

Making Ideas Work for Society: University Cooperation in Knowledge Transfer

6

Jozef Ritzen

List of abbreviations

EU	European Union
GDP	Gross domestic product
KT	Knowledge transfer
OECD	Organization for Economic Cooperation and Development
R&D	Research and development
UAE	United Arab Emirates
WEF	World Economic Forum

1 Introduction: KT (Knowledge Transfer) as an Imperative for a University

1.1 It's Ideas That Count for Progress

It was a shock when economists (in the 1950s) realized that economic growth could only partly be accounted for by investments in buildings, machines, and land ("physical capital"). The "wealth of nations" [1] was apparently not only in physical capital as Smith (and with him most economists) had believed for some 200 years. The part of economic growth not explained by physical capital, the "residual," was attributed to ideas and knowledge derived from research and incorporated in people [2]. The 2018 Nobel Prize for economics was awarded to Paul Romer in recognition of his contribution to deepening our understanding of the roles of ideas and well-trained (wo)manpower as drivers of sustainable economic growth [3].

Ideas arise everywhere, but they are more likely to be the result of organized research as happens in universities or other research institutes. The ideas and the new knowledge, however, may easily remain in the confines of the university

halls and rooms. Making them work for society is the topic of this chapter, with an emphasis on how university cooperation can contribute in this respect.

1.2 KT as an Imperative for a University

Universities are known to provide education and to do research. Beyond these goals, universities should also pursue, according to their charters, "knowledge transfer" (KT) or "knowledge valorization." Universities can have a substantial impact on the economy of the world, their country, and in particular, their region, through KT. KT is a term used to encompass a broad range of activities to support mutually beneficial collaborations between universities on the one hand and businesses and the public sector on the other hand. These collaborations tend to enhance, first and foremost, the economic growth of the region as most of the benefits of the new knowledge, whether patented or not, contribute most directly to the places where the knowledge is generated.

KT of a university is described as a "contact sport;" "it works best when people meet to exchange ideas, sometimes serendipitously, and spot new opportunities" [4]. Technology transfer is a subcategory: It concerns the transfer of innovative solutions to problems that are protected by different intellectual property rights.

Unlike in education and research, collaborations in KT over long distances are mostly among the top universities in the world. For other universities, the collaborations are mostly in the region or are in the form of "learning from each other's experiences."

1.3 Content of This Chapter

Making ideas work for society: That is the role which universities have in addition to education and research. Section 2 presents the development of the awareness of KT in

J. Ritzen (✉)
Maastricht University, Maastricht, The Netherlands
e-mail: j.ritzen@maastrichtuniversity.nl

universities and in society at large. These days, most universities around the world have recognized the importance of contributing to society through KT—often with the universities in Silicon Valley as shining examples. The awareness of KT as one of the drivers of innovation has been increasing in the past decades. Innovation itself is increasingly recognized as an important driver of sustainable economic growth. Countries strive to be high up on the international innovation ranking index.

This book is written in the context of King Abdulaziz University in Jeddah, Saudi Arabia. All of the oil-rich countries on the Arabian Peninsula strive toward less economic dependency on oil revenues. In Sect. 2.3, we briefly discuss the role of innovation toward decreased oil dependency.

In Sect. 3, we explore in more detail KT at the level where it happens: the individual university and its impact on the region. In Sect. 4, we consider the crucial factors, which contribute to valorization and how to organize KT in a university. In Sect. 5, we look into existing forms of cooperation, and Sect. 6 presents conclusions.

2 Competitiveness Through Innovation; Innovation for Less Oil Dependency

2.1 Valorization and Innovation

In 1938, one of the first university spin-offs was created by Bill Hewlett, a student of Stanford University, encouraged by his Professor Fred Terman to start a company based on an idea from his own master's thesis. He then founded, together with his colleague David Packard, Hewlett-Packard Company. HP became a huge success: It was ranked 24th in 2004 and 48th in 2018 out of 500 best prospering companies in the USA [5].

HP was the beginning of Silicon Valley: the notion that the proximity between the university knowledge of top universities and business could create high technology agglomerations, with high economic growth as a result. However, being a top university does not automatically imply a high contribution to the region through KT: Several high-quality universities such as Berkeley, Cal Tech, Columbia, Chicago, Harvard, and Johns Hopkins have hardly played a vital role as incubators for the high-tech industry in the region. Varga concludes: "The same university research expenditure was associated with dramatically different levels of innovation" [6].

Learning from success stories about the links between business and universities is high up on the policymaker's wish list. Governments call on university leadership to take up the "third goal" of the university (KT) with the same dedication as the first (education) and second (research) goals.

Continental Europe has had a mixed experience with knowledge transfer. In the postwar period (after 1945), the universities, in particular, the technical universities, were important to regain a competitive edge in production in the electronics sector, in the chemical sector, in car manufacturing, and in mechanical equipment, only to mention examples. However, in the period of the rapid expansion of universities from 1965 onwards, the relations with industry, as well as with the region, became looser. The period of the 1990s presented a turning point. It was felt that the European economies had lost their comparative international strength and that this needed to be mended by increased innovation. Knowledge-driven innovation became a key word.

At that time, the European continent was recognized as having a comparative *advantage in creating* knowledge and a comparative *disadvantage in transferring* it to other sectors and turning it into innovation and growth. Europe has produced and continues to produce a comparatively large amount of basic research (around 30% of the world's scientific publications) with less than 8% of the world's inhabitants. At the same time, it used to be unable to get much industrial innovation and economic growth out of it. This phenomenon was widely known as the "European paradox." The "European paradox" was explained as resulting from "institutional factors" [7] like the lack of communication between scientists about current research, the lack of sharing information ahead of wider publication, and limited networks connecting people in companies, universities, research institutes, and elsewhere. The limited university autonomy in many EU countries is hampering KT [8].

The EU set up the Horizon 2020 program (see Web site Horizon 2020) to promote smart, sustainable, and inclusive growth for EU states through research and innovation. The scale and scope of the Horizon 2020 program expanded the past EU frameworks by funding a wide range of diverse activities along the whole value chain, from basic research all the way to market uptake.

The importance of industry-academia links is evident in the strategies of many universities in countries like Finland, Germany, Ireland, Norway, the Netherlands, and the UK. However, in many EU countries, the challenge to make university ideas work for society has hardly (as yet) been taken on.

Table 1 Metrics for innovation ranking

Six equally weighted metrics were considered and their scores combined to provide an overall score for each country from zero to 100
1. Research and development: Research and development expenditure as a percentage of GDP
2. Manufacturing: Manufacturing value-added per capita
3. High-tech companies: Number of domestically domiciled high-tech public companies—such as aerospace and defense, biotechnology, hardware, software, semiconductors, Internet software and services, and renewable energy companies—as a share of world’s total high-tech public companies
4. Postsecondary education: Number of secondary graduates enrolled in postsecondary institutions as a percentage of cohort; percentage of labor force with tertiary degrees; and annual science and engineering graduates as a percentage of the labor force and as a percentage of total tertiary graduates
5. Research personnel: Professionals, including Ph.D. students, engaged in R&D per 1 million of the population
6. Patents: Resident utility patent filings per 1 million of the population and per \$1 million of R&D spent; utility patents granted as a percentage of world total

Source [9]

The success of these strategies can be gauged by the competitiveness of the countries. This is the topic of the following subsection.

2.2 Countries Ranked by Level of Innovation

KT contributes to the competitiveness and the level of innovation of the country. Countries are keen to see themselves high on the ranking of innovation. Rankings on innovation make the headlines in the financial and economic newspapers. The general pattern of rankings of countries is well illustrated with the Bloomberg ranking of countries and sovereigns based on their overall ability to innovate [9]. This ranking identifies the top 50 countries by level of innovation with the metrics presented in Table 1.

Other rankings, like that of the World Economic Forum (WEF), are more sophisticated [10]. In 2018, the top 10 ranked economies over the last four years were: 1. Switzerland 2. Netherlands 3. Sweden 4. United Kingdom 5. Singapore 6. USA 7. Finland 8. Denmark 9. Germany 10. Ireland. Northern Africa and Western Asia with 19 economies show that Israel (11th world wide) and Cyprus (29th) achieved the top two spots in the region for the sixth consecutive year. Third in the region is the United Arab Emirates (38th). It should be noted, however, that the WEF report does not include KT from universities as one of the main drivers of sustainable economic growth.

2.3 Innovation in Resource-Rich Countries

This book is written by authors associated with the King Abdulaziz University, Saudi Arabia: a resource-rich country. Oil-rich countries like those in the Arabian Gulf have almost since their inception strived for innovation as a way to

become less dependent on oil, both in terms of GDP, or as a percentage of government revenue or as a percentage of exports. They are, however, generally not high on the list of the most innovative countries, despite these efforts. Albasam [11] documents that these efforts have not been very successful in the period 1970–2015, while at the same time, countries like Norway (oil), Chili (copper), Botswana (diamonds), and even the UAE (oil) have become less dependent on their natural resources.

The road toward less oil dependency is paved by innovation, in which KT from universities is an essential part. Yet, KT still has a long way to go in many of the oil-rich countries in the Arabian Gulf. A higher place on the list of the most innovative countries would be important.

In the next section, we discuss the research findings on the way KT works out for the region in which the knowledge creation takes place.

3 Knowledge and the Region

3.1 The Distributed Impact of Knowledge

The first study to show that investments in new knowledge have by and large local effects is from Jaffe [12].¹ He demonstrated empirically the effects of public research and development (R&D) on innovation in relation to the distance between the spot of origin of the new knowledge and its economic impact. The number of patents was used as an indicator for the production of new knowledge. He shows that public R&D has a strong locational impact: the higher the public R&D in the region, the more patents in that region. This is explained by the “spillovers” of knowledge

¹This section draws on a study of the Central Planning Office (CPB) of the Netherlands [13].

toward that region. His findings have been corroborated by a large number of other studies which looked at Austria, France, Germany, Italy, Spain, Sweden, and the EU as a whole. However, the impact of new university knowledge on the region differs substantially between sectors: It appears to be substantial in sectors like pharmaceuticals and medicine, optics, electronics, and nuclear technology, but less so for chemical products or metal products.

R&D investments not only lead to more patents in the region, but also to more product innovations (patented or unpatented) [14]. That effect is even stronger than on patents. This and other studies confirm the hunch that the application of new knowledge is more likely to happen close to the place where it is originated, simply because of the contacts between the people who invent and those who apply. Of course, this does not exclude the application of new knowledge on a long distance. For example, international firms realize new knowledge through central research institutions or countries with central research facilities in selected areas. The personal factor in generating innovation close to the university is borne out by the larger number of partnerships between firms and universities close to the university [15–17].

In general, one expects smaller firms to benefit more from the proximity of (new) university knowledge. Yet at the same time, larger firms may prefer to locate their

research-intensive production or their research laboratories close to a university with a comparative edge in their sector. It is then not surprising that Audretsch and Vivarelli [18] for Italy and Ponds et al. [19] for the Netherlands find that both large and small companies in the region benefit from the presence of a university. Also, Ghinamo [20] finds from an analysis of 44 papers on the impact of the university on the region that these support the existence of a genuine spillover effect of university research on regional innovation. To be sure, the studies quoted above are just examples of a large number all with the same conclusion: The region benefits substantially from KT.

This makes us curious as to the measures used to come to this conclusion of substantial benefits and what the impact is of the universities on the region according to these measures.

3.2 Measuring Impact

Impact is part of the “performance” indicators of KT. The other two are: inputs and outputs. Table 2 gives an overview of these three categories of performance indicators.

The Horizon 2020 program of the EU uses 23 similar performance indicators. They add the leverage of venture funding as well as the relation with KT with *societal challenges* to the performance indicators.

Table 2 Classification of indicators of KT performance

Categories	Indicators
Inputs	<p>Resources: R&D expenditure; university’s governmental income; non-government donations, grants and contracts; industry sponsorship of university research; scholarships; and number of researchers</p> <p>Researchers’ capabilities: number of publications, citations, projects, and reports or patents done in the past</p> <p>Researchers’ motivation: number of previous industry contracts in the department/university; number of strategies concerning industry–university cooperation in the department/university; amount of resources dedicated to support cooperation in department/university; and perception of researcher about the benefits from the cooperation with industry</p> <p>Firms’ absorptive capabilities: quality certificates (ISO); previous collaboration with academia; membership of some association or research group; number of scientists; and structure of employees by occupation and education</p> <p>Firms’ motivation: number of previous contracts with universities; involvement with university (e.g., alumni, lecturer); and perception of the firm about the benefits from the cooperation with university</p>
Outputs	Patent applications; patents; license revenues; publications; joint publications; postdoctoral or doctoral positions offered within alliance; joint supervision; master and/or doctoral theses; secondment of researchers; intensity of collaboration; spin-offs; meetings; seminars; and workshops
Impact	GDP per capita; total factor productivity; productivity renewal indicator; number and share of high-growth enterprises; renewal rate of enterprises; share of inward FDI per GDP; knowledge intensity of production; success of spin-off companies; productivity growth; turnover growth, export growth, the increase in exports created by new inventions; net increase of jobs, employment growth; recruitment of graduates; and science citation index

Source [41], p. 20

Table 3 Economic effects of a university

	Example
Employment at the university	Number of jobs at the university and related institutions
Income of the university	State contributions, tuition fees, financial benefits, e.g., from book sales and merchandising
University spending	Purchase of goods and services by the university
Income and spending of university employees	Wages, salaries, and social security costs. Expenditures in shops, on entertainment and culture, and on public transportation
Labor market effects	Delivery of educated labor. Heightened productivity effect
Spin-off business	Companies founded by (former) students and university employees, whether employing academic knowledge and technology
Marketing of knowledge	The sale of knowledge in a variety of forms: from ideas and courses, to patents

Source [26]

3.3 Evidence on the Impact of Universities on the Region

Regional scientists have extensively studied the economic impact of universities in the community [21–24]. The impact of the university on the region goes far beyond KT as Wylie and the contributors to his book show [25]. “Universities can affect the lives of many members of the community via their applied research and aspiration raising activities. They create new knowledge, realize it commercially and fix it locally.” Lambooy gives an overview of the different types of economic effects as indicated in Table 3 [26].

Originally, the impact on the region was mostly assessed through employment in the university and the expenditures from students, using regional multipliers [27, 28]. Subsequently, Biggar Economics [29] also included KT activities. The total economic impact of the League of European Research Universities (LERU) with 23 participating universities was computed at 71.2 billion Euros, of which almost one-third was generated by KT (technology licensing, consultancy, contract and collaborative research, spin-outs and start-ups, research and science parks, workforce training, and staff volunteering).

In evaluating the role of KT, it turns out that it is often the combination of the supply of well-trained young people and knowledge valorization which makes the difference (see for example [30] for the USA or [31] and [32] for European examples). Knowledge valorization enhances the chances that the graduates of the university remain in the region. This is, of course, relevant in regions with a shrinking and aging population such as Finland [33]. Universities can be important for the investment climate which in turn might seduce firms to locate near to a university.

Grant analyzed 6679 impact case studies of the 2014 Research Excellence Framework (REF) in UK [34] and finds that larger institutions make large contributions to fields such as “Clinical guidance” and “Dentistry,” while small institutions make a greater than anticipated contribution to fields

such as “Sports,” “Regional innovation and enterprise” and “Arts and culture.”

DeVol et al. [35] have made a ranking of the best US universities for technology transfer, with the University of Utah heading the list. The research done at Global University Leaders Forum (GULF) (made up out of the leaders of 27 top universities from 11 countries) is mostly connected to a business in the fields of life sciences and computing. A list of the 20 companies that co-publish the most papers with academics is dominated by major IT firms such as Microsoft, IBM, and Google and by large pharmaceutical companies such as GlaxoSmithKline and Pfizer² (see Fig. 1).

Worldwide the WEF has published the ranking of the regions which score highest in international patent filings and scientific publishing. These are listed in Table 4.

Notice the close correspondence between countries by level of innovation and the regions of innovation.

This section brings us to the question of how to organize KT so as to gain the maximum benefits for the region and the country.

4 Organizing Innovation Systems: Making KT Work

4.1 Institutional Setting: Triple Helix

KT does not happen by itself, but requires an institutional setting in which the different actors (knowledge suppliers and knowledge users) find each other easily or are even partners, plus incentives which make the actors move in the right direction. In general, one may say that KT has the best

²At the background of the strong links between university research and industry in the pharmaceuticals sector may have been the downsizing of the research capacity in the drugs industry in favor of an investment into putting new drugs into clinical trials, while they are looking for smaller biotech firms and universities for the early-stage innovation.

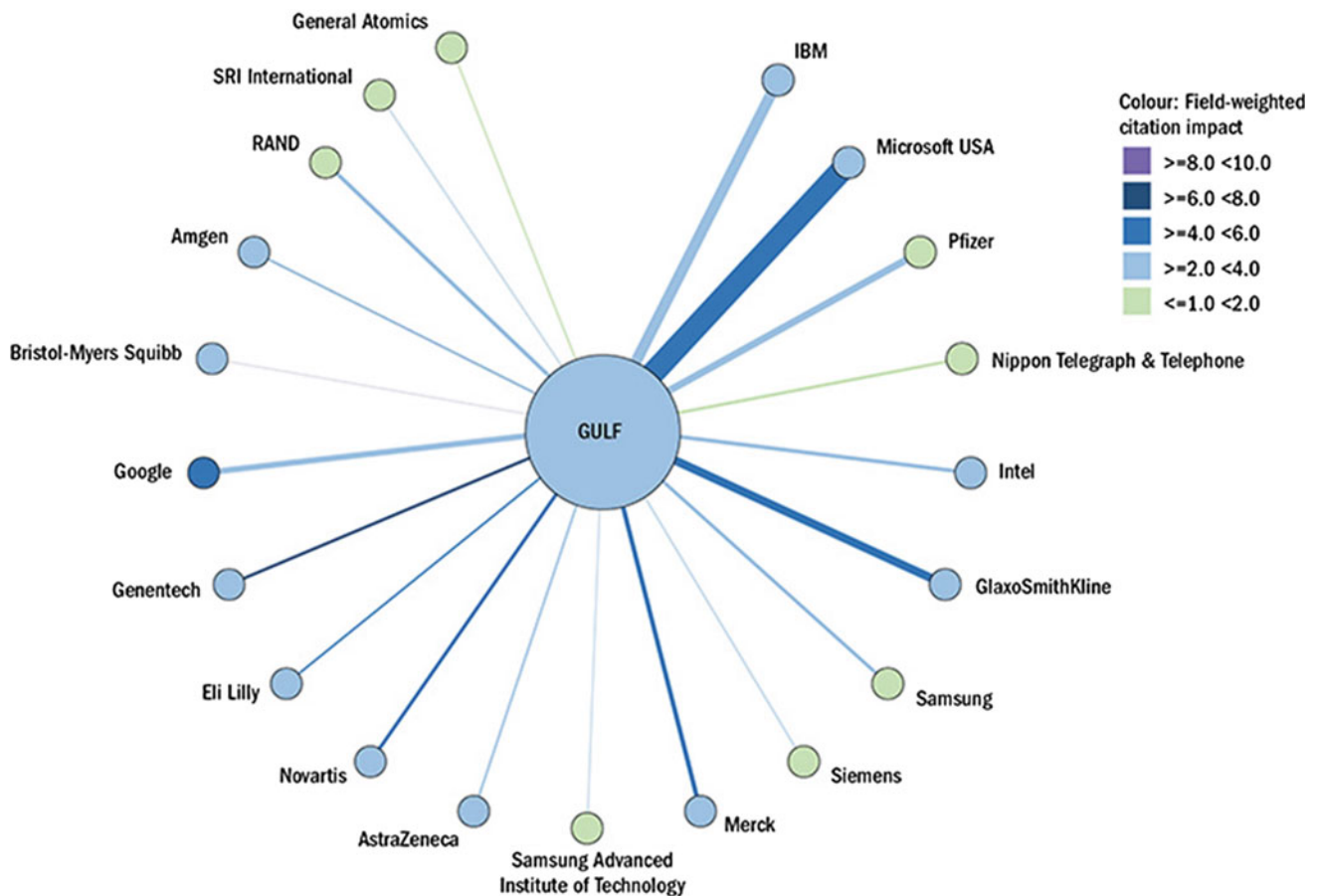


Fig. 1 Connection between GULF universities and industry. **Key:** Node color = institution FWCI (Field-Weighted Citation Impact); Node size = number of publications; Thickness of line = number of co-publications; Color of line = collaboration FWCI. Source [42]

chances for success in a compact between the university and the region, often termed the triple helix. This helix has three parties: the local government, the university, and both the public and the private sector [36]. A compact ensures joint strategies. Increasingly universities and regions learn from each other or cooperate in realizing the economic and social benefits from KT from the universities through joint research between universities and industry, start-ups, scale-ups combined with other forms of cooperation (for example, in the education area), as well as with a social commitment of the university toward its setting: the region in which it located. This requires an engagement of the university in incentivizing KT (as we see in Sect. 4.2). But it also needs engagement from the region. This applies not only to the regional government but also to the business community and the public sector in the region. An important element to make cooperation succeed is the availability of angel and venture capital.

Regions with well-developed compacts clearly show substantially more socioeconomic progress compared to regions in which there is little connection between the different partners.

KT goes substantially beyond the patenting of university innovations. Patents can be a source of valorization if they can be applied either by third parties or by university start-ups. But the majority of the valorization comes through new products, improvements in products, or in production technologies which are difficult to patent. The use of new knowledge contributes to a comparative advantage for the first mover. This is also relevant in the context of open science (see Sect. 4.5).

The size of public research is clearly recognized as contributing to innovation. All of the top clusters in innovation in Table 4 receive substantial amounts of public funds [37]. Yet, these funds are often targeted as a result of “industrial policy” toward knowledge creation in the university which is closely related to the business sectors in the region. This underlines that the triple helix not only involves the region. It is best suited for innovation if the national level is included as well.

The institutional framework for KT requires university autonomy in close harmony with the accountability of public universities to their funding agent [8], which is often the public (i.e., the government).

Table 4 Top cluster of economies or cross-border regions within the top 50

1	Tokyo–Yokohama
2	Shenzhen–Hong Kong
3	Seoul
4	San Jose–San Francisco
5	Beijing
9	Paris
15	London
17	Amsterdam–Rotterdam
20	Cologne
22	Tel Aviv–Jerusalem
28	Singapore
29	Eindhoven
30	Moscow
31	Stockholm
33	Melbourne
37	Toronto
38	Madrid
44	Tehran
45	Milan
48	Zurich

Source [10], p. xii

A regional triple helix compact is a good starter for KT, but does require the follow-up of actions at the university level, for universities to be successful in KT.

4.2 Readiness of Universities for Innovation

The EU and the Organization for Economic Cooperation and Development (OECD) have analyzed what it takes for a university to be successful in KT. This happens to resemble closely the insights of Pertuzé et al. [38]. The combined EU/OECD analysis has resulted in a self-assessment tool: HEInnovate [39]. Eight key areas are distinguished for the capacity of the university to contribute to innovation in the region and beyond:

1. Leadership and governance: Strategically, strong governance and good leadership are required for entrepreneurship
2. Organizational capacity: sufficient funding, people, and incentives so institutions can minimize their formal structure which often is adverse to entrepreneurship
3. Entrepreneurial teaching and learning
4. Preparing and supporting student and staff entrepreneurs

5. Acknowledging digital transformation and digital capabilities as key factors for entrepreneurship and innovation
6. Building and sustaining good relationships with a wide range of stakeholders including the public sector, regions, businesses, alumni, and professional bodies
7. Internationalization as essential for entrepreneurship
8. Monitoring and measurement of the size of KT.

The EU and OECD offer to review the engagement of universities in KT through the Regional Innovation Impact Assessment (RI2A). For this review, universities prepare their own case studies which are then assessed by international experts.

4.3 Personal or Institutional KT Partnerships?

Bodas Freitas and others have looked into the quantitative effectiveness of the organization of KT along two lines: personal contractual interactions between academicians and partners outside the university and institutional partnerships [40]. Their econometric estimations suggest that personal contractual interactions are used relatively more by small firms involved in technology and open innovation strategies,

while institutional interactions are mostly used by large firms that vertically integrate R&D activities.

4.4 A Practical Example

Here, we present a to-do list for a university which desires to be “entrepreneurial.” This is to some extent derived from the practice and good intentions at Maastricht University in the Netherlands.

1. Leadership

- The university strategy should be embedded in a triple helix. The region should be involved in the development of the university strategy.
- The university leadership (board and deans) should have ownership for KT as part of their performance agreements. (However, it should be noted that some deans believe that this might be counterproductive.)
- Goals should be set in terms of the number of start-ups, scale-ups, and other forms of KT which occur within a given time frame.
- Deans should be rewarded for success in the entrepreneurship of students and graduates and in patenting.
- Successful entrepreneurs from university incubators should be rewarded with a substantial part of the shares. Clear and trustworthy guidelines should be set up for this.

2. Entrepreneurship Education

- Research-based teaching (as part of problem-based teaching) should be enlarged to start-up-based teaching: using the examples of start-ups as part of the learning experience.
- Bachelor and master theses should be devoted to business plans for start-ups.
- Ph.D. theses should have a compulsory section on “validation,” indicating the relevance of the research to society. These validations should be stored in an open access depository which can be consulted by the public and business at large, as a way to “unlock the knowledge safe.”
- A course in entrepreneurship should be included in all disciplines, striving to catch at least 10% of the students. It should be made a compulsory part of the curriculum in economics and business.
- Alumni who have successfully started companies should be involved in public university lectures or in the regular teaching program. This is one of the ways in which a stimulating environment for entrepreneurship is built.

- A small number of “entrepreneurs in residence” at the university should be involved in teaching and research in entrepreneurship.

3. Supporting Structures

- An incubator for start- and scale-ups should be developed. The incubator should be supported with angel and venture capital supplied or organized by the university. New businesses should be supported in the incubator with assistance in marketing and administration.
- An entrepreneurship center should be created for the delivery of entrepreneurship courses. The center should also lead pre-incubation services with angel funding from the university. Students should be allowed to start a business in the center as part of their credits. The university should own only a small percentage of the shares of the start-up.
- One or two entrepreneurship weeks should be organized annually to inspire students to become entrepreneurs and to discuss successful practices of start-ups including how to find funding.
- Master courses in engineering and science should be established on industrial sites related to the master courses, making the research facilities of businesses part of the university campus.
- The returns of start-ups and spin-offs should accrue mostly to the individuals who have supplied the entrepreneurship.
- Entrepreneurial achievements and patents should be recognized on par with academic publications for academic careers.
- A department of the economic analysis of innovation should be set up.
- Four faculties should take the lead: economics (financial and business services), medicine, science, and engineering.
- An annual university entrepreneurship prize should be established for the most promising start-up of that year.

4.5 Open Science

At present, there is a substantial drive to do research as “open science”, implying that research findings are accessible to the broad public and not locked into intellectual property rights. The main purpose of open research is to spread knowledge and allow that knowledge to be built upon by giving free access to the information so it can flow without restriction.

Open science allows researchers to apply each other's findings without costs and expands access to students to new knowledge. However, it is questionable whether these advantages are sizeable; accept by reducing costs of peer-reviewed publications for the academic community at large if fees to be paid by authors for publishing are less than the present subscription costs of journals.

The impact on entrepreneurship is undecided. On the one hand, intellectual property rights were established to create an incentive for new knowledge. On the other, open science allows for a higher speed of application.

One notices a move toward more open innovation models involving larger multinationals, like the Structural Genomics Consortium. All the results from this research—into the three-dimensional structures of human proteins—are open access. Firms can still see the long-term potential of using the discoveries for later-stage commercial benefit by being close to the new knowledge generated.

In information technology, open innovation and the sharing of discoveries are more established. Firms recognize the benefits that accrue from that dissemination, including more thorough review, consideration and critique, and a broad increase in the scientific, scholarly, and critical knowledge available.

The bottom line is that open science will increasingly get hold of society, definitely when public research is involved. Open science, if anything, facilitates KT.

5 Cooperation in Innovation

Cooperation in KT goes hand in hand with cooperation in research. Existing forms of cooperation are mostly through three channels:

1. **The region.** This is exemplified in Table 4. In terms of size, this is presumably the largest cooperation worldwide in KT/research. The region lends itself well to cooperation in KT as it can be embedded in a triple helix connecting universities, regional administration, and the businesses in the region.
2. **Top universities.** The cooperation in KT of the “Gulf” universities with top universities has been well documented. Figure 2 gives an overview. Notice that the kernel of worldwide cooperation between universities and industries is in the USA and the UK. The impact of this inter-group collaboration on research citations is massive: The darker hue of the lines in the network map shows that the field-weighted citation impact of work co-authored by academics from the institutions is consistently high. On the one hand, many companies are often attracted to large institutions with a

wide breadth of excellent research, but on the other hand, companies may also simply choose to work with their nearest higher education institution.

Continental Europe is still not highly visible in this context, despite the EU efforts. This might be the result of a lesser entrepreneurial spirit among academics on the continent, but it may also be due to too little autonomy for the universities [8] and too little infrastructure in terms of incentives within the university (as mentioned in Sect. 4.2).

3. **Other forms of university cooperation.** There are many university networks like LERU in which universities search for joint interests and joint commitments in education, research, and KT. In contrast to the GULF universities, there is little information available on the size of the KT or the research cooperation in these networks. This category of “other” also includes cooperation between universities through mutual Memoranda of Understanding (MOU). To say it blandly: MOUs generally appear to be little more than a license for the university administration to travel and to learn about experiences elsewhere with little translation to the work floor and little actual cooperation in KT.

University cooperation in KT is hard work, carried out by the work floor: the active researchers. Encouraging and incentivizing researchers is generally the best way forward, with the university administration in the roles of encourager and possibly door opener.

6 Conclusions

Sustainable economic growth is more brought about by ideas, knowledge, and human capital than by physical capital, like machines, buildings, or land. Universities are one of the sources of ideas and of human capital. We focus on the third function of universities, next to education and research, and in particular on KT. KT is highly visible in agglomerations like Silicon Valley. Many countries nowadays have strategies to step up KT as a source of sustainable economic growth. Countries strive for a good position in the rankings of countries by innovation. Generally, the countries which are high on the list are also actively pursuing KT strategies for their universities.

Knowledge is recognized to have its strongest potential impact close to the place where it is generated. This makes a university attractive to the region in which it is located as there is a substantial knowledge spillover from the university to the region. The university contributes to sustainable economic growth not only through the expenditures associated with the running of the university, but perhaps more

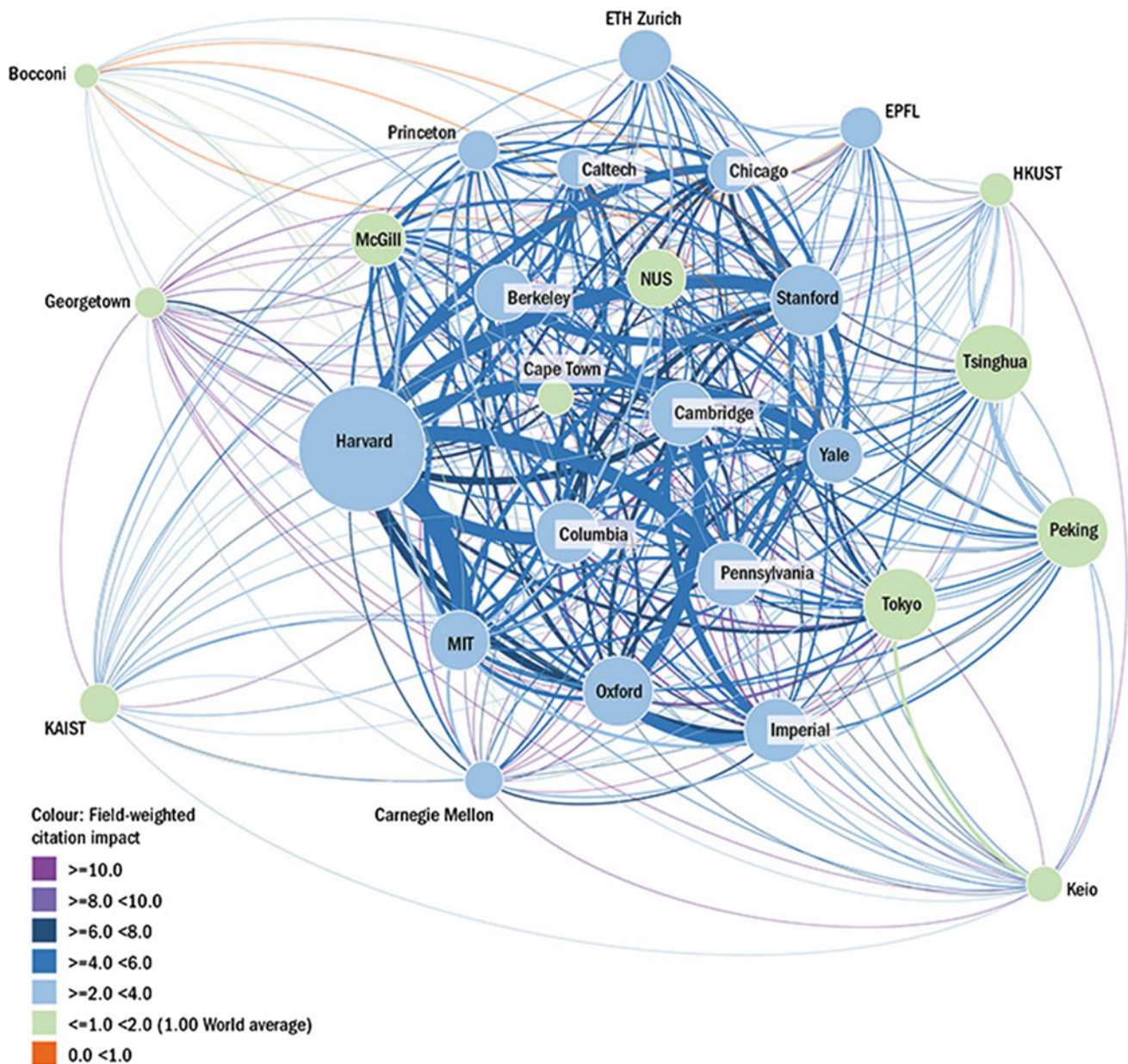


Fig. 2 Collaborations between GULF universities (co-publications university–industry). **Key:** Node color = institution FWCI; Node size = number of publications; Thickness of line = number of co-publications; Color of line = collaboration FWCI. *Source* [42]

by the KT. Smaller firms tend to benefit more from the proximity of university knowledge, while larger firms choose to locate their research close to top universities. KT appears to be substantial in sectors like pharmaceuticals and medicine, optics, electronics, and nuclear technology, but less so for chemical products or metal products.

KT does not come by itself. It requires action and strategy on the part of the university, the region and local public, or private actors (businesses and public organizations). This is captured in the “triple helix” notion: universities, businesses, and regional government should engage in a regional

compact which allows for strategies which are closely tuned to each other. National government should also be included. KT is better facilitated if universities have the freedom/autonomy to act without too much red tape. The readiness of universities to engage in KT can be deduced from the commitment of the leadership, from the orientation of the university toward entrepreneurship and from the organizational structure, with attention for an incubator, for the systematic study of innovation and for rewards for success in KT.

Open science (without protecting intellectual property) is increasingly the mode of operation because it increases the

speed of KT. Large firms in pharmacy and ICT see the advantages of open science.

It appears that US- and UK-top universities are more prominent not only in realizing cooperation with business, but in cooperating with each other in KT. This is clearly a challenge for universities on the European Continent and for universities elsewhere in the world.

Acknowledgements I gratefully acknowledge comments by Peter Mollgaard, Dean of the School of Business and Economics, Maastricht University and Luc Soete, Former Rector, Maastricht University.

References

- Smith, A. (1776). *The wealth of nations*.
- Denison, E. F. (1962). The sources of economic growth in the United States and the alternatives before us. *The Economic Journal*, 72(288), 935–938.
- Romer, P. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5), 71–102.
- Minshall, T. (2018). *What is KT?* Cambridge University. <https://www.cam.ac.uk/research/news/what-is-knowledge-transfer>. Accessed November 1, 2018.
- Fortune 500. (2018). <http://fortune.com/global500/>. Accessed March 28, 2019.
- Varga, A. (1997). Regional economic effects of university research: A survey. *DoNorth*. http://www.donorth.co/appurtenancy/pdfs/varga_effects_%20econ_devel.pdf. Accessed March 28, 2019.
- European Commission. (2017). *Investing in the European future we want*. Report of the Independent High Level Group on Maximising the Impact of EU Research & Innovation.
- Hoareau, C., Ritzen, J., & Marconi, G. (2013). Higher education and economic innovation, a comparison of European countries. *IZA Journal of European Labor Studies*, 2(24).
- Bloomberg. (2015). <https://www.bloomberg.com/graphics/2015-innovative-countries/>. Accessed March 28, 2019.
- Cornell University, INSEAD, & The World Intellectual Property Organization. (2018). *The global innovation index 2018, energizing the world with innovation*. <https://www.globalinnovationindex.org/gii-2018-report>. Accessed March 28, 2019.
- Albassam, B. A. (2015). Economic diversification in Saudi Arabia: Myth or reality? *Resources Policy*, 44, 112–117.
- Jaffe, A. B. (1989). Real effects of academic research. *American Economic Review*, 79(5), 957–970.
- Braam, A. M., Harderman, S., Kiseleva, T., & van Elk, R. (2017, April 4). *De regionale impact van universiteiten; een literatuuroverzicht*. CPB-Achtergronddocument. Den Haag: Centraal Planbureau (in Dutch).
- Acs, Z. J., Audretsch, D. B., & Feldman, M. P. (1994). R&D spillovers and recipient firm size. *The Review of Economics and Statistics*, 76(2), 336–340.
- d'Este, P., Guy, F., & Iammarino, S. (2013). Shaping the formation of university–industry research collaborations: What type of proximity does really matter? *Journal of Economic Geography*, 13(4), 537–558.
- Hong, W., & Su, Y. S. (2013). The Effect of institutional proximity in non-local university–industry collaborations: An analysis based on Chinese patent data. *Research Policy*, 42(2), 454–464.
- Hülsbeck, M., & Pickavé, E. N. (2014). Regional knowledge production as determinant of high-technology entrepreneurship: Empirical evidence for Germany. *International Entrepreneurship and Management Journal*, 10(1), 121–138.
- Audretsch, D. B., & Vivarelli, M. (1996). Firms size and R&D spillovers: Evidence from Italy. *Small Business Economics*, 8(3), 249–258.
- Ponds, R., Van Oort, F., & Frenken, K. (2010). Innovation, spillovers and university–industry collaboration: An extended knowledge production function approach. *Journal of Economic Geography*, 10(2), 231–255.
- Ghinamo, M. L. (2012). Explaining the variation in the empirical estimates of academic knowledge spillovers. *Journal of Regional Science*, 52(4), 606–634.
- Maskell, P., & Törnqvist, G. (2003). The role of universities in the learning region. In *Economic geography of higher education*. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.456.9141&rep=rep1&type=pdf#page=144>. Accessed March 28, 2019.
- Siegfried, J. J., Sanderson, A. R., & McHenry, P. (2007). The economic impact of colleges and universities. *Economics of Education Review*, 26(5), 546–558.
- Jaeger, A., & Kopper, J. (2014). Third mission potential in higher education: Measuring the regional focus of different types of HEIs. *Review of Regional Research*, 34(2), 95–118.
- Goddard, J., & Vallance, P. (2013). *The university and the city*. London: Routledge.
- Wylie, R. (Ed.). (2018). *Higher education and regional growth; the power of universities to shape local economies*. Policy Network.
- Lambooy, J. G. (1996). *Knowledge production, organization and agglomeration economies*. Achievement Motivation and Emotion (AME) Research Group, Congress Paper.
- Garrido-Iserte, R., & Gallo-Rivera, M. T. (2010). The impact of the university upon local economy. *Annals of Regional Science*, 44, 39–67.
- Kotosz, B., Lukovics, M., Molnár, G., & Zuti, B. (2015). How to measure the local economic impact of universities? Methodological overview. *Regional Statistics*, 5(2), 3–19.
- Biggar Economics. (2017). *Economic contribution of the LERU universities*. A report to LERU. <https://www.leru.org/files/Economic-Contribution-of-the-LERU-Universities-Full-paper.pdf>. Accessed March 28, 2019.
- Winters, J. V. (2011). Why are smart cities growing? Who moves and who stays. *Journal of Regional Science*, 51(2), 253–270.
- Organization for Economic Cooperation and Development. (2010). *OECD review of higher education in regional and city development: Berlin*. OECD.
- Organization for Economic Cooperation and Development. (2010). *OECD review of higher education in regional and city development: Rotterdam*. OECD.
- Haapanen, M., & Tervo, H. (2012). Migration of the highly educated: Evidence from residence spells of university graduates. *Journal of Regional Science*, 52(4), 587–605.
- Grant, J. (2015). *The nature, scale and beneficiaries of research impact: An initial analysis of Research Excellence Framework (REF) 2014 impact case studies*. Research Report 2015/01. King's College London and Digital Science.
- DeVol, R., Lee, J., & Ratnatunga, M. (2017). *Concept to commercialization: The best universities for technology transfer*. Santa Monica: Milken Institute.
- Etzkowitz, H. (1993). Enterprises from science: The origins of science-based regional economic development. *Minerva*, 31(3), 326–360.

37. Mazzucato, M. (2013). *The entrepreneurial state: Debunking public vs. private sector myths*. Anthem Press.
38. Pertuzé, J. A., Calder, E. S., Greitzer, E. M., & Lucas, W. A. (2010). Best practices for industry-university collaboration. *MIT Sloan Management Review*, 51(4), 82–90.
39. European Commission. (2018). OECD. <https://heinnovate.eu/en>. Accessed March 28, 2019.
40. Freitas, B., Maria, I., Geuna, A., & Rossi, F. (2013). Finding the right partners: Institutional and personal modes of governance of university–industry interactions. *Research Policy*, 42(1), 50–62.
41. Seppo, M., & Lilles, A. (2012). *Indicators measuring university-industry cooperation*. University of Tartu. <https://core.ac.uk/download/pdf/25068797.pdf>. Accessed March 28, 2019.
42. Baker, S. (2018, January 25). Research that pays: KT at the world's top universities. *Times Higher Education*.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.



The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.