

Chapter 4

Enhancing knowledge exchange and collaboration in Hungarian higher education institutions

This chapter expands on the findings presented in Chapter 2 related to knowledge exchange and collaboration. It provides an in-depth discussion of the challenges and opportunities and suggests that higher education institutions (HEIs) should not shy away from becoming “pioneers” in the sense that they actively promote and reward entrepreneurship, innovation and the third mission by aligning strategy with operational day-to-day practice. Students, researchers, administrative staff, academics and the HEI leadership, as well as the general public, lend increasing support to the HEI’s role in enhancing knowledge exchange with a general trend towards the Knowledge Society. The chapter explores current strategies and practices to organise knowledge exchange across the HEI and provides learning models on effective support structures.

Introduction

The modern higher education institution (HEI) is an organisation in transition. The traditional roles of research and teaching are increasingly complemented by the ability to transfer knowledge and technology into other realms, where it will benefit industry, politics and wider society. The third mission, as this new task of HEIs is referred to, paves the way for HEIs to assume a more active role as innovators on a regional, national or even a global scale. The new mission does exhibit opportunities for closer co-operation with external stakeholders, provides new sources of knowledge (possibly also financing) and helps HEIs to get rid of the myth of “ivory towers” once and for all. Notwithstanding the potential benefits, there are also challenges for the organisational routines of HEIs which are mostly adapted for delivering research results and educating students.

With the progression through the Knowledge Era, society faces more complex challenges that often demand a combination of knowledge or technology spread across different fields. Complexity of “real world” problems mirrors an increased complexity in research projects, many of which (both basic and applied) have become transdisciplinary in nature. At the same time, knowledge production has become an extremely specialised task. Whereas in times of Leibniz¹ (1646-1716) it was still possible to unify the most essential knowledge of the time in one individual, rapid accumulation of knowledge and scientific progress have led to a fragmentation in terms of individuals that possess certain expertise in a scientific field. The result is a distribution of knowledge within HEIs over several hundred (if not thousands of) individuals that are all experts in a very narrowly defined area.

In addition to the fragmentation in scientific knowledge, science has seen fundamental changes in how financial resources are allocated. Elements of competition for funding have been introduced to a substantial degree into research funding schemes to increase efficiency and reduce costs. In order to successfully compete against others, researchers need information on funding opportunities and specific skills to apply for a grant. Activities that would be referred to as “in-house consulting” or “internal services” in a business context have increased in HEIs. This has resulted in a further division of labour between “scientists” and “university professionals”. The internal state of the modern HEI thus is such that scientific knowledge is dispersed and procedural knowledge is decoupled from the scientist. Consequently, the efficiency of an HEI in solving complex and meaningful problems and successfully competing for resources depends upon how fast and easy knowledge flows are organised inside and across institutional borders.

At the same time, pressure on HEIs has increased to “produce something useful” and to help diffuse research results to the general public. More and more emphasis is thus on projects with translational character including direct involvement of firm research and development (R&D) in the very early stages of the research process. These developments regarding the nature and kind of research projects affect several dimensions such as the composition of research partnerships, prerequisites for external funding and expected results.

The third mission (and subsequent developments) emphasise the role of HEIs in shaping societies or, at least, in expanding its role in society beyond the traditional activities of education and research. For this, HEIs need to know what is going on in their environment. Especially in regions where HEIs also constitute a major economic force (as an employer and a demand factor), assuming an active role among regional stakeholders is in the HEIs' own interest, but requires organisational capabilities that have previously not played a major role.

Transdisciplinarity and translationality closely correspond to the needs of internal and external knowledge exchange. Whereas internal exchange in HEIs helps to ease frictions in bringing together different disciplines – and along with it different theories, methods and traditions – exchange with externals becomes increasingly important, too. This requires researchers to be informed about collaboration opportunities and supported in the management of joint projects. In order to prevent fragmentation and simultaneously comply with the expectations of the third mission, a sufficient level of knowledge sharing and exchange is needed. Ideally, the modern HEI possesses (or builds) the capacity for conducting a professional knowledge management.

Knowledge exchange (especially with the environment) is not an entirely new phenomenon and has always taken place at HEIs. Bits of information are continuously exchanged by people at their workplace and beyond. However, increased complexity, fluctuations of personnel and amount of information, as well as speed of information flows, call for co-ordination (“knowledge management”) at least to some extent to arrive at meaningful exchanges conveying true “knowledge” and not purely “information”.

Engaging with others in any organisation is often complicated by interfacing problems. Especially with external partners that originate in other realms, different organisational logics complicate communication and call for a mediator. This can be an experienced technology transfer office (TTO) or, on a more abstract level, a set of institutional arrangements like industry-sponsored labs, professorships held by industry professionals or the opening of HEI facilities for public exhibitions that incentivise knowledge sharing and facilitate knowledge flows.

Turning uncoordinated and random encounters between HEI members and the “outside” into continuous, directed and mutual beneficial exchanges, which result in institutional impact going beyond the level of individuals involved is one of the main challenges for HEIs. This does not mean that uncoordinated knowledge exchange is undesirable or useless. Granovetter (1973) emphasised the relevance of (informal) “weak ties” in knowledge flows as being more flexible and faster than (institutionalised) “strong ties”. Trust is often mutually established through personal contacts and acts as a major facilitator of knowledge flows.

The emphasis on formal knowledge exchange institutions in this (and many other) recommendations is an attempt to provide a framework for regular and co-ordinated knowledge flows that are sustainable and efficient in the long-run and on an organisational level. Informal contacts, mutual trust and even mutual “liking” among different parties will, without doubt, still play a role in the extent to which knowledge is exchanged and the success of co-ordination attempts as a result.

Analysis and findings

The following discussion of findings from the review of current knowledge exchange strategies and practices in five HEIs in Hungary should be considered with caution, because not all of them may be applicable to all sorts of HEIs in general and to the Hungarian ones in particular.

- The visited HEIs differ in their structure and focus of academic disciplines. Some are fully-fledged “universities” with every scientific field covered, others are more specialised in their areas of education and research. This is likely to have an effect, for example, on the need for cross-disciplinary exchange, which will be less of a problem in “focused” universities, where knowledge base, common research and teaching traditions can be expected to be more similar.
- HEIs differ in their age and reputation in the country. Some are considered “national heritages” by their peers, whereas others have assumed university status more recently. This is likely to influence access to resources and political support through reputation effects and/or strategic considerations.
- Some HEIs were in a restructuring process with significant organisational stress surfacing throughout the visits. For those HEIs it may be detrimental to introduce new initiatives before restructuring is completed, as it is likely to have adverse effects through increasing pressure even further. Any efforts to pursue activities along a third mission agenda should be at least thoroughly co-ordinated with any ongoing projects for integration of departments at the HEIs in question. Furthermore, it is highly likely that those HEIs will prioritise restructuring and may have neither the financial resources, nor the time to pursue an elaborate third mission development plan.
- Some HEIs are regionally concentrated, whereas others have up to 100km distance between their campuses (partly because of the aforementioned restructuring). Although positive effects in terms of the ability to tap into different regional configurations may exist, it is likely that the dispersed HEIs will have difficulty in maintaining a cohesive organisational culture and strategy. In the best case, a federation-like model of departments may emerge that benefits from a variety of knowledge bases and experience. In less desirable scenarios, the HEI leadership is unable to find a good balance between organisational freedom and central co-ordination, which creates barriers that reduce collaboration between different departments.
- The environments of HEIs are different. Those in or close to Budapest are nearer to the “national central hub” and may benefit from proximity to policy makers, larger co-operation partners or infrastructure to name but a few. On the other hand, more constraints may exist as regards external financing (e.g. for the EU structural funds), because Budapest is not as much a “developing region” as many other Hungarian districts. Conversely, HEIs in these “outer regions” may have a less vibrant/dynamic environment, but perhaps a better access to financing.

Positive attitude and general commitment towards knowledge exchange

The HEIs visited demonstrated a strong commitment to knowledge exchange, at least at the highest level of leadership. Several promising activities are underway (or already finished). Public authorities put more and more emphasis on the impact of scientific knowledge generated in HEIs, urging them to engage with (local) industry and community organisations if they apply for funding. Building bonds with local firms and devising strategies for research

orientations that take the regional environment into account should thus also enhance future prospects of successfully securing funding from national and supra-national sources.

The HEIs should not shy away from becoming “pioneers” in the sense that they actively promote and reward third mission activities aligning strategic mission statements with operational day-to-day practice. Individuals (students, researchers, higher education professionals, etc.) as well as the general public (government, tax payers, etc.) lend increasing support to third mission and with a general trend towards the Knowledge Society, this is likely to further increase in the future. In particular, HEIs that face challenges in the other two missions – for example, because they are less reputed, smaller and/or younger or located in more remote areas – should embrace the new mission, even if it is still evolving and entails uncertainty as to what kind of activities it actually encompasses. Admittedly, changing attitudes and directions at HEIs takes time and resources. However, in the end, it is supposed to be “the” third mission of HEIs, not “a” third mission. Accordingly, required changes are of fundamental nature.

Knowledge exchange and collaboration, or the third mission, is a comparatively new expectation by society that HEIs have, however, always engaged in, albeit not in a structured way. Third mission activities, if taken seriously, should be on par and in synergy with the traditional missions of HEIs, which are education and research. The difficulty of prioritisation arises, because the latter two are well established and proven indicators exist to measure their effectiveness. All strategies and mission statements include mentioning of various forms of knowledge exchange and collaboration. This, and the reference to the third mission in the country’s new higher education strategy, confirms the importance of the issue to all stakeholders. However, the understanding of knowledge exchange was limited to technology transfer activities in general, and research spin-off companies in particular. Largely missing was the wider notion of knowledge exchange activities as engagement with business and industry, the community, public policy, other education providers, as well as activities related to the artistic, cultural and sporting life of the local economy.

Some of the HEIs (or parts thereof) have been subject to frequent restructuring. Without doubt, the rationale behind this poses at least as many threats as opportunities. Opportunities may consist in the possibility to incorporate new, previously not available knowledge and competencies into the HEI. However, the visited HEIs seemed to be under severe stress and the “new” departments did not seem to primarily consider the restructuring to be an opportunity. Together with the rather high level of distrust (see below) there is a risk that the newly incorporated parts remain isolated. This may result in disconnected knowledge bases with a lot of potential unlikely to be activated. There are cases where parts of the same HEI are now located across a radius of several hundred kilometres, which makes it even harder to connect knowledge bases and establish a common institutionalised knowledge exchange framework, both inside and outside the HEI.

The visited HEIs have shown resilience and openness to experimentation, however, the enthusiasm at top-leadership level has not yet diffused through all parts of the HEIs. Some interviewees expressed their worries that many new ideas are coming “from above” without the necessary support. Researchers seem to be confused and overwhelmed on what to prioritise once confronted with leadership expectations to get more involved in knowledge exchange activities. A well-communicated strategy, which explains objectives, activities and resources of the third mission helps to legitimise the “new” role of the organisation both externally and within the HEI.

Promising examples of knowledge exchange activities with external stakeholders

All the visited HEIs are responding to an increasing pressure from society to interact with external stakeholders and assume a more proactive role in local and regional development. This results in a range of activities pertaining to internal structure and specialisation in academic disciplines, as well as institutional self-consciousness and characteristics of the surrounding economy. A surprising range of activities has crystallised to be successful at different HEIs. This emphasises the illusion of “one true” model of the third mission and the need to adapt to existent structures, resources and environments. It also indicates that there is room for mutual beneficial exchange of what the third mission entails and how it can be organised across different HEIs.

Local governments are key partners of HEIs. Naturally, co-operation is stronger in smaller cities and more rural areas where public authorities constitute a comparatively stronger stakeholder and HEIs a comparatively larger employer. Experience from other jurisdictions also indicates that in less centrally located regions, where there is only one (larger) HEI, co-ordination with local authorities is often easier (though less professional), because HEIs do not have to compete against each other for attention (and public resources).

The HEIs recognise that their role in a region is closely connected to the existing environment and its stage of development. Regional proximity also very often facilitates knowledge flows, especially if large components of it are tacit. Furthermore, it helps to build trust and increases the likelihood of forming of “weak ties”. Regional firms are also more likely to face similar challenges to HEIs, especially if regional development is less dynamic. As a result, flexibility was evident in the kind of structures and support measures to be set up for knowledge exchange and technology transfer. Sometimes, experimentation had led to unique organisational solutions. In other examples, strong regional industries have become the priority target of the HEI. Consequently, third mission activities of HEIs often mirror the capacities in the region for external and research co-operation. Adaptation has often led to a focus industry (or several industries) as well.

Co-operation and exchange with local firms range from research projects on various scales to external financing of whole departments. The Széchenyi István University is fortunate to have, with Audi Hungaria, a strong regional partner with a factory employing a significant proportion of the local workforce and sponsoring an entire faculty specialising in automobile engineering. The relationship between Audi Hungaria and the university is sustained by a number of institutional arrangements. A dedicated contact person in Audi Hungaria co-ordinates the relationship. Firm employees are members of placement commissions for professorships and frequent exchanges at the researcher level enrich research activities on both sides. All of these are regulated by a formal co-operation agreement, but significant exchange is also happening on a much more informal basis, for example in the form of factory visits, joint coffee & chat sessions etc. Exchange and formal co-operation also exist in teaching. Whether it is by “invitation” of the university or through Audi’s own commitment, the mutual knowledge exchange seems to also work well beyond the automobile engineering faculty. However, a word of caution is needed: a narrow focus on one strong partner may be damaging in the long-run and leave smaller opportunities untapped. For the moment, however, Széchenyi István University seems to have found a good balance between courting the firm’s engagement and developing other areas with regard to the third mission.

The Eszterházy Károly University of Applied Sciences has established co-operation with the local dairy industry, albeit small and not particularly long-lasting. This also includes a new research laboratory that was partly financed by the EU. Researchers consider the co-operation a success in so far as a viable platform for collaboration has been developed. Still, they pointed out that further co-operation may be complicated by capacity issues on the side of the firms and different “passages of time” in the university and the local producers. Moreover, discussions revealed that the collaboration more or less ends on the university side when a new product is created, whereas for the firm side further resources would have to be devoted to development and marketing, and future collaboration may depend on whether the new product actually brings a return on the market.

The collaboration portfolio with industry on education activities is growing. It spans from short-term internships to fully-fledged dual education programmes (read more on this in Chapter 1). Particularly in certain disciplines, students are benefitting from the possibility to work with top-tier equipment, which was partly sponsored by firms. The ground gained with respect to co-operation in education is, however, overshadowed by the fear of HEIs to lose too many students to firms once they have entered an internship and encounter with modern work environments. HEIs also expressed their worry that firms often make attractive offers to students resulting in a high attrition rate after they graduate from Bachelor programmes. Many seem to even quit their undergraduate studies and start a job without having completed higher education. This is alarming because it leaves the students without a formal education, which may negatively affect their future job opportunities and the HEIs will lose out on promising future researchers if they are unable to retain enough students for academic careers.

Different measures come to mind to counter this development. First, a modular and more flexible system of entering and leaving the HEI, with the possibility to suspend studies and recognition of study credits should incentivise students to “come back” after having gained work experience (see final section in Chapter 3). Second, an even closer co-operation in education with industry may help students to see their studies through to the end. The challenge in this respect is twofold: students have to be convinced that they are actually learning something “applicable” and “useful for real-world problems” and the HEI has to provide something a firm cannot deliver through learning-on-the job. The former presupposes up-to-date equipment and a good understanding of current challenges in industry, whereas the latter demands cutting-edge teaching methods.

Dedicated dual education programmes that are already in place in several HEIs could be enlarged to provide a source of funding for those students that face difficulties financing their studies. Because these programmes are often paid by firms (at least partially), the HEI has to deliver knowledge, skills and learning experiences that cannot be attained by other means. There is room for action to introduce more dual forms of education at postgraduate levels. So far, there are only a few industrial PhDs and no dual programmes at Master level. This is surprising as several of the HEIs visited clearly have an orientation towards Science, Technology, Engineering and Mathematics (STEM). A possible explanation may be the fear of losing students or the missing regional capacity. An important opportunity for both firms and HEIs to bring in new knowledge and collaboratively engage in innovation and problem-solving is thus overlooked.

Efforts are underway to create support structures for knowledge exchange

Strategic planning for knowledge exchange is still ongoing the HEIs. Learning curves are steep and some HEIs may not have had enough time to accumulate sufficient

experience and evidence to prioritise activities and to establish an effective support framework. Academics, administrative staff and even HEI leaders seem to be sometimes unsure of how to translate strategic plans into their “daily” work and routines. Moreover, there is uncertainty among staff as to whether one is rewarded or punished for third mission activities, which are all too often perceived as add-ons requiring additional time and resources. Uncertainty on which activities to foster and which to cut is still high both at the institutional and the individual levels. All too often the attitude seems to be “me-too” or “must-have” rather than an informed motivation to enrich education and research through engagement with knowledge users.

At an individual level, a significant number of research collaborations exist both nationally and internationally. As in other countries, personal connections and inter-organisational employee mobility between HEIs play a significant role in this regard. The question is how to develop this into a framework that allows for individual links to create institutional spill-over effects, such as new knowledge exchange activities or new areas of collaboration.

Experience in organising institutional support structures for third mission activities plays a crucial role for success. Some of the HEIs have recognised the need to bring in external expertise. The University of Debrecen, for example, hired an outside professional with experience abroad as head of the TTO to help set up new activities. Although an “outsider” may face difficulties in engaging with researchers and external stakeholders at first (because of being from “elsewhere”), s/he may be in a better position to implement necessary changes without having to pay attention to personal contacts or institutional short-cuts that may have built up over time and that will always bias an individual who has been part of the HEI for a long(er) time. Additionally, s/he may act as a figure of authority with respect to perceived expertise.

Hiring new and competent personnel for the third mission should enhance the ability of HEIs to introduce changes. However, with quite some variation in how much freedom and command over resources the newly appointed person has, legitimacy of his/her position may be comparatively weak. Even more so, because it will take an outsider some time to get acquainted with the existing organisational structure and its underlying institutional roots and routines, and find the key people in the HEI who may act as “door-openers”. It is worth a thought to team the “new” employee with a highly reputed academic, who enjoys the trust of leadership (perhaps even a retired professor) and who can simultaneously act as a conduit to reach out to HEI staff and current/past HEI partners. Otherwise, many opportunities will be forfeited simply because researchers and the TTO do not want to speak to each other or are not able to understand each other, because they do not speak the same language.

New communication tools for knowledge exchange

HEIs and their external stakeholders, especially from industry, often have different institutional logics. These result in differences in structural set-up (for example the departments or sub-units to be expected) but also determine the speed and direction of knowledge flows. For a potential partner coming from the respective other realm it is often difficult to understand how the HEI works. This can create barriers to finding the right partner to help solve a problem, and posing questions to the right department or person.

A possible way to ease this problem is to set up “one-stop-entry-points” that reduce the time it takes for externals to get fully acquainted with the HEI’s institutional logic.

Similar to other services (e.g. student counselling), a potential partner approaches a central authority, whose task it is to re-distribute a request to partners within the HEI. Thus, the responsibility of finding the right person to speak to is shifted from potential partners to a person or office in the HEI that is informed about both the competencies of staff and the peculiarities of the HEI's institutional logic.

With a growing number of knowledge exchange activities, this should not only work for outside stakeholders but become an entry point for “insiders” as well. Very often, a complex third mission portfolio branches out at some point into different activities, for example, licensing, start-up support, innovation consultancies, etc. Various support schemes, external partners, or sometimes just “divisional thinking” may result in different departments of the HEI practising some of these activities without other departments being aware of them. At this point it might be difficult for internals, e.g. researchers, to find the right contact person. A “one-stop-entry-point” should then be turned into a platform that serves both internal and external stakeholders. In all of the visited HEIs such “one-stop-entry-points” exist; and at least one staff member had been appointed as responsible for communication with the outside environment. A common practice is to put a technology transfer officer in charge, who reports directly to the HEI's top-leadership.

A “one-stop-entry-point” is often organised through an online contact or ticket system, where requests are collected and then referred to the relevant units or individual staff members. The Szent István University recently introduced such a system and designed knowledge sharing tools targeted at different audiences. These included research catalogues and a “knowledge map” for better advertising of the HEI's research topics and competencies to external stakeholders.

Professional knowledge sharing tools become important once an institution reaches a size which makes it impossible to only rely on face-to-face communication. They allow for easy access from different parties and act as a long-time archive with the option of analysing knowledge flows for process optimisation purposes. Crucial points for any such tool are its ease-of-use, presentation and structuring of information, and regular input from its users. Often, a platform, map or sharing tool is introduced with great effort, but stays dormant thereafter, because users find it too cumbersome to utilise.

A knowledge map may aid in this endeavour as it visualises competencies and can act as a decision support tool. Furthermore, it may also help to display proficiency/competencies/fields of knowledge to external stakeholders and parties potentially interested in co-operation. Besides their function as a display to the “outside”, knowledge maps can also act as a strategic planning instrument for HEIs' leadership, because they highlight competitive advantages and weaknesses. A regularly updated map can provide information on what opportunities to pursue with the combination of knowledge at hand and which to let pass, because resources would be mobilised in vain.

Although there is a degree of path-dependency when setting-up support structures for knowledge exchange, and some decisions may prove irreversible in the short-run, this flexibility is something to treasure in future developments. Experience of the Silicon Valley in California and attempts to recreate its success in other regions “out of thin air” have shown that there is no one-size-fits-all solution to the challenges faced by modern-day HEIs. Organisations are well-advised to take into account un- or underutilised resources to support experimentation (and perhaps failure) before finding the “right” model that fully fits their needs.

The Széchenyi István University demonstrates a noteworthy amount of flexibility and openness to trial-and-error learning with regard to the institutional set-up and the size of its TTO. At the time of the study visit there was no formal TTO but a technology transfer council as a more formal approach “just did not seem to work”. This adoption to idiosyncratic needs is much desired when setting up third mission activities. Empirical work has revealed some common factors for successful knowledge and technology transfer (e.g. size and staffing of the TTO, extent of organisational inertia, legitimacy from university leaders, etc.). These should not be taken as a blueprint. Environmental conditions play a huge role for success and activities should be carefully adopted in size and scope. Taking a step back is sometimes an option if initiatives do not yield the desired outcome. Future expansion possibilities notwithstanding, finding a working model and having confidence in it may be a success factor for HEIs. The current model also seems to require slightly less resources and causes less co-ordination work. Furthermore, the university also has an intermediary organisation, Universitas, that acts as a complement to the technology transfer council and a separate legal entity. The ability to bundle knowledge from across the all faculties makes the university an attractive partner as whole portfolios can be offered instead of single technologies. A challenge seems to be that as an independent legal entity Universitas is not entitled to act as an official representation of Széchenyi István University, which is often desirable for means of reputation and legitimacy (see Chapter 2).

Not enough connections with linking institutions and incubators

A constant dialogue is needed to tailor knowledge and technologies to the needs of firms, which often work along lines of cost-benefit, potential demand and product-portfolio effects. In the case of the visited HEIs, partner SMEs often lack resources and capacity to engage in large-scale projects. And even if local firms are not missing capacities (see below), they need to realise that HEIs are the right partner for their innovation activities. For this, the HEIs need to understand the institutional logic of their partner firms; simply “presenting” results and hoping for application/commercialisation is not enough. Research projects earning recognition for HEIs’ researchers may have no apparent value for firms. Very often, however, results have the potential to improve firms’ operations if their criteria for success are taken into account early on. Sometimes, a little more effort in development may be needed, which calls for reserving (or redistributing) a certain amount of (financial) resources after a research project is finished.

Even with mutual knowledge about the partners’ institutional logic and modes of operation, the gap between HEIs and firms, but also society at large, is often too wide to be bridged without a linking institution or a mediator. Although not always initiated by the HEIs themselves, the possibilities of (brokered) contact with industry and society increase, and the intensity of exchange is likely to grow in the future. HEIs also show increasing interest and build up their own science centres to attract incubators to their respective locations. Initiatives by HEIs come at a time when public and governmental support is on the rise, both nationally and internationally (especially support from the EU). The environment for setting up and attracting linking institutions is therefore especially favourable at present.

Contact with mediator institutions depends heavily on geographic and knowledge proximity, that is, whether these are present in the regional environment and match with the discipline portfolio of the HEI and its third mission agenda. In other words, contact depends on factors not always to be influenced by HEIs.

The visited HEIs showed only a few connections to incubators. One reason could be that they do not exist in a sufficient number outside of Budapest (yet) and HEIs themselves do not have enough resources to establish them. If they have resources, a slight tendency to focus on physical infrastructure (perhaps as a result of public support schemes) rather than on institutions, structures and going concerns was evident (see Chapter 5).

Dominance of personal contacts in knowledge exchange

Procedures exist in all visited HEIs to enhance a formalised knowledge exchange that is not bound to single individuals, who would create a “gap” if ever they left the HEI. However, the majority of knowledge flows is still through personal contacts. This is true for both the inside and the outside dimension. This is not to say that personal contacts are bad. As mentioned earlier, knowledge exchange through personal contact is one of the oldest forms of interaction with the (industrial) environment for HEIs. “Weak ties” are essential facilitators of knowledge diffusion. Additionally, scientists may prefer personal contact, because, once established, it is a faster and less bureaucratic way of interacting with the outside environment.

However, in most HEIs knowledge sharing is still not seen as an activity, but rather something that “happens alongside” other activities, and professional knowledge management is missing or in a very early phase. The potential damage to the HEI is severe.

- First, connections to long-lasting partners are often lost if they existed only on a personal basis. This constellation is especially unfortunate, because the HEI can influence only one side (that is, its own) whereas the connection may be lost if the interlocutor on the other side leaves. Empirical evidence also shows that individuals often carry their personal network with them as they leave (in fact they may have been hired because of their network). If knowledge exchange is largely based on personal contacts, it is quite possible that a departing employee will also take with them the co-operation partner.
- Second, the HEI has less control over what is actually arranged in collaborations, which has multiple issues. On the one hand, scientists may simply have no idea about what is common “on the market” and sell their services significantly below value. On the other hand, what is a good deal for an individual may simply not be as good for the HEI as a whole. Further problems are a lack of quality control and possible damage to reputation if the delivery was not satisfactory.
- Third, the HEI forgoes information possibilities on industry trends and may possess competencies that it is not aware of, because both information and competencies are not publicly revealed or honoured. A good example in this regard is grant writing experience that would often benefit a number of individuals but tends to be scattered across a few highly active researchers, unless a central service exists that collects information and assists individual researchers in formulating their grants.

To sum up, for fast and efficient knowledge flows, resources have to be allocated for the establishment of an effective knowledge management system, with an observatory of relevant industries, support tools and ways to institutionalise individual contacts.

Incentivising knowledge exchange

Incentives can help to align the individual motivations of employees with the (knowledge exchange) aim of the organisation. The range of possibilities in this regard is long, and spans from purely symbolic recognition, to changes in the job description, to financial rewards. The conclusion from the study visits and the interviews is that the

institutional culture is not very outward looking and conducive to knowledge exchange. A striking commonality is the distrust that people have in sharing information through institutional channels. Knowledge exchange seems to work almost exclusively through personal contacts. Incentives for exchange or collective “burden sharing” are virtually non-existent. Vital competencies are isolated and procedural knowledge (for example with regard to grant writing) is shunned by colleagues, either for fear of opportunistic exploitation or because of the lack of mechanisms for diffusion through the organisation. On the positive side, some researchers seem to utilise their freedom to voluntarily engage with industry, sometimes in a very informal way. They conveyed that these contacts are essential for their research and that they are not inhibited by the HEI, either because the HEI is not aware of the contact or it (passively) endorses the exchange.

The Eszterházy Károly University of Applied Sciences has established a quality assessment system for teachers and researchers. Even if this system may not work perfectly or does not have a direct impact on the salary of employees (like a provision system in a firm would have), the very fact of having a quality assessment says a lot on performance orientation but also on the value of transparency and willingness to engage in (friendly) competition (see Chapter 3).

A quality assessment with universal criteria ensures transparency among colleagues. Its usage also demonstrates a high level of trust between employees. Transparency and trust are highly effective facilitators of (internal) knowledge transfer. Furthermore, for outside stakeholders such a system may convey an increased level of “professionalism” and act as a positive signal of quality to be expected (for example when engaging in formal co-operation).

From an organisational side, there seemed to be too few credible incentives in place to facilitate exchange and no “punishment” for bad practices existed. Additionally, a rift between administrative personnel and scientists exists (although to some degree this is normal in HEIs). Administrative staff are sometimes perceived as not helpful and often unknowledgable (from the scientists’ side). However, this is a one-sided view and the truth may be that administration is as overwhelmed with the “new” mission as scientists are. Unfortunately, distrust between scientists and administration will inhibit vertical knowledge exchange and the flow of procedural knowledge. This, in turn, may lead to a mutual blockade between academic and administrative staff.

There was a widespread fear of losing proprietorship when revealing knowledge and a common fear of others taking advantage. Co-operative behaviour seems to be frowned upon and works mainly with close partners and personal contacts. Consequences of the high level of distrust correspond closely to the ones highlighted above, but here they are particularly challenging because distrust, if rooted in personality and general behaviour, will be hard to overcome in the short to medium term. Some interviewees expressed the view that the lack of trust is a feature of the common cultural consciousness of Hungarians. As such, it would need strong individual incentives, role model setting by leadership and a lot of patience to overcome. Trust issues did not seem to be as prevalent in international co-operation, possibly because the involved individuals do not compete for the same resources and/or funding schemes at national institutions.

Unused potential in transdisciplinary research

Internal co-operation among researchers is a common feature in all the visited HEIs and good examples of transdisciplinary projects exist, also with other HEIs nationally and abroad.

Room for improvement exists with regard to possibilities to set-up interdisciplinary initiatives outside of external funding calls. HEIs could set aside some resources for fields with strategic importance and medium- to long-term relevance in society. This could also help to develop a more distinct research profile and may include external stakeholders to emphasise a transfer agenda.

There are several examples, at the visited HEIs, of research projects spanning several academic fields, thus fostering cross-disciplinary knowledge flows. These collaborations take on various forms, from externally financed projects to cross-disciplinary doctoral training schools. However, strategic initiatives for cross-departmental research are still rare. There seems to be no room for an agenda on “challenge-based” programmes (e.g. ageing society, e-mobility, climate change). Accordingly, transdisciplinary knowledge exchange (apart from the examples mentioned herein) takes place mainly only on a personal basis and in reaction to calls for application to research funds. Virtually no resources exist for “bottom-up” cross-faculty co-operation. This is unfortunate for at least three reasons.

- First, publicly available research grants move towards an emphasis on multi-disciplinary approaches. If consortia are only formed at times of opening of calls, the respective HEI may simply be too late to file for a competitive application.
- Second, as already outlined in the introduction, challenges faced by society grow in complexity and very often demand expert knowledge from different fields to arrive at an acceptable solution.
- Third, horizontal co-operation may be an opportunity for HEIs whose departments would otherwise be too small to make an impact (see below). With a focus on a few strategic areas (to be decided upon by the scientists themselves) spanning larger parts of the HEI, resources may yield synergies that were hence undiscovered. Furthermore, smaller HEIs may actually benefit from their size in this regard because a shorter personal distance in smaller organisations tends to facilitate knowledge flows and increases success of transdisciplinary endeavours.

All visited HEIs had some sort of “PhD council” supervising graduation procedures of young researchers, which offer a co-ordination mechanism for knowledge flows across departments. These councils provide a good example for institutionalised knowledge exchange in a specific area, which is neither at the “rector”, nor at the “dean” level. The *raison d’être* for the councils is a task-based orientation: regulatory control on assigning PhDs and implementation of related operational frameworks. In some form or another, structures like the PhD councils will exist in most other countries as well, because it is often one of the privileges of universities to assign PhDs to individuals. Most (senior) researchers, independent of nationality or discipline, should share a common understanding of “how and why” with regard to this particular institution. It is therefore conceivable that they act as a blueprint for other knowledge exchange institutions, even if those focus on a different task. Researchers often hold academic freedom in high esteem and are often resistant to change, simply because they associate additional workload and not benefits. Although an HEI may sacrifice some efficiency, it could be worthwhile to think about designing knowledge exchange mechanisms that work along the basic principles of the ones already accepted by researchers.

Capacity issues

Some of the visited HEIs are too small (taken individually and not necessarily in all their research fields) to achieve critical mass as partners for industry. This seemed especially true for large multinational companies. Interviewees expressed a dilemma here: Local firms are often too small and lack the capacity for joint research projects, whereas larger, foreign-owned firms have the choice with whom to engage and ruthlessly execute their greater negotiation power. Additionally, those firms have standards that cannot always be met by HEIs, both in terms of quality and quantity. As a result, HEIs claimed that they are very often only a “junior” partner if they were able to persuade the larger firms to co-operate. For example, in life sciences large multi-national corporations dominate the market and the competition for research co-operation happens on a global level. Interviewees pointed out that, despite available capacity with high standards and top-tier equipment, the HEI may lose out to research universities from abroad who are better connected. Strategic alliances between HEIs and the restructuring of the higher education system can create critical mass.

HEIs often cited the lack of critical mass in their environment as an obstacle to increased knowledge exchange and collaboration. Some of the HEIs are perhaps too small and possess not enough bargaining power to approach big firms for research collaborations. A national co-operation framework initiative that “directs” firms to regions outside of Budapest and enhances collaboration between HEIs and with public research organisations could help to overcome this.

In the United States, the Association of University Transfer Managers (AUTM) is a long-standing organisation bringing together professionals from different HEIs. At the European level, ASTP-proton is perhaps the closest equivalent (with personal membership). In Germany, a national body called “Technologieallianz” is in its seed-stage. This organisation is based on institutional membership and unites TTOs from different universities and, perhaps even more important, the different non-university research organisations in Germany. A similar approach in Hungary (if not yet existing), could unite third mission professionals from the different HEIs and provide them with an opportunity to exchange knowledge on common challenges or individual solutions to the most pressing problems. Overall, specificities of the Hungarian context will be best mirrored in a Hungarian network, and knowledge flows may be increased between people that deal with similar problems in their daily work. Over time, such an institution may grow into a co-ordination platform for knowledge exchange and technology transfer in Hungary and may even act as an entry point for cross-national transfer activities in the EU. Furthermore, it should enhance possibilities for co-operation, because this allows it to tap into knowledge bases presumably different from its own. As quite diverse approaches to the third mission were encountered during the study visit, exchange should be mutually beneficial. Even if other HEIs “copied” a particular model, the harm to the individual institution should be marginal as it operates in different environments.

Pooling resources for technology transfer

Not all HEIs are “fully-fledged” universities and they may sometimes have activities in only a limited number of research fields. Others may focus more on teaching. Because individually they will be hardly able (or willing) to set up their own mediator institution (like a formal TTO), they could consider establishing a common shared-service organisation. Legal considerations aside, this institution will be able to turn knowledge and

technologies from individual HEIs into portfolios and is more likely to achieve a meaningful scale compared to sole, non-integrated activities at single HEIs.

Cambridge Enterprises in the UK and MINATEC in Grenoble (France) are examples of centralised technology transfer offices with a shared-service centre catering for several higher education institutions (HEIs). Cambridge Enterprises at the University of Cambridge (2017) and MINATEC (2017) can probably not act as blueprints for most of the Hungarian HEIs. However, the idea of centralising certain aspects of the third mission outside of the focal HEI may solve the perceived size problem reported by some interviewees. In addition, the model would provide opportunities to share resources across HEIs that might otherwise be too small to have their own TTO and offer the possibility to participate in concentrated procedural knowledge. The basic idea is to establish a (formally) independent institution that handles a number of aspects of technology transfer for its members ranging from contract management to patent portfolio assembling to responsibility as a point of “first contact” for all external stakeholders. The advantages of such a centre are its high visibility, professionalism and negotiation power. Disadvantages may come from the need to share time across different institutions, which may lead to a focus on the big partners with frequent and profitable knowledge and neglect of the smaller ones. Furthermore, because the office will be physically and institutionally separated from most of its members, a combination with Knowledge Facilitators (Box 4.3, below) will be useful to keep a constant flow of new knowledge coming in from researchers.

The third mission in its comprehensive interpretation, going beyond technology licensing and spin-offs, is still a rather recent development. This poses opportunities and threats at the same time when trying to attract qualified staff. On the up-side, challenges are still fundamental and relatively similar across countries. This makes it easy for experts to “do a good job” when changing between countries, even if some peculiarities in Hungary will of course exist. A slight lagging-behind of some Hungarian HEIs compared to pioneers in the realm of the third mission may well turn into an advantage if the HEIs are able to promote vacancies as particularly interesting job opportunities with far-reaching responsibilities and room for creativity in dynamically evolving environments. This is needed to attract individuals that are not entirely focused on income, because technology transfer experts are sought-after personnel in many countries and common salaries are likely to exceed what the individual HEI is able to provide in many cases. The alternative and/or complementary approach is to offer job vacancies with third mission objectives to researchers from within the HEI. A surprisingly large number of researchers believe that they will never reach a tenured position (especially post-doctorate researcher) but do not want to work for a company either (this may be a development that has not yet gained momentum in Hungary). Some may also be rooted in the region and do not want to comply with mobility, which a researcher’s career often dictates. These make excellent candidates for scouts and facilitators, as they are also familiar with the academic structures and individual connections within the HEI.

Reluctance to technology transfer (and the third mission more broadly) often results from information deficits or time-constraints on the side of the scientist. Many discoveries do not diffuse into the commercial realm because scientists are too occupied with research, and transfer is not their foremost priority. Active scouting activities could be developed to increase the number of research results that lead to transfer and application activities. This way, the TTO gets a better understanding of the (potential) competencies and projects at hand, whereas the researcher gets assistance in the decision on where to take a project, and opportunities may open up for funding schemes previously not thought of.

Box 4.3. Knowledge Transfer Facilitators

Knowledge Transfer Facilitators, also “Project Scouts” or “Innovation Managers”, are individuals or teams acting as mediators between scientists and technology transfer offices (TTOs). With the growth of TTOs, these often become decoupled from the scientific day-to-day work of academia. Moreover, from a scientist’s perspective, administrative burdens, especially with regard to third-party funding, have increased during recent years. Therefore, encouragement to engage in third mission activities is often met with reluctance. This is particularly true if the initiative has to be from the scientist’s side and TTOs are merely “sitting and waiting” or see themselves as one-directional transmitters of knowledge and technology from the HEI to outside firms (traditional role in technology transfer).

A “rift” between scientists and administrative personnel exists to some extent at almost every HEI. Scientists often perceive TTO employees as “the others” (or worse “the enemy”) and may have less confidence in their ability if they are not familiar with the scientific discipline in which they seek transferable knowledge. The Knowledge Transfer Facilitator bridges this gap and acts as an in-house mediator between scientists and the “right” administrative position. Because of the familiarity with the research field, knowledge exchange should be bi-directional (the facilitator knows about the research, and the researcher knows about the transfer possibilities). Examples of this kind of active scouting model exist at many universities.

Knowledge Transfer Facilitators report to the TTO, but they do not necessarily have an office there. Their task is to actively scout for possible transfer-relevant projects on a department level (or any other suitable institutional level). It is imperative that they have some knowledge in at least one of the disciplines they are scouting in. This supports trust-building with scientists. As a direct benefit to scientists, Knowledge Transfer Facilitators help to find the right grant for a project or refer individuals to the administrative unit where help is most likely to be found. In larger HEIs, organisational structure can become quite complicated and with a lot of support schemes (e.g. third-party funding support, internationalisation, mobility, training-on-the-job, etc.) it may be difficult and too time consuming for scientists to find the right information and contacts. The same holds for the quickly increasing number of possible grant providing organisations and schemes.

Funding Knowledge Transfer Facilitators may be a challenge. For finding the best fit between projects and funding institutions, it is necessary that the Facilitator is largely independent and not bound to one specific funding scheme. A solution may be to fund Facilitators through project overheads. The drawback is that this creates incentives to focus on large projects and neglect smaller ones or those which are particularly risky.

Source: Author’s own work.

Structures for transdisciplinary research

Research in certain disciplines can be very capital-intensive, requiring large and continuous investments in infrastructure. This is increasingly true for STEM-related fields. Moreover, in some industries (e.g. pharmaceuticals and biotech) the market is dominated by large multinational players and Hungary is likely to be only a minor player, which is a problem shared by many countries. However excellent a single HEI may be, the scale of the challenges ahead necessitates co-operation in areas of national strategic importance to ensure optimal usage of capital-intensive equipment and enhance global visibility. Co-operation within the country, for example in the form of shared-use agreements for costly research equipment, or sharing data for scientific use, would also increase

distribution of knowledge in the long-run. The patient data base at Semmelweis University is a good starting point.

Scientific areas such as engineering, biotech, pharmaceuticals and chemistry offer inherent potential for translational research because of strong traditions in industry co-operation. It is thus quite common to have doctorate students that work on a research question that is heavily influenced by practical concerns, but may have developed into a more fundamental issue calling for basic research. All too often these students are considered “lost” to academia, because most leave for firm labs afterwards. Aiming at an increase in translational activities calls for embracing them as opportunities to exchange knowledge, keeping track of trends in industry, and building mobility schemes. The inclusion of industrial partners in PhD committees is a good way to enhance these outcomes. This may require changes to the programme accreditation requirements.

Public research grants have a greater emphasis on multi- and transdisciplinary approaches. If consortia are only formed at times of opening of calls, the respective HEI may simply be too late to file for a competitive application. Internal horizontal co-operation is an opportunity for HEIs whose departments would otherwise be too small to make an impact. A response to this is the creation of an innovation fund that offers seed financing for the start-up of a transdisciplinary research initiative, which builds on existing research capacity and knowledge exchange activities with industry and local government on a topic of local/regional relevance (e.g. ageing society, e-mobility). This creates room for increased collaboration across departments, and brings together individual knowledge links into an institutional framework. If funding is available, this could be further developed into the creation of a transdisciplinary research centre (see Box 4.1).

Box 4.1. Enhancing structures for transdisciplinary research

Transdisciplinary research can be encouraged through the establishment of a formal “centre”, which brings together different scientists under a common research theme that is often related to a specific/global challenge and leaves room for different discipline perspectives. Centres allow for a profile-building of faculties and entire HEIs and are most effective if they are in line with the HEI’s overall institutional objectives; however, room should be left for bottom-up initiatives from scientists as they are often close to the trends in their own academic field. Horizontal centres mainly facilitate internal knowledge exchange, but there is no reason why they should not also include external stakeholders, especially in more permanent forms of organisation.

The centre’s structure varies, ranging from a virtual organisation to a fully-fledged institute with its own building, resources and board of directors (and supervisors). The centre is a temporary institution, which is evaluated in regular time periods (e.g. 5-7 years). A virtual centre does not need a lot of additional resources. If the centre is not working well or the research theme challenge it was dealing with is no longer of importance, it can be dismantled. Finding the most appropriate size for a centre is not an easy task. Small centres are easily established, do not require much commitment from their members but may have few additional resources and are less likely to encompass many different disciplines. Thus, they often “live on” although they do not provide any knowledge exchange or synergies at all. Large centres, on the other hand, need significant commitment and bureaucratic effort to be established and often create a gravitational force that, over time, accumulates and binds resources. They are also less likely to “die” even if general scientific (or societal) attention has long shifted to other challenges.

Box 4.1. Enhancing structures for transdisciplinary research (cont.)

An example of a more formalised approach is the International Centre for Higher Education Research (INCHER) at the University of Kassel in Germany. This is an entity acting as a separate institute within the university with its own constituting documents, own budget, administrative structures and a regular evaluation. The research focus is theme-based and researchers mainly include graduated sociologists, economists and psychologists, but also physicists and historians (University of Kassel, 2017). On a lower level, the Centre of Public and International Economics (CEPIE) at the Technical University of Dresden bundles the expertise of several economists and increases visibility to the outside (Technical University of Dresden, 2017). In contrast to INCHER, CEPIE is more an effort to structure local expertise and communicate it to the outside. The centre, as such, does not have its own budget and all members belong to individual institutes/departments of the university or local research institutes.

Source: University of Kassel (2017); Technical University of Dresden (2017).

Perceived lack of R&D capacity in local firms

Another challenge is the perceived lack of R&D capacity in local firms. This is especially true for HEIs not located in Budapest. In less developed regions, outside the Hungarian capital, multinational firms tend to have production facilities only (no R&D activities) and local SMEs are often lacking capacities for a long-standing engagement with HEIs. The visited HEIs also expressed that smaller local firms are often unwilling to co-operate, be it out of a perceived incompatibility between HEIs and industry or out of an unwillingness to grow. The problem for the automobile engineering faculty in one of the HEIs was that it had access to the local factory, but there was virtually no local research co-operation. The firm more or less acted as a sponsor and stayed in close contact with the HEI, but they did not seem to view the HEI as a dedicated research partner.

If local R&D capacity is (currently) missing, HEIs may be well-advised to think about co-operative activities that require less resources and less commitment. Of course, these will be less prestigious as well, but they could provide a seed that grows into collective R&D activities (or similar) if nourished continuously. Examples of such activities could include “Transfer Days”, where local firms and HEIs showcase their research and engage in discussion on current technology trends. Furthermore, intensified co-operation in teaching is imaginable, which could include structured internships or collaborative supervision of Bachelor and Master theses.

Linking mobility with knowledge exchange

An often overlooked resource in knowledge exchange are students and employees on mobility programmes, for example working or studying abroad but also those that have changed HEIs, for example between Bachelor and Master programmes or when taking a new career step.

Students returning from abroad often have to deal with administrative burdens at their home HEI, because credits are not easily transferable. Unfortunately, the home HEI most often is not interested in the students’ experience beyond that. Of course, most universities have co-ordinators for the respective exchange programmes (for example Erasmus) and these engage in exchange with partner HEIs regularly. But this exchange is

often about administrative issues and not teaching (or research) content. The student who has actually experienced how teaching (and perhaps even research) works elsewhere is seldom asked. Instead his/her exposure is treated as a personal matter. Unless HEIs also engage in collaborative teaching with partner HEIs, or the returning student takes up the initiative, the acquired information is lost for the HEI. The same is true for “incoming” students from partner HEIs.

Mobile employees on the other hand, often face difficulties becoming accustomed to the new organisation and need a lot of time to figure out how things work. By the time they are in a position to change things, contacts with the former organisation may have already been lost. Furthermore, the new employees are often confronted with resistance. Departments have a tendency to stick to the status quo, because any kind of significant change is related to heavy administrative burdens.

A similar problem also pertains to students undertaking internships. Many students are required to do an internship as part of their studies. Quite often, they are also required to write a report at the end. Although this report sometimes needs to be graded, the contained knowledge on firm practices, current challenges and technological trends is seldom exploited. Unless an individual researcher has a keen interest and approaches the student (or has contacts with the firm) asking for details of his/her practical experience, the internship and the lessons-learned are, as with the mobile students/employees, treated as a personal matter.

International students as “internationalisation links” for students and knowledge partners

Most HEIs have large numbers of international students. These can form the basis for a very diverse pool of knowledge waiting to be tapped into. Their relevance may not be restricted only to teaching, but could enrich research and entrepreneurial activities as well. Attracting foreign students is a business model based on tuition fees. Studying in Hungary is a well-known model to circumvent admission barriers (*numerus clausus*) in Germany, especially for study programmes in veterinary and human medicine. Semmelweis University seems to have perfected this model by opening up an off-campus centre in Hamburg resulting in German students not even having to leave the country if they want to study at Semmelweis.

The current situation is that international students are rather isolated; they follow a separate course programme and do not have much education-related contact with Hungarian students. The point is not to criticise the HEIs for their creativity in bringing in money (on the contrary), but to highlight the fact that this is foregoing a huge potential to let Hungarian students benefit from an international experience through education-related contact with international students. The local presence of students and academics with diverse backgrounds offers potential in at least three important ways.

- International students increase the range of knowledge at hand, which allows the HEI to pursue a wider range of questions or to look at problems from more than one perspective. International students/employees can also bridge language barriers, which would be important for international collaboration, but also the reading of texts (journal articles, laws, historical papers, etc.) previously inaccessible to the HEI.
- Diversity fosters intercultural learning experiences among both faculties and administration. With an increasing level of international exchange and globalisation of production and

research, the ability to communicate and empathise with people of different nationality, gender, religion, etc. is one of the most sought-after “soft skills” in today’s job market. HEIs that can provide this skill to their students and employees will certainly benefit a lot in terms of future co-operation and attractiveness for students and staff.

- Substantial numbers of foreign students and academics call for organisational arrangements not necessarily needed in HEIs with only a few individuals from abroad. In order to become attractive for students and researchers that do not necessarily speak Hungarian, a variety of documents needs to be translated into English (or other languages) and administrative staff as well as researchers may face higher expectations with regard to foreign language proficiency. Over time, this should raise the organisational competency level, which can in turn become a source of competitive advantage, for example, for international research projects.

Integrating incoming international students, even if it is only for a limited period of time, should be a priority for HEIs. Lund University in Sweden offers relevant learning (Box 4.2).

Box 4.2. Internationalisation at home: Lund University (Sweden)

An example of how to make internationalisation at home work effectively is the University of Lund in Sweden. Starting with a very comprehensive (English) website, the university offers a written guide to academic life and has an impressive number of student associations, as well as sports activities and cultural events. Naturally, not all of these will be specifically aimed at international students, but great effort is undertaken to integrate those that are willing to participate. Furthermore, the University of Lund partners incoming foreign students with local students that act as “buddies”, helping them to cope with new challenges and showing them around. This makes international students feel at home and provides international experience, including language and soft skills, to “native” students.

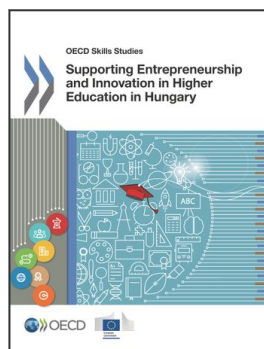
Source: University of Lund (2017).

Notes

1. Gottfried Wilhelm von Leibniz, a German mathematician and philosopher made several major contributions to physics and anticipated concepts that emerged many decades later in a wide array of sciences, such as probability theory, biology, medicine, psychology, linguistics, and computer science.

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