

An Appraisal of R&D Management Research Literature as the Output of a Virtual Organisation

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We have created a database of information about papers in a body of research publications on R&D Management, and used this to examine the structure of research activity in the field. We found that different types of author tended to produce papers with different types of outcome and also that different authors appeared to subscribe to different schools of thought about the R&D management process. Researchers generally subscribed to different schools of thought from researching practitioners, which raises a question about the utility of this body of research for those who might be thought to be its intended beneficiaries.

Introduction

There is a large body of research publications on the topic of management of industrial research and development. As is normal, this body of knowledge has arisen piecemeal from the world research community without any overall plan or deliberate structure. This research community could be considered to be a virtual organisation, which is clearly stable and productive, but we think that the nature and usefulness of its output is worth examining.

There is also a large body of people who actually practice the management of R&D as their primary occupations. These practitioners are presumably the intended recipients of the output of all this research effort.

We have set out to appraise the body of research by studying its product, i.e. its body of publications. This was done by constructing a database of information about the publications and then analysing it.

Definition of the body of research studied

Most publications on R&D address corporate level concerns, but in a large organisation the need to know how to manage is also felt strongly at the level of the section or unit, which often has considerable autonomy. Our concern was with papers which dealt wholly or in part with a topic defined as "R&D management concerns of the R&D section". This is a subset of publications on all topics in R&D management.

Our method of research

When setting out to review literature in the field just defined, it was decided to record reference details of all reviewed publications in a database. This proved to be unexpectedly fruitful, and led on to our research method, which consists of compiling a database of information about all the papers in the field, and then examining the database to look for summary information and relationships.

An example of the method - author type and output type

It was noticed during initial reading of the papers that authors might be placed into the following categories of *author type*:

- *academics*
- *journalists*
- *consultants*: individuals or employees of consultancy organisations
- *practitioners*: practice or directly supervise R&D
- *corporate*: managers above practitioner level who write on R&D

Academics dominated, which is not surprising, but the significant contribution made by journalists was not expected by us.

It also proved possible to classify the *output type* of the paper into the following classes:

- rules
- strategy
- tactics
- model
- comment only
- data
- measurement method

While reading the papers, the impression arose that the type of author was significant in predicting the type of output of a paper. To test this, it was decided to create columns in the database for recording these two attributes of a paper. *Author type* was gleaned from the authors' biographical notes or addresses in their papers, and was deducible for all but one paper. *Output type* was assigned by the reviewer, and this proved practicable for 100% of papers. The following table was then extracted.

OUTPUT TYPE	Academic	Journalist	Consultant	Practitioner	Corporate
Rules	80	3	22	6	23
Strategy	67	17	13	11	68
Tactics	60	20	24	26	20
Model	59	0	4	6	12
Theory	19	0	2	2	6
Comment only	0	8	8	4	7
Data	18	0	0	0	3
Measurement method	11	0	2	0	4
Totals	314	52	77	55	144

Table 1. Variation of Output Type of papers with Author Type

Without enquiring into what interpretation should be put on the above results, it was decided to conduct further work along the same lines.

Construction of the database

Selection of attributes

The database was then expanded to record the following *attributes* of each paper in addition to *title*, *author*, *reference*, *author type* and *output type*:

1. The research methodology used.
2. Nationality of authors.
3. Affiliations of authors.

4. How formal the work was; whether it reports:
 - opinion
 - experience
 - a research result
5. The subject matter of the paper:
 - strategy
 - tactics
 - R&D management
 - general management
 - organisational structure
6. The contribution of the paper to theory;
 - describes theory
 - tests theory
 - is not relevant to theory
7. Degree of relevance to R&D management
8. A grading of our opinion of the importance of the paper
9. A grading of the quality of writing of the paper
10. The school of thought underlying the work; (this concept will be explained below).

The list above was modified and extended slightly in the light of experience with the papers. Once this was done there was no particular difficulty in categorising all the papers.

The publications included

By April 1996, 676 papers relevant to the subject of R&D management at the unit level, published since 1975, had been entered. The bulk were refereed journal papers, which were found by the usual methods of computer searching of indexes, scanning of identified key journals, and some citation analysis. The list of papers is thought to be more or less comprehensive for the restricted field in question, and comprises about 20% of papers on all R&D Management topics. The decision was made not to do searches for key authors as this might bias the database towards those who feature a number of times, and lead to neglect of rarer authors.

Categorising the papers

All papers included were read by the reviewer, and were categorised according to his opinion. The list of attributes above was modified and extended slightly in the light of experience with the papers, and then there was no particular difficulty in categorising all of them.

Some results from the database

The publications were distributed among 119 journals as shown in the league table below.

PUBLICATION	PAPERS
Research Technology Management	152
IEEE Engineering Management Review	62
Research Management	51
R&D Management	51
Engineering Management Journal	19
Management Science	19
Professional Engineering	7
5 journals	5
7 journals	3
12 journals	2
70 journals	1

Table 2. Where papers in this field were published

The table shows that publications are quite widely dispersed in this field with 22% of papers found in Research Technology Management, and 52% of papers found in the top 6 journals. The last 10% of papers are dispersed individually among 70 journals.

We extracted a league table showing which countries papers originated from. A Japanese researcher working in France and publishing in the USA would be classed as French.

COUNTRY	PUBLICATIONS
USA	438
UK	114
Canada	45
Japan	14
Germany	8
Switzerland	6
Holland	5
France	4

Table 3. National origins of the publications

The database concerns solely papers written in English, which may explain the small number from Japan. One author has significantly distorted the results, by elevating Canada to third position almost by himself. Professor R. J. Cooper of McMaster University and his co-authors have written 26 papers within the field of study.

We examined how many papers came from each organisation. Work in this field is very widely dispersed, with the most prolific organisation producing only 26 papers, 4% of the whole. The next most prolific produced only 10 papers and, 125 organisations produced 1 paper each.

We defined four levels of *formality of research* as follows:

- *Formal Study*, which is the reporting of a research project.
- *Review*, which is a review of existing information.
- *Theory*, which represents a theoretical discussion or analysis.
- *Comment*, which is a report of the author's views only, with no formal research.

	Journalist	Academic	Consultant	Corporate	Practitioner
Formal	2	65	4	15	6
Review	7	85	13	43	11
Theory	6	80	24	38	9
Comment	37	92	22	52	30

Table 4. Research Formality and Author Type

Table 4 shows that surprisingly few papers were classed as formal research.

Schools of thought in R&D management

While recording a case study in an industrial R&D laboratory, which was the working environment of one of us, it was noticed that different managers, when apparently faced with the same information, drew quite different conclusions and favoured different courses of action. We formed the hypothesis that these different managers think in different ways or perhaps subscribe, consciously or unconsciously, to different forms of reasoning about management activity. The publications on R&D management also appeared to reveal the presence of these same schools of thought underlying the approaches to research on the topic. The *schools of thought*, as formulated by us, were as follows:

- 1) *Cookbook* - Empirical rules can be found that apply most of the time
- 2) *Deterministic* - R&D can be managed by logic and reason

- 3) *Chaotic* - R&D is complex and variable, and there are limits to manageability
- 4) *Biological* - R&D management must adapt continuously to change

We allocated a school of thought to each paper, and produced a table to show how the schools of thought are distributed among the papers of the different researcher types.

	Journalist	Academic	Consultant	Corporate	Practitioner
Cookbook	30	189	55	46	11
Deterministic	9	89	11	92	12
Chaotic	7	26	8	2	13
Biological	5	10	3	7	21

Table 5. Variation of School of Thought with Author Type

Practitioners were strongest on the biological school, which was least favoured by the other author types. This raises a question about the match between the mind sets of the majority of those who supply research papers and of those who presumably would be expected to benefit from them.

Verification by authors' own opinions

All of the above relies on our opinions in classifying the papers. To investigate whether the authors of the papers would agree with our classifications, a questionnaire was developed and sent to 296 of the more recent authors. This asked for the same information as is contained in the database, and to date 115 responses have been received, a response rate of 39%. The responses indicate good correlation with the researcher's opinions and appear to validate our findings.

We in effect asked authors to classify each paper according to its school of thought by asking the following question:

"Which of the following most closely describes the conceptual framework in which your paper is set?"

and authors were asked to tick one of the four definitions shown under Schools of Thought above. All but one author answered this without any apparent difficulty. We take this as an indication that the Schools of Thought hypothesis has validity.

Discussion

We believe that the type of analysis which has been presented here shows promise as a means of providing information about the total effort in a research field. The database can be interrogated remarkably rapidly to ask new questions within its scope, but the number of correlations possible is too large to be conveniently reported. No one controls the total research effort in the field examined, and it is not subject to market forces. It is perfectly possible that it does not supply knowledge to the presumed end users efficiently. One of us (LTF) is a practising R&D manager and he found no publications at all concerning his core problem, which was how to decide strategy at the unit level.

Most practitioners must obviously be non-publishers, and these have played no part in this study. A preliminary trial of non-publishing practitioners has indicated that these are mainly of the biological school of thought, quite unlike most of the researchers, but more in line with researchers who are practitioners. We intend to carry out a further study of practitioners.