Chapter 7
Dimensions and Indicators

Gero Federkeil, Ben Jongbloed, Frans Kaiser, and Don F. Westerheijden

7.1 Introduction

Having set out the design context for U-Multirank in the previous chapter, we now turn to a major part of the process of constructing U-Multirank: the selection and definition of the indicators. These indicators need to enable us to measure the performances of higher education and research institutions both at the institutional and at the field level, in the five dimensions identified in our conceptual framework: teaching & learning, research, knowledge transfer, international orientation, and regional engagement. U-Multirank thus offers two levels of rankings (focused institutional rankings and field-based rankings) in five dimensions. This chapter provides an overview of the sets of indicators selected for the five dimensions, and briefly describes the selection process.

7.2 Stakeholders' Involvement

The indicator selection process was highly stakeholder-driven. Various categories of stakeholders (student organizations, employer organizations, associations and consortia of higher education institutions, government representatives, and international organizations) were involved in an iterative process of consultation to come to a stakeholder-based assessment of the relevance of various indicators.

The first step in the indicator selection process was a comprehensive inventory of potential indicators from the literature and from existing rankings and databases.

G. Federkeil (✉)
Centre for Higher Education (CHE), Gütersloh, Germany

B. Jongbloed • F. Kaiser • D.F. Westerheijden
Center for Higher Education Policy Studies, University of Twente,
Enschede, The Netherlands

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This first list was exposed for feedback to stakeholders as well as to groups of specialist experts. Stakeholders were asked to give their views on the relative relevance of various indicators, presented to them as potential items in the five dimensions of U-Multirank.

The information gathered was fed into a second round of consultations with stakeholder organizations. To facilitate the consultation process we presented expert information on the availability of data, the perceived reliability of the indicators, and the frequency of their use in existing rankings.

The stakeholders' consultation process led to the selection of a set of indicators based on the criterion of *relevance* (according to stakeholders' perspectives). In addition, we applied four additional criteria to produce our list of indicators.

- *Validity* – The indicator measures what it claims to measure and is not confounded by other factors. This criterion is broken down into:
- *Concept* and *construct validity*: the indicator focuses on the *performance* of (programs in) higher education and research institutions and is defined in such a way that it measures 'relative' characteristics (e.g. controlling for size of the institution).
- *Face validity*: The indicator is used in other benchmarking and/or ranking exercises and thus may be regarded as a measure of performance, which already appears to be used.
- *Reliability*: The measurement of the indicator is the same regardless of who collects the data or when the measure is repeated. The data sources and the data to build the indicator are reliable.
- *Comparability*: The indicators allow comparisons from one situation/system/location to another; broadly similar definitions are used so that data are comparable.
- *Feasibility*: The required data to construct the indicator is either available in existing databases and/or in higher education and research institutions, or can be collected with acceptable effort.

The selected indicators were tested in a pilot test on the basis of which the final selection of indicators was made.

7.3 Overview of Indicators

Following our conceptual framework, the five subsections that follow present the indicators for the five dimensions (teaching & learning, research, knowledge transfer, international orientation, regional engagement). For each indicator we include a number of comments that relate to the criteria (relevance, validity, reliability, comparability, feasibility) used for the selection of the indicator.

7.3.1 Teaching and Learning

Education is the core activity in most higher education and research institutions and comprises all processes to transmit knowledge, skills and values to learners

(colloquially: students). Education can be conceived as a process subdivided in *enablers* (inputs,[1] process[2]) and *performance* (outputs and outcomes[3]). Teaching and learning ideally lead to the *impacts* or *benefits* that graduates will need for a successful career in the area studied and a successful, happy life as an involved citizen of a civil society. Career and quality of life are complex concepts, involving lifelong impacts. Moreover, the pace of change of higher education and research institutions means that long-term performance is of low predictive value for judgments on the future of those institutions. All we could aspire to in a ranking is to assess 'early warning indicators' of higher education's contribution, i.e. outcomes and outputs. Students' learning outcomes after graduation would be a good measure of outcomes. However, measures of *learning outcomes* that are internationally comparable are only now being developed in the AHELO project.[4] At this moment such measures do not exist, but if the AHELO project succeeds they would be a perfect complementary element in our indicator set.

Therefore, a combination of indicators was sought in order to reflect performance in the teaching and learning dimension. Teaching and learning can be looked at from different levels and different perspectives. As one of the main objectives of U-Multirank is to inform stakeholders such as students, their perspective is important too. From their point of view, the output to be judged is the educational process, so especially for the field-based rankings we include indicators that from a macro perspective are perceived as enablers.

Another approach to get close to learning outcomes lies in assessing the quality of study programs. Quality assurance procedures, even if they have become almost ubiquitous in this world's higher education, are too diverse to lead to comparable indicators (see Chap. 2): some quality assurance procedures focus on programs, others on entire higher education institutions; they have different foci, use different data, different performance indicators and different 'algorithms' to arrive at judgments. The qualifications frameworks currently being developed in the Bologna Process and in the EU may come to play a harmonizing role with regard to educational standards in Europe, but they are not yet effective (Westerheijden et al., 2010) and of course they do not apply in the rest of the world.

Indicators of the type of studies offered have been taken into consideration as objective bases for different qualities of programs, such as their interdisciplinary character. Besides, measures of students' progressing through their programs can be seen as indicators for the quality of their learning.

Proceeding from the adage that 'quality is in the eye of the beholder', indicators for quality can be sought in student and graduate assessments of their learning experience. The student/graduate experience of education is conceptually closer to what those same

[1] Inputs include resources for the education process: staff quality and quantity, facilities such as libraries, books, ICT, perhaps living and sports, funding available for those resources, and student quality and quantity.

[2] The process of education includes design and implementation of curricula, with formal teaching, self-study, peer learning, counseling services, etc.

[3] Outputs are direct products of a process, outcomes relate to achievements due to the outputs.

[4] http://www.oecd.org/document/22/0,3343,en_2649_35961291_40624662_1_1_1_1,00.html

students learn than judgments by external agents could be. Students' opinions may derive from investment or from consumption motives, but it is an axiom of economic theories as well as of civil society that persons know their own interest (and experience) best. Therefore we have chosen indicators reflecting both.

An issue might be whether student satisfaction surveys are prone to manipulation: do students voice their loyalty to the institution rather than their genuine (dis-) satisfaction? This is not seen as a major problem as studies show that loyalty depends on satisfaction (Athiyaman, 1997; Brown & Mazzarol, 2009; OECD, 2003).

Another issue about using surveys in international comparative studies concerns differences in culture that affect tendencies to respond in certain ways. Evidence from CHE rankings and from European surveys (e.g. EuroStudent[5]) shows, however, that student surveys can give valid and reliable information in a European context.

Table 7.1 lists the Teaching & Learning indicators that were selected for the pilot test of U-Multirank. The column on the right-hand side includes some of the comments and findings that emerged during the stakeholder/expert consultations.

One indicator dropped from the list during the stakeholder consultation was *graduate earnings*. Although the indicator may reflect the extent to which employers value the institution's graduates, it was felt by the majority of stakeholders that this indicator is very sensitive to economic circumstances and institutions have little influence on labor markets. In addition, data availability proved unsatisfactory for this indicator and comparability issues negatively affect its reliability.

For our field-based rankings, subject-level approaches to quality and educational standards do exist. In business studies, the 'triple crown' of specialized, voluntary accreditation by AACSB (USA), AMBA (UK) and EQUIS (Europe) creates a build-up of expectations on study programs in the field. In the field of engineering, the Washington Accord is an 'international agreement among bodies responsible for accrediting engineering degree programs. It recognizes the substantial equivalency of programs accredited by those bodies and recommends that graduates of programs accredited by any of the signatory bodies be recognized by the other bodies as having met the academic requirements for entry to the practice of engineering' (www.washingtonaccord.org).

In general, information on whether programs have acquired one or more of these international accreditations presents an overall, distant proxy to their educational quality. However, the freedom to opt for international accreditation in business studies may differ across countries, which makes an accreditation indicator less suitable for international comparative ranking. In engineering, adherence to the Washington Accord depends on national-level agencies, not on individual higher education institutions' strategies. These considerations have contributed to our decision not to include accreditation-related indicators in our list of Teaching & Learning performance indicators.

Instead, the quality of the learning experience is reflected in the student satisfaction indicators included in Table 7.1. These indicators can be based on a student

[5] http://www.eurostudent.eu:8080/index.html

Table 7.1 Indicators for the dimension teaching & learning in the focused institutional and field-based rankings

	Focused institutional ranking	*Definition*	*Comments*
1	Expenditure on teaching	Expenditure on teaching activities (including expenditure on teaching related overhead) as a percentage of total expenditure	Data available. Indicator is input indicator. Stakeholders questioned relevance
2	Graduation rate	The percentage of a cohort that graduated x years after entering the program (x is the normal ('stipulated') time expected for completing all requirements for the degree times 1.5)	Graduation rate regarded by stakeholders as most relevant indicator. Shows effectiveness of schooling process. More selective institutions score better compared to (institutions in) open access settings. Sensitive to discipline mix in institution and sensitive to economic circumstances
3	Interdisciplinarity of programs	The number of degree programs involving at least two traditional disciplines as a percentage of the total number of degree programs	Based on objective statistics. Relevant indicator according to stakeholders: shows teaching leads to broadly-educated graduates. But sensitive to regulatory (accreditation) and disciplinary context. Data collection and availability problematic
4	Relative rate of graduate (un)employment	The rate of unemployment of graduates 18 months after graduation as a percentage of the national rate of unemployment of graduates 18 months after graduation (for bachelor graduates and master graduates)	Reflects extent to which institution is 'in sync' with environment. Sensitive to discipline mix in institution and sensitive to (regional) economic circumstances. Data availability poses problem
5	Time to degree	Average time to degree as a percentage of the official length of the program (bachelor and master)	Reflects effectiveness of teaching process. Availability of data may be a problem. Depends on the kind of programs
	Field-based ranking	*Definition*	*Comments*
6	Student-staff ratio	The number of students per fte academic staff	Fairly generally available. Is an input indicator. Depends on educational approaches. Sensitive to definitions of 'staff' and to discipline mix in institution
7	Graduation rate	The percentage of a cohort that graduated after x years after entering the program (x is the normal ('stipulated') time expected for completing all requirements for the degree times 1.5)	See above institutional ranking

(continued)

Table 7.1 (continued)

	Field-based ranking	*Definition*	*Comments*
8	Investment in laboratories [for Engineering FBR]	Investment in laboratories (average over last 5 years, in millions in national currencies) per student	High standard laboratories essential for offering high quality education. International comparisons difficult
9	Qualification of academic staff	The number of academic staff with PhD as a percentage of total number of academic staff (headcount)	Proxy for teaching staff quality. Generally available. Input indicator. Depends on national regulations and definitions of 'staff'
10	Relative rate of graduate (un)employment	The rate of unemployment of graduates 18 months after graduation as a percentage of the national rate of unemployment of graduates 18 months after graduation (for bachelor graduates and master graduates)	See above institutional ranking
11	Interdisciplinarity of programs	The number of degree programs involving at least two traditional disciplines as a percentage of the total number of degree programs	See above institutional ranking
12	Inclusion of issues relevant for employability in curricula	Rating existence of inclusion into curriculum (minimum levels/standards) of: project based learning; joint courses/projects with business students (engineering); business knowledge (engineering); project management; presentation skills; existence of external advisory board (including employers)	Problems with regard to availability of data
13	Inclusion of work experience into the program	Rating based on duration (weeks/credits) and modality (compulsory or recommended)	Data easily available
14	Computer facilities: internet access	Index including: hardware; internet access, including WLAN; (field specific) software; access to computer support	Data easily available
15	Student gender balance	Number of female students as a percentage of total enrolment	Indicates social equity (a balanced situation is considered preferable). Generally available But indicator of social context, not of educational quality

	Student satisfaction indicators	Indicators reflecting students' appreciation of several items related to the teaching & learning process	Student satisfaction is of high conceptual validity. It can be made available in a comparative manner through a survey. An issue might be whether student satisfaction surveys are prone to manipulation: do students voice their loyalty to the institution rather than their genuine (dis-)satisfaction? Global comparability problematic: cross-cultural differences may affect the students' answers to the questions
16	Student satisfaction: overall judgment of program	Overall satisfaction of students with their program and the situation at their higher education institution	Refers to single question to give an 'overall' assessment; no composite indicator
17	Student satisfaction: research orientation of educational program	Index of four items: research orientation of the courses, teaching of relevant research methods, opportunities for early participation in research and stimulation to give conference papers	
18	Student satisfaction: evaluation of teaching	Satisfaction with regard to student's role in the evaluation of teaching, including prevalence of course evaluation by students, relevance of issues included in course evaluation, information about evaluation outcomes, impact of evaluations	
19	Student satisfaction: facilities	The satisfaction of students with respect to facilities, including: Classrooms/lecture halls: index including: availability/access for students; number of places; technical facilities/devices; Laboratories: index including: availability/access for students; number of places; technical facilities/devices; Libraries: index including: availability of literature needed; access to electronic journals; support services/e-services	

(continued)

Table 7.1 (continued)

	Field-based ranking	*Definition*	*Comments*
20	Student satisfaction: organization of program	The satisfaction of students with the organization of a program, including possibility to graduate in time, access to classes/courses, class size, relation of examination requirements to teaching	
21	Student satisfaction: promotion of employ-ability (inclusion of work experience)	Index of several items: students assess the support during their internships, the organization, preparation and evaluation of internships, the links with the theoretical phases	
22	Student satisfaction: quality of courses	Index including: range of courses offered, coherence of modules/courses, didactic competencies of staff, stimulation by teaching, quality of learning materials, quality of laboratory courses (engineering)	
23	Student satisfaction: social climate	Index including: – Interaction with other students – Interaction with teachers – Attitude towards students in city – Security	
24	Student satisfaction: support by teachers	Included items: availability of teachers/professors (e.g. during office hours, via email); informal advice and coaching; feedback on homework, assignments, examinations; coaching during laboratory/IT tutorials (engineering only); support during individual study time (e.g. through learning platforms); suitability of hand-outs	

25	Student satisfaction: opportunities for a stay abroad	Index made up of several items: the attractiveness of the university's exchange programs and the partner universities; availability of exchange places; support and guidance in preparing for stay abroad; financial support (scholarships, exemption from study fees); transfer of credits from exchange university; integration of the stay abroad into studies (no time loss caused by stay abroad) and support in finding internships abroad
26	Student satisfaction: student services	Quality of a range of student services including: general student information, accommodation services , financial services, career service, international office and student organizations/associations
27	Student satisfaction: University webpage	Quality of information for students on the website. Index of several items including general information on institution and admissions, information about the program, information about classes/lectures; English-language information (for international students in non-English speaking countries)

survey carried out among a sample of students from specific fields (in our pilot study: Business Studies and Engineering). As shown in the bottom half of the Table 7.1, this survey focuses on provision of courses, organization of programs and examinations, interaction with teachers, facilities, etc. Stakeholders' feedback on the student satisfaction indicators revealed that they have a positive view overall of the relevance of the indicators on student satisfaction.

In the field-based rankings, some specific indicators are used in addition to the student satisfaction indicators. Most are similar to the indicators in the focused institutional rankings. Some additional indicators are included to pay attention to the facilities and services provided by the institution to enhance the learning experience (e.g. laboratories, curriculum).

7.3.2 Research

Selecting indicators for capturing the research performance of a higher education and research institution or a disciplinary unit (e.g. department, faculty) within that institution has to start with a clear definition of *research*. We take the definition set out in OECD's *Frascati Manual*[6]:

> Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

The term R&D covers three activities: basic research, applied research and experimental development. Given the increasing complexity of the research function of higher education institutions and its extension beyond PhD awarding institutions, U-Multirank adopts a broad definition of research, incorporating elements of both basic and practice-oriented (applied) research. There is a growing diversity of research missions across the classical research universities and the more vocational oriented institutions (university colleges, institutes of technology, universities of applied sciences, Fachhochschulen, etc.). This is reflected in the wide range of research outputs and outlets mapped across the full spectrum, from discovery to knowledge transfer to innovation.

Research performance indicators may be distinguished into:

- *Output indicators,* measuring the quantity of research products. Typical examples are the number of papers published or the number of PhDs delivered.
- *Outcome indicators,* relating to a level of performance or achievement. For instance the contribution research makes to the advancement of scientific scholarly knowledge. Typical examples are citation rates, awards and prizes.
- *Impact indicators,* referring to the contribution of research outcomes to society, culture, the environment and/or the economy.

[6] http://browse.oecdbookshop.org/oecd/pdfs/browseit/9202081E.PDF

Table 7.2 Primary form of written communications by discipline group

	Natural sciences	Life sciences	Engineering sciences	Social sciences & humanities	Arts
Journal article	X	X	X	X	X
Conference proceedings	–	–	X	–	–
Book chapters	–	–	–	X	–
Monographs/books	–	–	–	X	–
Artefacts	–	–	–	–	X
Prototypes	–	–	X	–	–

Source: Expert Group on Assessment of University-Based Research (2009)

Given that in most disciplines publications are often seen as the single most important research output of higher education institutions, research performance measurement frequently takes place through bibliometric data. Data on publications, texts and citations is readily available for building bibliometric indicators (see Table 7.2). This is much less the case for data on research awards and data underlying impact indicators. In addition to performance measures, sometimes input-related proxies such as the volume of research staff and research income are in use to describe the research taking place in a particular institution or unit. Compared to such input indicators, bibliometric indicators may be more valid measures for the output or productivity of research teams and institutions. Increasingly sophisticated indicators such as citation indexes and co-citation indicators have been developed over time. However, an important issue in the production of bibliometric indicators lies in the definition of items that are considered as relevant.

The Expert Group on Assessment of University Based Research[7] defines research output as referring to individual journal articles, conference publications, book chapters, artistic performances, films, etc. While journals are the primary publication channel for almost all disciplines, their importance differs across disciplines. In some fields, books (monographs) play a major role, while book chapters or conference proceedings have a higher status in other fields (see Table 7.2). Therefore, focusing only on journal articles may not do justice to the research performance in particular disciplines. Moreover, the complexity of knowledge has led to a diverse range of output formats and research outlets. One may mention audio visual recordings, computer software and databases, technical drawings, designs or working models, major works in production or exhibition and/or award-winning design, patents or plant breeding rights, major art works, policy documents or briefs, research or technical reports, legal cases, maps, translations or editing of major works within academic standards.

Apart from using existing bibliometric databases, there is also the option to ask institutions themselves to list their research products, without restrictions on the type, medium or quality. While this may improve data coverage, such self-reported accounts may not be standardized or reliable, because respondents may interpret the

[7] See: http://www.kowi.de/Portaldata/2/Resources/fp/assessing-europe-university-based-research.pdf

definitions differently. For example, they may overestimate unpublished but accepted articles. This means that in the case of field-based rankings, the choice of one of these options will depend on the field.

The indicators for research performance in the focused institutional rankings and the field-based rankings are listed below (Table 7.3), along with some comments reflecting their assessment (by stakeholders and experts) against the criteria discussed in the first section of this chapter. The indicators in the table were used in the pilot test (see Chap. 9). The majority of the indicators were normalized by taking into account measures of an institution's (or a department's) size – that is: referring to total staff (in fte or headcount), total revenues or other volume measures.

Bibliometric indicators (citations, publications) are part of every research-based ranking. To acknowledge the output in the arts, an indicator reflecting arts-related output is included in U-Multirank as well. However, data availability is posing some challenges here. Research publications other than peer-reviewed journal publications are included, but this requires self-reporting by institutions based on clear definitions of the types of publications.

An indicator that was considered for use but dropped was 'Presence of research-related promotion schemes for academic staff'. A performance-based appraisal/incentive system (e.g. tenure track system) may increase the attractiveness of an institution to strong researchers, but it proved difficult to define such an indicator in a uniform way across multiple contexts (institutions, borders, disciplines).

Yet another indicator excluded during the process was 'Share of within-country joint research publications'. The number of publications that involve at least one author from another organization in the same country reflects successful national research cooperation. While such data is available, it is limited only to national authors. During the indicator selection process the relevance of the indicator was questioned, more so given the fact that research often is an international endeavor.

Some of the indicators in Table 7.3 are of an input type, such as expenditure on research, competitive grants and post-doc positions. However, stakeholders regarded them as relevant, even though data availability and definitions may sometimes pose a challenge. Therefore it was decided to keep them in the list of indicators for U-Multirank's institutional ranking.

Indicators for reflecting research performance in the field-based rankings are fewer in number. The ones that are included are largely overlapping with indicators for the institutional ranking. The fact that they are relating to a particular field opens up the door for additional indicators, i.e. doctoral productivity.

7.3.3 Knowledge Transfer

Knowledge transfer has become increasingly relevant for higher education and research institutions as many nations and regions strive to make more science output readily available for economic, social and cultural development. There are

Table 7.3 Indicators for the dimension research in the focused institutional and field-based rankings

	Focused institutional ranking	*Definition*	*Comments*
1	Expenditure on research	The amount of money spent on research activities in the reference year as a percentage of total expenditure	Reflects involvement in (and priority attached to) research. Thus input indicator. Data mostly available. Recommended by Expert Group on University-based Research. Difficult to separate teaching and research expenditure in a uniform way
2	Research income from competitive sources	Income from European research programs + income from other international competitive research programs + income from research councils + income from privately funded research contracts as a share of total income	Success in winning grants indicates quality of research. Expert Group regards the indicator as relevant. Levels of external funding may vary greatly across disciplines and countries. Lack of clear delineation affects comparability. In some countries, competitive public funding may be difficult to separate from other public funding
3	Research publication output	Frequency count of research publications with at least one author address referring to selected institution (within Web of Science)	Broadly accepted. Data largely available. Widely used in research rankings (Shanghai, Leiden ranking, HEEACT). Different disciplinary customs cause distortion. Since publications are in peer-reviewed journals, they also signify a certain degree of research quality. However, focus on peer reviewed journal articles is too narrow for some disciplines
4	Post-doc positions (share)	Number of post-doc positions /fte academic staff	Success in attracting post-docs indicates quality of research. Reliability affected by the contextual characteristics of a country's science system. Definitions may vary across countries. Data availability may be weak
5	Interdisciplinary research activities	Share of research publications authored by multiple units from the same institution (based on self-reported data)	Research activities are increasingly becoming interdisciplinary. Indicator may be difficult to define (and collect) satisfactory

(continued)

Table 7.3 (continued)

	Focused institutional ranking	*Definition*	*Comments*
6	Field-normalized citation rate	Field-normalized citation impact score, where the fields are equivalent to the Thomson Reuters Journal Categories. 'Actual' citation counts are compared to 'expected' counts based on the average impact score of all journals assigned to a field. A score larger than one represents a citation impact above world average within that field of science, whereas scores below one represent below average impact	Indicates international scientific impact. Widely used and accepted indicator, especially in the exact sciences. Certain parts of social sciences, humanities and engineering are less well covered by citation indexes. Disregards impact of publications in journals aimed at professional audience
7	Share of highly cited research publications	Share of top 10% most highly cited publications; comparing 'actual' citation counts to 'expected' counts per field; citation impact distributions are calculated by applying a fixed citation-window, for two 'research-based' document types: articles, reviews. These data refer to database years	Publishing in top-ranked, high impact journals reflects quality of research. Indicator relevant primarily for exact/natural sciences. Data largely available. Books and proceedings are not considered. Never used before in any international classification or ranking
8	Number of art related outputs	Count of all relevant research-based tangible outputs in creative arts /fte academic staff	Recognizes outputs other than publications (e.g. exhibition catalogues, musical compositions, designs). This allows musical academies and art schools to be covered in ranking. Data suffers from lack of agreed definitions and lack of availability. Quantities difficult to aggregate
9	Number of international awards and prizes won for research work	Prizes, medals, awards and scholarships won by employees for research work and in (inter-) national cultural competitions, including awards granted by academies of science	Indicator of peer esteem. Recognition of quality. Data suffers from lack of agreed definitions and lack of availability. Quantities difficult to aggregate. Comparison across disciplines difficult

	Field-based ranking	*Definition*	*Comments*
10	External research income	Level of funding attracted by researchers from contracts with external sources, including competitive grants and research income from government, industry, business and community organizations, as a percentage of total income	Success in winning grants indicates quality of research. Lack of clear delineation affects comparability. Annual and accurate numbers hard to retrieve, research contracts may run over several years
11	Research publication output	Frequency count of (Web of Science) research publications with at least one author address referring to selected institutional unit (relative to fte academic staff)	Frequently used indicator. However, research findings are not just published in journals
12	Doctorate productivity	Number of completed PhDs per number of professors (head count)*100 (3-year average)	Indicates aspects of the quantity and quality of a unit's research. Indicator affected by the contextuality of a country's science system
13	Field-normalized citation rate	See definition under institutional ranking	See comments made above for corresponding entry under institutional ranking
14	Highly cited research publications	See definition under institutional ranking	Top-end citation indices are less useful in some fields where high-profile research findings are also published in other outlets (books, reports, conference proceedings)

large differences between efforts and performance of individual institutions in this respect, partly because of the official mandate of an institution and partly because of the strategic profile chosen by individual institutions. *Knowledge transfer* is a broader and more encompassing concept than *technology transfer*. It may be defined as:

> The process by which the knowledge, expertise and intellectually linked assets of Higher Education Institutions are constructively applied beyond Higher Education for the wider benefit of the economy and society, through two-way engagement with business, the public sector, cultural and community partners. (Holi et al., 2008)

Measuring the impact of the knowledge transfer (or knowledge exchange) process in higher education and research institutions and ultimately on users, i.e. business and the economy, has now become a preoccupation of many governing and funding bodies, as well as policy-makers. So far, most attention has been devoted to measuring Technology Transfer (TT) activities. Traditionally TT is primarily concerned with the management of intellectual property (IP) produced by universities and other higher education and research institutions. TT means identifying, protecting, exploiting and defending intellectual property (OECD, 2003). Higher education and research institutions often have *technology transfer offices* (TTOs) (Debackere & Veugelers, 2005), which are units that liaise with industry and assist higher education and research institutions' personnel in the *commercialization* of research results. TTOs provide services in terms of assessing inventions, patenting, licensing IP, developing and funding spin-offs and other start-ups and approaching firms for contract-based arrangements.

The broader nature of Knowledge Transfer compared to TT also means it includes other forms – *channels* – of transfer than those requiring strong IP protection. A typical classification of mechanisms and channels for knowledge transfer between higher education and research institutions and other actors would include four main interaction channels for communication between higher education and research institutions and their environment:

- Texts, including scientific, professional and popular,
- People, including students and researchers,
- Artefacts, including equipment, protocols, rules and regulations,
- Money.

Texts are an obvious knowledge transfer channel. Publishing in scientific or popular media is, however, already covered under the research dimension in U-Multirank. In the case of texts, it is customary to distinguish between two forms: *publications*, where copyright protects how ideas are expressed but not the ideas themselves, and *patents*, which grant exclusive rights to use the inventions explained in them. While publications are part of the research dimension in U-Multirank, patents will be included under the Knowledge Transfer dimension.

People are another channel of knowledge transfer. People carry with them competences, skills and *tacit* knowledge. Indeed, many knowledge exchanges will be person-embodied. This type of knowledge transfer, however, is captured through the

Teaching & Learning and Regional Orientation dimensions included in U-Multirank. Knowledge transfer through people also takes place through networks, continuous professional development (CPD)[8] and research contracts.

Money flows are an important interaction channel, next to texts and people. Unlike texts and people, money is not a carrier of knowledge, but a way of valuing the knowledge transferred in its different forms. The money involved in contract research, CPD, consultancy and commercialization is one of the traditional indicators of knowledge exchange, often used in surveys of TTOs, such as the one carried out by the US-based Association of University Technology Managers (AUTM) for its Annual Licensing survey.

Artefacts make up the fourth major channel of interaction. Artefacts are concrete, physical forms in which knowledge can be carried and transferred. They are more or less 'ready to use', such as machinery, software, new materials or modified organisms. This is often called 'technology'. Artefacts may also extend to art-related outputs produced by scholars working in the arts and humanities disciplines. These works of art, including artistic performances, films and exhibition catalogues have been included in the scholarly outputs covered in the Research dimension of U-Multirank.

Most approaches to knowledge transfer measurement primarily address revenues obtained from the commercialization of Intellectual Property (IP). Clearly the measurement of income from IP is an incomplete reflection of knowledge transfer performance. For this reason, new approaches have been developed, such as the Higher Education-Business and Community Interaction (HE-BCI) Survey in the UK.[9] This UK survey began in 2001 and recognizes a broad spectrum of activities with both financial and non-financial objectives. However, it remains a fact that many indicators in the area of Knowledge Transfer are still in their infancy— in particular the ones that try to go beyond the IP issues.[10] Moreover, there is a need to define knowledge transfer more clearly in order to delineate it from dimensions such as Teaching, Research and Regional Engagement. Like research, knowledge transfer is a process, where inputs, throughputs, outputs and outcomes may be distinguished. Most knowledge transfer measurements focus on the input, some on the output and even fewer on the outcome (or impact) side of this process.

[8] CPD may be defined as: The means by which members of professional associations maintain, improve and broaden their knowledge and skills and develop the personal qualities required in their professional lives, usually through a range of short and long training programs (offered by education institutions), some of which have an option of accreditation.

[9] http://ec.europa.eu/invest-in-research/pdf/download_en/knowledge_transfer_web.pdf. The HE-BCI survey is managed by the Higher Education Funding Council for England (HEFCE) and used as a source of information to inform the funding allocations to reward the UK universities' third stream activities. See: http://www.hefce.ac.uk/econsoc/buscom/hebci

[10] The European Commission-sponsored project E3M (Montesinos et al., 2008) aims to create a ranking methodology for measuring university third mission activities along three subdimensions: Continuing Education (CE), Technology Transfer & Innovation (TT&I) and Social Engagement (SE).

U-Multirank particularly wants to capture aspects of knowledge transfer *performance*. However, given the state of the art in measuring knowledge transfer (Holi et al., 2008) and the near absence of (internationally comparable) data (see Chap. 4),[11] it proved extremely difficult to do so. Most candidates for additional indicators are of an input-type.

The knowledge transfer indicators are presented in Table 7.4, together with – in the right-hand column – some of the pros and cons of the indicators expressed by experts and stakeholders during the indicator selection process. The first selection of indicators was inspired by the international literature on knowledge transfer metrics and existing surveys in this area. An important reference is the report published in 2009 by the Expert Group on Knowledge Transfer Metrics (EGKTM) set up by DG Research of the European Commission.[12]

Cultural awards and prizes won in (inter)national cultural competitions would be an additional indicator that goes beyond the traditional technology-oriented indicators. However, the indicator is difficult to define uniformly and data is difficult to collect. Therefore this indicator was not kept in the list for the pilot.

While there is a large overlap in terms of indicators between the institutional ranking and the field-based ranking, the indicators related to licensing were felt to be less relevant for the institution as a whole. Licensing income is part of the third party funding indicator for the institutional level though. The number of collaborative research projects (university-industry) is another example of a knowledge transfer indicator that was not selected for the Focused Institutional Ranking.

7.3.4 International Orientation

Internationalization is a widely discussed and complex phenomenon in higher education. The rise of globalization and Europeanization have put growing pressure on higher education and research institutions to respond to these trends and develop an international orientation in their activities. Internationalization activities can be categorized in three types (Teichler, 2004):

- Activities to develop and promote international mobility of students and staff,
- Activities to develop and enhance international cooperation,
- Activities to develop and increase international competition.

[11] See also the brief section on the EUMIDA project, included in this report. One of EUMIDA's findings is that data on technology transfer activity and patenting is difficult to collect in a standardized way (using uniform definitions, etc.).

[12] See: http://ec.europa.eu/invest-in-research/pdf/download_en/knowledge_transfer_web.pdf

Table 7.4 Indicators for the dimension knowledge transfer (KT) in the focused institutional and field-based rankings

	Focused institutional ranking	*Definition*	*Comments*
1	Incentives for knowledge exchange	Presence of knowledge exchange activities as part of the performance appraisal system	Such a scheme encourages staff to engage in KT. Information available in institutions. Difficult to define uniformly across institutions, borders, disciplines. New indicator
2	Third party funding	The amount of income for cooperative projects that are part of public programs (e.g. EC Framework programs) plus direct industry income as a proportion of total income	Signals KT success. Some data do exist (although definitions may vary). Is regarded as relevant indicator by EGKTM
3	University-industry joint publications	Relative number of research publications that list an author affiliate address referring to a business enterprise or a private sector R&D unit; relative to fte academic staff	Indicates appreciation of research by industry. Reflects successful partnerships. Less relevant for HEIs oriented to humanities, social sciences. ISI databases available. Used in CWTS University-Industry Research Cooperation Scoreboard
4	Patents	The number of patent applications for which the university acts as an applicant related to number of academic staff	Widely used in KT surveys. Included in U-Map. Depends on disciplinary mix of HEI. Data are available from secondary (identical) data sources
5	Size of technology transfer office	Number of employees (FTE) at Technology Transfer Office related to the number of FTE academic staff	Reflects priority for KT. Input indicator, could also show inefficiency. Data are mostly directly available. KT function may be dispersed across the HEI. Not regarded as core indicator by EGKTM
6	CPD courses offered	Number of CPD courses offered per academic staff (fte)	Captures outreach to professions. Relatively new indicator. CPD difficult to describe uniformly
7	Co-patents	Percentage of university patents for which at least one co-applicant is a firm, as a proportion of all patents	Reflects extent to which HEI shares its IP with external partners. Not widely used in TT surveys. Depends on disciplinary mix of HEI. Data available from secondary sources (PatStat)

(continued)

Table 7.4 (continued)

8	Number of spin-offs	The number of spin-offs created over the last 3 years per academic staff (fte)	EGKTM regards Spin-offs as core indicator. Data available from secondary sources. Clear definition and demarcation criteria needed. Does not reveal market value of spin-offs
	Field-based ranking	*Definition*	*Comments*
9	Academic staff with work experience outside higher education	Percentage of academic staff with work experience outside higher education within the last 10 years	Signals that HEI's staff is well-placed to bring work experience into their academic work. Data difficult to collect
10	Annual income from licensing	The annual income from licensing agreements as a percentage of total income	Licensing reflects exploiting of IP. Indicator is used widely. HEIs not doing research in natural sciences/engineering/ medical sciences hardly covered
11	Co-patents	Percentage of university patents for which at least one co-applicant is a firm, as a proportion of all patents	See above institutional ranking
12	Joint research contracts with private sector	Budget and number of joint research projects with private enterprises per fte academic staff	Indicator of (applied) R&D activities. Indicator only refers to the size of projects, not their impact in terms of KT
13	Number of licence agreements	The number of licence agreements as a percentage of the number of patents	Licensing reflects exploiting of IP. Indicator is used widely. HEIs not doing research in natural sciences/engineering/ medical sciences hardly covered. Number of licences more robust than licensing income
14	Patents awarded	The number of patents awarded to the university related to number of academic staff	Widely used KT indicator. Data available from secondary (identical) data sources. Patents with an academic inventor but another institutional applicant(s) not taken into account. Not relevant for all fields
15	University-industry joint publications	Number of research publications that list an author affiliate address referring to a business enterprise or a private sector R&D unit, relative to fte academic staff	See above institutional ranking. Differences in relevance by fields

The rationales that drive these activities are diverse. Among others, they comprise (IAU, 2005):

- The increasing emphasis on the need to prepare students international labor markets and to increase their international cultural awareness,
- The increasing internationalization of curricula,
- The wish to increase the international position and reputation of higher education and research institutions (Enquist, 2005).

In the literature (Brandenburg and Federkeil, 2007; Enquist, 2005; IAU, 2005; Nuffic, 2010) many indicators have been identified, most of which refer to inputs and processes. The outcomes and impacts of internationalization activities are not very well covered by existing internationalization indicators.

For many of the indicators data are available in the institutional databases. Hardly any of such data can be found in national or international databases.

The various manifestations and results of internationalization are captured through the list of indicators shown in Table 7.5. The table includes some comments made during the consultation process that led to the selection of the indicators.

It should be pointed out here that one of the indicators is a *student satisfaction indicator*: 'Student satisfaction: Internationalization of programs'. This describes the opportunities for students to go abroad. Student opinion on the availability of opportunities for a semester or internship abroad is an aspect of the internationalization of programs. This indicator is relevant for the field level.

An indicator that was considered, but dropped during the stakeholders' consultation process is 'Size of international office'. While this indicates the commitment of the higher education and research institution to internationalization, and data is available, stakeholders consider this indicator not very important. Moreover, the validity is questionable as the size of the international office as a facilitating service is only a very crude indicator of internationalization.

The indicator 'international graduate employment rate' was dropped from the list for focused institutional rankings because a large majority of stakeholders judged this to be insufficiently relevant. At the field level this indicator was however seen as an attractive indicator for the international orientation of the program.

'International partnerships', that is the number of international academic networks a higher education and research institution participates in, is a potential indicator of the international embeddedness of the institution (department). However, it was dropped from the list during the stakeholder consultation as there is no clear internationally accepted way of counting partnerships. The same argument was used to exclude the indicator 'Joint international research projects'.

7.3.5 Regional Engagement

The *region* has become an important entity in the processes of economic and social development and innovation. Gaps between regions in terms of these processes are growing and regions that have skilled people and the infrastructure for innovation

Table 7.5 Indicators for the dimension international orientation in the focused institutional and field-based rankings

	Focused institutional ranking	*Definition*	*Comments*
1	Educational programs in foreign language	The number of programs offered in a foreign language as a percentage of the total number of programs offered	Signals the commitment to international orientation in teaching and learning. Data availability good. Relevant indicator. Used quite frequently. Sensitive to relative 'size' of national language
2	International academic staff	Foreign academic staff members (headcount) as percentage of total number of academic staff members (headcount). Foreign academic staff is academic staff with a foreign nationality, employed by the institution or working on an exchange basis	Considered to be relevant by stakeholders. Nationality not the most precise way of measuring international orientation
3	International doctorate graduation rate	The number of doctorate degrees awarded to students with a foreign nationality, as a percentage of the total number of doctorate degrees awarded	Indicator not used frequently. Some stakeholders see it as less relevant. Availability of data problematic
4	International joint research publications	Relative number of research publications that list one or more author affiliate addresses in another country relative to research staff	Only indicator addressing research internationalization. Data available in international databases, but bias towards certain disciplines and languages
5	Number of joint degree programs	The number of students in joint degree programs with foreign university (including integrated period at foreign university) as a percentage of total enrolment	Integration of international learning experiences is central element of internationalization. Data available. Indicator not often used
	Field-based ranking	*Definition*	*Comments*
6	Incoming and outgoing students	Incoming exchange students as a percentage of total number of students and the number of students going abroad as a percentage of total number of students enrolled	Important indicator of the international 'atmosphere' of a faculty/department. Addresses student mobility and curriculum quality. Data available
7	International graduate employment rate	The number of graduates employed abroad or in an international organization as a percentage of the total number of graduates employed	Indicates the student preparedness on the international labor market. Data not readily available. No clear international standards for measuring
8	International academic staff	Percentage of international academic staff in total number of (regular) academic staff	See above institutional ranking

9	International research grants	Research grants attained from foreign and international funding bodies as a percentage of total income	Proxy of the international reputation and quality of research activities. Data are available. Stakeholders question relevance
10	Student satisfaction: internationalization of programs	Index including the attractiveness of the university's exchange programs, the attractiveness of the partner universities, the sufficiency of the number of exchange places; support and guidance in preparing the stay abroad; financial support; the transfer of credits from exchange university; the integration of the stay abroad into studies (no time loss caused by stay abroad)	Addresses quality of the curriculum. Not used frequently
11	Joint international publications	Relative number of research publications that list one or more author affiliate addresses in another country relative to academic staff	See above institutional ranking, but no problems of disciplinary distortion because comparison is made within the field
12	Percentage of international students	The number of degree-seeking students with a foreign diploma on entrance as percentage of total enrolment in degree programs	Reflects attractiveness to international students. Data available but sensitive to location (distance to border) of HEI. Stakeholders consider the indicator important
13	Student satisfaction: international orientation of programs	Rating including several issues: existence of joint degree programs, inclusion of mandatory stays abroad, international students (degree and exchange), international background of staff and teaching in foreign languages	Good indicator of international orientation of teaching; composite indicators depend on the availability of each data element

have a competitive advantage (Ischinger and Puukka, 2009). Higher education and research institutions can play an important role in the process of creating the conditions for a region to prosper. Creating and expanding this role in the region has become highly relevant for many public policymakers at the national and regional level, as well as for institutional administrators. How well a higher education and research institution is engaged in the region is increasingly considered to be an important part of the mission of higher education institutions.

Regional engagement is part of the broader concept of the 'third mission' of an institution. In the European project on third mission ranking (Montesinos et al. 2008) this 'third mission' consists of three dimensions: a social dimension, an enterprise dimension and an innovation dimension. The latter two dimensions are covered in the U-Multirank dimension 'Knowledge Transfer'. Indicators for the social dimension of the third mission comprise indicators on international mobility (that are covered in the U-Multirank dimension International Orientation) and a very limited number of indicators on regional engagement.

Activities and indicators on regional and community engagement can be categorized in three groups: outreach, partnerships and curricular engagement.[13] Outreach focuses on the application and provision of institutional resources for regional and community use, benefitting both the university and the regional community. Partnerships focus on collaborative interactions with the region/community and related scholarship for the mutual beneficial exchange, exploration, discovery and application of knowledge, information and resources. Curricular engagement refers to teaching, learning and scholarship that engage faculty, students and region/community in mutual beneficial and respectful collaboration.

Both enabling indicators and performance indicators are suggested in the literature on regional and community engagement. However, most attention is paid to the enablers and to indicators addressing the way an institution organizes its engagement activities. These indicators are based on checklists assessing the extent to which regional engagement is part of the institutional mission and integrated in the routines and procedures of the institution. Do the reward and promotion schemes of the institution acknowledge regional engagement activities? Are there visible structures that function to assist with region-based teaching and learning? Is there adequate funding available for establishing and deepening region-based activities? Are there courses that have a regional component (such as service-learning courses)? Are there mutually beneficial, sustained partnerships with regional community partners? These are typical items on such checklists (Furco & Miller, 2009; Hollander et al., 2001). The problem with these checklists is that the information is not readily available. Institutional or external assessors need to collect the information, which makes the robustness and reliability of the results in an international comparative setting highly questionable.

[13] See: http://classifications.carnegiefoundation.org/details/communityengagement.php

Other indicators for regional engagement capture the relative size of the interaction. How much does the institution draw on regional resources (students, staff, funding) and how much does the region draw on the resources provided by the higher education and research institution (graduates and facilities)?

Clarification is required as to what constitutes a region. U-Multirank starts with the existing list of regions in the Nomenclature of Territorial Units for Statistics (NUTS) classification developed and used by the European Union,[14] in particular the NUTS 2 level. For non-European countries the lower level (Territorial level 3) of the OECD classification of its member states is used. This is composed of micro-regions.[15] As with most standard lists, these work fine in the majority of cases, but there are always cases where a different definition is more appropriate. In the pilot study we allowed higher education and research institutions to specify their own delimitation of region if they felt there were valid reasons for doing so. Table 7.6 includes the indicators on regional engagement, along with the comments made during the stakeholder and expert consultations.

In the dimension Regional Engagement there are a number of indicators were considered but not included in the pilot test:

- 'Co-patents with regional firms' reflect cooperative research activities between higher education institutions and regional firms. While data may be found in international patent databases, the indicator is not often used and stakeholders did not particularly favor the indicator. Therefore it was dropped from our list.
- The same holds for measures of the regional economic impact of a higher education institution, such as the number of jobs generated by the university. Assessing what the higher education and research institution 'delivers' to the region (in economic terms) is seen as most relevant but data constraints prevent us from the use of such an indicator.
- Public lectures that are open to an external, mostly local audience, are a way to intensify contacts to the local community. However, stakeholders felt this indicator not to be relevant.
- A high percentage of new entrants from the region may be seen as the result of the high visibility of regionally active higher education and research institutions. It may also be a result of the engagement with regional secondary schools. This indicator however was not included in our list, mainly because it was not considered to be that relevant.

The above discussion makes it clear that regional engagement is a dimension that poses many problems with regard to availability of performance-oriented indicators and their underlying data. In the next chapter we will discuss the data gathering instruments that are available more extensively.

[14] http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/regional_statistics/nuts_classification

[15] http://www.oecd.org/document/62/0,3343,en_2649_34413_36878718_1_1_1_1,00.html

Table 7.6 Indicators for the dimension regional engagement in the focused institutional and field-based rankings

	Focused institutional ranking	*Definition*	*Comments*
1	Graduates working in the region	The number of graduates working in the region, as a percentage of all graduates employed	Frequently used in benchmarking exercises. Stakeholders like indicator. No national data on graduate destinations
2	Income from regional/local sources	Institutional income from local regional authorities, local/regional charities and local/regional contracts as a percentage of total institutional income	Reflects connection and engagement with regional/local society. Sensitive to way public funding for HEI is organized (national versus regional/federal systems). Availability of data problematic
3	Regional joint research publications	Number of research publications that list one or more author-affiliate addresses in the same NUTS2 or NUTS3 region, relative to fte academic staff	Reflects 'local' research cooperation. Data available (Web of Science), but professional (laymen's) publications not covered
4	Research contracts with regional business	The number of research projects with regional firms, as a proportion of the total number of collaborative research projects	Seen as valid and relevant indicator, hardly any records kept on (regional) contracts. New type of indicator
5	Student internships in local/regional enterprises	The number of student internships in regional enterprises as a percentage of total enrolment (with defined minimum of weeks and/or credits)	Internships open up communication channels between HEI and regional/local enterprises. Stakeholders see this as important indicator. Definition of internship problematic and data not readily available. Disciplinary bias

	Field-based ranking	*Definition*	*Comments*
6	Degree theses in cooperation with regional enterprises	Number of degree theses in cooperation with regional enterprises as a percentage of total number of degree theses awarded, by level of program	Reflects regional cooperation and curricular engagement. Indicator hardly ever used
7	Graduates working in the region	The number of graduates working in the region, as a percentage of all graduates employed	See above institutional ranking
8	Regional participation in continuing education	Number of regional participants (coming from NUTS3 region where HEI is located) as percentage of total number of population in NUTS3 region aged 25+	Indicates how much the HEI draws on the region and vice versa. Covers important aspect of curricular engagement. Data not readily available. Indicator hardly ever used
9	Student internships in local/regional enterprises	Number of internships of students in regional enterprises (as percentage of total students)	See above institutional ranking, but disciplinary bias not problematic at field level
10	Summer school/courses for secondary education students	Number of participants in schools/courses for secondary school students as a percentage of total enrolment	Addresses outreach activities. Limited availability of data. Lack of internationally accepted definition of summer school courses

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