

# A Bibliometric Comparison of the Research of Three UK Business Schools

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**Abstract**— The Leiden ranking methodology (LRM), also sometimes called the crown indicator, is a quantitative method for evaluating the research quality of a research group or academic department based on the citations received by the group in comparison to averages for the field. There have been a number of applications but these have mainly been in the hard sciences where the data on citations, provided by the ISI Web of Science (WoS), is more reliable. In the social sciences, including business and management, many journals and books are not included within WoS and so the LRM has not been tested here. In this research study the LRM has been applied on a dataset of over 3,000 research publications from three UK business schools. The results show that the LRM does indeed discriminate between the schools, and has a degree of concordance with other forms of evaluation, but that there are significant limitations and problems within this discipline.

**Index Terms**—citations, crown indicator, Leiden methodology, research quality assessment

## I. INTRODUCTION

In recent years, excellent scientific research, as the main driving force of our modern society, has been proved to be the source of breakthroughs in the diffusion of our knowledge of the world. The evaluation of such scientific research is considered to be of paramount importance. One of the main factors in the assessment of research performance is international scientific influence, representing a measurable aspect of scientific quality.

Current research evaluation methodologies are either qualitative or quantitative assessments of research performance. The former is primarily peer review methodologies - reviews conducted by colleague-scientists (peers) in order to evaluate research groups and programs, to make appointments of research staff, to judge research proposals and projects etc. The latter contains certain bibliometric methodologies for evaluating research performance within the framework of international scientific influence.

Both qualitative and quantitative methodologies have limitations in their application for academic research quality evaluation [1]-[4]. It should be noted that certain quantitative elements are present in the class of qualitative methods, while qualitative elements appear also in the quantitative methods. Furthermore, new classes of hybrid

methodologies incorporating both qualitative and quantitative advantageous elements are being developed. Although peer reviewing and other related expert-based judgments are considered the principal methodologies of research quality evaluation, bibliometric methods when applied in parallel to peer based evaluation methodologies can offer substantial improvements of decision making procedures. Bibliometric methodologies have proved to perform efficiently in the large majority of applied sciences, natural and medical sciences, and in certain fields of social and behavioral sciences (provided that the performance measurements cover wide ranges of years), [5] but have not been widely applied within the social sciences and humanities more generally [6].

At the individual researcher level the most important aspects of researchers' performance are: (i) the productivity, represented by the number of different papers and (ii) the impact, represented by the number of citation per paper, [7],[8]. At the departmental or institutional level, citation rates for the individual researchers can be measured, but it is generally agreed that these need to be normalised for comparative purposes. First, because the different disciplines or fields vary immensely in their citation rates, and second because citations grow over time and so cannot be compared across different time periods. One of the most widely used approaches for departmental evaluation, that has been developed by the Centre for Science and Technology Studies (CWTS) at Leiden University, uses a standard set of bibliometric indicators including the crown indicator, called here the Leiden Ranking Methodology (LRM) [9]. In essence, the LRM compares the citations per paper (CPP) for each publication of a department with that which would be expected on a world-wide basis across the appropriate field and for the appropriate publication date. In this way, it normalises the citation rates for the department to rates for its whole field. Typically, top departments may have citation rates that are three or four times the field average.

The contribution of this paper is in applying the crown indicator for the first time to social science departments, in this case three business schools in the UK. The reliability and limitations of the results are assessed.

## II. THE LEIDEN METHODOLOGY (THE CROWN INDICATOR)

In using citations as a measure of a paper's quality, or perhaps impact, many empirical studies have shown that the average number of citations varies significantly across disciplines [10]-[11], [3]. It is also clear that citations depend on the length of time that a paper has been published

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for. There may well be other factors that are significant, such as the type of paper – article, letter or review. This means that it is not possible to compare citations directly, in absolute terms, they must always be normalised with respect to these factors. .

There have been several ways of implementing this normalisation and one of the most well-known is that developed by CWTS which they call the crown indicator. The method works as follows. First the number of citation for a paper is found from the ISI Web of Science (WoS), assuming that the publication journal is actually included in WoS. Next, the method calculates how many citations such a paper would have expected to have received based on its field and its year of publication (type of document is not counted). The expected number is calculated from data in WoS. The citations for all the journals in the appropriate field for the particular year are accumulated and divided by the number of papers published to provide the overall field normalised cites per paper (FCSm). Note that the list of appropriate journals for the field is simply taken from the list provided by WoS. The exact basis for these WoS lists is not transparent – a point we shall return to below. CWTS also calculate a figure for the cites per paper for the particular set of journals that the department or institute concerned actually publishes in (JCSm). .

To calculate the crown indicator, the total of actual citations received by the department's papers is divided by the total of the expected citations to give an overall ratio. If the ratio is exactly 1 then the department is receiving exactly as many citations as should be expected for its field or fields. If the number is above 1 it receives more citation than the average, and below 1 it receives less. The result typically ranges between [0.5 , 3.0].

This is the traditional crown indicator, and is the one primarily examined in this paper. However, recently this approach to normalisation has been criticised [13]-[15] and an alternative has been used in several cases [16]-[18]. This has generated considerable debate in the literature [19]-[24]. The alternative method calculates the expected number of citations for a field in the same way but then, instead of summing the actual citations and the expected citations and then dividing the two, it performs the division first for each paper. In other words, it calculates the ratio of actual to expected for each paper and then averages these ratios. It might be thought that this is purely a technical issue, but it has been argued that it can affect the results significantly. In particular, the older CWTS method tends to weight more highly publications from fields with high citation numbers whereas the new one weights them equally. Also, the older method is not consistent in its ranking of institutions when both improve equally in terms of publications and citations. Reference [23], [24] (from CTWS) have produced both theoretical and empirical comparisons of the two methods and concluded that the newer one is theoretically preferable but does not make much difference in practice. This is an ongoing debate and we have calculated both versions for our data. .

Although the crown indicator is the most informative single measure, the LRM actually utilizes a range of bibliometric indicators: .

(P): the total number of published papers in a particular time period.

(C): the total number of citations received by the P papers in a predetermined time period.

(CPP) the mean number of citation per publication .

(%Pnc): the percentage of not-cited papers.

(JCSm): the journal citation score – the mean citations per paper for the journals that the department publishes in (its journal set) .

(CPP/JCSm): the average impact relative to the worldwide citation rate for the department's journal set.

(FCSm): the field citation score – the mean cites per paper worldwide for all journals in the field (these journals being defined by the WoS field definitions).

(CPP/FCSm): the average impact relative to the worldwide citation rate for the field's journal set.

(JCSm/FCSm): compares the mean impact of the department's journal set with the mean impact of the field as a whole. Thus, if a department publishes in particularly good journals this ratio will be greater than 1. If it publishes in low impact journals the ratio will be less than 1.

(%Scit): the percentages of self-citations.

Note that it is the eighth bibliometric indicator (CPP/FCSm), the internationally standardized impact indicator, that is the crown indicator enabling us to classify directly the performance level of a considered research group, institution or academic foundation, i.e. the performance evaluation position in the international impact standard of the field.

There are two more general issues that we should mentioned before moving to the results. The first is the source of the citations. There is a range of bibliometric databases including discipline specific (ACM Digital Library) and generic (Elsevier's Scopus), classified into the following three main types: (i) those that search the full text of documents for citations (e.g., Scirus, Emerald full text) or home pages and repositories on the web (e.g., Google Scholar); (ii) those that search the cited reference field of the documents (EBSCO products) and (iii) WoS type designed for capturing citations (e.g., Scopus) [25]. It has been reported that WoS has a clearly specified list of journals and records all the citations from such journals; has special tools for collecting accurate citations in particular concerning the unique identification of authors; and has also a satisfactory coverage in many natural sciences but has poor coverage in social sciences and humanities [26]-[28] .

A comparison of the ISI Web of Science (WoS) and Google Scholar (GS) citation indices in the field of business and management has been recently presented [29]. A data set of over 4,600 research publications from three UK Business Schools (the same data set as used in this paper) was used for measuring the research outputs produced by their academic staff from 2001 to 2007. The numerical results showed that the WoS citation index has poor coverage of social sciences picking up less than half of the research journals, research articles and citations found by GS. This is because WoS has only a limited coverage of journals in the social sciences and humanities, and does not cover books at all. Offsetting this, to some extent, is that WoS provides much more reliable and accurate results as it

works directly from the papers themselves. GS simply searches the Web for citations and so this can be much more hit and miss, and also includes citations from non-research documents such as teaching materials [30]. The research study concluded that the WoS should not be used for measuring research impact in management and business. But, CWTS always use WoS for their citation analyses, partly because it provides the field lists and also because they have special access to WoS results. Because of this, it was decided that in this study WoS would also be used, not least to see if the limitation caused a major problem.

The second general point is that, as [4], [31] have argued, bibliographic measures should not be used individually or by themselves, but rather should be used in conjunction with other approaches, especially peer review. Various national research assessment exercises are presently performed in several countries. A recent research study [32], compares qualitative methods (peer review) with quantitative methods (bibliometric approach). Special emphasis is given to the following six main components of any measurement system: (i) accuracy, (ii) robustness, (iii) validity, (iv) functionality, (v) time and (vi) costs. The authors conclude that for the natural and formal science (i.e. mathematics and computer sciences, physics, chemistry, biological sciences, medical sciences, earth sciences, Engineering etc.) bibliometric methodology proved to be far preferable to peer reviewing approach. They also claim that by setting up national publication databases by individual authors derived from WoS or Scopus would lead to better, economical and frequent national research assessments. Thus, although we are only testing the specific LRM, the recommendation is that it should always be used in combination with others, especially peer review.

### III. DATA COLLECTION AND METHODOLOGY

The LRM bibliometric indicator methodology has been applied in a large scale data set consisted of over 3,000 research outputs produced by academic staff at three UK business schools, primarily from 2001 to 2008. Although the three business schools are of similar sizes, they have certain different academic characteristics. Specifically, School A is relatively new as a business school but has gained very high scores in the UK Research Assessment Exercise (RAE) and belongs to a world-leading university. The second business school, School B, is also relatively new, belonging to a traditional university, and has expanded considerably in recent years. Finally, School C has been established since the 1990s but has recently oriented itself more towards research rather than teaching. An classification of the number of research publications and

other informative publication type of members of staff has been presented in [29]. It is summarised in Table 1.

The main thing that Table 1 shows is that WoS includes only a proportion of all the research outputs produced – roughly 50% of the journal papers and only 20% of the total publications.

**TABLE 1  
RESEARCH OUTPUTS FOR THREE SCHOOLS**

	Years covered by outputs	Staff in the 2008 UK RAE	Authors involved in outputs	Total outputs	Total journal papers	Total outputs in Web of Science
<b>School A</b>	1981-2008	45	816	1933	705	403
<b>School B</b>	1984-2009	39	675	1455	629	309
<b>School C</b>	1980-2008	39	461	1212	548	292

The output of the academic members of staff of the three business schools for the time period 2001-2008 has been used. We looked up the corresponding citations of every research paper that was included in WoS and recorded how many citations each publication received from its year of publication until 2008 on an annual basis. This is a very time consuming process, not least because the publication details in the databases were often inaccurate. We then divided up the time period 2001-2008 into 5 four-year sub-periods as follows: 2001-2004, 2002-2005, ..., 2005-2008. This enables us to see if the departments are changing over time. It has been reported that in natural and life sciences the average peak in the number of citations is the 3<sup>rd</sup> or 4<sup>th</sup> year cycle, while in the social sciences the time lag is much longer, i.e. around 5<sup>th</sup> or 6<sup>th</sup> year cycle [32], [4]. In our research study the above moving and partially overlapping 4-year analysis period has been chosen as an appropriate for the research quality assessment.

Having looked up the actual number of citations per paper it is then necessary to determine the expected number for a paper in that particular field published in that year. Here, the fields as defined by WoS are used in the LRM although this is not ideal as will be discussed below. There are in fact several fields that are potentially relevant – Management, Business, Business and Finance, Information and Library Science, and Operational Research and Management Science (which appears in the Science Citation Index (SCI) rather than the Social Science Citation Index (SSCI)). This is one of the criticisms of the LRM methodology – the rather *ad hoc* nature of the WoS fields and the fact that they overlap significantly.

**TABLE 2**  
**WOS FIELDS AND OVERLAPPING COVERAGE**

	Business	Business Fin.	Economics	Ind. Rel.	Inf. Sci.	Int. Rel.	Management	Ops. Res.
<b>Business</b>	103	-	13	-	-	1	39	-
<b>Business Finance</b>	-	76	35	-	-	1	1	-
<b>Economics</b>	13	35	305	4	-	10	9	1
<b>Ind. Rel.</b>	-	-	4	22	-	-	4	-
<b>Inf. Sci.</b>	-	-	-	-	77	-	8	-
<b>Int. Rel.</b>	1	1	10	-	-	78	-	-
<b>Management</b>	39	1	9	4	8	-	144	8
<b>Ops. Res.</b>	-	-	1	-	-	-	8	75

We can see from Table 2 that there is significant overlap between the business and management categories, and also overlap between business finance and economics, while international relations and information science are largely autonomous (note that the IS field is mainly information science journals rather than information systems ones, and that they may have different citation characteristics). We can see from Table 2 that there is significant overlap between the business and management categories, and also overlap between business finance and economics, while international relations and information systems are largely autonomous (note that the IS field is largely information science journals rather than information systems ones, and that they may have different citation characteristics).

There are several issues concerning the field definitions and this is important as the field normalisation is the main attraction of the LRM methodology. First, are these particular fields appropriate for the business and management (B&M) area as a whole? It is notable that the Association of Business Schools journal listing for B&M, for example, has 14 distinct fields. Obvious ones missing are more specific fields such as marketing, operations management and strategy. Second, are the journals correctly classified within them – there is no information within WoS as to the justification for the classification? And third, there is the problem of a journal being classified in more than one field - how should we estimate its expected number of citations if the fields differ markedly? We will also find that there are many papers in our dataset submitted to journals outside even this quite large range of fields.

To some extent, the seriousness these problems all depend on the extent of differentiation of citation rates between the fields. If, in fact, all the fields have similar citation rates then it does not matter very much and we could actually just normalise to the B&M field as a whole, but if the fields differ markedly these problems will be exacerbated. The other issue is the coverage of journals. As with much social science, WoS has a poor coverage in general, often less than 50% and it does not cover books at all. But there is evidence [29] that there is a differential coverage within fields with management science and economics being high while accounting and finance is low. This would mean that a department might be advantaged or disadvantaged depending on its subject mix. Information on the differences between fields will be presented in the results section.

#### IV. RESULTS

In the following text we present indicative numerical experimentation and relative results of the application of LRM in three UK business schools using the fields of management, business, and economics for predetermined time periods. The definitions of coverage of these fields in WoS are (WoS scope notes 2011):

**Management** covers resources on management science, organization studies, strategic planning and decision-making methods, leadership studies, and total quality management.

**Business** covers resources concerned with all aspects of business and the business world. These may include marketing and advertising, forecasting, planning, administration, organizational studies, compensation, strategy, retailing, consumer research, and management. Also covered are resources relating to business history and business ethics.

**Business, Finance** covers resources primarily concerned with financial and economic correlations, accounting, financial management, investment strategies, the international monetary system, insurance, taxation, and banking

As stated above, the first step, and a major task, is determining the expected number of citations for each field. Because the majority of papers were in journals contained in the fields management, business and economics these were the only ones for which statistics were calculated. This is, in itself, one of the problems with the LRM when applied to departments like business schools which encompass within themselves a wide range of disciplines. When the methodology was developed, primarily for the natural sciences, it was expected that a research department or institute would be fairly specialized. For example, in one of the main studies produced by Leiden, of a medical research institute, [4, p.5] says, “Often an institute is active in more than one field. ... For instance, if the institute publishes in journals belonging to genetics and heredity as well as to cell biology, then ...”. Here there are only three different but related fields.

However, business and management is markedly more diverse than that. In fact, the journals used by our three business schools actually occur in *sixteen* different fields within WoS, some in SSCI and some in SCI, and some journals are included in more than two fields. Also, the field categorisations in WoS are not very consistent in their level of resolution, for example, whereas there is only one field of “management” there are ten different fields of “psychology”.

**TABLE 3**  
**A COMPARISON OF RESEARCH OUTPUTS ACROSS SCHOOLS**

ISI WoS subject areas	School A		School B		School C	
	Number of publications	Number of journals	Number of publications	Number of journals	Number of publications	Number of journals
Agriculture*	-	-	-	-	30	10
Business	76	34	34	18	32	19
Business Finance	14	5	11	4	2	2
Computer Science*	17	10	3	3	20	14
Economics	60	33	37	21	59	23
Engineering	14	10	17	7	20	10
Environmental Sciences	25	9	2	2	11	6
Environmental Studies	-	-	6	3	12	7
Ethics	10	2	-	-	1	1
Food Science Technology	-	-	2	2	15	4
Geography	10	4	7	5	4	4
Health Care Sciences & Services	3	2	32	6	-	-
Management	135	46	79	29	78	24
Mathematics Applied	12	7	6	2	30	13
Operations Research & Management Science	20	10	6	3	60	14
Pharmacology Pharmacy	1	1	10	2	-	-
Planning Development	14	7	10	5	3	4
Political Science	-	-	15	5	2	2
Public Administration	4	4	11	5	9	4
Social Sciences*	21	7	14	10	10	6
Others (<10 Publications/ Field)	30	54	38	90	24	44
Journal papers not in WoS	302		320		256	

Table 3 shows the breakdown of journals between the various WoS fields. The top three fields that all schools have produced their most research output are business, economics and management (BEM). However, the proportion of research output in these three fields differs between the schools. We also note that there are certain relevant ‘not BEM’ fields in which one institute is active while another is not. That can be considered as an indicator of interdisciplinarity within the same broad scientific field and it points out the need for extending the research output of a department beyond a traditional defined field. The increasing production of research output in hybrid fields (research output that can be classified under more than one area within the same scientific field) can be seen as an (positive) indicator of improved/efficient scholarly communication within the scientific community, in the sense that high quality research in one scientific field influences the development and improvement in the advancement of another scientific field.

It is also possible to see from the original data (although not included as a table here) that school A has increased the proportion of its journals that are included in these three fields consistently over the years, suggesting a policy, explicit or implicit, of concentrating on the mainstream business and management journals at the expense of the more peripheral. This again may well be an effect of trying to improve in the UK Research Assessment Exercise. This Table also reveals starkly the extent to which a methodology based on WoS excludes large numbers of research outputs (counting only journal papers).

Moving now to the expected cites per paper per field, Table 4 shows the values by field and period.

To be clear on the data used, the citations for a set of

papers in a particular period were confined to that particular period – e.g., the citations for papers published in the period 2001-2004 were only those between 2001-2004. Thus each four year period is directly comparable. The first and most obvious comment is that the expected citations have risen significantly in all three fields over the years. Given that the periods only differ by a year and are overlapping these rises are quite large. This agrees with other data – e.g., that the journal impact factors produced by WoS (which are essentially citations per paper over a two year period) have also been rising. This presumably reflects both greater research productivity and also perhaps a greater use of citations because of the greater publicity given to bibliometric methods.

**TABLE 4**  
**EXPECTED CITATIONS PER PAPER BY FIELD AND PERIOD**

	Business	Economics	Management
<b>2001-2004</b>	0.73	0.83	1.05
<b>2002-2005</b>	0.84	0.88	1.16
<b>2003-2006</b>	0.99	0.92	1.29
<b>2004-2007</b>	1.06	0.95	1.38
<b>2005-2008</b>	1.30	1.06	1.70
<b>% change</b>	78%	28%	60%

The other question to be addressed is differences between the fields. Here we can see that management has substantially more cites per paper than the other two fields. Business started off below economics but has risen quickly to be above it by the end of the period. These differences suggest that it is important to consider a range of different fields within business and management as they do have distinctively different citation patterns.

**TABLE 5**  
**LEIDEN INDICATOR FOR THREE UK SCHOOLS FOR SEVERAL TIME PERIODS**

	P	C	CPP	Total papers of journals	Total cites of journals	JCSm	CPP/JCSm	CPP/FCSm	MNCS	JCSm/FCSm
2001-2004										
A	108	193	1.79	17,324	15,682	0.91	1.97	1.95	2.03	0.99
B	60	94	1.57	11,359	9532	0.84	1.87	1.69	1.70	0.91
C	56	55	0.98	11,155	8,975	0.80	1.22	1.07	1.03	0.87
2002-2005										
A	124	242	1.95	17,528	18,907	1.08	1.81	1.91	1.90	1.05
B	50	53	1.06	10,454	10,154	0.97	1.09	1.03	1.07	0.95
C	70	51	0.73	13,008	10,954	0.84	0.87	0.72	0.73	0.83
2003-2006										
A	121	235	1.94	20,712	24,585	1.19	1.64	1.74	1.67	1.06
B	61	80	1.31	11,809	12,224	1.04	1.27	1.15	1.20	0.91
C	75	101	1.35	13,970	13,661	0.98	1.38	1.22	1.24	0.88
2004-2007										
A	143	299	2.09	24,110	32,521	1.35	1.55	1.77	1.73	1.14
B	65	102	1.57	12,661	14,724	1.16	1.35	1.31	1.34	0.97
C	94	150	1.60	16,389	16,785	1.02	1.56	1.34	1.40	0.96
2005-2008										
A	118	346	2.93	23,642	41,520	1.76	1.67	2.05	2.01	1.23
B	60	162	2.70	10,111	12,954	1.28	2.11	1.87	1.97	0.89
C	79	190	2.41	16,114	20,943	1.30	1.85	1.70	1.71	0.92

Moving now to the actual calculations of the crown indicator, Table 5 shows the values by business school and period. If we consider the first row it is for Department A, 2001-2004. There were 108 publications in journals that were included in the three WoS fields. These gathered 193 citations within the period giving a basic CPP of 1.79 cites per paper. The next columns show the particular set of journals used by the department. They published 17,324 papers, gaining 15,682 citations for a CPP for the journal set (JCSm) of 0.91. Thus normalizing their CPP to their particular set of journals gives a value of 1.97 – the department gained citations at around double the rate for its journal set. The crown indicator itself (CPP/FCSm) is calculated from the expected field citations as in Table 2. The actual citations for the papers are totaled up and then divided by the total of the expected citations for the relevant fields. A special weighting is used when a journal appears in more than one field. The result in this case is 1.95 – very close to the value for the journal set, showing that this department publishes in journals that are broadly representative of the field.

The next column, MNCS, shows the crown indicator calculated in the alternative way as discussed above – i.e., dividing the ratios and then averaging rather than summing and then dividing. Its value of 2.03 is very close. The final column, the ratio of the journal citation score to the field citation score just confirms that the journal set is neither particularly good nor poor.

From the data presented in the Table 5 we can see that there is a noticeable difference between the average citation rates of the 3 institutes. School A appears to have the higher CPP in all time periods. It is also rising slightly but with a particularly significant rise in 2005-2008. Schools B and C are below A but alternate in terms of which is better. Again, they both rise particularly in 2005-2008. It may be relevant that the UK RAE exercise was in 2008 which probably led to an increase in publications in the run-up to it. The main

question to be answered is whether the significant extra effort in normalization actually gives a better picture of the differences between the schools or the standing of the schools more generally.

We can begin by looking at JCSm/FCSm which reflects the quality of the school’s journal set relative to the field as a whole. All three schools were just under 1 in the first period, but school A rose significantly to 1.23 by 2005-2008. This suggests that there was a significant improvement in the quality of journals used during the period by A. The others remained the same. Looking at CPP/JCSm, all schools are significantly above 1, although there is a degree of volatility from year to year. There is no overall trend. Finally, the crown indicator shows that all the schools, in almost every period, were above 1 showing they are performing better than the field average. School A actually fell for the first four periods before rising. This may reflect the fact that they were improving the quality of their journal set and thus competing against a stronger field. School C has also generally risen with the exception of one year.

The differences between the two versions of the crown indicator are very marginal, the only consistency being that school A was generally lower in the new version than the old one. This does fit in with the arguments about the two if it is the case that school A tended to publish in better, higher cited journals.

So, can we say from this example that the crown indicator is better than the un-normalised CPP rates? Both sets of figures clearly show that school A is better than the other two, with B initially being better than C, but C then to some extent catching up. There are perhaps two things that we can see with the normalized data that are hidden with the raw data. First, that A has been improving the quality of its journal set whilst B and C have not. Second, that although the CPP for A shows a steady and continuous rise, suggesting a strong improvement in citation performance, the normalized figures actually show a fall for the first three

years before rising again. This is because the field citation rates were rising generally so the apparent continual improvement is actually a field effect. Finally, we could say that the field normalization would allow us to compare these schools against other business schools with perhaps significantly mixes of fields, or against other departments in completely different fields. This would obviously be of importance when evaluating the quality of universities as a whole rather than departments in a particular field.

How do the results compare with the actual results from the UK RAE which was carried out in 2008? In the RAE, every department was assessed on a 4-point scale (where 4 indicated "world-leading" quality and 1 merely "national" quality). The proportions of the department's work in each quality level was evaluated (e.g., 20% 4, 30% 3, 40% 2 and 10% 1) and this was then used to calculate an average quality level or GPA which was then reported to the nearest 0.05. The actual results were: School A: 3.05, School B: 2.45, and School C 2.50 (where the highest was 3.35 and the lowest 1.25).

The two sets of results clearly show a degree of concordance with School A being significantly better than Schools B and C, which were themselves roughly equivalent. So one could argue, admittedly on the basis of a small sample, that bibliometrics produced similar results to the peer review exercise.

#### V.CONCLUSIONS

In this paper we have demonstrated how the Leiden Ranking Methodology can be implemented for a sample of three UK business schools. Practically speaking, it required a significant amount of effort just for these three schools and utilising only three field categories in WoS. Clearly if it were to be done on a wide basis it would require some form of automation through WoS, which is how Leiden do it.

The main purpose of the method is to normalise the raw citation scores for the field and the year of publication – other factors such as type of publication or country could be included if desired. The purpose of this is to generate standardised scores so as to properly compare across different departments, disciplines and universities. The results we have obtained do indeed reveal more than the basic citation scores. For instance, school A had continuously rising citation rates but when normalised they actually fell over some years because the citations in the field as a whole were rising. It was also possible to compare the quality of the journal sets used by the different schools. .

Against this, we must recognise severe problems with the methodology at least using WoS in the social sciences. We saw from Table 1 that WoS only includes around 20% of a department's total research outputs, that is about 50% of its journal papers. We then saw that there are significant problems with the field categories in WoS: they are poorly defined; there are many that could apply to business and management; and journals appear in more than one often with different normalised citation rates. In our example, where we concentrated on the three major fields, this reduced the proportion of outputs analysed still further..

Given this, our conclusion is that at the moment the LRM is not suitable for evaluating the performance of

departments in business and management although it is a good idea in principle. One possibility is for it to be based on Google Scholar instead. This gives a much wider coverage of all disciplines and includes books and reports although the reliability and validity of its results is questionable [29]. The main practical problem is that it does not include any field categorisations as does WoS. It might be a valuable activity for scholarly associations to perhaps agree lists of journals that are relevant to their disciplines without, of course, assessing their quality.

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