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RADMA in 2013: 40 plus years of R&D Management, a long and winding road

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This paper examines the achievements of one of the earliest journals to develop the technology and innovation management field, R&D Management. Established in 1970, R&D Management is today one of the leading journals of a field that spans the business and management subject areas, and continues to publish innovative research with high academic interest.

A number of descriptive and non-parametric bibliometric methods are used to examine the historic performance of the journal, the trends and features of the field and to provide evidence on the challenges facing the journal which are to continue to engage with practitioners and to demonstrate impact upon the world of R&D management itself.

1. Introduction

> "Efficient and purposeful management of our R & D, whether in government, industry or universities, is a vital element in the effective deployment of our research and industrial resources. The evolution of management techniques, especially for research and development, and the availability of courses in this field, is very necessary. Equally there is a need for a forum in which ideas and thoughts can be expressed and exchanged. This journal has therefore a valuable role to play, and I am sure it will command widespread support. This is a key activity; there is probably no other which has so much potential for good or ill in shaping our future lives." (Davies 1970)

The R&D Management journal, published since 1970 and now its 44th year, has played an important role since its inception in the development and dissemination of knowledge in the fields of business and management and in particular within the specialism of technology and innovation management. Since the first edition, the journal has been one of the first in the field to develop new topics against a backdrop of significant changes affecting those engaged in "the efficient and purposeful management of our R & D", to academics and the way they work, to the other journals also making contributions to these and the related fields, and to the technologies of publication and dissemination. It has been a long and winding road. This paper is both retrospective and prospective, looking at times past and present, and at time future. The paper highlights some of the major contributions the journal has made in contributing to and leading debates in the field of technology and innovation management, and then looks forward to consider such questions as what topics is the journal now dealing with that might be important in the future and what topics might it deal with that it does not yet do so?

R&D Management has, like many of the related journals, conducted periodic reviews of the fields in which it is located, and these have grown more common, rising slowly over the first decade and a half, and then taking off after 1999. This paper seeks to be a further reflection on the journal, its achievements past and present, and on possible future directions. The introduction of information technologies hardly foreseen in 1970 that have given rise to data mining and automatic rating of research (Priem 2013), the great

challenges and potential benefits of open access (Gargouri, Hajjem et al. 2010) although perhaps anticipated in papers in R&D Management itself (Butler, Ball et al. 1976) are beginning to remake the world of knowledge generation and dissemination. There has been increasing discussion of the relationship between citations and downloads from the publishers web site (Moed 2005) (Schloegl and Gorraiz 2011), the decision by journals to make download figures public for every paper they publish on line (Watson 2009), and the prospects for using new web technologies to improve knowledge generation and dissemination (Breivik, Hovland et al. 2009). While this review of R&D Management uses citation index data, future reviews of the field are likely to employ very different methods as new forms of data, and in particular download data, becomes more widely available.

A wide variety of actors are greatly interested in the activity of academic journals: journal editors, journal board members, journal publishers, authors, would be authors, senior academics in management roles, and library and information systems staff, and of course the wider readership of the journal that in any area of research where application of knowledge is of concern will include practitioners in business, industry and indeed other professions. Motives vary, but can be said to include the following most important ones: a) identifying the journal's position in a field or fields in terms of its rank and importance so as to know how well the journal performs; b) understanding the academic environment and contexts – in terms of field or fields - in which the journal publishes so that editors can orient the journal towards relevant topics and, potentially, to lead academic debates and generate impacts beyond academe; c) using information about a journal's rank and its location in knowledge generation and knowledge impact to assess the journal so that decisions about whether to publish in the journal and or to reward others for doing so. These motivations can lead to research that is partly historical but also directed towards anticipating future developments. Most of the major journals in the technology management field have paid visible attention to these questions over the years, publishing articles that examine their own and the related journals and the contributions they make, the development of the field, the internal structure, the examination of the impacts of decisions taken by editors, and likely future developments.

Two main approaches have been taken to the study of journal activity. These are sometimes combined but are more often not. The first of these approaches are bibliometric ones that use co-occurrence, mainly of citation (co-citation), authorship or keyword, to delineate the field in which journal is located to reveal the field's internal characteristics and the role which the journal plays within it. This is done usually to generate rankings to assess the importance of the journal within the field (Linton and Thongpapanl 2004; Linton 2006; McMillan 2008; Linton 2011; Thongpapanl 2012). Studies may show how changes have occurred over time and the development or emergence of particular fields of discourses. An example of such studies are recent work on the emergence of design management (Erichsen and Christensen 2013; Johansson-Sköldberg, Woodilla et al. 2013). Such bibliometric studies also include works that focus on the use of the use of including the ownership of and application of concepts by specific groups, for example those in developing countries (Beyhan and Cetindamar 2011). Approaches that are bibliometric vary their unit of analysis, some examining the field, others the journal. An example of journal level study is that by Durisin and Calabretta (2010) where the focus is on the Journal of Product Innovation Research. Such approaches are widespread and reflect the desire amongst academic researchers to understand the communities in which they work, focal points for debate in terms of journals and issues, bridging structures and communities. A example of such a recent study outside the technology and innovation management is that by Jensen and Kristensen (2013) on European Union studies. Bibliometric approaches have the strengths of their weaknesses: their potential breadth of reach provides a way of delineating the wide influences of a core literature on other fields and finding a rising trend; but the patterns and links that are observed with bibliometric methods may be artefacts and or chance events that do not signify important theoretical or conceptual connections.

A second important approach is seen in literature reviews that analyse the key texts of the field to determine which theories and concepts used are key ones (Harmancioglu, Droge et al. 2009), and to draw lessons for the future. The approach is similar to the writing of review papers (and also editorials) that reflect self-critically upon the field, its achievements, its direction with reference to what has been written (Gassmann 2006; Enkel, Gassmann et al. 2009; Hsuan and Mahnke 2011; Stanko and Calantone 2011; Jelinek, Bean et al. 2012; Linton 2012; Schiederig, Tietze et al. 2012). The scientific literature generally conceives of review to comprise three types, narrative review, systematic review and meta-analysis.

A third type of study that looks self-critically at the contribution of a particular body of work and focuses upon one or a few aspects. A good example is that by Ball (1998). This study examines the use by those in industry of the knowledge generated and disseminated by a journal (i.e., not a field). In this case it is the R&D Management Journal itself. Writing in 1998, Ball suggested that the impacts of the research published in the literature of R&D, technology and innovation management were little known beyond the university, a state of affairs that he regarded as unfortunate and was potentially a deciding moment for the journal.

This paper uses mainly bibliometric methods to examine the R&D Management journal from 1970 to the present day, to assess its strategies, key achievements, topic focus and likely future directions and opportunities. The paper's findings are in three main parts, a) a retrospective, looking at the main trends that can be observed over the lifetime of the journal, in terms of publication strategies and topic coverage; b) a section on the current position of the journal in its contexts of knowledge production and

use; and c) a look at what might happen in the future in terms of topic coverage and the journal's approach to publication and dissemination as we move towards a world of open access publishing.

2. Methods

2.1 Bibliometric Data Preparation

Bibliometric data is generally increasingly available and easy to use. Indexing organisations are providing more data from the historical record in their computerized indexing services and analysis of the bibliometric record is now easier with the emergence of new data management tools with which to capture, manipulate and analyse the data. However, bibliometric data is often still of poor quality and great effort still has to be applied to ensure that data is accurate and can be processed using automated systems that may compound errors present in the original data. There are two main difficulties with the data provided: a) omission; and b) variation or ambiguity. For example, the number of different addresses at the University of Manchester used by authors over the period from 1970 to the present day is 47. The address information for authors is not available for all years in the data set. Funding acknowledgement data is not systematically available for the journals of the technology and innovation management set.

The approach here was to use a combination of data from the Thomson Reuters Web of Knowledge (in this study about R&D Management itself) and from Elsevier's Scopus, for the R&D Management journal and for 14 other related journals that have been included in other recent analyses of the technology and innovation management fields. Various data sets were prepared for analysis depending upon the quality of the original data contained, and on the period of time for which data was required. The R&D Management data for the whole of the period of publication of the journal was obtained from the Web of Knowledge and used for a number of specific analyses of the R&D Management journal exclusively. The data relating to the 15 technology and innovation management journals were obtained from Scopus as not all 15 journals are indexed by Thomson Reuters Web of Knowledge.

Data were downloaded to the VantagePoint programme. VantagePoint is a desktop computer text mining programme that can be used on structured databases to analyse the relationships between fields on the basis of their content to identify patterns and linkages. Using co-occurrence, linkages between fields can be identified allowing, for example co-word analysis and by linked jointly cited papers, and journal to journal citation, which is widely used to examine the pre-eminence of journals within a group or field. VantagePoint can also be used to explore the numerical properties of data. Its calculating functions are equivalent to and in some cases exceed those of such programmes as Excel, and BibExcel.

The general approach here was not to use complex methods that involved extensive manipulation of the data – such as co-citation analysis - but to employ a range of simpler tests based on co-occurrence to investigate a number of important questions about journal behaviour.

3. Results

3.1 The Journal Since 1970

3.1.1 Citation Impact

A major area of interest for those looking at the performance of a journal over its lifetime is the citation impact of the journal's papers. This conference paper presents various forms of evidence on the citation impact, beginning with the occurrence of uncited papers by year. This analysis, which uses simple counts of uncited papers, may give some insight into the policy of the journal at different times. The following table shows the count of uncited articles each year. Clearly, the number of papers that remain uncited over time would, all things considered, be higher for those papers that are published more recently. At the end of the period, this does indeed occur, the number of uncited papers rising from 2009 (2009, 2010, 2011, and 2012).

Data is apparently absent from the citation index for the period from 1970, but a general trend can be observed from around 1990 when the annual count of uncited papers falls. Before this period the number of papers that are uncited in each year remains high. Other forms of analysis might consider uncitedness per year as a proportion of the number of articles published per year, or time lag to citation per year. The simple count of uncited papers per year has been chosen as these other transformations require additional assumptions to be made.

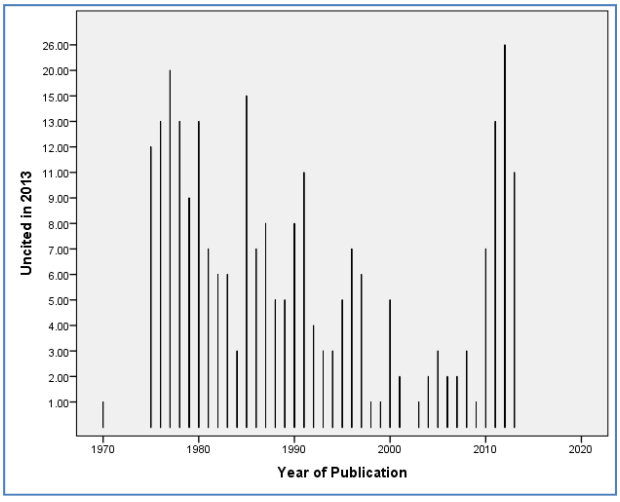

Figure 1 Uncitedness and Year of Publication

Comparison with two other key journals over respective journal lifetimes is shown in the next table. It is possible to observe that in spite of a greater number of published papers, both Research Policy and Technovation have a smaller proportion of their papers uncited overall. A further piece of analysis that examines the R&D Management journal and Research Policy over their respective lifetimes is then presented.

Journal	Period	Papers (Articles, Conference Papers, Editorial, Review	Cited	Uncited	% Uncited
R&D Management	1970-2013	1196	926	270	23
Research Policy	1974-2013	2200	1978	220	10
Technovation	1981-2013	1731	1453	278	16

Table 1 Cited and Uncited Papers, (Articles, Conference Papers, Editorial, Review)

The following figure shows how the tendency for papers in both journals (R&D Management and Research Policy) to be uncited has fallen over the period but the rate of decline has been sharper for R&D Management. As can be seen, for all years but two (1999 and 2002), the journal Research Policy has a higher rate of citation (a lower rate of uncitedness) than R&D Management. It would appear that both journals have achieved greater citation levels for the papers they publish. The figure shows regression lines for each of the journals. These lines are shown for illustrative purposes. The effect of reducing uncitedness, which is very noticeable, is achievable through a variety of possible mechanisms, many of which may interact.

Firstly the quality of the peer review system may have improved. This may have attracted more higher quality papers to the journal over time. Such an effect when combined with the first might lead to an effect that produced higher quality. Subject choice, led perhaps by special issues but also promoted by journal editors at other times may also be responsible. The policy of other journals is also a potential driver of citation in other journals. For example, wrong topic choice or topic promotion in other areas may lead authors to move away from one journal to another as they seek maximum exposure of their work. It remains the case that such data as is shown here could change in time as more of the articles in R&D Management, or Research Policy are subsequently cited, although this seems unlikely to change the picture greatly. The rate of uncitedness falls in the limit to 0. But an uncited rate of 0 may suggest risk aversion on the part of the journal, a behaviour that while successful in the short term may have consequences in the longer term.

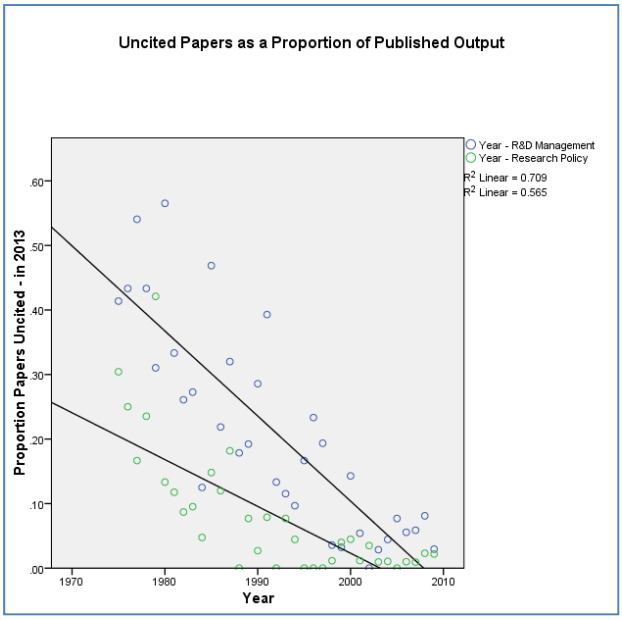

Figure 2 Uncited Papers as a Proportion of Published Output over Period 1975-2009

3.1.2 Engaging with Industry: Author Involvement

One of the journal's original purposes was to engage with industry and commerce. It was expected that the knowledge published within the journal would be of use to practitioners, although not necessarily produced or co-produced by them with academic researchers. Involvement with industry can be assessed by a range of measures. Two mutually inclusive forms of evidence which provide a relatively straightforward means of assessing engagement are: the involvement of industrially based researchers in the writing of papers published in the journal; and the focus upon topics primarily of interest to those based in industry (as opposed to those who might be based within the university or in government), identified by keyword search within the title keyword listing or elsewhere in the paper's paratext. Both methods have serious shortcomings. As has been noted above, the concept of engagement is difficult to define, as topics that concern the industrial or commercial activity may be discussed in such a way that they are of little interest to or do not constitute engagement with actors who will take account of the findings of the publication directly. Conversely, topics that might have no apparent practical application as seen by those who produce them, and no industrial participation in either the writing of the article or as research subject matter, might ultimately prove to be profoundly useful to practitioners.

The approach chosen here to investigate how close the involvement with industry has been over the lifetime of the journal, data permitting, was a review of the addresses of authors. This review included a broader range of types of paper (correspondence / letters) in order to make it more likely that the interests of practitioners were included. A comparison was made

between R&D Management, Research Policy, Technovation, and Research Technology Management journals over a recent period for which it was possible to obtain information concerning the addresses of the authors contributing papers to each of the journals. The dataset began in 1970 and finished in 2012. A number of years were absent for each journal during this period.

In order to simplify the searching and disambiguation of the data, institutional addresses were read and those which indicated a commercial or industrial or governmental organisation were recorded. The decision over which journals to include was based on a review of the paper by Ball and Rigby which had considered the contribution of academic and non-academic authors to the journal output of the main papers. Research Technology Management was added as a comparator known to be heavily engaged with industrial and commercial interests. Detailed review of the author information allowed the authors of this 2006 paper to consider the extent to which the different journals of the technology management field were likely to address the issues considered by industrial and commercial practitioners. The results of the analysis conducted for this paper are consistent with those produced by this previous methodology. They show the three journals in the same rank order in terms of the number of industrial addresses listed for authors by year over the whole of the period.

	Journal				Year
	R&D Management	Research Policy	Technovation	RTM	
Count of Papers with Commercial and Industrial Address	28	11	0	NA	1970-79
	23	16	12	NA	1980-89
	23	23	16	149	1990-99
	24	26	56	348	2000-09
	0	0	10	49	2010-12

Table 2 Count of Papers with Commercial and Industrial Address

However, while the overall picture for the journals suggests similarity with the findings of Ball and Rigby (Ball and Rigby 2006), a trend is observable that commercial / industrial participation in the writing of the literature is rising within Technovation, while in R&D Management it is static. Comparing Research Policy and R&D Management, it is difficult to determine a difference. Using a chi-square test that compares the count of papers with commercial and industrial authors for R&D Management and Research Policy, there is no significant difference. Comparing either R&D Management or Research Policy with Technovation or R&D Management and Research Policy together with Technovation using a chi-square test of significance suggests a difference. Technovation would appear to have an increasing level of commercial and industrial participation. This form of assessing the engagement of practitioners is just one way of determining how the literature is being written and the characteristics of its use. Were funding acknowledgement data available for this type of publication, there would be more information to use which could bear on this issue.

Research Technology Management reflects a much greater involvement of industrial organisations in the writing of papers, a finding that is not surprising. The count of industrial and commercial organisations is however rising for Research Technology Management in spite of the fact that the number of papers each year remains relatively constant.

The analysis has not examined engagement through co-authorship, collaboration or co-production of knowledge. Instead, it has simply used the counts of authors whose address is given as an industrial or commercial organisation. Such as approach provides a measure of engagement of industrial authors with the journal as a institution rather than with the production of knowledge of the journal. Co-authorship analysis between industrial and academic organisations would be a useful measure to use on all four of the journals here although as can be seen with the three journals, industrial and commercial participation is at a relatively low rate.

3.1.3 Historic Topic Focus and Main Areas of Impact

The review of the journal's major contributions to the field of technology and innovation management has examined the topics covered by the most highly cited papers and annual rate of citation for these papers. Two tables are presented below. The tables both contain the highly cited papers of the journal. The entries in the first table are those papers which while highly cited and have over 50 citations each and have annual citations exceeding 6. The second table includes those papers who annual citations lie between 6 and 2 and whose total citations are over 50.

Authors (Full Name)	Title	Times Cited	Times Cited Per Year
Chesbrough, H; Crowther, AK	Beyond High Tech: Early Adopters Of Open Innovation In Other Industries	1 1 5	16 .4 3
Chesbrough, Henry; Enkel, Ellen; Gassmann, Oliver	Open R&D And Open Innovation: Exploring The Phenomenon	6 0	15 .0 0
Gassmann, O	Opening Up The Innovation Process: Towards An Agenda	1 0 0	14 .2 9
Rothwell, R	Successful Industrial-Innovation - Critical Factors For The 1990s	2 8 3	13 .4 8
Piller, Ft; Walcher, D	Toolkits For Idea Competitions: A Novel Method To Integrate Users In New Product Development	7 9	11 .2 9
Dodgson, M; Gann, D; Salter, A	The Role Of Technology In The Shift Towards Open Innovation: The Case Of Procter & Gamble	7 6	10 .8 6

Gallagher, Scott; West, Joel	Challenges Of Open Innovation: The Paradox Of Firm Investment In Open-Source Software	6 6	9. 43
Allen, TJ; Katz, R	Investigating The Not Invented Here (NIH) Syndrome - A Look At The Performance, Tenure, And Communication Patterns Of 50 R-And-D Project Groups	2 6 8	8. 65
Gemuenden, HG; Herstatt, C; Lettl, C	Users' Contributions To Radical Innovation: Evidence From Four Cases In The Field Of Medical Equipment Technology	5 3	7. 57
Etzkowitz, H; Klofsten, M	The Innovating Region: Toward A Theory Of Knowledge-Based Regional Development	5 8	7. 25
Kim, J; Wilemon, D	Focusing The Fuzzy Front-End In New Product Development	7 0	6. 36
Bierly, PE; Gopalakrishnan, S; Kessler, Eh	Internal Vs. External Learning In New Product Development: Effects On Speed, Costs And Competitive Advantage	8 2	6. 31

Table 3 Part 1 R&D Management, 12 Most Highly Cited Papers: Annual Citation > 6

The review of the R&D Management corpus has also aimed to identify the most highly cited papers, their date of publication, and their authors and choice of subject. Clearly, more recent papers are those which have had less time to accumulate citations.

Authors (Full Name)	Title	Times Cited	Times Cited Per Year
Von Zedtwitz, M	Managing Foreign R&D Laboratories In China	53	5.89
Howells, J; James, A; Malik, K	The Sourcing Of Technological Knowledge: Distributed Innovation Processes And Dynamic Change	55	5.50
Cooper, R; Edgett, S; Kleinschmidt, E	Portfolio Management For New Product Development: Results Of An Industry Practices Study	66	5.50
Thamhain, HJ	Managing Innovative R&D Teams	53	5.30
Malone, DE; Roberts, EB	Policies And Structures For Spinning Off New Companies From Research And Development Organizations	90	5.29
Gassmann, O; Von Zedtwitz, M	Trends And Determinants Of Managing Virtual R&D Teams	51	5.10
Linton, JD; Morabito, J; Walsh, St	Analysis, Ranking And Selection Of R&D Projects In A Portfolio	56	5.09
Dodgson, M; Rothwell, R	External Linkages And Innovation In Small And Medium-Sized Enterprises	108	4.91
Meyer, M	Academic Entrepreneurs Or Entrepreneurial Academics? Research-Based Ventures And Public Support Mechanism	49	4.90
Boutellier, R; Gassmann, O; Macho, H; Roux, M	Management Of Dispersed Product Development Teams: The Role Of Information Technologies	70	4.67
Chiesa, V; Piccaluga, A	Exploitation And Diffusion Of Public Research: The Case Of Academic Spin-Off Companies In Italy	60	4.62
Bonaccorsi, A; Piccaluga, A	A Theoretical Framework For The Evaluation Of University-Industry Relationships	80	4.21
Bohlin, E; Granstrand, O; Oskarsson, C; Sjoberg, N	External Technology Acquisition In Large Multi-technology Corporations	81	3.86
Tidd, J; Trewhella, MJ	Organizational And Technological Antecedents For Knowledge Acquisition And Learning	61	3.81
Gassmann, O; Von Zedtwitz, M	Organization Of Industrial R & D On A Global Scale	55	3.67
Chiesa, V; Manzini, R	Organizing For Technological Collaborations: A Managerial Perspective	51	3.40
Gemunden, HG; Herden, R; Heydebreck, P	Technological Interweavement - A Means Of Achieving Innovation Success	67	3.19
Westhead, P	R&D 'Inputs' And 'Outputs' Of Technology-Based Firms Located On And Off Science Parks	51	3.19
Rothwell, R	Characteristics Of Successful Innovators And Technically Progressive Firms (With Some Comments On Innovation Research)	111	3.08
Katz, R; Tushman, M	An Investigation Into The Managerial Roles And Career Paths Of Gatekeepers And Project Supervisors In A Major R-And-D Facility	97	3.03
Forrest, JE; Martin, MJC	Strategic Alliances Between Large And Small Research Intensive Organizations - Experiences In The Biotechnology Industry	60	2.86
Demeyer, A	Management Of An International Network Of Industrial Research-And-Development Laboratories	54	2.70
Allen, TJ; Sloan, AP	Communication Networks In R And D Laboratories	116	2.70
Demeyer, A; Mizushima, A	Global R-And-D Management	62	2.58
Shaw, B	The Role Of The Interaction Between The User And The Manufacturer In Medical Equipment Innovation	69	2.46
Bae, ZT; Choi, DK; Lee, JJ	Technology Development Processes - A Model For A Developing-Country With A Global Perspective	58	2.32
Cooper, RG; Kleinschmidt, EJ	What Makes A New Product A Winner - Success Factors At The Project Level	53	2.04
Allen, TJ; Katz, R	The Dual Ladder - Motivational Solution Or Managerial Delusion	54	2.00

Table 4 R&D Management, 28 Most Highly Cited Papers: Annual Citation > 1.9 < 6.0

The table shown below indicates the count of citations and the year for the papers published in the journal that have more than 60 citations. The table was constructed to determine if the very highly cited papers were generally recent or had been published some time ago. A successful journal would be one that had been able to continue to publish papers with high impact continuously. The distribution of citations to papers and the distribution of highly cited papers over time is the result of a number of factors, but two particularly are

important. The first is that more recent papers would generally have fewer citations as papers require time to accumulate citations. A second effect upon citation count is the journal policy. Journals may be able through various strategies to maintain or increase the impact of papers. As has been shown in an earlier table, the level of uncited papers published by R&D Management has fallen consistently. These two factors may work together or against each other.

	Period			
Times Cited	1970-1980	1980-1990	1990-2000	2000-2010
61-80	0	2	4	5
81-110	0	1	3	2
111-283	2	1	1	1

Table 5 Most Highly Cited Papers in R&D Management by Year

The table shows that the very highly cited papers, those with over 55 citations, have occurred throughout the history of the journal. 2006 though appears to be an unusual year with five papers in this very highly cited category, although we may note that 1992 saw three papers of very highly cited papers, including the most highly cited paper in the journal by (Rothwell 1992) entitled "Successful industrial-innovation - critical factors for the 1990s", this being the year that marked a reduction in the occurrence of uncited papers.

3.2 The Present

We now look at the journal in the present day using some of the standard metrics employed by authors and journals to assess impact influence and immediate relevance of papers. 14 journals are shown in the table, Science and Public Policy is omitted as the relevant data was not available in the form to allow comparison.

Current Citation Based Measures for 14 TIM Journals

Abbreviated Journal Title	(Borner, Glanzel et al.) Total Cites	Total Cites Rank	IF	IF Rank	IF-5	IF-5 Rank	Immed. Index	Immed. Index Rank	(Borner, Glanzel et al.) Articles	Rank Articles 2011	Cited Half-Life	Rank Cited Half Life
Engineering Management Journal	140	14	0.09	14		#N/A		#N/A		#N/A	9.1	3
IEEE Transaction on Engineering Management	1594	6	0.96	9	1.77	8	0.07	11	55	7	9.6	2
Industrial and Corporate Change	1868	5	1.37	6	2.11	6	0.42	3	55	7	9.1	3
Industry and Innovation	440	13	0.75	11		#N/A	0.28	5	36	9	5.7	14
International Journal of Technology Management	866	8	0.52	13	0.70	11	0.03	13	74	4	8.2	8
Journal of Engineering and Technology Management	568	12	1.03	8	1.93	7	0.06	12	18	13	8.7	6
Journal of Product Innovation Management	2836	2	2.11	4	3.64	2	0.27	6	85	3	9.9	1
Journal of Technology Transfer	650	10	1.18	7		#N/A	0.28	4	32	10	6.6	11
R&D Management	1378	7	2.51	3	3.17	3	0.16	9	32	10	7.4	9
Research Policy	7774	1	2.52	2	3.98	1	0.26	7	115	2	8.8	5
Research Technology Management	637	11	0.89	10	1.06	10	0.14	10	29	12	8.7	6
Technology Analysis and Strategic Management	726	9	0.70	12	1.49	9	0.20	8	64	5	6.7	10
Technovation	2165	4	3.29	1	2.76	4	0.52	1	56	6	6	13
Technological Forecasting and Social Change	2212	3	1.71	5	2.21	5	0.50	2	131	1	6.3	12

Table 6 Current Main Citation Based Measures for the 14 TIM Journals (SPP Omitted, 2013 Data)

3.2.1 Impact Measure Comparisons – Comparison with other Journals in the Field

Impact Factors – IF and Five Year IF

Over five years, Technovation has the highest impact factor, while for the present period, Research Policy has the highest impact factor. R&D Management is ranked third in the list for both the immediate impact factor (the impact factor) and the five year impact factor. The immediacy index measures the extent to which papers from the current year are cited in that year, we note that R&D management is ranked 9th.

Immediacy Index

The immediacy index is the average number of citations an article receives in the year of its publication. This index measures the extent to which journals accumulate citations in the year of their publication. As was noted, the extent of differences is large. A journal such as Technovation will have 52% of its papers cited within a year of publication, while the Journal of Engineering and Technology Management has only 3% of its papers published within the year also cited within that year. There are three journals which appear to have strong immediate citation (i.e. within the year) of the publications they publish (Technovation, Technological Forecasting and Social Change, and Industrial and Corporate Change), then there is a cluster of papers which have similar immediacy index, (Industry and Innovation, Journal of Product Innovation Management, Journal of Technology Transfer, and Research Policy). R&D Management falls into a middle category of journals.

Journal Citing (No. of Cites) \ Journal Cited (No. of Cites)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**150**	38	2		4	1	44	1	6	14	11		3	2	4
2	19	**571**	30	4	2	48	250	12	73	250	8	2	26	14	60
3		28	**612**	20	15	4	59	60	31	686	4	7	17	5	18
4		13	129	**227**	13	4	77	38	28	559	3	9	14	16	44
5	3	96	93	28	**256**	33	239	38	206	579	82	9	55	48	159
6	2	76	22	3	16	**422**	219	3	50	140	37		23	16	85
7	11	164	45	8	29	63	**2215**	5	149	337	133	2	18	16	78
8	1	17	77	15	34	12	136	**360**	52	788	11	32	23	25	83
9	5	77	55	14	58	36	398	32	**494**	440	95	8	65	26	92
10	2	93	391	92	81	39	412	310	209	**3847**	29	141	134	161	213
11	2	18	3		13	4	51	4	46	32	**184**		6	3	7
12		5	41	14	19	1	22	78	22	532	4	**503**	55	37	51
13	10	94	117	15	14	49	132	31	120	916	9	38	**1963**	222	315
14	7	70	67	13	54	26	177	81	115	626	51	30	198	**380**	141
15	10	103	135	37	108	42	527	169	284	1257	90	23	163	72	**1434**
Column total	222	1463	1819	490	716	784	4958	1222	1885	11003	751	804	2763	1043	2784

Table 7 Journal Citing in and Out – Citation Counts for Period (2008-13)

(see Table 8 for Key to Journal Titles)

Journal Cited Half-Life

The (Journal) Cited Half-Life measures the median age of the articles from the journal cited in the current year. Citations are counted if they are within the Thomson Reuters Journal Citation Report. A longer cited-half life for a journal suggests that its papers are generally older than those from a journal with a shorter cited-half life. In the data set, those journals with the longer cited-half life are the Journal of Product Innovation Management, the IEEE Transactions in Engineering Management, Industrial and Corporate Change and the Engineering Management Journal. Those journals who cited papers are more recent are the Journal of Technology Transfer, Technological Forecast and Social Change, Technovation and Industry and Innovation.

3.2.2 Journals Citing Behaviour

Journal citing behaviour can be examined to show which journals are important within a field and beyond it. Citing behaviour is directional and citations from journal A to journal B indicate the dependence of the former upon the latter. Such directional link or dependence can be used to assess the prestige of the journal, although impact factor is sometimes referred to as a measure of prestige.

The tables provide information about journal citing within the 15 journals of the set. Journal 9, whose entries are underlined, is R&D Management. Journal 10, which has the largest count of citations to itself, and the largest number of citations overall, is Research Policy.

Journal	Code
Engineering Management Journal	1
IEEE Transaction on Engineering Management	2
Industrial and Corporate Change	3
Industry and Innovation	4
International Journal of Technology Management	5
Journal of Engineering and Technology Management	6
Journal of Product Innovation Management	7
Journal of Technology Transfer	8
R&D Management	9
Research Policy	10
Research Technology Management	11
Science and Public Policy	12
Technological Forecasting and Social Change	13
Technology Analysis and Strategic Management	14
Technovation	15

Table 8 Journal Name and Code

The diagonal values of **Table 7** are the journal citations to itself, i.e. the count of citations to articles published within the journal in the period to other articles in the journal some of which may be within the period and some outside it. As can be noted, some journals do not cite other journals, for example journal 12 does not cite journal 1, while journal 11 does not cite journal 4 or journal 12. R&D Management cites itself most (which is normal practice) and then cites other journals in the following order: Research Policy, Journal of Product Innovation Management, and then Research Technology Management. R&D Management is cited most by itself followed by Technovation, Research Policy, and then the International Journal of Technology Management. The findings are consistent with the observations of Thongpapanl (2012) page 263 who recently conducted a similar but more extensive citing analysis between the journals in the set and a number outside.

Each journal has a rank ordering of the other journals in terms of citations to the other journals or received by it from the other journals. Journals could be assessed as similar if the rank ordering of the other journals they cite are similar. Such similarity is partly a reflection of the count of citations in any case but the journal ranking approach provides a journal level assessment of similarity and reflects patterns of citation or source use at the journal level. Using the data from the table of citation counts in **Table 7**, a ranking of the journals using citing (out) behaviour was carried out. Those journals that were most similar on this basis were Journal of Product Innovation Management, Technovation, Technological Forecasting and Social Change, and the International Journal of Technology Management. Those most unlike R&D Management were Journal of Technology Transfer, Research Policy, Science and Public Policy, Industrial and Corporate Change and Industry and Innovation. Research Policy appears to be different from R&D Management on this approach, which employs ranking, as the journals balance of citation to a certain number of journals is very different, these journals being Industrial and Corporate Change, Industry and Innovation, the Journal of Technology Transfer and Technological Forecasting and Social Change. So while there are close links in terms of citing from R&D Management to Research Policy (441 cites to RP from R&D Management out of a total of 1895 citations), Research Policy does not cite R&D Management to the same extent citing it only 209 times out of a total of 6152 citations.

A within field impact factor set entirely within the 15 journals can be produced by dividing the number of citations to the journal by the citing out of the journal to the other publications. The rank ordering is shown in the following table. The order can be compared with that shown in the overall metric table (**Table 6 Current Main Citation Based Measures for the 14 TIM Journals (SPP Omitted, 2013 Data).**

Code	Journal	Citing In to Journal	Citing by the Journal	Citing In/ Citing Out
1	Engineering Management Journal	72	130	0.55
2	IEEE Transaction on Engineering Management	892	798	1.12
3	Industrial and Corporate Change	1207	954	1.27
4	Industry and Innovation	263	947	0.28
5	International Journal of Technology Management	460	1668	0.28
6	Journal of Engineering and Technology Management	362	692	0.52
7	Journal of Product Innovation Management	2743	1058	2.59
8	Journal of Technology Transfer	862	1306	0.66
9	R&D Management	1391	1401	0.99
10	Research Policy	7156	2307	3.10
11	Research Technology Management	567	189	3.00
12	Science and Public Policy	301	881	0.34
13	Technological Forecasting and Social Change	800	2082	0.38
14	Technology Analysis and Strategic Management	663	1656	0.40
15	Technovation	1350	3020	0.45

Table 9 Journal Citing Behaviour within the 15 Journals Only

A final figure shown below (**Figure 3 Journal Position Based on Count of Citing and Cited Papers within the 15 Journals**) indicates how the journals differ in terms of their overall tendency to be cited by the other journals within the set of 15 and to cite the other journals within the set of 15. The journals are identified by a number, which is the same number as used in **Table 8 Journal Name and Code.** For each journal the number of citations out of the journal is shown on the horizontal axis, on the vertical axis, the number of citations to the journal is shown. The counts are net of journal self-citation. Generally, the measure of all citations to a journal / all citations from a journal is a form of impact factor, although not a time limited one and therefore potentially misleading. Nevertheless, some interpretation of journal behaviour is possible although care should be taken as the volumes of citation can depend on journal practices regarding the count of permitted references (citations).

The table suggests that journal 10 (Research Policy) receives more citations within this set than it makes to the other members of the set. Technovation, despite a high recent impact factor, has many fewer citations to it that the citations that it makes (to this set of journals). R&D Management is, within this field, in balance making as many cites to the other journals as receiving itself from them. This analysis is confined to the 15 journals.

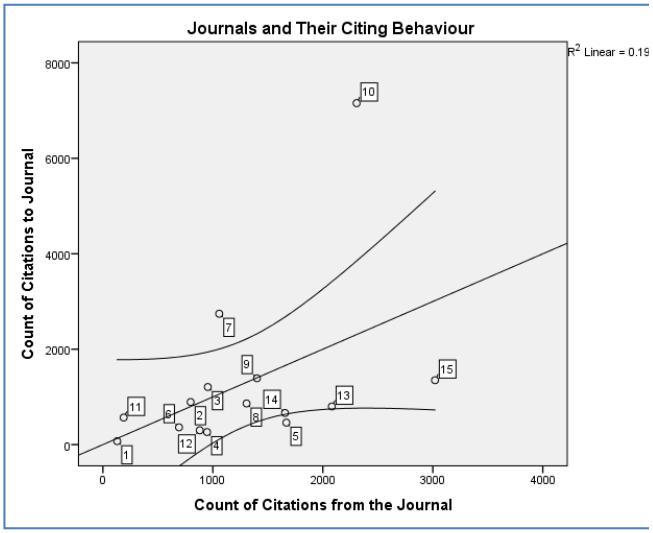

Figure 3 Journal Position Based on Count of Citing and Cited Papers within the 15 Journals

3.2.3 International Involvement in Articles and Conference Papers Published in R&D Management

Internationalization and collaboration are often regarded as leading to work that will be more highly cited and internationalization is a key element of journal behaviour. For this reason, examination was made of the count of countries across all papers (articles, article: proceedings paper, review, editorial material and correction), for each year for the period 2004 to 2013. A country was counted if it appears in the address of the author. If two authors from one country publish in one year, the country is counted twice. The data is shown in the following table. The country whose authors appear most commonly in R&D Management is the UK, followed closely by the US, then Germany. A number of countries (Taiwan, Canada, Switzerland, Sweden and the Netherlands) form a group which occur just over 20 times during the period. China appears only 12 times in the decade. There is no strong trend of growth of any country over the last decade.

Papers in Year	45	39	36	34	37	34	38	32	33	5
Publication Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
UK	7	8	9	6	7	4	9	7	6	1
USA	6	10	10	5	5	7	3	6	10	
Germany	1	4	6	1	5	10	8	8	4	
Taiwan	4	2	2	7	5	1	2	3		
Canada	2	2	2	2	5		5	3	2	
Switzerland	8		3		2	4	4	1	1	
Netherlands	1	2	5	2	1	2	5	2	2	
Sweden	3	5	3	2		2	3	2	1	1
Italy	3			1	1	5	2	3	1	
Spain		2	1	2	3	1	2		2	1
China	4			1	1		1	3	2	
Australia	3	1	2						2	1
Belgium	2		2	3			1			1
France	2	1	1	2		2		1		
Japan	1	1			2	1	2		1	
South Korea				1	3		1	2		1
Finland	1	2		1	1	1	1			
Austria		1	2			1		2		
Denmark					3			3		

Table 10 Country Involvement in R&D Management Papers

Count of Countries per Paper

There is general interest in the literature in the extent to which papers are multi-country. In R&D Management, multi-country paper appear to be less common than in Research Policy. The comparison made with Research Policy is shown in the following table. It identifies the count of papers by the number of countries identified in the addresses of the authors.

Journal	Count Papers with this Number of Countries in the List of Author Addresses						
	1	2	3	4	5	6	9
R&D Management	715	119	10				
No Countries	715	238	30				
Share %	85	14	1				
No of Papers	844						
N of countries	983						
Countries per Paper	1.1						
Research Policy	1357	352	86	14	3	1	1
No Countries	1357	704	258	56	15	6	9
Share %	75	19	5	1			
No of Papers	1814						
N of countries	2405						
Countries per Paper	1.3						

Table 11 Countries per Paper: R&D Management and Research Policy Comparison: (Period)

Country Affiliations of Papers

1	1101	1766	United States
2	588	845	United Kingdom
3	391	591	Netherlands
4	334	485	Germany
5	272	407	Italy
6	235	347	Spain
7	211	396	Taiwan
8	176	249	France
9	165	227	Canada
10	154	209	China
11	147	238	South Korea
12	137	209	Sweden
13	117	135	Denmark
14	113	146	Switzerland
15	106	142	Australia
16	101	162	Finland
17	98	154	Belgium
18	93	151	Japan

Table 12 Country Involvement in R&D (Count of Countries and Count of Affiliations)

A number of issues of interest that it has not been possible to consider is detail are as follows: Firstly we might ask whether the journals are similar in terms of the country affiliation of their authors. We might ask whether papers with authors from a particular country are likely to have more authors from other countries or are likely to be a one country paper only. We might further ask if the authors from particular countries are more likely to work with the authors of another country.

Internationalization Analysis of the Journals

Papers from the 15 journals from the period 2009-2013 were examined to identify the countries to which the authors of each paper were affiliated (through their connection with particular institutions). Papers (article, article in press, conference paper and review paper) were divided into two sets, international and national. National publications were those which had one country in the author's affiliations. International publications were those with more than one country. The top 18 countries (the 18 most common overall) were used in the analysis. All other country collaborations were excluded to simplify the data manipulation and counting. The result of this collation of publications is shown below.

	National	International
United States	601	355
United Kingdom	264	299
Netherlands	187	201
Germany	175	147
Italy	139	125
Spain	125	98
Taiwan	158	40
France	77	95
Canada	73	81
China	51	100
South Korea	92	50
Sweden	75	62
Denmark	54	63
Switzerland	48	60
Finland	70	30
Australia	45	54
Belgium	21	76
Japan	58	33

Table 13 National and International Papers by Country

A chi-square statistic was then calculated from the observed and expected values. Using this method of identifying differences, those countries that were less typical of the whole data set were the United States, the United Kingdom, Taiwan, China, and Belgium. The following figure indicates the location of countries on a scatter plot which can also be used to assess the extent to which countries vary from each other in respect of the involvement of authors in R&D Management papers.

Those countries which produce within this literature more national papers than international papers are nine in number. Of these countries, the US has the highest proportion.

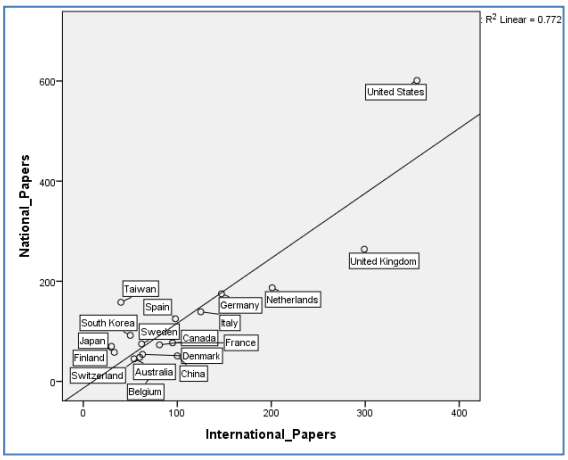

Figure 4 TIM 15 Journals Main Countries, International Papers and National Papers Scatter Plot

3.2.4 Recent Journal Growth Rates

It was also possible to investigate for the most recent period (2009-2013) the increase in the number of papers published each year in each in the fifteen journals of the TIM set. This review showed some significant differences between the journals in the number of articles published each year. In the following table, a growth rate is shown that is calculated from the increase in the total of the papers from the first two years (2009 and 2010) to the total papers from the second two years (2011 and 2012). While the number of papers in R&D Management has remained relatively stable, some journals have increased their papers over this period markedly. Research Policy is a particular example over a longer period but over the shorter period for which data is presented here, the journals which have most increased the number of papers they publish are Journal of Technology Transfer, Journal of Engineering and Technology Management - JET-M, Technological Forecasting and Social Change, Journal of Product Innovation Management, and Industry and Innovation.

Papers per Year Journal	Growth Rate (%) from 2009-10 to 2012-11
Journal of Technology Transfer	99
Journal of Engineering and Technology Management - JET-M	52
Technological Forecasting and Social Change	47
Journal of Product Innovation Management	41
Industry and Innovation	38
IEEE Transactions on Engineering Management	27
Research Policy	16
Technology Analysis and Strategic Management	14
Technovation	0
R and D Management	-9
Engineering Management Journal	-9
Industrial and Corporate Change	-10
Science and Public Policy	-15
Research Technology Management	-29
International Journal of Technology Management	-32

Table 14 Growth Rate in Papers per Year MOT Journals from 2009-10 to 2012-13

3.2.5 Current Topic Focus

In this section of the results, the focus is upon the most recent five year period from 2008-2013. The 14 journals were considered first and then R&D Management separately. The reason for this was that R&D Management indexing does not include author keywords, and only in the Web of Knowledge rather than in Scopus can publisher generated keywords be found.

Overall Technology Management Topic Focus

For the technology management journals as a whole, the most common keywords provided by Scopus as Index Keywords in the period 2009-2013 are shown in the table below. The second column shows the count of keywords, the third column shows the year of maximum count. The year 2013 is an incomplete year containing fewer articles and therefore keywords. The year of maximum count is therefore less likely to be 2013. Data from 2013 was used in order to give insight into the latest patterns of publication in the journal.

Index Keyword	Count of Index Keywords	Year of Maximum Count (2009-2013)
Innovation	1087	2012
Industry	525	2012
Research	364	2012
Technology	327	2009
Product Development	295	2011
Research And Development	293	2010
Technological Development	256	2011
Competition	243	2010
Patents And Inventions	228	2012
Commerce	185	2012
New Product Development	185	2012
Economics	178	2009
Investments	177	2010
Technology Transfer	176	2009
Decision Making	174	2011
New Product	171	2010
Technological Forecasting	167	2009
Knowledge Management	164	2009
Strategic Approach	161	2009
Management	158	2012
Project Management	153	2009

Table 15 the 14 Technology Management Journals, Common Index Keywords 2009-2013

The following table also uses Index Keywords from Scopus and presents those keywords that meet the following criteria: to have been used consistently for four of the five years of the period 2009-2013, and to have grown in frequency between the first two years and the second two years by a factor of over 3, the count of the keywords for 2013 was not used in applying this criterion. The Trend Increase column shows this factor which is calculated as follows:

$$\frac{count\ of\ keywords\ 2011 + count\ of\ keywords\ 2012}{count\ of\ keywords\ 2009 + count\ of\ keywords\ 2010} = \text{Trend Increase}$$

Applying these criteria created a dataset of 47 keywords (Index Keywords) which are in increasing use within the period 2009-2013, and which may indicate the topic focus of the journal. While this dataset includes generally keywords that are less frequent in use (shown in the count field), there are some exceptions which are widely used: industry, engineering and development process. These three terms are widely used and have some increase in their use in the period covered.

Index Keyword	Max Year	Count	Trend Increase	No Years
Biofuel	2011	10	8	4
Standard (Regulation)	2011	10	8	4
Field Studies	2012	9	7	4
Delphi Method	2011	15	6	4
Biofuels	2011	8	6	4
Business Model Innovation	2012	8	6	4
Core Competence	2012	8	6	4
Creativity	2011	8	6	4
Public-Private	2012	8	6	4
Policy Development	2011	13	5	4
Business Performance	2011	7	5	4
Dominant Design	2011	7	5	4
Entrepreneurial Activity	2011	7	5	4
Environmental Change	2012	7	5	4
Equipment	2011	7	5	4
Semi Structured Interviews	2012	7	5	4
Engineering	2012	63	4.8	5
Social Network	2011	22	4.5	4
User Innovation	2011	12	4.5	5
Data Processing	2011	19	4.33	5
Delphi	2011	17	4.33	4
Human Resource Management	2012	17	4.33	4
Development Process	2012	26	4.2	4
Data Mining	2011	12	4	4
Environmental Management	2012	11	4	4
Model Test	2011	11	4	4
Patenting	2011	10	4	4

Table 16 Technology Management Journals – Rising Trend Index Keywords 2009-2013

R&D Management Topic Focus

A view of the topics that may be of increasing importance in the R&D Management journal itself was obtained through the following procedure. As R&D Management journal articles do not publish author keywords systematically and citation indexes do not provide these for the journal, it was necessary to use Thomson Reuters own Keywords Plus keywords to identify the changing topic focus of the journal over time. Keywords Plus topics were collated with VantagePoint for the last 23 years including 2013 and reviewed. The frequency count of keywords was then made for each of the years. A selection of topics was then made using the following procedure. Those topics whose counts reached a maximum in the last four years were identified and then filtered to remove those topics which had only one occurrence. This step could remove topics of importance in the long term, but those topics which were only mentioned once might not necessarily be important, so the criterion of two occurrences of a keyword was used to define the set. This procedure produced a list of 40 keywords which are shown in the following table.

Year	Year of Most Occurrences	Count of Occurrences
Performance	2010	20
Product development	2011	16
Knowledge	2010	16
Capabilities	2010	13
Creativity	2012	11
Information	2011	11
Competition	2011	10
Market orientation	2011	9
Open innovation	2011	7
Framework	2012	7
Technology-transfer	2012	7
Dynamics	2011	6
Radical innovation	2012	6

Table 17 Index Keyword Occurrence in R&D Management, Recent Years Maximum Value

As can be seen from the list, the following keywords (Keywords Plus) have seven or more occurrences overall and have their highest annual count of use within the last period (2009-2013), these topics are performance, product development, knowledge, capabilities, creativity, information, open innovation, market orientation, and competition.

3.3 The Future

Two approaches were taken to analysing the existing data to give insight into future trends for the field of technology and innovation management. Firstly an extensive keyword search was carried out to review emergent topics in the field. Secondly, following the approach suggested by Erichsen and Christensen (2013), in which emphasis is placed on the scope and reach of a publication to other journals, a review of the citing of four journals including R&D Management was carried out.

3.3.1 Keyword Search of Emergent Topics

The review of topics was conducted using keyword frequency review and analysis. Keywords for the whole 15 journals were reviewed. Firstly, keywords prepared by indexation were reviewed for the period 2009 to 2012. 2013 was not included as it is a part year. These Index Keywords were not provided for the Journal of Technology Transfer, so this journal was not included in the Index Keyword search. Author Keywords were also reviewed. The analysis of Author Keywords did include the Journal of Technology Transfer. However R&D Management, which does not include author's keywords, was not included.

Keywords of both types were tallied and then analysed to identify those keywords which were increasingly frequent over the period 2009-2012. Those keywords (Index and Author Keywords) which increased in frequency over the period were noted and are included in the following list. The Index Keywords are more numerous than the Author Keywords.

There were 7909 actual terms used for Author Keywords in total from which ten were chosen as meeting the requirement for continuous increase in frequency of use, while there were 13479 actual terms used for the Index Keywords from which 26 met the same requirement for increasing frequency of use. The total number of times the Index Keywords were used within the four years was 2080 while the total number of times Author Keywords were used within the four years was 168.

Index Keywords	Author Keywords
Innovation	Innovation Performance, Innovation Studies
Industry	
Research	
Patents And Inventions	Patents
Commerce	
New Product Development	Innovation Performance
Sustainable Development	Sustainability
Information And Communication Technology	
Performance Assessment	
Economic Analysis	
Start-Ups	
Entrepreneurship	
Literature Reviews	
Standards	Regulation
Human Resource Management	
Performance Measure	Innovation Performance
Social Networking (Online)	
Innovation Network	
Innovation Capability	
Field Studies	
Core Competence	
Engineering Economics	Engineering Economics
Financial Service	
Semi Structured Interviews	
Cellular Telephone Systems	
Mass Media	
	Competition
	Alliances
	Tech Mining

Table 18 Index and Author Keywords – Rising Trends

The two sets of keywords were then matched and seven keywords were identified as present in both lists. These common keywords may be relevant signposts to areas that are of immediate and growing importance to the field. Of interest is the fact that these topics include are both very common and topics that are very uncommon in that they are infrequent within the overall list of topics. The criterion for inclusion is growth rate in consecutive years, which distinguishes this approach from that undertaken in section 3.2. The approach is simple and unsophisticated and makes the minimum of assumptions about author behaviour and journal choice, working with a relatively robust measure of the subject matter covered by papers. By counting the increase over a period of three years, the effect of special issues, which can distort keyword occurrence, is minimized.

3.3.2 Citing Range of Journals

A further approach to how well the journals of a field or a group of journals in a field is prepared and open to future developments is to explore the range of the citing journals as well as the range of subject categories used (or the Web of Knowledge Journal Categories). Scopus provides citing data for the innovation management journals and this can be used to identify the citing papers and journals. It does not provide subject category data but the count of journals citing has been used as a measure of what may be termed the journal's range. The work presented earlier in this conference paper has examined citing behaviour within the set of journals, in terms of flows in citing and flows out cited. In the approach employed here, the focus is upon the count of citing journals to our target journals' publications, in this year, the publications from 2009. Those journals which were tested here for their citing journals behaviour are those which are closest to R&D Management in terms of citing to it and from it, see **Table 7**. They are Journal of Product Innovation Management, Research Policy and Technovation.

For each journal (including R&D Management there were four in total), the papers from 2009 were put into a data set and citing journals identified. 2009 was taken as this was likely to have allowed significant citation counts to accrue and the influence of the papers to be recognized in other areas and leading to publication. Scopus data was used.

Journal	2009 Articles (A)	Citing Publications (P)	Cites (C)	Citing Pubs. Per Journal	Citations per Journal Publication
R&D Management	34	211	430	6.2	12.6
Journal of Product Innovation Management	50	291	620	5.8	12.4
Research Policy	137	590	1650	4.3	12.0
Technovation	79	816	1001	10.3	12.7

Table 19 Four Main Journals and Count of Citing Journals and Citations

The data shown indicate very similar levels of citations per journal publication for all journals, that is to say, for the average article of a journal, there is a very similar number of citing journals. Across the wider range of journals indexed here, the impacts for the journals appear very similar. However, the range of the journal, noted by the citing publications per journal column, suggests that while three of the journals are very similar in terms of their reach, one journal has a higher reach, achieving an average of ten citing publications per paper overall. Technovation therefore appears to have a significantly higher reach, an indication of greater relevance of its authors' work to a larger body of other researchers.

4. Discussion

4.1Past Performance

The R&D Management has consistently published highly cited articles within the field of technology and innovation management since its inauguration. The journal continues to publish research articles that are highly cited, although it should be noted that the authors of such articles may develop their ideas across a range of other publications, mainly within the field but also beyond it.

The journal remains one of the core publications of the field, and is cited by and cites to the other leading journals of the field. Major changes in citing within the field do not appear to have changed significantly since the last major study of citing behaviour in 2012.

The journal takes publications largely from UK based authors whose involvement with other out of country authors (international collaborations) are less than Research Policy and it publishes within a field that has significant US dominance with many papers involving solely US authors.

In common with the leading UK based academic policy and innovation journal, Research Policy, R&D Management has achieved a reduction in the proportion of uncited articles during its lifetime. Analysis of uncited papers shows a regular and steady decline in the publication of uncited papers for both of these journals. Strategies to maintain quality and the interest of articles are likely to be responsible. However, if journal policy for acceptance of articles is geared towards that those which may be cited, there is a possibility that research which is novel and whose quality is more difficult to assess, will not be published. On the assumption that research articles which are novel carry a risk of being uncited, journals that aim to reduce the number of uncited papers may discriminate against novelty.

4.2 The Present

R&D Management's increase in citedness of its publications and the decline in the incidence of uncited articles, coupled with limited engagement with industrial co-authors suggests that at present there is an increasing focus upon immediate relevance to others writing (and citing) in the technology and innovation management field.

Journal size, which can be measured by the number of articles carried, has been reviewed. This is an indicator of the ambition of the journal and the resources available to the journal owners. Present and recent strategy of the journal appears to be to reduce the number of articles published in recent years, but the decline is small. Other journals have however very different behaviour with some significantly increasing the number of articles produced during the period examined here (2009-2013). All of the journals which have been identified as closest in citing behaviour to R&D Management (Journal of Product Innovation Management, Technovation and Research Policy) have increased their size in the period examined. It has not been possible to determine if the REF cycle, which affects UK authors (and their collaborators) is generally responsible, but given the importance of R&D Management to UK authors affected by the REF, it is difficult to see why the effect is not present for R&D Management also.

4.3 The Future

A review of topic choice through keyword searching and engagement with the broader literature were the approaches used to look towards the future for the journal. The fast rising trends identified here point to the importance of patents, sustainability, regulation, innovation performance, engineering economics, and the continued importance of innovation itself, which, while a key aspect of the domain performance, appears to be increasing as even as keyword.

The extent to which the journal reaches out to other publications is however more limited than one of the key companion journals of the field, Technovation. On the basis of the limited analysis conducted on citing journals, Technovation appears to be reaching a broader range of readers and citers – a wider community, including practitioners. If as seems likely, increasing openness of publication – open innovation qua academic engagement – will require a broader level of engagement of the journal than has been the case in recent years.

5. Conclusions

R&D Management was established as a journal to engage with practitioners with the aim that such engagement would lead to the more effective and efficient use of resources. The development of the journal as a publication in which academic researchers has sought to have their work published has been an undoubted success, with a rising impact factor, and high rank in the field of technology and innovation management journals. However, the contemporary fashion, brought on by austerity, is to re-emphasize this link between thoughts and deeds, between the world of theory formation, certainly valuable as an activity in itself, and theory use, refinement and impact. The proliferation of new media of openness and communication technologies provides new channels through which impact may flow, of theory upon practice and practice upon theory. R&D Management's level of engagement with the world of practice, and the coming of new forms of computer mediated communication and working present challenges to the status quo. In the UK research assessment framework currently being introduced, impact is now significant, and may well catch on more widely. Moving ahead in

this environment requires more engagement of the work, an effect that would show up in the immediacy index, but also with more company funding and consultant and company involvement in publication activity.

One option for journals generally within the field is to engage more openly with practice and to accept the multifarious forms of interaction that flow from new technologies and which open access can facilitate. An approach that would encourage authors (from academe and more particularly outside) to submit their work could be to introduce a new category for publications that would include the practically oriented and engaged. Papers in that category would be expected to have different citation characteristics. Impact factors calculated with this in mind would not adversely affected a journal's reputation.

The future will see a wide variety of forms of publications and measures of journal impact and of journal quality will proliferate. New methods, including extensive text-mining will be used to conduct reviews of the kind prepared here and provide the new mirror at which we look for evidence of what has been achieved, and what is still yet to be done.

6. References

Ball, D. F. (1998). "The needs of R&D professionals in their first and second managerial appointments: are they being met?" R&D Management 28(3): 139-145.

Ball, D. F. and J. Rigby (2006). "Disseminating research in management of technology: journals and authors." R & D Management 36(2): 205-215.

Beyhan, B. and D. Cetindamar (2011). "No escape from the dominant theories: The analysis of intellectual pillars of technology management in developing countries." Technological Forecasting and Social Change 78(1): 103-115.

Borner, K., W. Glanzel, et al. (2011). "Modeling science: studying the structure and dynamics of science." Scientometrics 89(1): 347-348.

Breivik, M., G. Hovland, et al. (2009). "Trends in Research and Publication: Science 2.0 and Open Access." Modeling Identification and Control 30(3): 181-190.

Butler, J., D. F. Ball, et al. (1976). "The analysis of technological activity using abstracting services." R&D Management 7(1): 33-40.

Davies, E. A. (1970). "Foreword by Dr. E. A. Davies for R & D Management." R&D Management 1(1): 1-1.

Durisin, B., G. Calabretta, et al. (2010). "The Intellectual Structure of Product Innovation Research: A Bibliometric Study of the Journal of Product Innovation Management, 1984-2004." Journal of Product Innovation Management 27(3): 437-451.

Enkel, E., O. Gassmann, et al. (2009). "Open R&D and open innovation: Exploring the phenomenon." R and D Management 39(4): 311-316.

Erichsen, P. G. and P. R. Christensen (2013). "The Evolution of the Design Management Field: A Journal Perspective." Creativity and Innovation Management 22(2): 107-120.

Gargouri, Y., C. Hajjem, et al. (2010). "Self-Selected or Mandated, Open Access Increases Citation Impact for Higher Quality Research." PLoS ONE 5(10): e13636.

Gassmann, O. (2006). "Editorial: Opening up the innovation process: Towards an agenda." R and D Management 36(3): 223-228.

Harmancioglu, N., C. Droge, et al. (2009). "Theoretical lenses and domain definitions in innovation research." European Journal of Marketing 43(1-2): 229-263.

Hsuan, J. and V. Mahnke (2011). "Outsourcing R&D: A review, model, and research agenda." R and D Management 41(1): 1-7.

Jelinek, M., A. S. Bean, et al. (2012). "21st-century R&D." Research Technology Management 55(1): 16-26.

Jensen, M. D. and P. M. Kristensen (2013). "The elephant in the room: mapping the latent communication pattern in European Union studies." Journal of European Public Policy 20(1): 1-20.

Johansson-Sköldberg, U., J. Woodilla, et al. (2013). "Design Thinking: Past, Present and Possible Futures." Creativity and Innovation Management 22(2): 121-146.

Linton, J. (2006). "Ranking of technology and innovation management journals." Technovation 26(3): 285-287.

Linton, J. D. (2011). "How influential are Technology Innovation Management journals-Technology Innovation Management Journal 2010 Impact Factors in comparison with Financial Times 45." Technovation 31(9): 425-426.

Linton, J. D. (2012). "What's hot and what's not: A summary of topics and papers in technology innovation management that are getting attention." Technovation 32(12): 653-655.

Linton, J. D. and N. Thongpapanl (2004). "PERSPECTIVE: Ranking the technology innovation management journals." Journal of Product Innovation Management 21(2): 123-139.

McMillan, G. S. (2008). "Mapping the invisible colleges of R&D Management." R & D Management 38(1): 69-83.

Moed, H. F. (2005). "Statistical relationships between downloads and citations at the level of individual documents within a single journal." Journal of the American Society for Information Science and Technology 56(10): 1088-1097.

Priem, J. (2013). "Scholarship: Beyond the paper." Nature 495(7442): 437-440.

Rothwell, R. (1992). "SUCCESSFUL INDUSTRIAL-INNOVATION - CRITICAL FACTORS FOR THE 1990S." R & D Management 22(3): 221-239.

Schiederig, T., F. Tietze, et al. (2012). "Green innovation in technology and innovation management - an exploratory literature review." R and D Management 42(2): 180-192.

Schloegl, C. and J. Gorraiz (2011). "Global Usage Versus Global Citation Metrics: The Case of Pharmacology Journals." Journal of the American Society for Information Science and Technology 62(1): 161-170.

Stanko, M. A. and R. J. Calantone (2011). "Controversy in innovation outsourcing research: Review, synthesis and future directions." R and D Management 41(1): 8-20.

Thongpapanl, N. (2012). "The changing landscape of technology and innovation management: An updated ranking of journals in the field." Technovation 32(5): 257-271.

Watson, A. B. (2009). "Comparing citations and downloads for individual articles." Journal of Vision 9(4).