Trends in Project Management 1966 – 2015

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Abstract

This study charts the trends and changing emphases in project management. A quantitative, positivistic study, using frequency analysis and 116,202 records, this paper uses 16 a priori categories to search for keywords in the period 1966 to 2015.

Graphs are presented for each of the 16 categories showing the percentage of publications in the study period. The categories were analysed using a linear trend line to predict the future trajectory of the category.

The key findings were that 13 of the 16 categories of project management were expected to increase in frequency in the literature. The findings of this study agree and disagree with previous studies and this was attributed to the different samples used and how the search terms were identified and grouped.

This paper will be of benefit to those studying project management, to academics who work in this sphere and to others interested in this subject area.

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Project management, meta-analysis, research trends, bibliometrics

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Introduction

As a practice, profession and topic of research, project management has been growing steadily since the disparate elements we now associate with the topic began to coalesce as a distinct subject area (Carden and Egan 2008; Artto et al 2009; Bredillet 2009; Ika 2009; Morris et at 2011). With its history in construction, engineering and government (especially defence), project management practices existed in isolation before the 1950s and it is from this time that the pre-cursors of project management are traceable. Since this period, the widening use of project management, in new industries, countries and areas is reflected in the literature as practitioners and researchers raise issues of concern to them at the time (Urli and Urli 2000; Bredillet 2003; Crawford et al 2006). This means that a chronological study of the literature can inform those interested in project management about how the field has changed over time and can identify the trends, fads and transitory interests of those who have contributed to literature.

There have been a number of previous studies which have looked at changes in the field. This quantitative, positivistic study adopts a longer time horizon and a wider range of publications in an attempt to add new information on the trends in project management over the last 50 years. While this study is based on historical data, it is hoped that some light might be shed on the future direction of the field, presuming that past interest is indicative of the literature to come.

We do not start this paper with a definition of project management as there are a wide range of such definitions, for example from the Association for Project Management (APM 2012) and the Project Management Institute (PMI 2013) who both offer similar definitions. Instead, we accept the definitions and descriptions provided by the authors who wrote about project management using their own words and understanding of the subject area. It is not for us to judge whether their interpretation was correct because there is no basis for making such a judgement. We therefore disagree with authors, such as Abrahamson (2009), who would see this perspective as deficient because the basis for the analysis is undermined if there is not an agreed understanding in place.

By trend we mean the change, over time, of interest in a topic as evidenced by the number of publications that mention that particular topic by name. There is a hierarchy of topics. For the purposes of this study, project management is at the apex of the hierarchy. Below project management are a number of sub-topics that comprise project management. We call these categories and examples include risk, planning and project management methods. Categories represent the unit of analysis in this paper.

The aims of this study and paper are to:

1. Review the literature on trends in project management.
2. Identify the categories in project management research and the topics that comprise them.
3. Build a dataset of project management literature for the period 1966-2015.
4. Build a search capability to enable the literature to be searched by category and topic.
5. Chart the occurrence of the categories in literature.
6. Identify whether the categories are increasing or decreasing in the literature.
7. Make the data available to other researchers and identify further research opportunities.

First we begin with a review of the previous literature.

Previous research

To understand the previous research on project management it is first helpful to review how the subject has developed in the last 50 years. Several authors have charted the key milestones in the history of project management (Kerzner, 2006; Egeland 2009; Morris et al 2011). These significant events are shown in Table 1. Table 1 is arranged by decade to align with the decades in this study. The year is in the second column. In the third column are the milestones in the development of project management.

To align with this study, we begin the table in 1966 by which time there had already been significant developments in the area (Kerzner, 2006; Morris et al 2011). 1957 saw the development Program Evaluation Review Technique (PERT) and the Critical Path Method (CPM) was developed by Du Pont. 1959 witnessed the start of academic research into project management. In 1962 work breakdown structures were devised and precedence scheduling was developed by IBM. These early developments were the pre-cursors to a half century of further development.

Decade	Year	General developments
1966 to 1975	1968	Resource scheduling
	1969	Project Management Institute founded
	1970	Waterfall method
	1975	PROMPT II; HERMES started
1976 to 1985	1979	CCTA adopts PROMPT II
	1983	PMBOK published containing 6 knowledge areas (scope, time, cost, quality, human resources and communication management)
	1985	Total quality management

Decade	Year	General developments
1986 to 1995	1986	SCRUM named as a method; Capability maturity modelling
	1987	PMBOK issued as a white paper
	1988	Earned value management
	1989	PRINCE
	1990	Concurrent engineering
	1992	APMBOK 1st edition
	1994	Life cycle costing; APMBOK 2nd edition; GAPPS founded; IRNOP conferences begin
1996 to 2005	1996	PMBOK 1st edition; PRINCE2; APMBOK 3rd edition; Theory of constraints; PM certification
	1997	Project offices developed; Critical chain
	1998	IPMA Competence Baseline; PMBOK becomes a standard
	2000	PMBOK 2nd edition; APMBOK 4th edition; Concept of programme management; PMI research conferences begin
	2001	Maturity models; P2M (Japanese); Agile Manifesto
	2002	P2M (English)
	2004	PMBOK 3rd edition
	2005	Six sigma project management
2006 to 2015	2006	Total cost management
	2007	Lean project management developed
	2008	PMBOK 4th edition
	2012	APM 6th edition; ISO 21500:2012 standard
	2013	PMBOK 5th edition
	2015	PRINCE2 Agile

Table 1 History of project management

With a wide range of developmental activity coupled with the expanding use of project management (Morris et al 2011), assessing and reporting on the trends in this subject has been a popular activity amongst researchers. Table 2 lists the 15 previous studies into trends in project management. The table lists the year of the article, author(s), period of the research, from where the data was extracted, frequently using the International Journal of Project Management (IJPM) and the Project Management Journal (PMJ), the number of records consulted and the type of classification used (PRI for a priori research where the researcher looked for existing terms or POST if the researcher allowed the classifications to emerge during the research). The majority of previous studies have adopted an a priori approach.

Year	Authors	Period	Scope	Records	Type
1995	Betts and Lansley	1983-1992	IJPM	347	PRI
2000	Themistocleous and Wearne	1984-1998	IJPM and PMJ	748	PRI
2000	Urli and Urli	1887-1996	ABI-inform	3,565	PRI
2000	Zobel and Wearne	1996-1998	4 PMI conferences	633	PRI
2000	Morris et al	APMBoK 3rd edition	APMBOK	N/A	PRI
2002	Kloppenborg and Opfer	1960-1999	Online sources	3,554	PRI
2006	Crawford et al	1994-2003	IJPM and PMJ	1,051	PRI
2007	Smyth and Morris	2005	IJPM	68	PRI
2008	Carden and Egan	1968-2004	IJPM and PMJ	98	PRI
2009	Artto et al	1986-2007	23 business (but no PM0 journals	1,681	POST
2009	Kwak and Anbari	1950s-2007	18 business (but no PM0 journals	537	PRI
2009	Ika	1986-2004	Project success in IJPM and PMJ	30	PRI
2010	Williams	1998-2007	IJPM and PMJ	828	PRI
2011	Biedenbach and Müller	1994-2007	3 IRNOP conferences	116	PRI
2015	Pollack and Adler	1962-2012	Web of Science and Scopus	94,472	POST

Table 2 Previous research

Crawford et al (2006) summarised the work of 6 of the studies listed in table 2 (Themistocleous and Wearne (2000), Zobel and Wearne (2000), Urli and Urli (2000), Betts and Lansley (1995), Morris et al (2000) and Kloppenborg and Opfer (2002)) to produce a list of 43 project management topics:

Communication, competency, context/environment, contracts, cost, financial management, goals/strategies, HR projects, human factors, industrial relations, information management, information systems, innovation, integrative management, leadership, legal awareness, life cycles, management by projects, managers, monitor and control, operations research, optimising, organisational change, performance, PERT, planning, procurement and purchasing, program management, project close, project start-up, project organisation, quality, requirements management, risk, safety/health/environment, scheduling, stakeholder management, standards and certification, stress, success criteria, systems management, teamwork, time.

The summary indicated whether the original research had found the topic to be of interest in the research, of no interest and whether there was any increasing or

decreasing levels of interest. For some topics, the data was consistent. For example, all three of three studies showed an interest in risk. However, in some cases, the data was contradictory. Project start-up, for example was found to be of increasing interest in one study yet of no interest in two other studies.

The findings from the Crawford et al (2006) study produced a table of project management categories and topics which is reproduced in Table 3.

Category	**Topic**
Cost Management	Cost Management
Cross Unit Outcomes	Estimating; Integration Management; Project Context/Environment; Project Life Cycle/Phasing
Finalisation	Project Closeout/Finalisation; Testing, Commission, Handover and Acceptance
Interpersonal	Conflict Management; Leadership; Negotiation; Problem Solving; Teamwork;
Legal Issues	Legal Issues; Safety, Health and Environment
Marketing	Marketing
Product Functionality	Configuration Management; Design Management; Requirements Management; Technology Management; Value Management
Program Management	Program Management
Project Evaluation and Improvement	Organisational Learning; Performance Management; Project Evaluation and Review
Project Planning and Control	Change Control; Project Monitoring and Control; Project Planning
Project Start-up	Goals, Objectives and Strategies; Project Initiation/Start-up; Success (Criteria and Factors)
Quality Management	Quality Management
Relationship Management	Benefits Management; Document Management; Information and Communication Management; Reporting; Team Building and Development
Resource Management	Personnel/Human Resource Management; Procurement; Project Organisation; Resource Management
Risk Management	Risk Management
Scope Management	Scope Management
Strategic Alignment	Business Case; Financial Management; Project Appraisal; Strategic Alignment
Time Management	Time Management

Table 3 Categories and topics (Crawford et al 2006)

In the decade since Crawford et al (2006) produced the hierarchy shown in Table 3, the subject of project management has progressed and additional studies have been undertaken. Building on the category-topic model created by Crawford et al (2006), the table can be augmented with additional findings from later studies to generate a set of project management word and phrases that can be tested against a current dataset of literature. Table 4 shows the source of this additional material and the topics that have been identified as not present in Table 3. In addition to the more recent research, the findings from Urli and Urli (2000) and Zobel and Wearne (2000) have been revisited to review their findings.

Year	Authors	Eligible topics
2000	Urli and Urli	Discounted cash flow; scheduling; skills; roles; net present value; resource allocation; critical path; PERT; cost estimates; cost control; group dynamics; training; performance; organisational change; outsourcing
2000	Zobel and Wearne	Project organisation; project appraisal
2007	Smyth and Morris	Competence; decision making; risk allocation; culture; management competence; subcontractor management; cash flow forecasting; project cost overruns; value engineering; sustainability
2008	Carden and Egan	Critical chain; quality assurance; project software; benchmarking; float; activity networks
2009	Artto et al	TQM/total quality management; competitive advantage; productivity
2009	Kwak and Anbari	Portfolio management; value of project management; marketing and operations research; decision sciences; operation management; supply chain management; earned value management; project finance; project accounting; process improvement; project uncertainty; trust; project buffers; tendering; public sector; knowledge sharing; sense-making; principal-agent; customer satisfaction; organisational forms; managing expectations
2011	Biedenbach and Müller	PM school of thought: contingency; modelling; optimisation; success; governance; marketing; process; decision; behaviour
2015	Pollack and Adler	Software engineering, computer simulation; environmental impact; AHP

Table 4 List of additional topics

The last year has witnessed further developments both inside project management and its environment which have given rise to addition topics to be considered for inclusion

in this study. An example of how current trends are developing is the annual Pulse of the Profession report published by the PMI which in 2016 was completed by 2,902 project management professionals, senior executives and PMO directors. Practitioner publications such as those listed in Table 5 provide a perspective which can inform academic research and study.

Year	Authors	Eligible topics
2016	PMI (PMI 2016b)	PMO; Enterprise PMO; executive sponsors; active sponsors; benefits realisation; maturity; standardised project management practices; internal/proprietary methodologies; scrum; extreme project management; event chain methodology; PRINCE2; certification;
2016	Arras People	Age profile of project practitioners; gender in project management; accreditation; PM education; career development; social media

Table 5 Practitioner list of additional topics

Fifteen prior studies into trends in project management have been identified and these attest to the increasing academic interest in the subject. With the exception of the most recent study by Pollack and Adler (2015), many of the earlier studies were relatively small in size and tended to focus solely on the project management journals, specifically IJPM and PMJ. The Pollack and Adler study added much needed breadth to the narrow search window that characterised earlier studies. With the broader availability of information and the combination of academic and practitioner input, the potential for understanding trends in project management are themselves on an upward trend.

Method

The advent, growth and expansion of digital repositories has greatly eased the task of collating research information for studies such as this. The ability to search and extract data for subsequent analysis has never been easier with a variety of tools available to process and make sense of information.

The method designed for this study followed a five stage process:

1. **Identification**. In the identification phase, online repositories were chosen and then queried and searched for information.
2. **Extraction and creation of the study dataset**. The second stage involved extracting the information and the building of a composite dataset from the data sources.
3. **Data cleansing**. With all the records in one dataset, the third stage involved cleansing the data by removing duplicates and correcting corruptions in the data.

4. **Definition of categories and topics**. Based on previous research, this stage developed the topics to be searched and grouped these into categories.
5. **Search engine creation**. This stage involved the building of a capability in Microsoft Excel able to search the dataset created in the first three stages of this method against the categories and topics defined in the fourth stage.

The five stages are described in detail in the next section.

Identification

The data used for this paper were sourced from four online databases. The databases are listed in Table 6. These sources were chosen because of their size and credibility in the online research database sphere. For example, the IEEE library contains 4 million records (IEEE 2016) while Scopus and Web of Science contain around 60 million records each (Thomson Reuters 2014; Elsevier 2016).

Source	URL	Date extracted
Scopus	http://www.scopus.com	7 Feb 2016
IEEE Xplore	http://ieeexplore.ieee.org	7 Feb 2016
Web of Science	http://wok.mimas.ac.uk	7 Feb 2016
EBSCOhost	https://www.ebscohost.com	8 Feb 2016

Table 6 Data sources

As the extraction took place in early February, it is possible that some articles published in 2015 had not been added to the online databases. However, many publications publish before the date printed on their cover so it is expected that most of the December 2015 records are included.

Each database presents the user with its own search facility. The search terms used in each database is shown in Table 7. Using defined search terms gave the dataset high content validity (Saunders et al 2012).

Source	Search	Matching records
Scopus	Search for “project management” in article title, abstract and keywords, between 1965-2015	86,276
IEEE Xplore	Search for “project management” in basic search, between 1965-2015	15,180
Web of Science	Search for “project management” in topic	12,597
EBSCOhost	Search for "project management" in title, abstract or subject terms, between 1965-2015 in the English language.	44,600
		158,653

Table 7 Search criteria

Across the four databases, a total of 158,653 records were identified as matching the search criteria. Having found the records, the next stage was to extract them from the online repository and add them to the study's dataset.

Extraction and creation of the study dataset

The fields in the export from Scopus were used as the structure for the study dataset. The study dataset was created in Microsoft Excel 2011. The fields were: Year; Authors; Title; Source title; Volume; Issue; Article No; Page start, Page end; Page count; Cited by; DOI; Link; Abstract; Author Keywords; Index Keywords; Document Type; Source. Of the fields in the dataset, the four most important to this paper are listed in Table 8:

Field	Rationale
Year	This field was required to support chronological analysis.
Title	While titles do not always reflect the content of the publication as they can be used to generate interest and draw attention, often they do contain the keywords used in this research and were included in the study's search fields.
Abstract	The abstract, where present, allows the authors to provide a concise summary of the publication and is therefore a key field for this study.
Keywords	Adding keywords to articles is a way for authors to use established words and phrases that aid researchers when searching for information. Both the authors' own keywords and the index keywords (added by the publication) were included in the search.

Table 8 Key fields in the dataset

The combination of these four fields is considered to provide a sufficient basis for this research. The other fields were retained for further investigation as the source of future research.

The data from IEEE Xplore, Web of Science and EBSCOhost did not align with the dataset structure and therefore required modification. This required data manipulation and this was carried out in Microsoft Excel. For example, the Scopus terms used to describe document types were different to the IEEE terms. The IEEE terms were remapped to give consistence, for example, 'IET Conference publication' and 'IEEE Conference publications' was both mapped to the Scopus 'Conference Paper'. While the mapping of conference papers created no uncertainty about the validity of the changes, this was not the case with articles. The IEEE uses categories such as 'Journal and Magazines' and these were mapped to the Scopus 'Article' but it is possible that the two categories are not viewed in the same way by both organisations because of the inclusion of 'magazines' in the IEEE category. Collating data from multiple sources is fraught with such difficulties but these only become manifest

when comparing records by publication type and care therefore needs to be exercised when this information is presented.

A major issue that arose when combining the data sources was that of duplication, that is, where the same record was collated from more than one source. To lessen the occurrence of duplicates in the data set, the Microsoft Excel remove duplicates function was used in a two stage process. After each individual set of records was added, the function was executed to check for records where all the fields matched. Such records were removed. Second, a more granular search for duplicates was undertaken, a duplicate being presumed where the year of publication, title, volume and issue were matched.

With a large dataset such as this, data quality was a key concern. The processes used to convey the data from the source database to Microsoft Excel required extraction to a CSV file followed by an import. Sometimes many CSV files were required. For example, the limit of 2,000 records (containing the fields required by this study) in an export from Scopus meant that 58 separate CSV files were first exported from Scopus and then imported to Microsoft Excel. 26 intermediary files were required for Web of Science, 11 intermediary files for IEEE Xplore and 3 for EBSCOhost. There was no common file format for the EBSCOhost extract and Microsoft Excel imports and the JabRef software package was used as an intermediary, adding another layer of importing and exporting to the data extraction and collation stage.

Once the dataset had been created and initial screening for duplicates had been completed, the third stage, data cleansing commenced.

Data cleansing

The process of cleaning or cleansing the data prior to analysis is key if valid and reliable results are to be generated (Saunders et al 2012). With a large set of records from multiple sources, this stage of the process was time-consuming. Table 9 summarises the key areas in data cleansing.

Area	Rationale
Data corruption	After importing the information to Microsoft Excel, it was found that some of the data was corrupt, for example text that was imported as special characters rather than text. If the corruption affected the legibility of the record, particularly in terms of the key information needed for this study (date, title, abstract and keywords), the record was removed from the dataset. If however the corruption related to a few characters in a field or to a field that was not used in the analysis (eg page count), the characters were either deleted or ignored.
Field matching	For matching fields in Excel, it was necessary to capitalise the information in order that a like-for-like comparison could be

	made but even then differences in, for example, the titles of articles meant that this process did not expunge all duplicate records.
Spelling	Examples are nouns ending –isation and those ending –ization. For the purposes of the study, -isation, was used throughout and 4,609 changes were made to the dataset. Spelling mistakes were also in evidence, for example "An Exploratory Re-Examination" (Scopus) and "An Expoloratory Re-Examination" (EBSCOhost).
Name consistency	It was not possible to match on authors' name due to the inconsistency with which they are listed in the online databases. For example, Web of Science sometimes lists forenames whereas other sources use only initials.
Missing data	It was notable that some records in the dataset did not contain any authors' names. In addition, the PMJ data in Scopus is only partially present for volumes 44 and 46 and required manual addition to allow for duplicate detection.

Table 9 Data cleansing aspects

Where possible, the process of data cleansing was automated using tools and commands in Microsoft Excel. Despite the actions taken to clean the data, it is expected that some errors are still present but that these appear with less frequency in those fields used in the study (year, title, keywords and abstract) and will therefore have less of an affect on the results. Whilst great care has been taken to base the analysis and findings on the best quality data possible, the caveat remains that the base data is not wholly accurate. It is believed to be of adequate quality for the needs of this study and the fact that the findings do accord with similar recent research (Pollack and Adler 2015) suggests the dataset does possess external validity.

Definition of categories and topics

The section on previous research on the trends in project management identified topics that had been elicited from 15 academic studies and augmented these with other topics gleaned from recent practitioner literature. The task in this stage of the method is to devise a logical, authentic and defensible set of categories and topics that can be used for analysis in this study. As there is no objective way to create this table, the authors have based it as far as possible on past structures and added and moved topics that, in their opinions, provides a valid hierarchy for analysis. The authors recognise that any definition of categories and topics is affected by their prior experience and education and also that such hierarchies are malleable and affected by time and the contextual environment. By making the hierarchy explicit, other researchers will be able to understand the basis for this study and analyse the information in different ways using the study dataset.

Table 10 lists the categories and topics that were created for this study.

Nr	Category	Topics
1	Strategic alignment	Strategy; business case; program/programme management; portfolio management; benefits; alignment; organisational change; financial appraisal; prioritisation
2	Project success	Project success; project management success; success factors; success criteria
3	Stakeholder management	Stakeholder; customer satisfaction
4	Project evaluation	Organisational learning; performance management; project review; project appraisal
5	Planning	Planning; estimating; scope management; schedule; scheduling; PERT; critical path; critical chain; activity network
6	Iron triangle	Time management; Cost management; Quality; TQM; total quality management; Earned value; EVM
7	Project start-up	Initiation; startup; start up
8	Project execution and control	Reporting; change control; life cycle; lifecycle; monitoring; control
9	Project close	Project close; testing; commission; handover; acceptance
10	Risk management	Risk
11	Procurement	Procurement; purchasing; contract management
12	Soft skills	Soft skills; conflict management; leadership; negotiation; problem solving; teamwork; decision making; trust
13	Environment	Legal; health; safety; environment; environmental impact; sustainability; culture; public sector; private sector
14	Project organisation	Project organisation; roles; responsibilities; communication; PMO; sponsor; executive; maturity
15	Project management method	Project management method; PRINCE2; PMBOK; APMBOK; Body of knowledge; BOK; agile; scrum; governance
16	Personal development	Training; accreditation; qualification; experience; certification; competence

Table 10 A priori categories and topics

Given that no category was connected to more than 10 topics, a constraint was introduced that 10 would be the maximum number of topics that could be linked to a category. The implementation of this constraint is described in the next section.

Having defined the extent of the searches needed to identify the trends in project management, the final stage of the method involved building a search engine in Microsoft Excel that would support the a priori data categories.

Search engine

To allow the investigation of categories and topics in the study, a search capability was built into the dataset. This enabled the searching of the dataset by category and topic within the title, keywords and abstract fields. No weighting was allowed for multiple occurrences of search topic in the title, abstract or keywords as this would have skewed the results by suggesting there were more references to the search item than was the case.

As a test of the search engine's capability a category was created that contained two search terms; 'project management' and 'project-management'. When the search was executed, the number of successful matches numbered 116,202 which confirmed that either of these two terms existed in one of the three search fields for every record in the dataset. The fact that every record was matched provided confidence in the construct validity of the study (Saunders et al 2012). To test whether the trend in the search category followed an upward or downward trajectory, a linear trend line was calculated by dividing the number of publications for the category into the total number of articles published that year. The method used Microsoft Excel's linear trend line fitting functions with the date providing the X axis values and the percentage for the Y axis.

Once the search engine had been successfully tested, it was ready for use with the study dataset. The category/topic sheet was built using the data shown in Table 9.

Findings

This section of the paper begins by describing some of the characteristics of the dataset in terms of the online databases sources that contributed records to it. The overall trend in project management research is discussed and there is an explanation of the publications identified in the research and the breakdown of the types of publication. This section contextualises the dataset in preparation for the analysis of the category/topic areas which follow.

Characteristics of the dataset

This section provides information on the study dataset of 116,202 records and provides data about the presence of information in the four key fields used in the analysis.

Table 11 showed how 158,653 records met the search criteria and the Method section has explained the processes followed to generate the study dataset of 116,202 records. The source of the records, from the four online databases used, is shown in Table 10.

Data source	Unique records contributed	Percentage of total
Scopus	82,581	71.1%
EBSCOHost	21,326	18.4%
IEEE Xplore	7,646	6.6%
Web of Science	4,649	4.0%
	116,202	**100%**

Table 11 Records by source

The analysis that follows is based on the four key fields (year, title, abstract and keywords). The presence of data in these fields affects the validity of the research and, as Table 12 shows, every record included a year of publication, all except 16 of the 116,202 records contained a title and the number that included an abstract and keywords was 98% and 93% respectively.

Field	Presence in the dataset	Percentage
Year	This field was present in every record	100.00%
Title	Only 16 records did not have a title	99.99%
Abstract	1,924 records contained no abstract. The average abstract length was 882 characters. The longest abstract contained 9,997 characters	98.34%
Keywords	7,814 records contained no keywords (using the combined UberKey field). 1,410,939 keywords	93.28%

Table 12 Key field presence

Table 12 suggests that a dataset suitable for analysis had been created because of very low rates of missing data in the four key fields. Figure 1 displays the number of records in the dataset ordered by year.

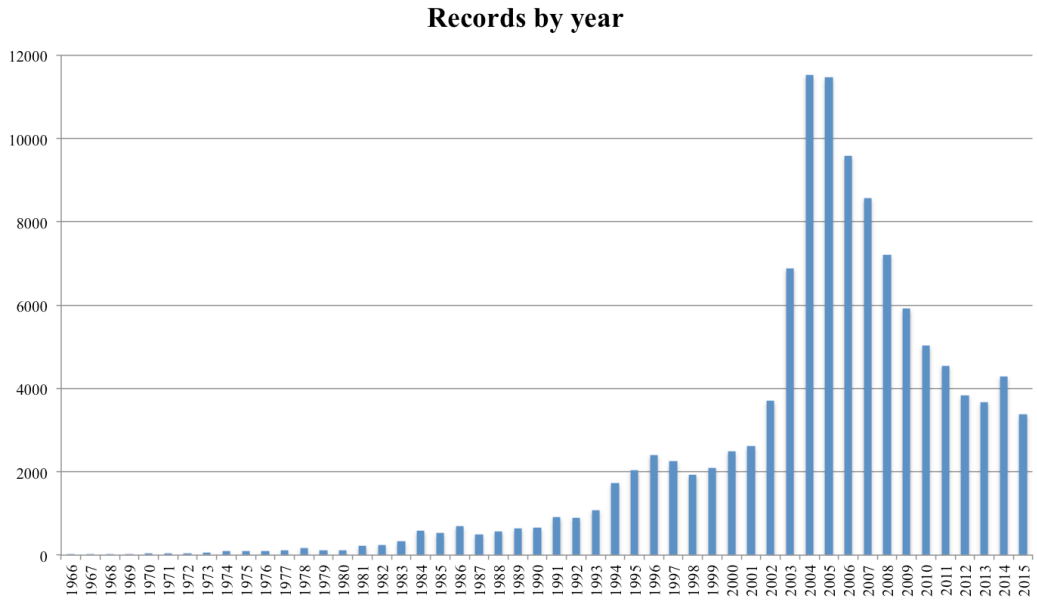

Figure 1 Records by year

The breakdown of records (shown as Recs in the table) by year is shown in Table 13.

Year	Recs	Year	Recs	Year	Recs	Year	Recs	Year	Recs
1966	26	1976	103	1986	690	1996	2409	2006	9582
1967	25	1977	110	1987	499	1997	2261	2007	8566
1968	24	1978	172	1988	571	1998	1931	2008	7217
1969	34	1979	121	1989	645	1999	2095	2009	5917
1970	51	1980	122	1990	661	2000	2500	2010	5028
1971	41	1981	221	1991	906	2001	2611	2011	4548
1972	50	1982	252	1992	904	2002	3701	2012	3844
1973	60	1983	328	1993	1082	2003	6883	2013	3678
1974	100	1984	579	1994	1725	2004	11530	2014	4288
1975	98	1985	533	1995	2039	2005	11465	2015	3376

Table 13 Records by year

Figure 1 demonstrates that for the first two decades in the period of study there were few publications that used the term 'project management' in their description. Between 1966 and 1985 only 3,050 records were identified. Table 14 shows the breakdown of records by decade.

Decade	Record count	Percent
1966 – 1975	509	0.4%
1976 – 1985	2,541	2.2%
1896 – 1995	9,722	8.4%
1996 – 2005	47,386	40.8%
2006 – 2015	56,044	48.2%
Total	**116,202**	**100%**

Table 14 Records by decade

It would appear from Table 14 that there is a continuous upward trend in project management research but as Figure 1 shows the publications on project management rose steeply after 2002 to reach a peak in 2004 and have since been on a steady decline. The data generate the trend graph but cannot explain it. 2004-2006 were years of great activity in project management literature, this three year period accounting for 28% of all publications.

The dataset included 17,745 different publication sources. Table 15 shows the fifteen sources that provided the most records. The first and fourth entries in the table refer to the same conference; ASEE Annual Conference Proceedings was the term used until 2004 and the title ASEE Annual Conference and Exposition, Conference Proceedings has been used since that date.

ASEE Annual Conference Proceedings	2115
International Journal of Project Management	1800
PM Network	1746
ASEE Annual Conference and Exposition, Conference Proceedings	1318
Lecture Notes in Computer Science	977
Proceedings of SPIE (International Society for Optical Engineering)	941
Journal of Construction Engineering and Management	736
MEED: Middle East Economic Digest	686
AACE International Transactions	674
Project Management Journal	660
Journal of Management in Engineering	606
Jane's Defence Weekly	597
Transportation Research Record	568
Journal of Construction Engineering & Management	489
Advanced Materials Research	436

Table 15 Top 15 publication sources

It is frequently stated of project management that it originated in construction and engineering (Morris et al 2011). The journals listed in Table 15 would certainly support this with a third of the publications directly related to these areas. This study, in line with other research eg Kwak and Anbari (2009), shows that project management has a far wider application as exemplified by the inclusion of publications from information and computing technology and defence in the list of the top 15 sources.

Table 15 lists the highest ranked sources of records but in the dataset are many more publication sources. There are 138 publications that have in excess of 100 records in the dataset. There is however a long tail of publications with few applicable records. There are 8,727 publications with a single record and 2,993 publications with two records in the dataset. The ability to access such a wide range of publications enables current researchers to heed the call of earlier scholars (for example Söderlund 2004) to pay more attention to non-project management journals when seeking to better understand the field.

The top 15 publications account for 14,349 (12.3%) of the total dataset. Three publications focussing on project management are listed in the top 15; The IJPM, PM Network and the PMJ. The metadata for these publications is shown in Table 16.

Publication	Earliest in dataset	Latest in dataset	Period in print
IJPM	1983 Vol 1, issue 1	2015 Vol 33, issue 8	1983 - present
PM Network	2003 Vol 17, issue 7	2015 Vol 29, issue 12	1986 - present
PMJ	1997 Vol 28, issue 2	2015 Vol 46, Issue 6	1970 - present

Table 16 Project management publication metadata

Table 16 demonstrates a flaw in the dataset because not all the publications from the three leading PM journals are contained within it. The largest gap is with the PMJ. A request was sent to the Project Management Institute however it proved impossible to obtain. The PMI website offers member searchable access to journals from 2005 and access to journals from 1984 (PMI 2016a). To what extent the missing data affects the results can be estimated. Of the 660 PMJ records in the dataset, the publications are not distributed evenly across the years. The dataset shows 17 records added in 1997, 20 in 1998 but 50 in each of the years 2013 and 2014. The number of records produced in the 28 years between 1970 and 1997 is likely to have a maximum of 28 years x 17 records = 476 records which represents 0.4% of the dataset, a number which is not expected to affect the overall trends.

Beyond the three project management publications that we have discussed, it is notable from the data the increasing number of journals that are focused on project management. One example is the International Journal of Managing Projects in Business (IJMPB) which contributed 124 records to the dataset with publications ranging from 2011, Volume 4, issue 3 to 2015, Volume 8, issue 4. Another example is the International Journal of Project Organisation and Management (IJPOM) which contributed 58 records from its inception in 2008. 61 records came from Project Management – Practice and Perspectives between 2014-2015. Finally, the Journal of Modern Project Management (JoMPM) added 41 records to the dataset from its commencement in 2013.

Figure 2 shows the number of unique publications that contained articles on project management. In 1966, the 26 PM articles were spread across 21 different publications, a ratio of 1.2 articles per publication which reflects the diversity in the field at that time. In 2015, the 3376 articles appeared in 1367 publications, a ratio of 2.5 articles per publication which represents the growing concentration of PM in the literature as well as its expansion across more fields.

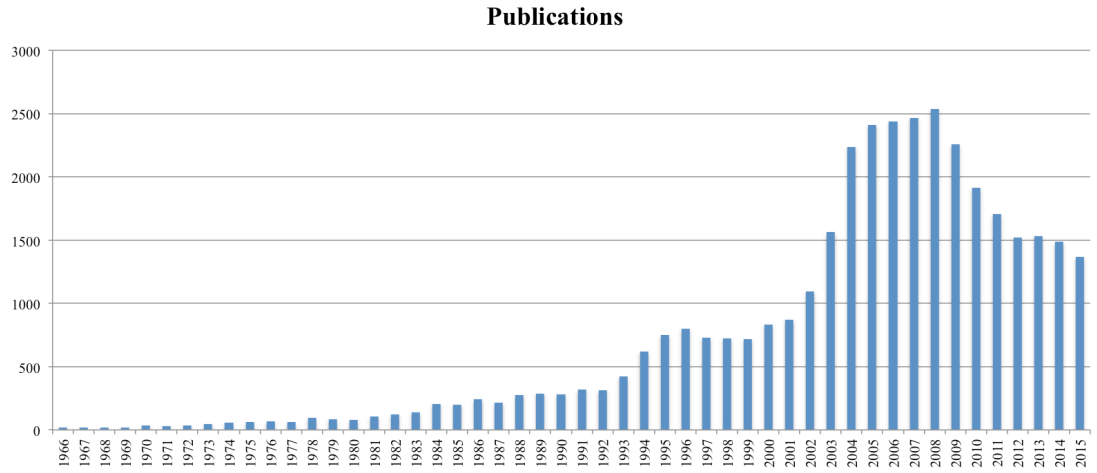

Figure 2 Publications containing PM articles

Having reviewed the publications in the dataset, we next move to assess the types of document that have been identified.

Types of document

The dataset is comprised of 21 different document types. These are listed in Table 17, sorted in descending order of the number of publications for each type.

Type	Records	Type	Records
Conference Paper	45,233	Article in Press	116
Article	31,622	Editorial	100
Unknown	22,182	Report	64
Review	8,701	Chapter	50
Short Survey	2,167	IEEE Standards	22
Book	2,063	Letter	14
Note	1,442	Erratum	6
Conference Review	720	Abstract Report	4
Series	699	eBooks	4
Book Chapter	502	IEEE Courses	1
Business Article	490	**Total**	**116,202**

Table 17 Document type

Table 17 shows the dominance of articles and conference papers in the literature on project management. Conference papers account for 45,233 (38.9%) and articles 31,622 (27.2%) and together this equates to 76,855 records (66.1%). The inclusion of a wide range of types may be argued by some to distort the view of the trends in project management but a counter argument would be that trends are not solely defined by conference papers and journal articles and are best reflected in the wide body of literature that appears in Table 17. Of some concern in Table 17 are the 22,182 documents where the type is not known and which are listed as 'Unknown'. In undertaking the data cleansing process, the inclusion of these records was debated and a decision taken to include them, for the same reason as document types other

than journal articles and conference papers were included. The sphere of project management is comprised of many people who have different interests in the subject both academic and practitioner. It seems to make intuitive sense that if the goal is to see the general trends in project management then the broadest range of literature should be consulted.

Analysis

In this section of the paper, we analyse the results. The results are collated in Table 18. The table contains the category number, name and then 10 columns (T1 to T10) representing the number of matches for the topics in that category (see Table 10) across all the years of the study, in the title, abstract and keyword fields.

Nr	Category	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
1	Strategic alignment	6683	342	0	1035	6778	1185	157	6	124	6683
2	Project success	2609	136	1750	222						
3	Stakeholder management	4751	2086								
4	Project evaluation	149	401	222	138						
5	Planning	31013	2144	78	8224	8552	13906	1534	647	164	
6	Iron triangle	523	685	21559	311	968	963	293			
7	Project start-up	507	497	140							
8	Project execution and control	1290	113	4008	1360	6606	31926				
9	Project close	44	6661	3542	119	1340					
10	Risk management	21263									
11	Procurement	3792	767	332							
12	Soft skills	273	249	3568	1128	4193	1706	8108	1691		
13	Environment	1607	6438	7658	28073	3087	2361	3859	1105	935	
14	Project organisation	192	1941	1275	15624	499	1728	2977	1844		
15	Project management method	939	147	428	1	669	528	2841	539	1587	
16	Personal development	8562	586	1013	13797	1298	1504				

Table 18 Category analysis

The number of occurrences for each category is not the sum of the topics from which it is comprised. For example, 'risk' appears 21,263 times in the title, abstract or keywords in the records. Often 'risk' appear in more than one of these three areas. Where this happens, the record is marked as including the search term but no allowance is made for the number of occurrences within one record. Table 19 shows the number of matches for all the categories. In the case of the risk category, the 21,263 search hits were linked to 11,910 records.

Figure 3 shows the prevalence of categories.

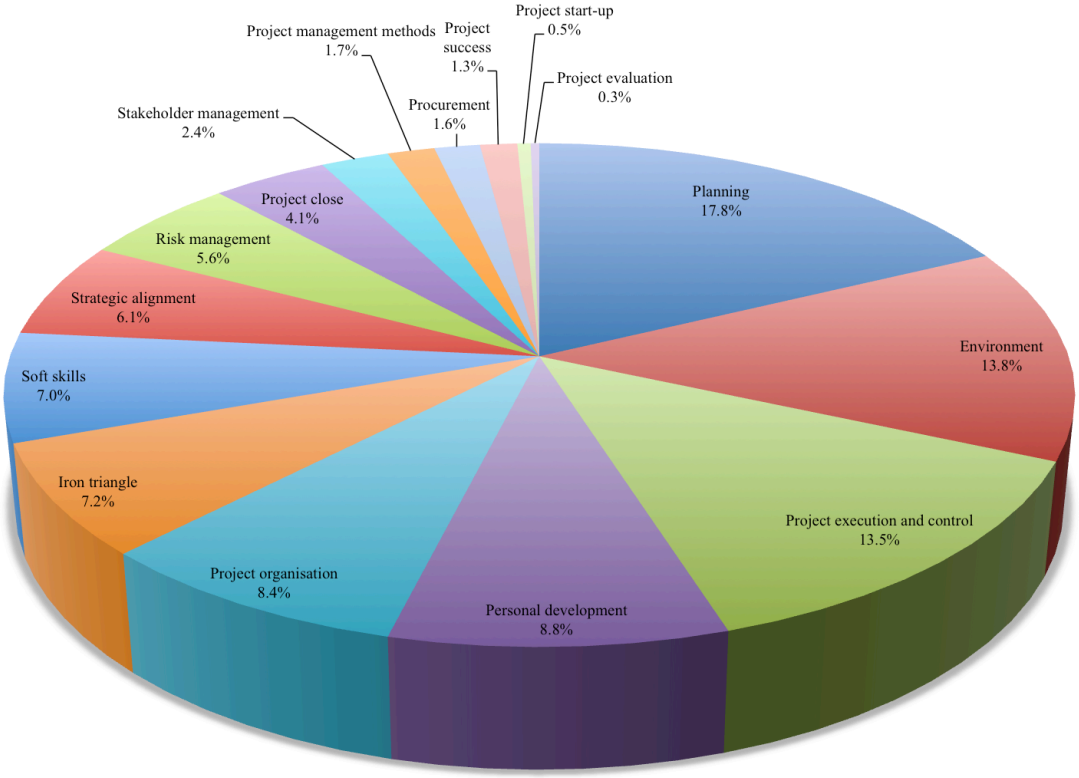

Figure 3 Category prevalence

To generate Figure 3, all the records in the dataset were used. Thus the pie chart shows the prevalence of the categories over the 50 years of this study.

In the next section, we look at each category and its trend over time. The data for all 16 categories follows a consistent format. The Y axis is the percentage of articles in the year for the category and the X axis contains the year. The 16 graphs are presented and then discussed.

Planning

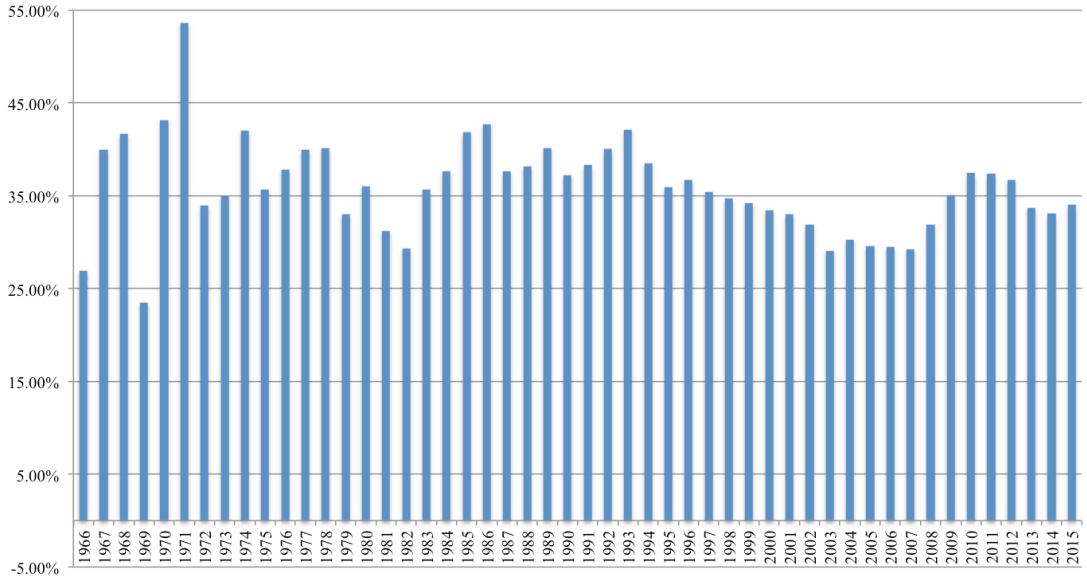

Figure 4 Planning category chart

Project environment

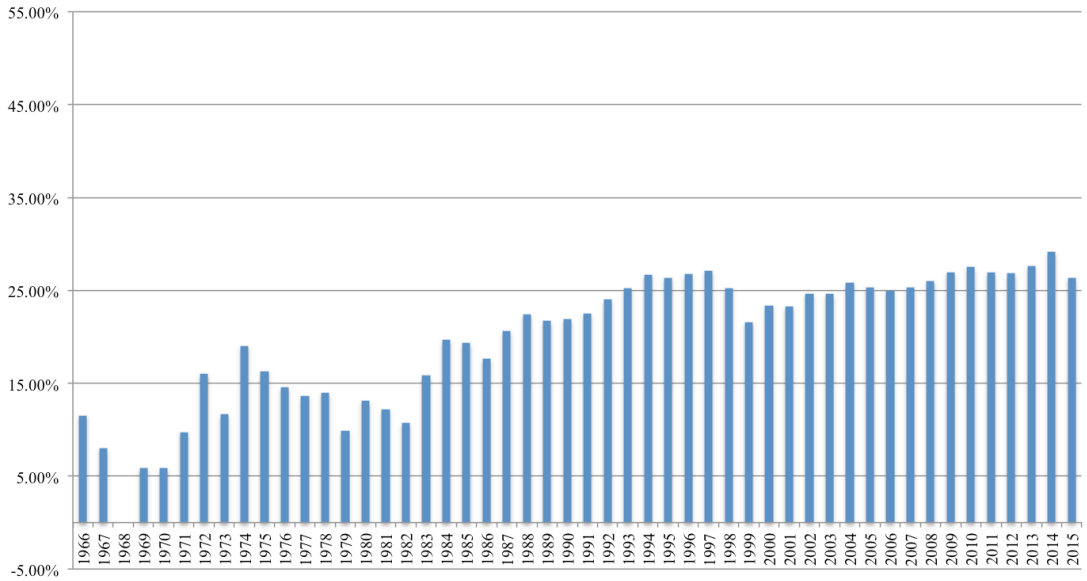

Figure 5 Project environment chart

Project execution and control

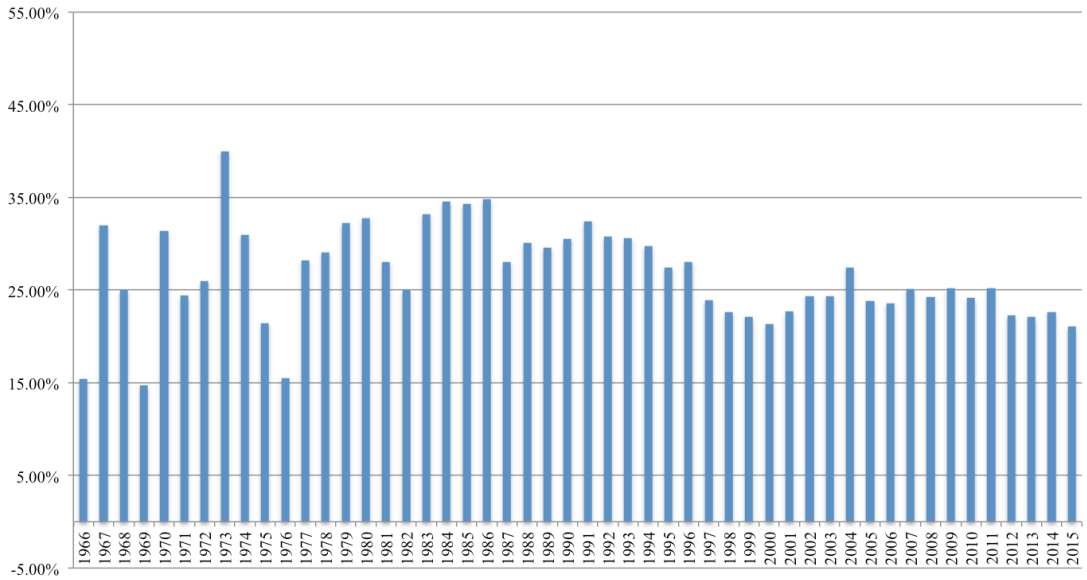

Figure 6 Project execution and control chart

Personal development

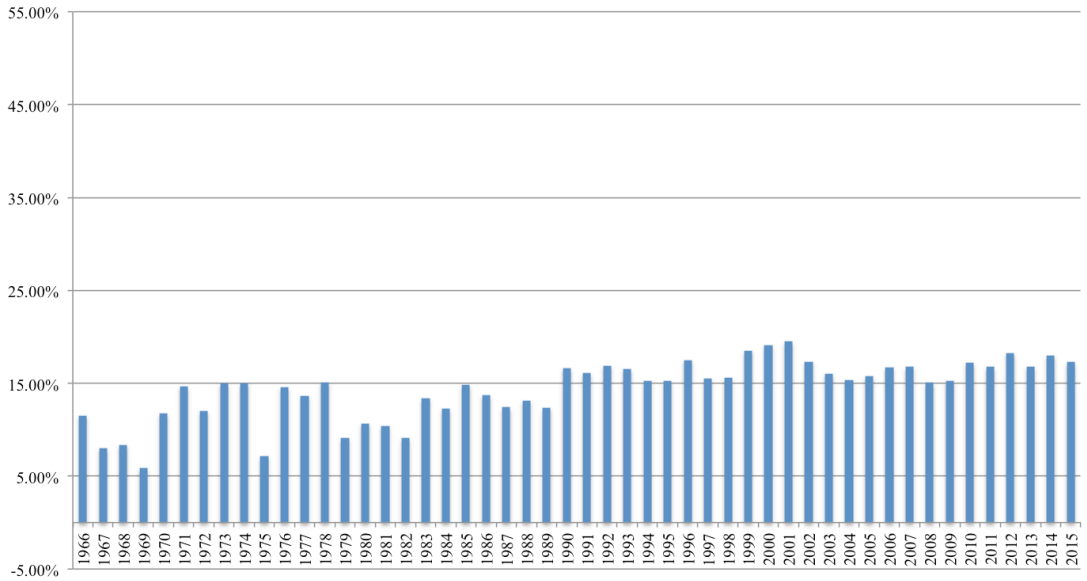

Figure 7 Personal development chart

Project organisation

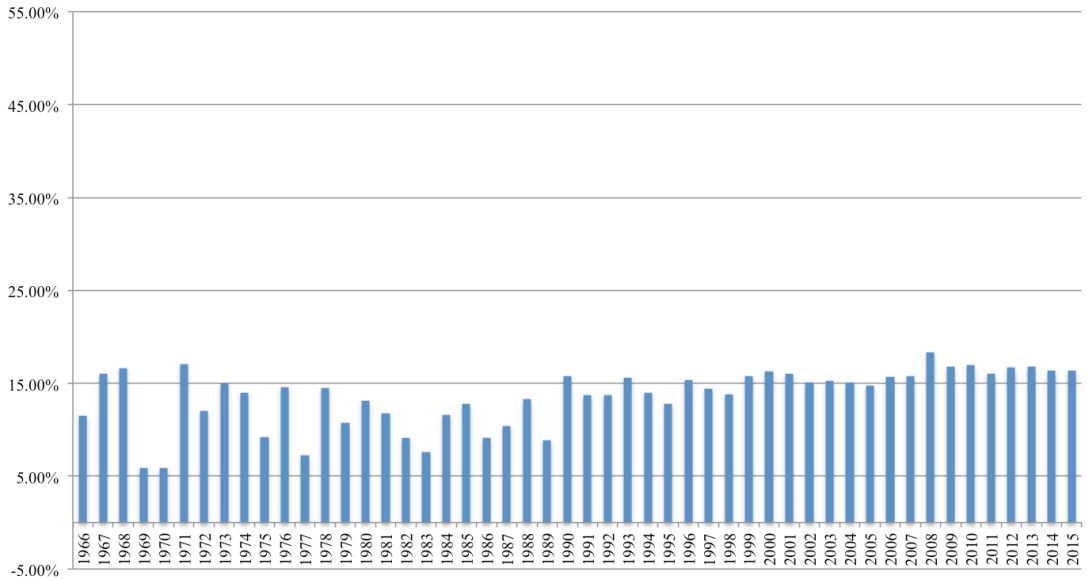

Figure 8 Project organisation chart

Iron triangle

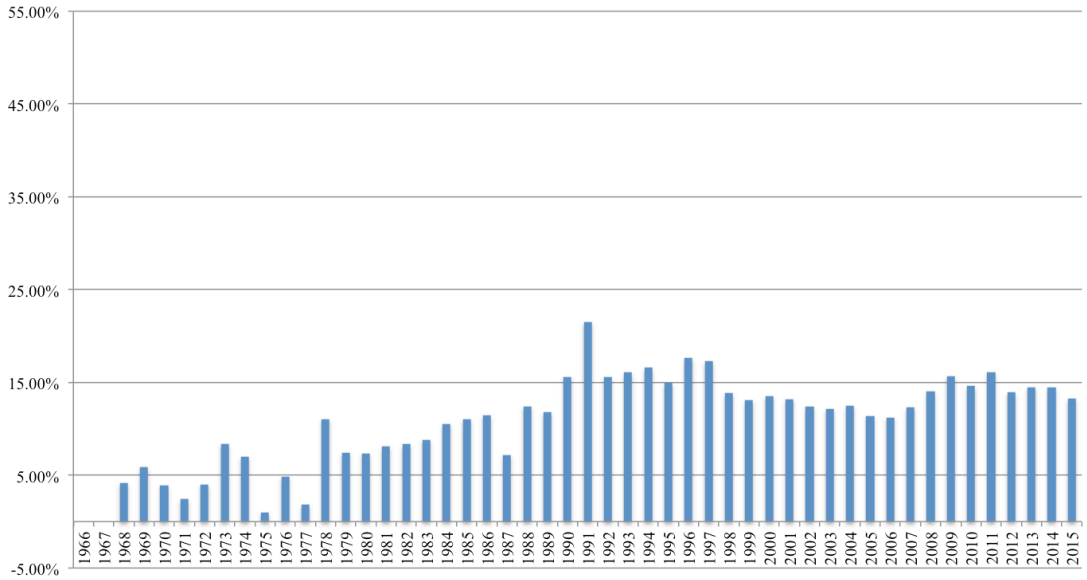

Figure 9 Iron triangle chart

Soft skills

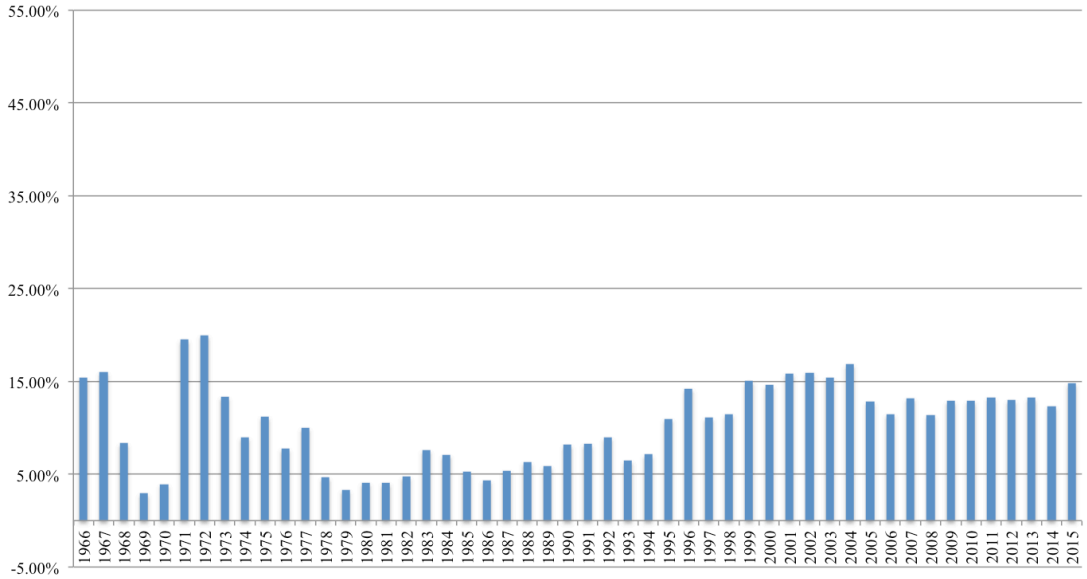

Figure 10 Soft skills chart

Strategic alignment

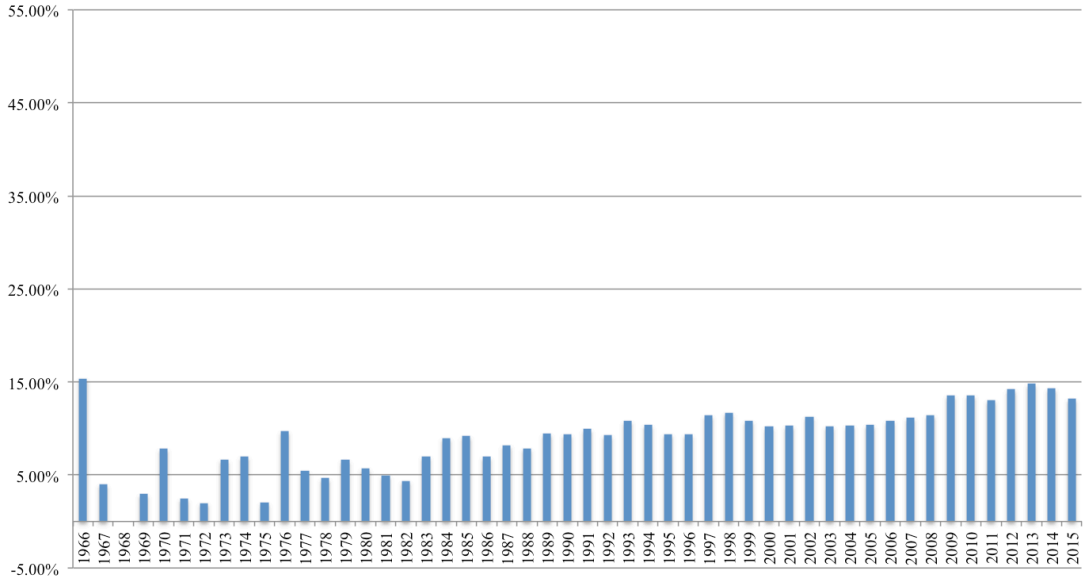

Figure 11 Strategic alignment chart

Risk management

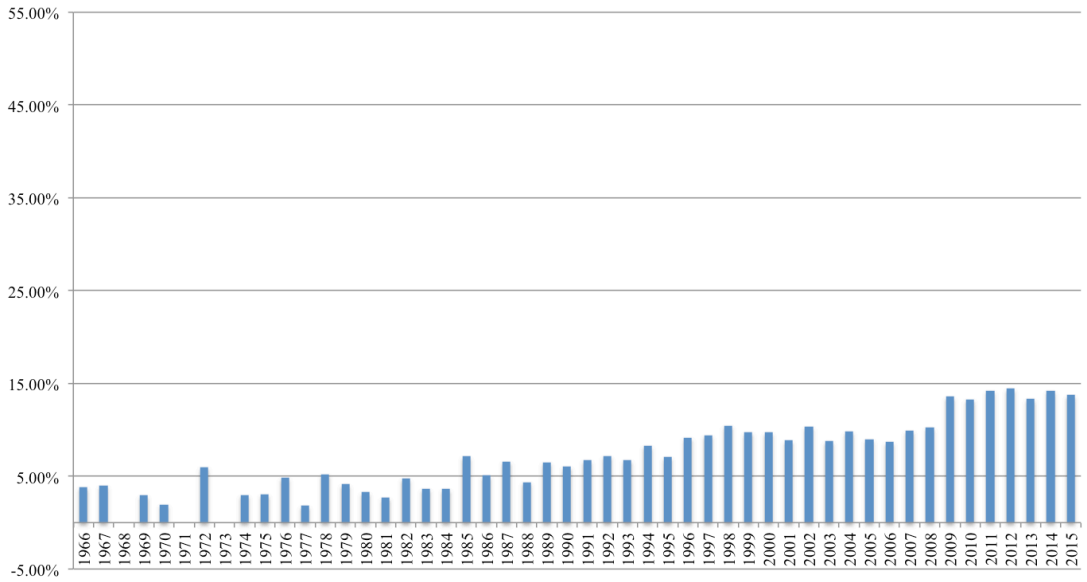

Figure 12 Risk management chart

Project close

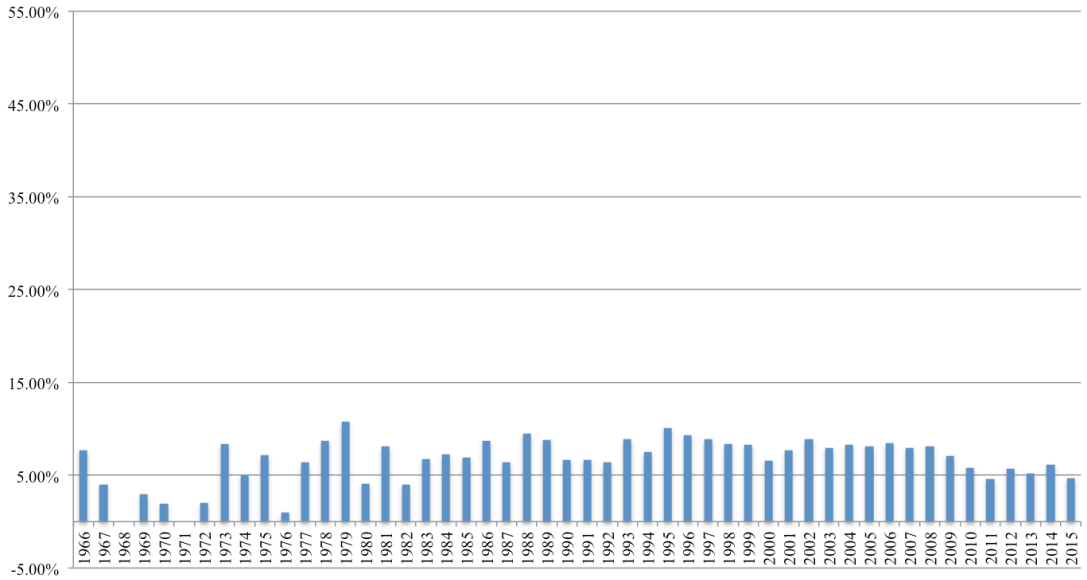

Figure 13 Project close chart

Stakeholder management

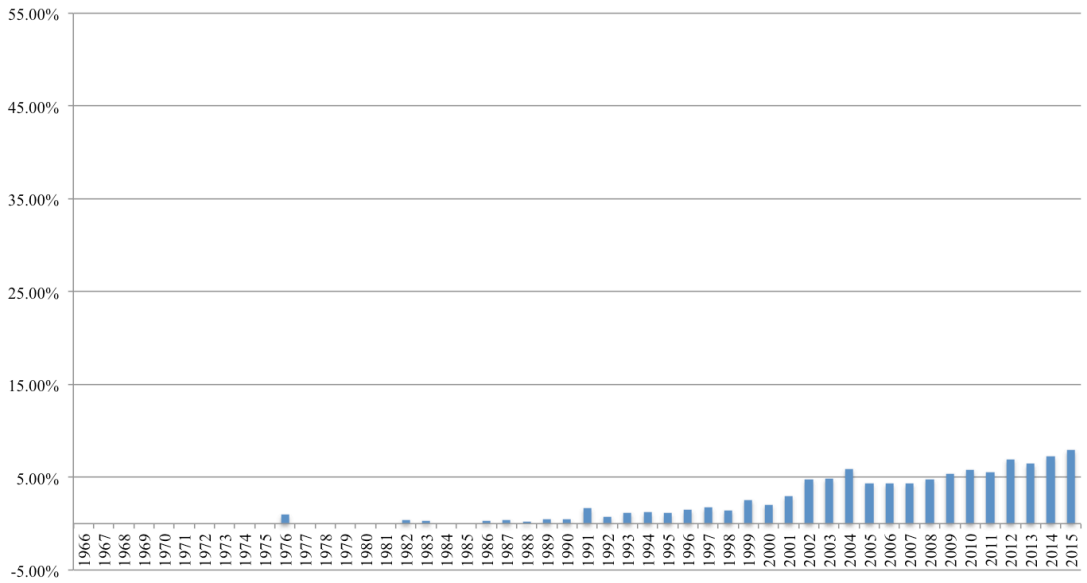

Figure 14 Stakeholder management chart

Project management methods

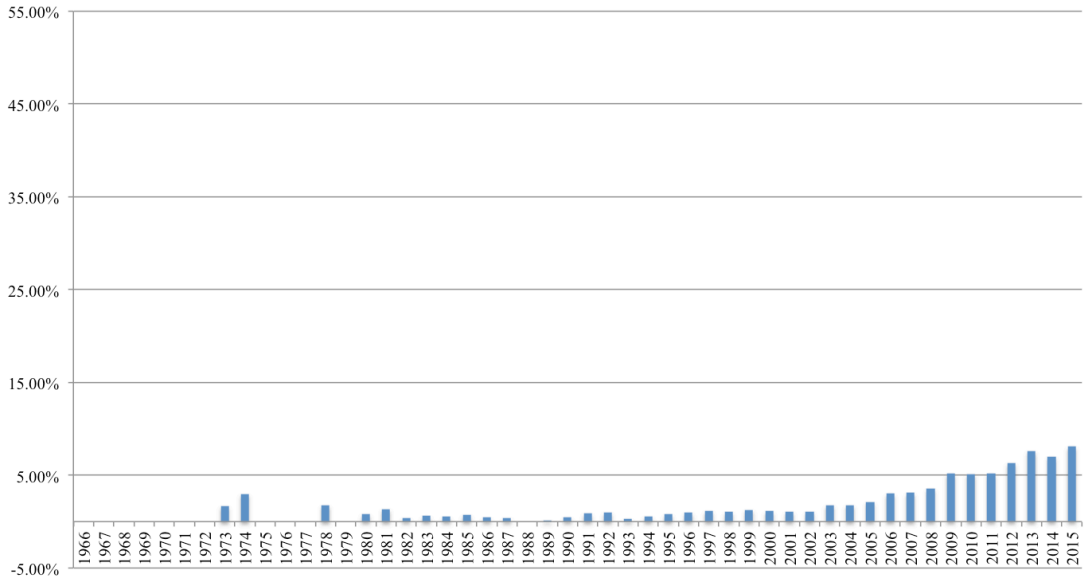

Figure 15 Project management methods chart

Procurement

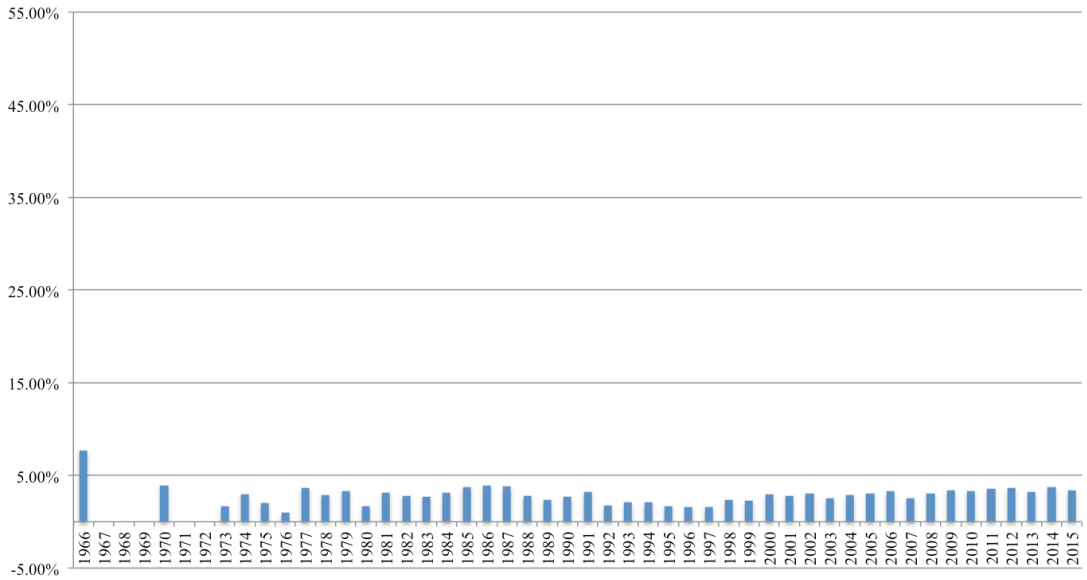

Figure 16 Procurement chart

Project success

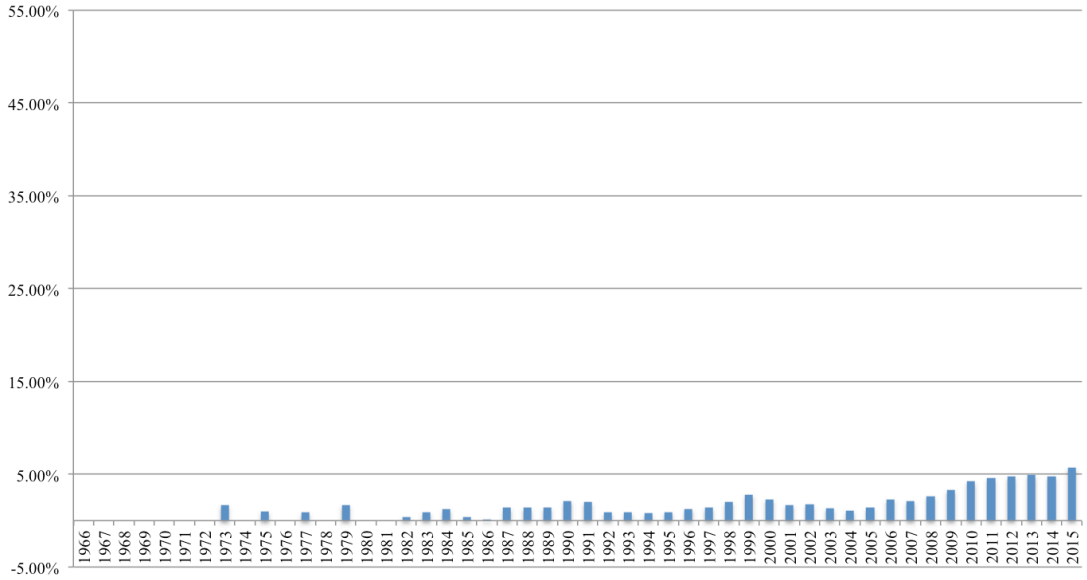

Figure 17 Project success chart

Project start-up

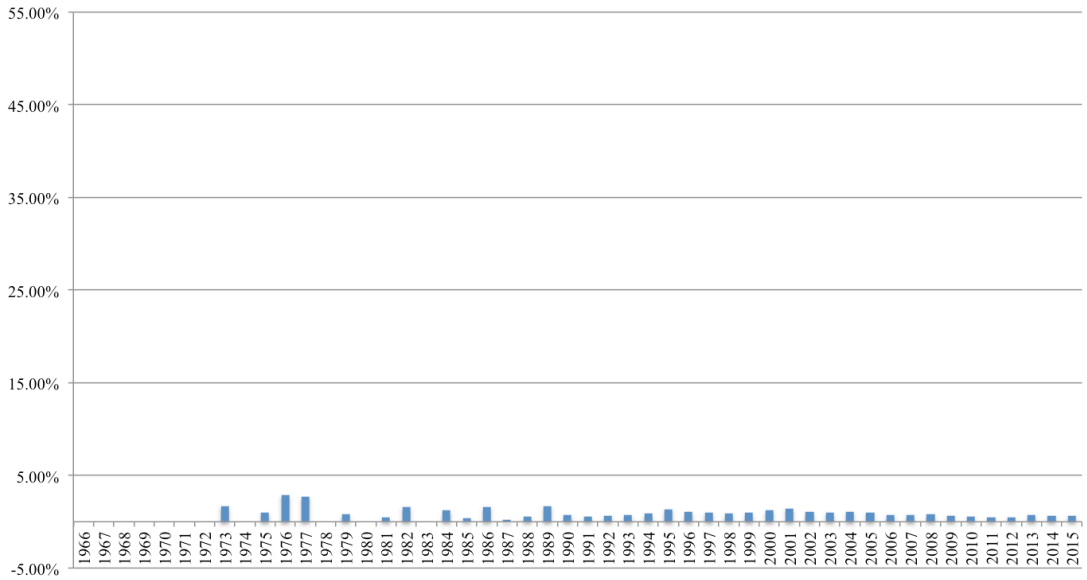

Figure 18 Project start-up chart

Project evaluation

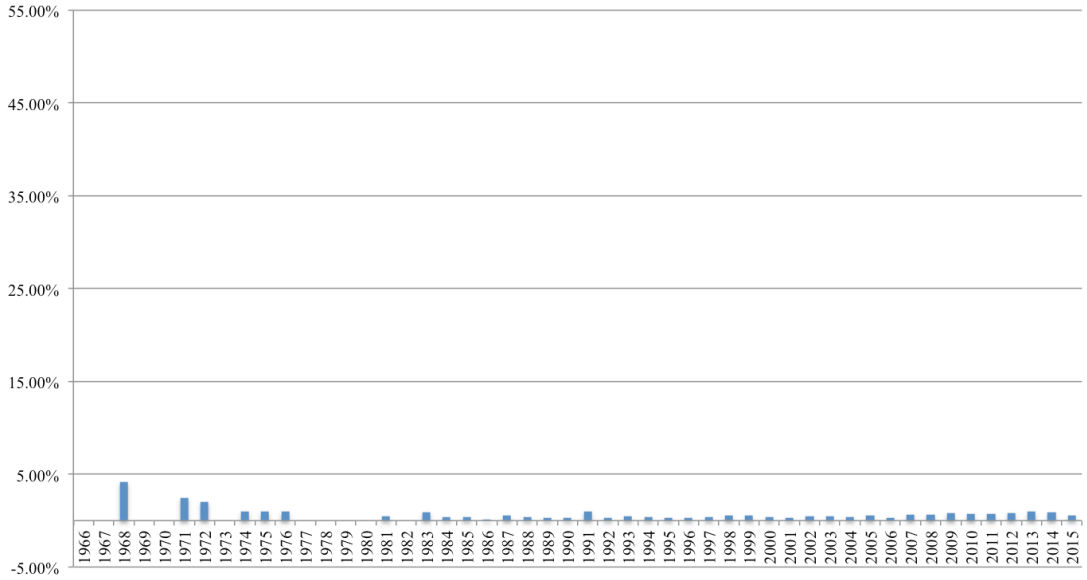

Figure 19 Project evaluation chart

Trend trajectories

As an indication of the direction of the trajectories traced out by the project management categories in this study, the gradient of the best fit linear forecast trend line was calculated for each category using the data from Table 18. The year was used as the X axis and the percentage of publications for that category in the year was used to calculate the Y axis.

Those categories with a positive gradient were deemed to be increasing as an area of concern and interest in the literature and those categories with a negative gradient were taken to be of less interest. In trend terms, the categories with positive gradients are expected to appear more frequently in the literature in the future and the negative gradient categories are expected to decline.

Repeating the calculation of the trend line for each of the 16 categories produces Table 19. The table lists the category number and name, the sum of search matches for the category and slope value. As the slope value are very small eg 0.0009, they have been multiplied by 1,000 to aid comparison. The table is sorted by slope in descending order.

Nr	Category	Matches	Slope
13	Project environment	29,508	4.4
6	Iron triangle	15,491	2.7
10	Risk management	11,910	2.5
1	Strategic alignment	13,147	1.9
16	Personal development	18,965	1.6
3	Stakeholder management	5,138	1.5
14	Project organisation	18,039	1.2
15	Project management method	3,543	1.1
12	Soft skills	15,022	1.1
2	Project success	2,800	0.9
9	Project close	8,698	0.6
11	Procurement	3,431	0.3
7	Project start-up	999	0.07
4	Project evaluation	644	-0.05
8	Project execution and control	28,934	-0.9
5	Planning	38,243	-1.1

Table 19 Trend trajectories

In can be seen in Table 19 that 13 of the 16 categories have a positive gradient and are therefore growing as a percentage of the overall PM literature.

Discussion

Planning has been the category most represented in the literature and this makes sense given the importance and long association with project management. In 1971, 54% of all articles published were tagged as planning. Since then, the ratio of the planning category to all PM literature has reduced but it continues to account for about a third of all literature. While planning continues to be a core element of project management, the growth of other aspects of the field is reducing the representation of planning across all articles. This explains how planning is both the category with the highest percentage of articles and also the category that is most declining in the literature.

The **environment** category is the second most common and also the category that is showing the highest level of growth (see Table 19). This is perhaps not surprising given the broad range of topics included in this category (including legal, health, safety, environment, sustainability and culture), topics that are common to all projects and therefore likely to appear frequently in the dataset. The Environment topic, perhaps the broadest of all, contributed 28,073 of the 55,123 topics (51%) in this category. This category has consistency contributed around 25% of the literature for the last 20 years (see Figure 5).

Project execution and control saw its peak in popularity in the 1970s and 1980s and since then has declined as a percentage of all publications. This category is predicted to decline further in the future. Many of the elements within this category (reporting, change control, life cycle, lifecycle, monitoring and control) are commonly found in the project management methods such as PRINCE2 and the bodies of Knowledge. One explanation for the decline in this category is that the interest in these topics is being captured within the project management methods category in line with the growth in certification in the 1990s which gave project managers a new vocabulary to refer to the issues in the area of executing and controlling projects.

In 2012, the millionth person passed a PRINCE2 certification examination ((APM Group 2012), a testament to the growing importance of qualifications to the field. This interest was supported by the development of competence models for project management for example from the IPMA (2013) and APM (2015). This would explain the positive trajectory of the **personal development** category in the literature and support the prediction that it will continue to grow in the future (Table 19).

For the last 20 years, the **project organisation** category has consistently contributed around 15% to the literature (see Figure 8) and is showing a predicted increase in the future

The **iron triangle** is a common way referring to the elements of time, cost and quality in a project. In the definition of iron triangle (Table 10), the terms 'cost management' and 'time management' were included in preference to 'cost' and 'time' as a way of limiting the search to those articles that related to the management of these areas rather than the broader topics of cost and time. Had 'cost' and 'time' been used as topics, the matches would have risen from 15,491 (Table 19) to 47,666, making this the largest category. The current definition of this category may therefore be under-reporting the importance of time, cost and quality in the literature. Even with this restricted definition, the category is forecast to grow in the future and the iron triangle has the second highest growth rate (Table 19). Similar studies eg Crawford et al (2006) found similar results and also identified the increasing significance of time and cost (but not quality) in the literature.

While many of the categories in this study may be considered to be the hard skills of project management, the category of **soft skills** includes topics such as leadership, negotiation, teamwork and trust. It can be seen from Figure 10 that soft skills have appeared in the literature throughout the study period. Soft skills are a growth area in the literature (Table 19).

Pinto (2013) is one of many authors to identify the strategic importance of projects to organisations. **Strategic alignment** is another growing trend in the literature (Table 19) including within its definition strategy, benefits and organisational change. Figure 11 shows that this category has been included in the literature in every year except one.

Risk management is needed on all projects due to their unpredictable nature, potentially long time scales and the influence of the external environment. It is no surprise that risk is a major topic in the literature with 11,910 matches and an increasing trend (Table 19). The category has appeared in the literature in most of the years in this study (Figure 12) and for the last 7 years has contributes nearly 15% to project management literature.

Project close relates to the stage in the project where many projects cease and the work is commissioned and handed over. Project close is a recurring category in the literature (Figure 13) and one that has a flat trend line suggesting it will continue to appear in the future at about the same rate, around 5%.

The identification of stakeholders and **stakeholder management** can be traced to the early 1990s (Figure 14). At this time, a distinction was starting to be made between project success that included the views of stakeholders and project management success that focused more on tine, cost and quality (Pinto and Levin 1988). The notion that a project can achieve its time and cost goals and still be considered a failure has provoked a constant and growing interest in the role of stakeholders in

project management. Stakeholder management is the sixth most growing category (Table 19).

Project management methods barely appeared in the literature before the early 1990s (Figure 15) ad while the overall trend for this category is increasing when viewed over the 50 years of this study (Table 19), there has been a strong upward trend in recent years. This can be attributed to the growth in methods such as PRINCE2 (OGC 2009), the use of standards from the PMI (2013) and APM (2012) and the growth in new software development methods such as Agile.

With 3,431 matches in the dataset (1.6%), **procurement** has been a recurring but low level category since 1973 that is predicted to continue at this level (Table 19). Not all projects have an element of procurement within them as internal projects and small project are likely not to need this level of formality. It is interesting to note the disagreement in the field about whether procurement is part of project management or a separate but allied discipline. For example the PMBOK (PMI 2013) includes a section on procurement while PRINCE2 (OGC 2009) sees this topic as being outside its remit.

The topic of **project success** first appeared in the literature in 1973 and has appeared regularly since then (Figure 17). Despite the differentiation between project success and project management success being clearly articulated by authors such as Pinto and Levin (1988) and Atkinson (1999), the topics of what constitutes success and how the projects success criteria and factors can be applied continue to be debated.

The importance of **project startup** is clearly articulated in the literature (OGC 2009; PMI 2013) but this category earns very little attention in the literature (Figure 18). The trajectory of this topic is flat (Table 19) so it is expected to continue at this low level in the future.

Of all the categories in this research, **project evaluation** generated the lowest number of matches at 644 (Table 19) and shows a slight declining trend (Figure 19). This may be because this topic has little interest to researchers or because its topics of evaluation and appraisal (Table 10) are reported under the benefits topic and thereby reported in the strategic alignment category. These results are contrary to those of Crawford et al (2006) who identified project evaluation and improvement as an increasing trend. This difference may be explained by the definition of the category which, for Crawford et al, included improvement, a topic included in a different category in this study.

While most of the categories in this study are predicted to appear more frequently as a percentage in the literature, these predictions must be seen again the background of publications in this field. As Figure 1 shows, there was a peak of interest in project management on the mid 2000s and this has been followed by a steady decline until

2014 when the first reversal to the downward trend was seen. The validity of the predictions in this study will be affected by the number of publications but, by using percentages rather than absolute numbers, it is hoped that the projections will be shown to have validity.

Comparing the findings of this study with previous studies identified some similarities but also differences. The different scope, focus and definitions of previous studies makes comparison meaningless. It is certain that, as more literature is added to the online databases, researchers define and redefine categories and topics for which to search and the field of project management also changes and develops in the future, studies such as this will continue to produce results which, although sometimes contradictory, do prove to be useful to researchers and those interested in project management.

Conclusion

This paper has examined trends in the literature on project management. This research set out with 7 aims, all of which were met.

A review of 15 publications looking at trends in project management was undertaken and their findings were tabulated to show the source of their data and the scope of their research (aim 1). It was noted how most of the previous studies had used relatively small datasets, frequently based on project management specific journals. The most recent study by Pollack and Adler (2015) had used a much larger dataset of 94,472 records. This paper has benefited from three more years of publications and was able to construct a valid and tested dataset of 116,202 records from online sources (aim 3).

Previous research was used to identify categories and topics for study. 16 categories comprised of 144 topics were used in the study (aim 2). Based on the characteristics of the categories and topics a search function was successfully built in Microsoft Excel that allowed the dataset to be queried (aim 4).

The search facility and dataset were used to identify the trends over the 50 years of data available. Thirteen categories were highlighted as being likely to see an increase in publications whereas the remaining 3 categories were expected to decline in publishing frequency (aims 5 and 6).

In such a large dataset there is much information still to be gleaned. The potential for using the topic as the unit of analysis, rather than the category offers the possibility to learn more about the trends in project management. Anyone wishing to use the dataset is asked to contact the lead author (aim 7).

Limitations

It was noted in the method section of this paper how the process of extraction, importing and subsequent data manipulation have affected the quality of the study dataset. While data errors have been uppermost in the researchers' minds, a limitation in this study is the quality of the dataset.

While the publications that appear in the dataset have been analysed and discussed, we must also pause to consider the publications that are not indexed by the major online databases and which are therefore excluded from our analysis. Examples of which the authors are aware include the International Research Network on Organising by Projects (IRNOP) which holds a bi-annual conference, the annual British Academy of Management (BAM) and the European Academy of Management (EURAM) conferences. Over time, the number of publications indexed online is likely to increase which will mean that future research studies of this type will have a more complete view of the field of project management.

Almost all of the publications included in the dataset have been written in English. While a few non-English documents are included, this study should be more properly termed the trends in project management as reflected in English publications. To what extent the non-English publications write about project management is unknown and this must been seen as both a limitation of this study and also an opportunity for further study.

In the discussion on the project evaluation category, the potential for this study to incorrectly categorise topics was mentioned. While the category and topic structure in Table 10 was based on previous literature, it is clear that the allocation of topics to categories is not a definitive activity. This study has presented a two level hierarchy of categories and topics but others may view the field of project management differently based on their axiology and derive different topological models. Analysing the data using a different model would produce different results which means that another limitation of this study is the authors' two tier project management model.

Further research

This initial analysis of the study dataset has used pre-existing search terms to identify the trends in project management. Given the availability of other techniques, as exemplified by the scientometric approach of Pollack and Adler (2015) and the many tools available for corpus analysis, it is planned to undertake further and less a priori analysis of the dataset in the future and to publish the results and findings if they appear to add to the existing information on trends in project management.

Many potential topic areas were identified in the literature review section of this paper. The majority of these were grouped into categories and researched with the category as the level of analysis. It would be possible to study each of the topics to determine

individual trends and whether the grouping into the category was a valid and helpful decision.

This analysis did not differentiate by industry or sector and assumed that project management is the same regardless of where it is used. Given the long established use of project management in some industries (such as engineering, construction and defence) and the more recent use in other industries (eg software design) it would be fascinating to see how viewing the dataset through the industry perspective, which would be achieved through a categorisation of the publications, would change our understanding of the trends in project management. Such research would build on the work already undertaken by Zobel and Wearne (2000), Kwak and Anbari (2009) and Williams (2010).

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