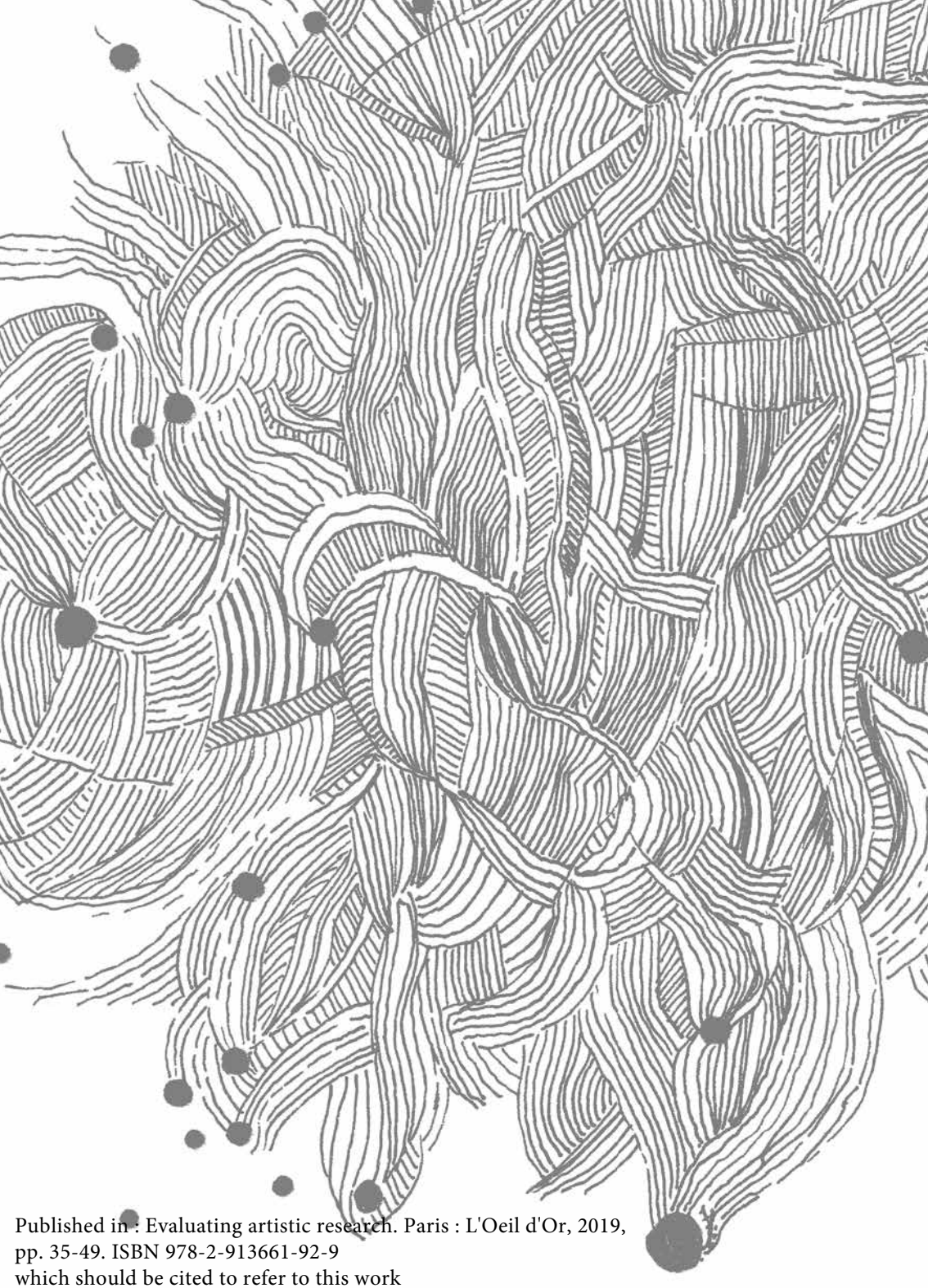

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# Progress Report in Different Fields and Results of the Subproject EDUPROF "Developing Indicators of Applied Research"

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The Swiss Federal Law on Universities of Applied Sciences and Arts[1] states that HES "practise activities in the field of applied research and development, and thus act as a link with the scientific community and the professional fields."[2] This specific statement regarding the applied nature of research and the link with the community of practice is considered specific to the research mission of HES. The law also states that these universities "incorporate outcomes into their teaching," which solidly anchors the research mission of the HES and justifies the fact that they belong to the level of higher tertiary education.

1 These schools are known as "Hautes écoles spécialisées," or HES.

2 *Loi fédérale sur les hautes écoles spécialisées du 6 octobre 1995 (État le 1er janvier 2013)*, art. 9 al. 1, Confédération suisse, recueil systématique RS 414.71.

Universities similar to the Swiss HES have been developed at a European level through the evolution of professional training institutions towards the higher tertiary level. Designations vary by country (Institut Universitaire de Technologie in France, Fachhochschule in the DACH region —Germany, Austria, and Switzerland—, Institute of Technology in Ireland, Instituto Politécnico in Portugal, etc.). We shall use the acronym UAS (University of Applied Sciences and Arts) to refer to these universities generically and the acronym HES when we deal more specifically with Swiss schools.

What sets UAS apart is also the fact that four groups benefiting from the outcomes of research can be considered: the scientific world, the world of professional practice, education, and society as a whole. As far as traditional universities are concerned, it is certainly the scientific world that is favoured, as its knowledge output is based on sharing the outcomes of research with the community as a whole. Education and society come second. On the contrary, the UAS address first and foremost the world of professional practice and education, yet without neglecting the other two circles of beneficiaries.

The mission being specific and the beneficiaries being different, evaluation should be carried out in an appropriate manner. What is true for what is called applied research can probably be extended to artistic research.

It is worth pointing out that we shall focus on one aspect of evaluating research, namely performance (or impact) indicators. We shall leave aside the scientific evaluation of research projects or of their outcomes, as it is essentially based on peer expertise.

Numerous initiatives have led to the development of lists of indicators for the performance of research, often with the aim of establishing a classification of universities. In this paper, we shall examine, as a point of reference, the Leiden Ranking—a system of university classification based on bibliometric indicators. We shall then go over some aspects of the work launched by the Rectors' Conference of Swiss Universities (CRUS), the reflections conducted at a European level as part of the U-Multirank project, and the conclusions of the

European project EDUPROF, which dealt specifically with measuring the performance of research in UAS. We shall examine what indicators have been selected, and finally mention some examples of indicators proposed as part of the complete re-working of the research incentive scheme put in place by the HES-SO.

## The Leiden Ranking

In order to better comprehend the concept of bibliometrics, it seems worthwhile to consider the Leiden Ranking, a well-established university classification established by the Centre for Science and Technology Studies (CWTS) of the University of Leiden (Netherlands).[3]

The Leiden system offers different classifications based on impact and collaboration. I shall focus here on the first category.

The first indicator (P) represents the raw number of publications in the Thomson Reuters Web of Science (ISI). This indicator is not directly considered an impact indicator, as its principal use is to add to the amount of publications of the institution concerned. If we focus on the 2013 classification for the European region, Oxford University (ninth at a world level) comes first, with 12,208 publications, followed by three other British institutions. As for Switzerland, the first institution is the Swiss Federal Institute of Technology in Zurich (Eidgenössische Technische Hochschule Zürich—ETH), in tenth position with 7,257 publications. This indicator depends in part on the size of the institution; when choosing other indicators, the CWTS has sought to break free of this.

Beyond the number of publications, another important dimension for bibliometrics is the number of citations. The more an article is cited, the more its impact is considered to be significant. Leiden proposes an average number of citations (Mean Citation Score, MCS)

3 http://www.leidenranking.com, retrieved 15 July 2013.

calculated from the total number of publications of a university. As regards Europe, in 2013, the university with the highest rank is that of Göttingen with 12.99 citations per publication, the second best in the world behind the Massachusetts Institute of technology (MIT) (13.18 citations), yet with a high stability interval that indicates that one or more major publications have been consistently cited. It is followed by three other British universities, then, very close behind, by the University of Lausanne and the Swiss Federal Institute of Technology in Lausanne (EPFL) (ranked 5 and 6 with respective scores of 8.75 and 8.72).

As the culture of citation is not the same in all of the disciplines, a normalised indicator of citation was introduced: the Mean Normalized Citation Score (MNCS). The number of citations in one publication is thus adjusted to the average number of citations in its field of research, so as to gain a better understanding of the impact of a university within its scientific environment. In 2013, the University of Göttingen also appeared to be well ahead of other European universities with a score of 2.07 and was in second position worldwide, behind the MIT (2.15). The EPFL is the second European university with a score of 1.60.

Finally, in order to measure the contribution to scientific excellence, the indicator PP (top 10%) indicates the number and proportion of an institution's publications among the 10% most frequently cited, in the same year and in the same field. The EPFL is in the lead in Europe (thirteenth worldwide) with 18.0%, the Swiss Federal Institute of Technology in Zurich ranking third (17.1%). The CWTS observes that this indicator is more stable than the MNCS and considers it as the most significant impact indicator of the Leiden Ranking.

This calls for three remarks. First at a global level, it can be observed that American universities maintain a dominant, if not hegemonic, position; they were probably placed very early in a competitive environment based on their publications. If we then look at the particular case of the EPFL, we observe that PP (top 10%) is particularly well adapted to an average size institution with

significant resources to pursue excellence in many of its fields of research. Finally, it has to be acknowledged that no UAS appear in the ranking, even in countries where this type of university is well established (such as Germany, Austria, Ireland, and Switzerland).

The fact that the research mission in UAS is still in its early days, coupled with the fact that they do not grant postgraduate degrees, makes it very difficult for them to be included in classifications based on bibliometrics. Furthermore, within the UAS whose research outcomes must, as we have seen, reach various audiences, an important effort of dissemination is directed towards the professional world. Yet, professional journals function differently from scientific journals and are not taken into account in scientific databases. Therefore, institutions that conduct practice-based research activities have considerable difficulty appearing in rankings based on bibliometrics. The prognosis is no better for artistic research, and the specific ways in which it is disseminated (production of artefacts, exhibitions, shows) are not taken into account either.

## The CRUS Project, measuring the performance of research

In 2008, after noting the increasing importance of the classification systems of universities at an international level, the Rectors' Conference of the Swiss Universities (CRUS) launched a project entitled "Measuring the Performance of Research", which was aimed at "conceiving a system of verification for the intellectual contribution of universities."[4] Even if the CRUS represents "traditional" universities, which thus have a stronger academic vocation than UAS, it is interesting to see how it positions itself in relation to bibliometrics and what other indicators it has listed among Swiss universities.

4 http://www.crus.ch/information-programmes/projets-programmes/projet-mesurer-les-performances-de-la-recherche.html?L=1, retrieved 15 July 2013

In one of its sub-projects, the CRUS has thoroughly analysed the position of Swiss universities within the Leiden system.[5] It concludes with certainty that bibliometrics "represents a powerful tool, which makes it possible to quantify the reactions of the scientific community as regards the publication of research outcomes," while bringing to light a number of limitations. Publications and citations are taken into account only when they are listed in the Web of Science database, and this can lead to important biases depending on disciplines and linguistic regions. The way disciplinary fields (fields, subfields)—and thus scientific journals—are organised does not correspond to the organisational structure of universities. This makes it difficult to analyse the performance by institution or faculty. Finally, the statistical approach is unsuited for comparing very small units.

In another sub-project, the CRUS has outlined some of the practices set up for measuring research performance in Swiss universities with the most commonly used indicators, which are grouped in seven categories, listed below: [6]

**a. Staff, counted by rank:**
Ordinary and extraordinary professors
Professors from other universities
Postdoctoral researchers and assistants
Administrative staff
Doctoral Students

**b. Research Training**
Number of doctoral students
Value of the scholarships funded by the Swiss National Science Foundation for International residences

5 *Projet « Mesurer les performances de la recherche »*, 1er *Rapport*, crus.ch, Conférence des Recteurs des Universités Suisses, September 2009.

6 *Ibid.*

**c. Financing for research projects**
Total amount of third-party funding from different sources

**d. Scientific publications—Bibliometrics**
Annual number of publications listed in the Web of Science
The impact factor of journals
All the bibliometric criteria

**e. International dimension**
Collaborative research projects
Socrates /Erasmus
Number of networks
Residences abroad in/out
Conference of specialists in/out
Residences abroad

**f. Transfer of technology**
Number of patents
Setting up of companies / transfer of knowledge

**g. Outputs / Visibility of research**
Organisation of conferences
Presentation at conferences and congresses
Scientific prizes and awards obtained
(international rankings)
Membership and participation in significant private public institutions
Invitations
Evaluation work led by experts
Practical references

When we examine the reflections carried out by Swiss universities, we can see that bibliometrics is viewed with a critical eye, even if the significance of international classification is undeniable, and that the importance given to bibliometrics greatly varies. The transfer of technology concept is little developed while the visibility of research is defined according to activities that remain for the most part associated with the academic world.

## The European U-Multirank project

The U-Multirank project was launched in 2009 as a feasibility study by the European Commission, that noted that the bibliometric approach corresponded rather well to the culture of research and of publication in the field of the so-called "hard" sciences, but not so well when applied to arts, humanities and social science, and that it did not take into account the impacts of research, the quality of teaching, or how those activities served society. With the new U-Multirank tool, the Commission hoped to provide students, teachers, parents, and other interested parties with a way to make informed choices between different institutions of higher education. The feasibility study has resulted in a very comprehensive report.[7] We shall analyse a few points below, but the original report is a reference document.

U-Multirank is comprised of two levels of description. The institutional level is based on a multidimensional performance and multi-criteria profile, partly borrowed from the U-Map project.[8] Five dimensions were considered: teaching and learning, research, knowledge transfer, international orientation, and regional engagement. Other, more specific, indicators have been added for a further description at the level of the scientific field (field level). The institutional level must allow for establishing classifications of institutions as a whole (focused institutional rankings), while the level of the scientific field must allow for classification in a specific field (filed-based rankings).

The system is devised to give users the opportunity to choose the institutions that they wish to compare and the indicators that they consider relevant, and thus obtain personalised rankings. Firstly, a set of institutions or units (faculties, departments, fields)

7 Frans Van Vught et Frank Ziegele, dir., *Design and Testing the Feasibility of a Multidimensional Global University Ranking—Final Report* (Consortium for Higher Education and Research Performance Assessment CHERPA-Network, June 2011), consultable online at http://ec.europa.eu/education/library/study/2011/multirank_en.pdf

8 www.u-map.eu, retrieved July 15th 2013.

that are homogenous in relation to the aspects judged relevant in a given context are identified. Next, the users decide if the comparison must cover institutions as a whole or as individual units. Finally, a set of indicators is selected on the basis of which rankings may be established.

The indicators corresponding to the institutional level are listed below:

**Teaching and learning**

1. Expenditure on teaching
2. Graduation rate
3. Interdisciplinarity of programs
4. Relative rate of graduate (un)employment
5. Time to degree

**Research**

1. Expenditure on research
2. Research income from competitive sources
3. Research publication output
4. Post-doc positions (share)
5. Interdisciplinary research activities
6. Field-normalised citation rate
7. Share of highly cited research publications
8. Number of art related outputs
9. Number of international awards and prizes won for research work

**Knowledge Transfer (KT)**

1. Incentives for knowledge exchange
2. Third party funding
3. University-industry joint publications
4. Patents

5. Size of technology transfer office
6. Continuing professional development courses offered
7. Co-patents
8. Number of spin-offs

**International orientation**

1. Educational programs in foreign language
2. International academic staff
3. International doctorate graduation rate
4. International joint research publications
5. Number of joint degree programs

**Regional engagement**

1. Graduates working in the region
2. Income from regional/local sources
3. Regional joint research publications
4. Research contracts with regional business
5. Student internships in local/regional enterprises

We observe that this set of indicators would help demonstrate the performance of a UAS better than simple bibliometrics. For instance, the rate of graduate (un)employment (teaching and learning) is an advantage for institutions in close relationships with the professional world. Unfortunately, regarding research, the indicators do not take into account the publications in professional journals; yet, interestingly, as regards universities of the arts, the number of research-based art-related outputs (exhibition catalogues, musical compositions, designs, etc.) is taken into consideration. The knowledge transfer indicators remain very orientated towards technological disciplines and industrial transfer. Regional engagement should advantageously reflect the strong regional base of UAS.

## Sub-project EDUPROF: Developing indicators of applied research

The project EDUPROF was funded by the European Commission as part of the LLP (Life-long Learning Programme), which aimed at sharing learning practices in UAS at a European level. One of its sub-projects was devoted more specifically to the development of indicators so as to measure the performance of applied research specific to UAS. This part has resulted in a report, some elements of which we shall analyse below, although the original report is a reference document.[9]

Firstly, the project team, consisting of representatives of UAS from ten European countries, established a long list of indicators taking into consideration the four categories of beneficiaries of research outcomes, i.e. the professional fields, teaching and training, the scientific community, and society as a whole. The list was then reduced to the twenty-three most promising indicators grouped into five categories: money, people, publications and media appearances, artefacts and services, patents/licenses/start-ups/spin-offs/awards and prizes.

The participants evaluated each of these indicators according to four criteria: relevance, validity, robustness, and feasibility. Relevance means that the value measured gives a good indication of the performance of research activity. Validity confirms that the value effectively measured—always indirectly—corresponds to the intended parameter. Robustness corresponds to a low risk of bias or manipulation. Finally, feasibility rests on the availability of the data measured.

The indicators were tested on the basis of the available data of the participating UAS. This validation stage showed that the majority of the chosen indicators (20 out of 23) were directly feasible, though sometimes with some caution.

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9 Alexander Scholtes et al., *The EDUPROF Project: Developing Indicators of Applied Research—Final Report* (Universities of Applied Sciences Network, October 2011) , consultable online at http://www.scienceguide.nl/media/700624/eduprof_report_november_2011.pdf

The EDUPROF indicators are listed below:

**Money**

1. Total income—reference value
2. Direct basic government funding for research—reference value
3. Research income from competitive research funding sources—impact on scientific body of knowledge
4. Research income from working fields, private and public—impact on professional fields

**People**

1. Total of academic staff—reference value
2. Total number of academic staff (FTE)—reference value
   Total FTE spent on research—measure the part of the research activity in a given institution
3. Total FTE spent on teaching—measure the part of the teaching and learning activity in a given institution
4. Total number of staff involved in both research and teaching—impact on teaching and training
5. Percentage of students involved in research—impact on teaching and training

**Publications and media appearances**

1. Total number of research publications—impact on scientific body of knowledge
2. Number of peer-reviewed research publications—impact on scientific body of knowledge
3. Number of research publications relevant to professional fields—impact on professional fields
4. Total number of research presentations—impact on scientific body of knowledge
5. Total number of research presentations relevant to professional fields—impact on professional fields

6. Total number of publications/presentations/appearances in popular media—impact on society at large

**Artefacts and services**

1. Total number of new artefacts and services in professional fields—impact on professional fields
2. Total number of Continuous Professional Development (CPD) courses offered as a result of research—impact on teaching and training

**Patents/licenses/start-ups/spin-offs/awards and prizes**

1. Total number of patents—impact on professional fields
2. Total number of licenses—impact on professional fields
3. Total number of start-up firms—impact on professional fields
4. Total number of spin-offs—impact on professional fields
5. Total number of awards and prizes won—impact on society as a whole

The project team identified a number of points for further reflection. As mentioned above, the indicators represent an indirect measurement of research performance, and this measurement combines institutional values and parameters applicable to research itself, to teaching or service-providing activities. The indicators do not measure the quality of the research work, as this evaluation is entrusted to peers whether for the allocation of research funds or for the publication of research outcomes in scientific journals. Tension will always remain between (national and institutional) contextuality and comparability between institutions. The issue of the availability of data must also be kept in mind because there is no database listing non-traditional research outputs.

It can also be observed that the distinguishing feature of the set of indicators developed within the framework of EDUPROF is the importance given to the impact of research in professional fields,

which corresponds to the distinctiveness of UAS. However, in UAS (and HES), the fields historically related to engineering and technology maintain a strong influence, not least of all on the indicators of knowledge transfer; at this level, the contribution of social science, health, and the arts will be more difficult to highlight.

### HES-SO — Sector-based strategies for the Applied Research and Development mission

By 2010, the Executive Committee of the University of Applied Sciences and Arts of Western Switzerland had already decided to entrust the Applied Research and Development (Ra&D) mission to six organisational units, or fields of study: Music and Performing Arts, Design and Visual Arts, Health, Social Work, Economy and Services, Engineering and Architecture. Each of these fields was requested to develop a specific strategy including objectives and indicators. By leaving each field the choice of indicators with which to measure research performance, each working context and its disciplinary specificities has largely been taken into account. By contrast, this comparison can be made only over time or in relation to announced objectives, but not between the fields.

Without going into detail about the sets of indicators that have not been made public and that include, depending on the field concerned, between four and fourteen different indicators, it can be noted that the number of scientific publications generally remains an important indicator even in HES. Furthermore, and more specifically, the Engineering and Architecture field attaches great importance to research contracts signed with public or private partners and to the related amount of exogenous fundings; Economy and Services gives considerable weight to financial volumes, while Social Work takes into greater account the number of research projects conducted by teams; as regards Health, with a view to training young researchers, what is taken into account is the number of faculty members active

in research as well as those who are engaged in long term studies (MA, PhD); in artistic fields, grants applications are currently the preferred activity.

### Perspectives

The bottom-up approach chosen by the HES-SO should allow for an efficient follow-up of the evolution of each field towards its development objectives as part of the Ra&D mission. Yet, if the HES-SO wishes to stand out in an international context, a directed approach should be preferred, in line with the strategy of the education office. It does not seem appropriate to aim for a good position in rankings such as the Leiden one: the publication of scientific research outcomes remains necessary for the institution to exist as a partner and to attract talented individuals; nevertheless, it cannot fulfil alone the diversified missions of HES. The framework offered by the EDUPROF project is a useful reference point as a guide for the evolution of this institution. It is however quite unlikely that it will be developed as a common standard. The most promising approach that has recently emerged consists in the integration in the U-Multirank programme, while giving priority to an institutional development targeting a subsection of carefully selected indicators.

In addition to the documents mentioned above, the second report of the European University Association (EUA) on university rankings and their impact constitutes an excellent reference source for further reflection.[10]

10 Andrejs Rauhvargers, *Global University Rankings and their Impact—Report II*, Brussels, European University Association, 2013 (http://www.eua.be/publications/eua-reports-studies-and-occasional-papers.aspx).