is the current, dominant emphasis on basic research as the strategic choice, supported by its narrowly tuned performance metrics at the universities. As a result, it is not wise for a scientist aiming at tenure or promotion to publish outside the basic research forums. Second, the basic research emphasis has created an influential control and management system, which cannot be easily penetrated by UXC initiatives. Furthermore, academicians often complain about such economic and institutional barriers hindering UXC as the lack of relevant funding, bureaucracy, and problems in dealing with the publicity of knowledge (Davey et al. 2013a, b). The need for new business models or ecosystems as a solution to this problem is rarely discussed.

Guidelines for promoting fast lane UXC

Based on our own experience (cf. Nyman 2013), the following guidelines, can be proffered for supporting the UXC platforms, for promoting the potential ecosystem development and to be researched:

1. Basic research as the core. Establish a firm economic and spiritual ground for basic research that is not threatened by economically successful UXC activities. Profitable applied research in UXC can sometimes have economic and human time constants significantly shorter than for basic research. Business models must be invented to support basic and applied research in coordination.
2. Early economic incentives. Build an economic environment with a fair, ethically sustainable incentive code for integrating basic research and an industry/business-oriented work.
3. New forms of ownership. The true market value of knowledge increases fast, and it is vital to keep the material and immaterial capital values in balance. Today, almost anyone with a small amount of venture capital can expect significant profits while the immaterial investment (time, knowledge, experience, and the networks of the researchers) is treated haphazardly, and its economic value is underestimated. This must change.
4. A social platform. Encourage cultural mobility within the UXC community. Dominating paradigms, also in basic research, can become closed systems that should be opened by mobility, cross-fertilization, and suitable incentive systems.

5. Partner sectors. Public sector, industry, and business representatives need to learn about the existing knowledge and process potential, cultures, and development processes in UXC contexts.
6. Early education of the younger university generation. The younger generation (first to second year students) should be offered compelling ways to join the UXC.
7. Economic independence by profitable business collaboration. UXC, especially with industrial and other business partners must be profitable. Contrary to the popular suspicions that the universities can become dependent on businesses, by innovating successful UXC models universities can actually reach economic independence, by innovating successful UXC models similar to those at the early University of Bologna; this can also help to fund its independent basic research.
8. Education of a new generation of researchers with knowledge, balancing ethos and their academic and UXC values.

Finally, it is rare to conceive of UXC as a systemic means to directly support and improve general academic education as well and to advance the culture and civilization in general. Instead, the education-related public and political discourse on innovation systems typically deals with university-ranking-related, national, or continental competiveness issues. This is quite astonishing, especially considering the speed of change in the near future societies (cf. Toffler 1995; Webster 2006) and the simultaneously increasing awareness of the imperative to protect nature. Universities, together with their networks, as the source of the highest-level knowledge creation and renewal, will unavoidably meet these challenges and new demands, perhaps increasingly political, will be directed towards them. In this situation, one would expect early, holistic, and future scanning views from the universities where UXC is seen as a valuable strategic aspect. Toffler sees knowledge creation as the most fundamental power in this coming development. Above, we have presented our conviction of the platform approach as a fast-lane answer, not excluding slower institutional approaches, to the acute need to build effective knowledge-creating engines within UXC.

Conclusions

UXC institutional lessons learned

Collaboration-friendly platforms exist and evolve within industrial, business, and consumer environments, and numerous best practice examples are known from the pharmaceutical, food, game, and car industries. They provide a functional architecture for UXC (production units, R&D, marketing and customer communities) and offer gains for the firm as the outcomes of the established knowledge engines. Motivated, academic individuals working at the universities must be the initiating partners by educating and recruiting people with relevant competences for participating in the platforms. It is practically impossible and at least risky to start any such projects without relevant substance knowledge and academic competences. Without proper incentives, this can be difficult to arrange and universities interested in UXC should improve this situation.

There are many reasons to be cautious with institutional arrangements for UXC. For example, traditional academic values such as research ethics, self-organizing work,

continuous method development, and respect for intrinsic motivation are a vital source to innovate UXC. However, these crucial factors come under threat if strong institutional arrangements and managerial control begin to dominate the way UXC is organized, resourced, evaluated, and lad. What has been traditionally the secret behind scientific progress can be a similar success factor for productive UBC and UGC. Short-range motivation to make money with UXC should not guide the universities.

As a peculiar example of the role of the university as an institution, during our 30-year experience with a number of UXC cases in Finland, our collaboration connections have never been created by the university officials or by their units whose actual job has been to advance such collaboration. The reason may be local, but it is straightforward: substance knowledge and trust-based relationships with the right people at the relevant levels in firms and organizations are crucial in building UXC dynamically and fast. Institutional relationships grow slowly, and they can be problematic, especially if they dominate the university initiatives.

Although the role of the right individuals is mentioned, the EU policies for boosting UBC focus on top-down or top-to-top relationships and building institutional support for UBC. Only occasionally are significant and detailed bottom-up practices suggested as social innovations in UBC. This is surprising considering the current trends in entrepreneurship, business life, organizational evolution in the society, and the emphasis on the value of *grass-roots platforms and ecosystems.* Most universities do have entrepreneurship programs and even the Horizon 2020 invites small-scale collaboration networks, but innovative, locally driven, and trust-based UXC models are also needed to open opportunities for university communities, especially the new generation of students.

The latest EU country report (e.g., Davey et al. 2013a) paints a dark picture about the internal human and social problems in UXC at most European universities, and these obstacles should not be overlooked. In our own, although a local case, but surely not the only one, there has been a paradoxical aspect of the long-lasting UXC collaboration: our own alma mater has been a non-interested and nearly a hostile environment where this kind of work with firms has been either explicitly or implicitly considered as suspicious or of little academic value, while at the same time, our business or governmental partners have been highly motivated to build effective UXC. As the EU data suggests, our case is not exceptional in Europe where the career prospects of academic researchers active in UXC are typically ambiguous or at least uncertain. The conflicting university demands cause the academics serious problems: a recent study from the UK shows serious motivational and even mental problems in the complex and ill-defined and 'non-caring' academic performance environment (cf. Shaw and Ward 2014). The young students and researchers joining the UXC will probably suffer even more if this controversial state of affairs prevails.

Building collaboration platforms and ecosystems

UXC platforms and ecosystems should be based on the best of traditional academic values and entertain respect for high-quality and tested knowledge. Individuals can be motivated to UXC by caring for these values, offering material and immaterial rewards and incentives to energize the individuals and their research and teaching communities,

including the recruited young students. Universities are not masters in achieving this, and relevant organizational and legal support is needed for encouraging the young generation interested in R&D and other multi-disciplinary and application- or business-oriented partnering.

Small businesses, perhaps even located on the campuses and mutually owned by the university and the participating university communities could work as a model environment where young researchers and faculty management could take realistic learning lessons of various forms of UXC. There is a successful, although special case example at Aalto University, in Finland, with a rather wide scale of activities covering the support from design and up to mass production processes[h]. There are excellent creative and dynamic UXC environments and possibilities in the United States, for example the d.school at Stanford University (cf. Kelly and Kelley 2014) and the acknowledged work under the concept of 'Innovation Space' - MIT and Harvard demonstrating the emergence of start-ups and leading to knowledge-driven regional development (Etzkowitz 2002; Etzkowitz and Ranga 2011). A regional approach, within the whole EU framework, is not straightforward, but could offer significant opportunities nationally.

In the middle of the economic and institutional problems, there are good reasons to maintain strong functional bonds even when direct economic support is not available - either from the university or from its partners. The partners can view such situations as an opportunity to invest in future competence building and as part of their social and knowledge capital. Breaking the bonds even for a short period makes regaining the lost capital expensive.

Future visions and the UXC challenges

We are all familiar with the numerous wake-up calls related to climate change (cf. World Bank report 2012) and forecasts predicting a problematic global future due to unsustainable resource use and growing inequality (cf. Wilkinson and Pickett 2010). A study from the UK Government Office for Science (Beddington 2009) warns about the speed at which the crisis, caused by the increasing need for food, water, and energy is approaching: serious problems can occur within two or three decades. Whatever the speed of this development and the nature of the solutions to these threats, universities need a reliable way to develop their future activities and plans to be agile and find their new UXC roles under these unavoidable pressures.

Recently, Wilenius (2014) has introduced a futurist analysis based on the Kondratieff wave/cycle model forecasting the global economic, technological, social, and cultural changes, which will also have a significant impact on the future universities. According to him, the emergence of the sixth wave has already started and will continue approximately from 2010 to 2050 and bring the challenges of scarce resources, globally growing inequality, and pressures to align corporate business objectives with social goals. There is a need to build learning organizations in place of organizational silos. Assuming that this development will occur, even at a crude level, it will introduce opportunities and needs for new industries in a number of sectors, ranging from cleantech to transportation, bringing with it changing value systems, new professions, and corporate cultures. The universities could and should be in a strategic position to meet these new demands that will profoundly touch all forms of UXC.

We do not claim here that national or continental science and education strategies should be politically directed only towards these coming problems. However, all basic sciences will be affected by these global developments, from legal and educational to economic and natural sciences where UXC will be a significant strategic channel to combine the interests and knowledge-creating potential of universities and their business and governmental partners. This is a straightforward call to the higher education and innovation systems planning and policy-making communities to reposition and renew the role of the universities in preparation for the future UXC. The dark side of this is the risk of political maneuvers aiming at guiding university research towards politically favorable problems at the expense of basic research quality and self-direction.

Endnotes

[a]http://ec.europa.eu/education/tools/university-business_en.htm

[b]http://www.waterhealth.com

[c]The definition of SMEs is not straightforward; hence, their UXC situations cannot be easily compared between countries (a SME has <50 employees/Finland; <100 employees/Norway; <300 employees/World bank definition; <500 employees/USA. Cf. Gibson 2008 for problems in defining SME).

[d]http://archive.sba.gov/advo/research/rs225.pdf

[e]https://www.sba.gov

[f]https://sites.google.com/site/mindpictureimage/home

[g]http://startupsauna.com

[h]http://www.aaltodesignfactory.fi

Additional file

Additional file 1: Translation of the abstract into Arabic.

Competing interests

The author declares that he has no competing interests.

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