The Future of Project Management

The Future of Project Management:

Adapting to Modern Needs

Edited by

Igor Vrečko and Brigita Gajšek

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TABLE OF CONTENTS

FOREWORD

Welcome to the pioneering volume of the "Researching Challenges in the World of Projects" series. This remarkable initiative emerges from the fervour and diligence of the Slovenian Project Management Association, an organisation deeply committed to elevating project management theory and practice. Born from a desire to span the chasm that often exists between the theoretical models and the practical realities of project management, this series is designed to serve as a valuable platform for practitioners, researchers, and enthusiasts alike. The rich tapestry of the series presents the dynamic nature of project management and acknowledges its many nuances, reflecting the constant evolution that characterises the discipline.

The inaugural volume of this series, "Project Management: Adapting to Future Needs," presents itself as a unique compilation of profound and insightful research. Our contributors have endeavoured to dissect, analyse, and address the multifaceted challenges that continue to shape the fabric of modern project management. Embarking on this exploration, we engage with intricate problems, unprecedented scenarios, and novel solutions that resonate with the unique demands of the contemporary world. As a scientific monograph, it presents diverse perspectives, stretching across different domains and disciplines, capturing the essence of a rapidly transforming field and relentlessly pushing boundaries. Our contributors have meticulously collected and synthesised knowledge from various corners of project management, threading together a narrative that both comprehends the rapid pace of change and anticipates the multifaceted needs of the future. This monograph, we believe, not only highlights these challenges but also inspires us to rethink, reimagine, and redefine our strategies and approaches to tackle them successfully.

In this anthology, we journey across the intricate terrains of project management, starting with a comprehensive review of the existing literature that sets the stage for subsequent discussions. It draws attention to the rapidly changing methodologies and tools redefining project management over the past decade. The intersection of technology and project management forms a significant portion of our narrative. From exploring the capabilities of artificial intelligence and machine learning to adopting sophisticated information and communication technologies, the monograph navigates the transformative power of technological advancements in

project management. The exploration of building information modelling (BIM) as a tool for optimisation illuminates one such innovation. Also woven into the narrative is an examination of the implications of data analytics in enhancing reporting and decision-making processes within project environments. This signifies the broader drive towards digital transformation and highlights the potential for technology-enhanced strategies in project management. A prominent aspect of the current project management landscape lies in its growing complexity and diversity. This volume delves into the multifaceted nature of international development projects and the nuances of open innovation projects that can present challenges and opportunities. The need for hybrid approaches to project management in today's volatile, uncertain, complex, and ambiguous (VUCA) world is also reflected on. The discourse includes the merits of integrating agile principles into traditional project management methodologies, underscoring the necessity of adaptive approaches in achieving project success. The educational aspects of project management also receive much-needed attention. The development of new learning paradigms and the role of project managers in multimedia production offer unique insights into the ongoing evolution of project management pedagogy. Sustainability also figures prominently in our discussions as the significance of environmental consciousness in project management continues to gain traction. With a greater understanding of projects' global impact, sustainable project management principles are becoming increasingly important. This monograph also recognises the generational shift occurring in the workforce. As newer generations with distinct values and expectations enter the labour market, project management must evolve to accommodate these changes.

The Slovenian Project Management Association is deeply honoured and privileged to present this inaugural monograph, a profound testament to the unwavering dedication and collaborative endeavours of an incredibly diverse group of contributors. As we embark on this momentous journey together, we are filled with immense pride and excitement for the future it heralds. With great anticipation, we extend our heartfelt hope that this monograph becomes a luminous beacon, guiding project management practitioners and researchers alike towards a sustainable, adaptive, and innovative future. It is our ardent desire that these pages ignite a spark within you, propelling you towards new frontiers of knowledge and empowering you to navigate the ever-evolving landscape of project management with confidence and finesse. Indeed, the journey has just begun, and the path stretching out before us is filled with infinite possibilities and untold discoveries. Within these meticulously crafted

chapters, you will find profound insights and inspiration to fuel your intellectual pursuits and practical endeavours.

As we traverse uncharted territories together, let us seize every opportunity to learn, grow, and evolve. Let this monograph be the catalyst that propels us towards a future where project management becomes a transformative force, creating sustainable value and fostering innovation across all sectors of society.

In closing, we express our deepest gratitude to all the contributors whose unwavering dedication and tireless efforts have made this monograph a reality. We sincerely appreciate our readers, whose thirst for knowledge and unwavering support inspires us to continually push the boundaries of excellence. Together, let us embark on this intellectual odyssey with open minds and hearts, knowing that through our collective pursuit of knowledge, we can shape a brighter and more prosperous future for project management and the world.

Welcome to a world where the only constant is change—the world of projects.

Prof. Igor Vrečko, PhD
President of the Slovenian Project Management Association

I

THE CHALLENGES OF MODERN PROJECT MANAGEMENT: A LITERATURE REVIEW

BRIGITA GAJŠEK AND SIMONA ŠINKO

1.1 Project Management in the 21st Century

Projects are the economic engine of the 21st century, the era of the project economy. This is not about introducing change overnight but about slow change, with increased time spent working on projects at the expense of reducing time spent on so-called regular, standardised and normalised work. Industries, particularly information technology, manufacturing and construction, are becoming project-orientated. The Project Management Institute (PMI), one of the world's leading authorities on project management, defines the project economy as a "fundamental paradigm shift" in which companies create value for stakeholders through the successful completion of projects. These deliver new infrastructure, products, services, software, and better living conditions, enable economic growth and contribute tangibly to the GDP, in Germany's case by more than 41% (Nieto-Rodriguez 2021). Today, projects deliver financial and social value. They are a means of organisational flexibility, which depends on project team members' project management skills.

The expansion of project work gave impetus to developing the profiles of project managers and leaders and the corresponding competencies. It also began grouping project management experts under professional associations' auspices. The International Project Management Association (IPMA) and PMI are the most influential international associations. Over the years, both have developed international networks based on national associations and chapters. The standards, the Individual Competence Baseline (ICB) and *A Guide to the Project Management Body of Knowledge* (the PMBOK Guide) define the processes in the project life cycle, tools and

methods for the work on projects and a list of competencies for project managers.

While business is concerned with delivering projects successfully and productively, a supportive environment for employers and their project managers is prepared and has a built-in mechanism for continuous improvement. International project management associations act as partners with the knowledge and mechanisms to further educate the workforce and grow a new generation of project management experts (PMI 2021). The work of the associations also includes education, research and development dimensions. Nevertheless, not everything runs smoothly. Problems arise in the field of the labour market. The increasing number of projects is reflected in the increased number of jobs requiring very well-developed project management skills. Due to economic growth, this phenomenon can be observed mainly in emerging and developing countries. However, developed countries are no exception, as the number of people retiring is increasing (PMI 2021). According to PMI forecasts, 77 million project management employees are expected to retire by 2030, and 25 million new project professionals will be needed. This requires 2.3 million project managers and change makers per year. PMI studies (PMI 2017; PMI 2021) show that project managers are important contributors to productivity. A talent shortage in the profession can potentially cause risks to the GDP of almost 204 billion EUR over ten years in the 11 countries studied. In response to the staff shortage, an offer of above-average salaries and the opportunity for lifelong training is being developed. The additional training pays off for employees and employers. Employees who are certified by international project management associations report higher average salaries than those without certification. Employers save through better utilisation of resources and a higher percentage of completed projects.

In addition to the term project economy, the terms ‘projectification’ (Jensen et al. 2016) and ‘project society’ (Händeler 2011; Lundin et al. 2015) are also frequently used, even in fields that are not traditionally project-orientated, such as scientific research, politics and art—neither private nor social life are exceptions. However, it is not just a matter of creating new terminology. Among other things, the structure of staff in the organisation is also changing. Whereas in the past, most employees were tied to regular work and departments with long-term, stable contracts, today, there are more and more project employees and project managers with temporary contracts (Hodgson & Cicmil 2006). A paradigm shift occurs (Schoper & Ingason 2019), regardless of what it is called and who writes about it. One must search the records under various keywords to understand the phenomenon described. Scholars, researchers and practitioners must do

much to clarify the shift and standardise the terminology in the coming years.

An increasing number of projects requires organisational adaptation or formalisation of the approach to managing projects within an organisation. Practice and science confirm that it is insufficient to change from one organisational form to another. The organisation must also master continuous improvement. Is there a best practice that makes sense to approach in small steps? An answer to this question has been attempted for many years by developing maturity models for project management, measuring the maturity level and analysing the results (Kerzner 2019). In this way, the developers wanted to give companies a tool to help them discover their gaps and plan the next steps in developing project management to a more mature stage. The timeliness of the topic and the eagerness to find solutions were reflected in more than 30 project management maturity models, between which it is easy to find overlaps and differences. None of them is suitable for all organisations. Of course, the challenging choice between maturity models is not the only way for an organisation to improve its project management tools, methodology and organisational alignment. There is also the classical approach of learning from one's and others' successes and failures and implementing a continuous improvement mechanism. A more efficient and faster way is based on the project management maturity model, which is also an excellent basis for maturing programme and portfolio management. Adapting the project management maturity assessment can transform a "portfolio of projects into strategic business outcomes that meet strategic business objectives" (Kerzner 2019). Currently, it cannot be claimed that there is a consensus on what project management maturity is. However, there is agreement that planning, reviewing and analysing to improve the project delivery system and its supporting environment must be done frequently to mature. Business operations in the era of the project economy require a shift to a certain level of project management maturity through minor or destructive improvements that, in extreme cases, may exceed employee acceptance and block the improvement process. Kerzner (2019) writes about the costs associated with maturing and improving using organisational change management. The project management office should do the most to reduce these costs, but awareness and application of these lessons in practice are low.

31 October 2020 was the opening day of Berlin Brandenburg Airport, a project with nine years of delays and costs that have risen from 2.83 to 7.3 billion EUR. The project was part of a political strategy to make Berlin more accessible and establish the city as a new world centre (Lopez 2019). The

privatisation of the airport was unsuccessful, leaving a group of politicians with questionable project management and construction skills in charge of the project (Larsson Castro et al. 2020). Berlin Airport and similar examples show the dividing line between public and private projects. It seems that the PMBOK theory and project management standards are practised to a lesser extent in the public sector. It cannot be denied that there are differences in the maturity of project management in the private sector depending on the industry. Cook-Davies and Arzymanow noted in 2002 that industries with a long tradition, such as the petrochemical and defence industries, have more mature project management than industries that have only recently adopted project management. Engineering-based industries also perform better than those that have only recently adopted project management, such as financial services or pharmaceutical research and development.

Project management has evolved differently in different environments. There are many versions of project management models. Each alternative acts as a shell within which project portfolios are managed in a specific ecosystem. There is excellent potential for exploring the differences and similarities between differently classified industries and companies, with maturity models providing a good basis for research. Grant and Pennypacker (2006) suggest examining and comparing project management maturity between companies that rely primarily on internal projects and companies that typically use external project support. They are interested in "a clear relationship between project management maturity and successful project delivery, which could be determined by performance indicators," as Kerzner (2019) suggested. In general, it is expected that a company that has reached a certain level of maturity in project management will maintain or improve the achieved level. Mullaly (2006) has shown that the level of maturity achieved can also decrease by one or several levels in successive years. The retirement of senior project managers and acquiring the necessary skills by novice project managers can lower the maturity levels of private or public organisations.

Project management is now a mature discipline recognised as an enabler of strategic change and economic growth. There are standards for project management at project, programme, portfolio and organisational levels. The supporting professional environment for project management professionals and novices is functioning, and maturity assessment models are available. On the other hand, companies perceive project management differently, on a continuum from a fad to a strategic enabler. Project management is considered necessary but not fully utilised as an organisational capability. Given the transition to the project economy/projectification/project society, companies will likely become more interested in using project management

as a competitive advantage. Interest in examples of best practices will increase depending on the type of industry and organisation. We also expect to see increased interest in project organisation, project programmes and portfolios, project managers' skills, digitalisation, automation, artificial intelligence in project management, knowledge management about project management and linking project management to strategic objectives. To facilitate engagement with the challenges of modern project management, we have examined the below articles in three eminent scientific journals regarding project management from 2015 to the first half of 2022. We are interested in the characteristics of scientific publications and trends to predict current research topics better. We believe that textbooks and project management standards are insufficient to support projectification and the increasing understanding by organisations and new entrants of lessons learned, benchmarking and other things that could help establish a project delivery ecosystem more quickly and achieve strategic and customer goals as expected.

1.2 Methodology

The quantitative approach of a bibliometric analysis was applied to summarise the scientific efforts in project management described in three scientific journals from January 2015 to July 2022. Two selected journals, the *International Journal of Project Management* (IJPM) and the *Project Management Journal* (PMJ), are affiliated with international project management associations. The third, the *International Journal of Managing Projects in Business* (IJMPB), is independent but focuses exclusively on project management. All three journals publish articles in management research and are ranked in the JCR—Serials Impact Factor of Journal Citation Reports (Table 1.1). The impact factor of all three journals decreased slightly in 2020, but IJPM remained in the first quarter.

The IJPM is published by the Association for Project Management and the IPMA. It claims to be: "The leading journal for the field of project management and organisation studies where its mission is to publish leading edge innovative research that significantly advances the field of project management" and organisation. IPMA is a federation of the leading project management associations in 71 countries. They are available in most European countries and are spreading to Asia and America, with tremendous growth and demand.

Table 1.1 *Serials Impact Factor from Journal Citation Reports*

Year	IJPM			PMJ			IJMPB		
	JCR IF	Q	Ranking	JCR IF	Q	Ranking	JCR IF	Q	Ranking
2020	7.17	1	38/226	3.57	3	126/226	2.63	3	164/226
2019	6.61	1	12/226	2.50	2	112/226	1.98	3	146/226
2018	4.69	1	30/217	2.04	3	121/217	1.60	3	106/147
2017	4.32	1	26/210	1.95	2	101/210	1.32	3	152/210
2016	4.03	1	21/194	2.71	2	52/194			
2015	2.88	1	29/192	1.76	2	77/192			

PMJ is the scholar and research journal of the PMI and contains the latest research, theories, techniques and applications in project management. PMJ's mission is to influence thinking about the need for using project management and its impact by publishing cutting-edge research that advances theory and evidence-based practice. PMI members are organised into over 300 PMI Chapters in approximately 100 countries. PMI Chapters are volunteer-led communities that enable members to interact with other project management professionals, develop their skills and make a difference in their local communities.

The IJMPB strives to promote the theory, research and practice of all aspects of project management. It seeks high-quality empirical and theoretical research to advance the understanding of project management and stimulate the publication of new knowledge in project management using multidisciplinary approaches entrenched in the social sciences.

Table 1.2 *Distribution of articles between journals*

Journal	JCR Ranking	Quarter	Number of articles	Share [%]
IJPM	38/226	Q1	534	54.16
PMJ	126/226	Q3	249	25.25
IJMPB	164/226	Q3	203	20.59
		Sum	986	100

Articles were selected from the *Web of Science* in July 2022 via a keyword search using "project management." Only articles in English were considered. The search results include 986 articles for further analysis. Five hundred and thirty-four (54.16%) articles are published in the highest ranked IJPM, 249 (25.25%) in PMJ and 203 (20.59%) in IJMPB (Table 1.2).

Bibliometrix 4.0 by R-Studio Biblioshiny is a network analysis software tool for visualising the dynamics and structures of science. It was used for

an in-depth study of the intellectual structures of the research field of project management.

1.3 Results

The world is facing an increase in the number of projects launched per unit of time, the phenomenon of projectification and the challenges of the project economy era. It seems that individuals' business and personal lives during working hours are increasingly permeated with project activities. In the past, the experience of undertaking projects and building a project environment was scarce and scattered across different cultures; today, there are enough data for real studies for the first time. It would be expected that intensive project work at the practice level would be followed by intensive academic research.

Table 1.3 contains the descriptive data on the scientific literature studied, published in three central and eminent journals in project management. The average number of authors in an article is 2.83; 1,907 authors wrote 986 scientific articles, of which 90 (9.12%) were written by a single author.

Table 1.3 *The descriptive data on studied scientific articles*

Query area		Result
Documents by document type	Scientific Article	964
	Review Article	16
	Editorial Materials	5
	Reprints	1
Number of international scientific journals		3
Annual growth rate for the number of published articles		-15.85%
Authors		1,907
Authors of single-authored documents		90
Co-authors per document		2.83
Author's keywords (DE)		960
Document average age		3.93

The annual growth rate for the number of articles published is 15.85%. This percentage shows that the number of articles on project management in the three central, eminent journals in project management is declining on average. A similar conclusion can be drawn from the average age of the articles, which is 3.93 years. The percentage is even lower as we only considered published articles from the first half of 2022.

Figure 1.1 provides more detailed insight into publishing project management articles for individual journals. IJPM had the largest decline in the number of publications. With 123 articles published in 2015 and 51 articles in 2021, the journal saw a 46.5% decline. The IJMPB did not publish any articles on project management in 2015 and 2016. Within the observed period, the journal published the most articles in 2020, with a sudden decrease after that year. The number of articles published in PMJ fluctuates steadily.

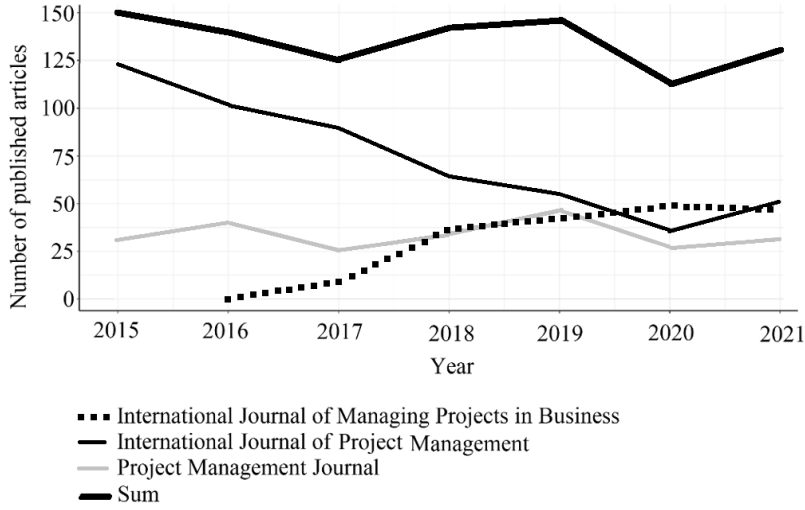

Figure 1.1 *The dynamics of publishing scientific articles*

One thousand nine hundred seven authors contributed to the articles selected for analysis. Table 1.4 shows 16 authors who contributed to eight or more articles during 2015–2022. The three most prolific authors are Müeller, who contributed to 23 (2.33%) articles; Aaltonen, who contributed to 15 (1.52%); and Anderson, who contributed to 12 (1.22%) articles. Three of the six most prolific authors published articles on project management each year. Müller, as the most prolific author, made the largest contribution in 2018 when he published five articles, which is also the highest number of published articles per author per year.

Table 1.4 *The most prolific authors*

Author	Year								N. of articles	[%]*
	2015	2016	2017	2018	2019	2020	2021	2022		
Müller	4	3	1	5	4	2	3	1	23	2.33
Aaltonen	2	1	2	1	3	3	2	1	15	1.52
Andersen	1		2	3	4	1	1		12	1.22
Martinsuo		1	1	2	4	2	1		11	1.12
Sankaran	2		1	3	2	1	2		11	1.12
van der Hoorn	3	3	1	1	1	1	1		11	1.12
Ahola		1	2	1	1	3	2		10	1.01
Aubry	1	2		4			2	1	10	1.01
Zhu				2	3	2	2	1	10	1.01
Gemünden	1	3	1	2	1	1			9	0.91
Geraldi		1	1	1	2	3	1		9	0.91
Kock		2	1	2	2	2			9	0.91
Whitty	3	1	1		1	2	1		9	0.91
Brunet		2		1	2		2	1	8	0.81
Davies	1	2		1	2	1	1		8	0.81
Yu				2	1	2	2	1	8	0.81

* Percentage is calculated based on 986 included articles

The co-authorship analysis helped us understand the structure of scientific contributions in project management (Figure 1.2, Table 1.5). It shows the presence of four collaborative Clusters with more than three article writers and measures the extent of joint publications between authors contributing to the advancement of knowledge in project management. Each node in Figure 1.2 represents one author. The size of the node represents the number of contributions by the author. The thickness of the connecting line shows the number of publications jointly authored by the authors.

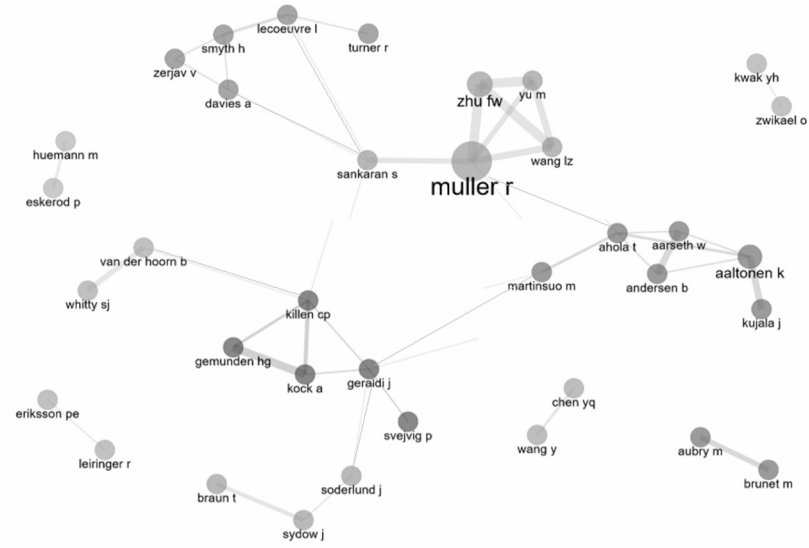

Figure 1.2 *Co-authorship analysis of authors*

The most prolific and collaborative author is Müller, and the most prolific Cluster is Cluster 1 (Figure 1.2, Table 1.5), which includes researchers from Norway, China and Australia. Three other clusters are the groups of equally productive authors. The Cluster 2 brings together six authors from Finland and Norway, the Cluster 3 and Cluster 4 five, and the smaller Cluster 5 three. The Cluster 3 includes researchers from the United Kingdom. In each cluster mentioned, two authors are linked by joint publications with authors from two other clusters. Müller, Sankaran, Ahola, Martinsuo, Killen and Geraldi connect the project management research community through publications with authors from other clusters. In addition to the interconnected clusters, ten researchers work in five pairs that are not meaningfully connected to the rest of the research community through joint publications.

The authors' countries were also analysed (Tables 1.5 and 1.6). Table 1.5 shows the countries from which the corresponding authors came who contributed ten or more articles. If we add up the contributions of corresponding authors from the European Union in Table 1.5, the European Union is in the lead with 290 (29.4%) articles. If we look at each country individually, China is in the lead with 154 (15.62%) articles, followed by Australia with 107 (10.85%) articles and the United Kingdom with 97 (9.84%) articles.

Table 1.5 *The distribution of authors and countries by Clusters*

Cluster	Authors within the cluster
Cluster 1	Müller R. (Norway), Sankaran S. (Australia), Zhu F.W. (China), Yu M. (China), Wang, Y (China)
Cluster 2	Aaltonen K. (Finland), Andersen B. (Norway), Martinsuo M. (Finland), Ahola T. (Finland), Aarseth W. (Norway), Kujala J. (Finland)
Cluster 3	Davies A. (UK), Turner R. (UK), Zerjav V. (UK), Lecoeuvre L. (independent), Smyth H. (UK)
Cluster 4	Gemünden H.G. (Germany), Geraldi J. (Denmark), Kock A. (Germany), Killen C.P. (Australia), Svejvig P. (Denmark)
Cluster 5	Sydow J. (Germany), Braun T. (Germany), Söderlund J. (Norway)
Cluster 6	Aubry M. (Canada), Brunet, M. (Canada)
Cluster 7	Chen Y.Q. (China), Wang Y. (China)
Cluster 8	Huemann M. (USA), Eskerod P. (Austria)
Cluster 9	Zwikael O. (Australia), Kwak Y.H. (USA)
Cluster 10	Leringer R. (Hong Kong), Eriksson P.E. (Sweden)
Cluster 11	van der Hoorn B. (Australia), Whitty S.J. (Australia)

Figure 1.3 shows a world map with countries from which the authors of the studied articles originate. The authors are active in 56 different countries around the world. We were interested in the countries without active authors. These countries are:

- Europe: Albania, Andorra, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Iceland, Kosovo, Latvia, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Northern Macedonia, San Marino, Slovakia;
- Asia: Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Brunei, Cambodia, Georgia, Iraq, Kazakhstan, Kuwait, Kyrgyzstan, Laos, Lebanon, Maldives, Mongolia, Myanmar, Nepal, North Korea (Dem. People's Republic), Oman, Philippines, Sri Lanka, Palestine, Syria, Tajikistan, Timor-Leste, Turkmenistan, United Arab. Emirates, Uzbekistan, Yemen.

Figure 1.3 *Countries with publications*

The authors associated with the countries of North America are active in Canada, Haiti and the US. The authors associated with South America are active in Brazil, Chile, Colombia and Peru. Authors associated with Australia are active in Australia and New Zealand, and authors associated with Africa are active in Angola, Egypt, Ethiopia, Ghana, Senegal and South Africa. The distribution of articles by year for each country separately is shown in Table 1.6.

Müller, who works for the Norwegian Business School, published articles with co-authors from 11 countries, and 12 articles (52%) were published with co-authors from China. Sankaran, who works for the University of Technology Sydney, published articles with co-authors from seven countries, five (45%) with co-authors from Norway. Figure 1.4 shows the international collaboration in publishing joint articles based on authors' publications linking the clusters identified in Figure 1.2. The associated researchers collaborate to a greater extent with Norwegian and Australian researchers, with Müller and Sankaran leading the way. This type of collaboration is also of interest to researchers from India, China, South Africa and Japan.

Sankaran from the University of Technology Sydney, Müller from the BI Norwegian Business School and Drouin from the Université du Québec à Montréal explored collaboration in project management research. They conducted collaborative research under the PMI umbrella involving researchers from nine countries: Australia, Canada, China, India, Lithuania, South Africa, Norway, Sweden and the Netherlands.

Table 1.6 *Articles per corresponding author's country*

Country	Articles per country							N. of CA**	Share [%]*
	2015	2016	2017	2018	2019	2020	2021		
China	19	24	18	13	9	12	20	154	15.6
Australia	20	19	17	13	19	12	14	107	10.8
UK	22	16	13	13	13	15	18	97	9.8
Canada	9	12	3	9	6	8	8	64	6.5
USA	20	10	14	12	14	2	10	60	6.1
Norway	8	8	6	15	14	6	5	54	5.5
Finland	2	5	4	7	9	5	5	41	4.2
Sweden	4	3	6	5	5	5	2	38	3.9
Brazil	3	6	4	4	5	6	6	37	3.8
Netherlands	6	8	6	5	8	2	2	37	3.8
Germany	3	7	3	8	10	3	5	35	3.5
Denmark	2	3	1	3	3	3	6	23	2.3
France	5	2	4	2	4	0	1	20	2.0
Spain	3	1	2	0	2	4	2	16	1.6
Italy	3	0	3	0	1	2	2	15	1.5
Pakistan	1	0	2	2	3	2	4	14	1.4
S. Korea	4	1	0	2	2	0	1	13	1.3
Belgium	2	0	2	0	2	0	1	12	1.2
India	1	3	1	2	2	2	2	12	1.2
Iran	1	1	0	3	0	3	1	12	1.2
Ireland	0	2	3	3	2	1	1	12	1.2
S. Africa	0	1	1	1	1	1	1	11	1.1
Austria	1	0	1	1	0	1	2	10	1.0

* Percentage is calculated based on 986 included articles
** Number of corresponding authors

Sankaran and Müller as researchers from developed countries working with researchers in emerging and developing countries. We could not understand whether this collaboration resulted from the desire to be mentored by a renowned top researcher or to work with a prestigious institution. The authors (Sankaran et al. 2021) found that collaboration with a renowned top researcher is often more important than belonging to a prestigious institution.

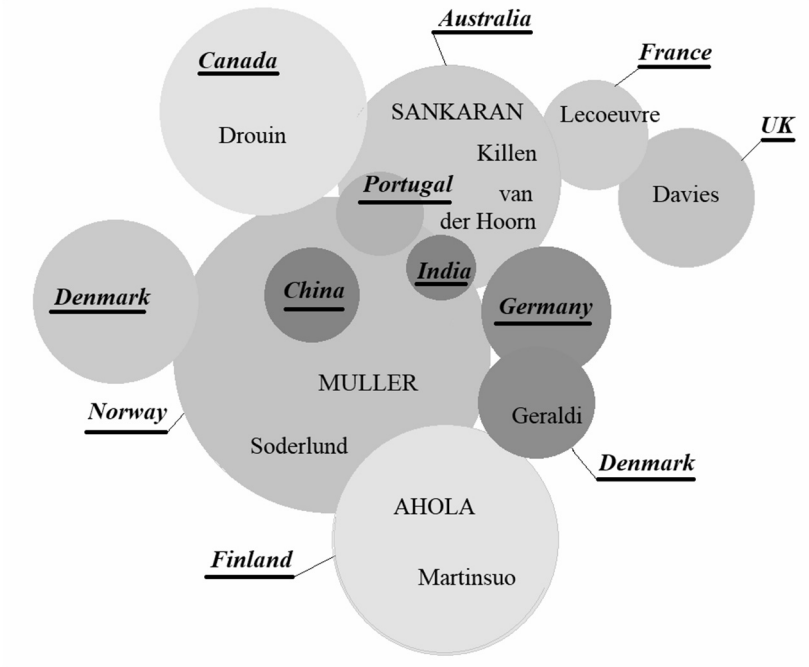

Figure 1.4 *International cooperation of authors who link the clusters*

1.3.1 Keywords analysis

Keyword analysis is a tool for studying trending topics, and scholars are focusing on this area (Song et al. 2019). Figure 1.5 shows four clusters of authors' keywords in four rows based on the 20 most frequently used words.

From the first line (Cluster 1, Figure 1.5), it can be seen that researchers are exploring the agile approach and SCRUM framework in their desire for flexibility and comparing it with traditional project management and its tools.

The second line (Cluster 2, Figure 1.5) describes a strong research stream in project management for infrastructure projects and construction. Contractors for such projects are mostly selected through public tenders. The main challenge is to evaluate the projects and select the most favourable and trustworthy contractor to implement the project within the limits and wishes set out at the beginning. The second challenge is implementing the project, which also brings many interesting research challenges.

The third line (Cluster 3, Figure 1.5) deals with project control as an important phase in the project's life cycle that requires accountability. Investors usually hire agents to carry out control and delegate decision-making powers to them. Agency theory assumes that the interests of the agents may differ from the interests of the investors and refers to these as principal-agent problems (Kopp 2021). The words in Cluster 3 summarise this area of research within project management very well.

The fourth line (Cluster 4, Figure 1.5) refers to the modern challenges of project organisations, multinational companies or firms where the number of projects is increasing. In the face of global change, more and more companies are affected by this problem. The PMI (Ross & Shaltry 2006) define a project portfolio as "A collection of projects, programmes and other work that is grouped to facilitate the effective management of that work to meet strategic business objectives. The projects or programmes of the portfolio may not necessarily be interdependent or directly related." A portfolio can be managed at either a functional or organisational level. In either case, it requires the implementation of a complex adaptive system.

Figure 1.5 *Authors' keywords cloud*

Figure 1.6 sums up the dynamics of the authors' keywords. The analysis revealed several groups of keywords that appeared and were used more frequently in a given period. The perceived relevance of the keyword groups (marked in Figure 1.6 with A, B, C, D, E) in the period between 2015 and 2021 is as follows:

- 2015 (keyword group A): absorptive capacity, knowledge management, managerial practices, R&D project management;
- 2016 (keyword group B): 5D BIM, cash flow analysis, financial decision-making, project financing;
- 2017 (keyword group C): active leadership, stakeholder management, community leaders, disaster recovery projects, case study, Japanese culture;
- 2019 (keyword group D): accelerating projects, benefits management, project value creation, project success and case study;

- 2020-2021 (keyword group E): open innovation, organisational capabilities, project capabilities, project capability-building, event structure analysis, ESA.

After project management matured from a methodological-technical perspective, the research focused on project success and types of capability (organisational, personal, project).

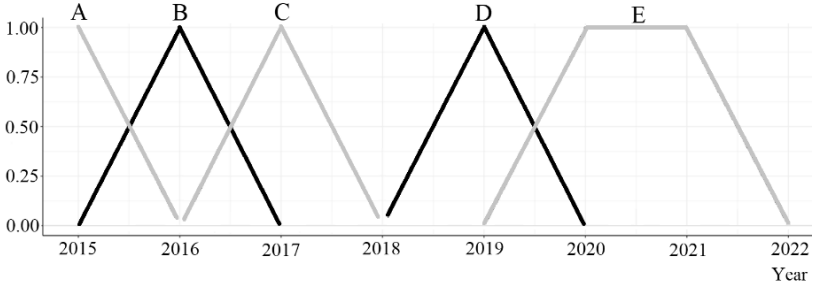

Figure 1.6 *Keywords dynamics*

1.3.2 Titles analysis

The most frequently used phrase in the titles of the 986 articles analysed is "project management" (Figure 1.7). It occurs in 166 (16.84%) titles, as seen in Table 1.7. The second most common phrase is "project managers," which occurs in 52 (5.27%) titles of articles.

Figure 1.7 *Most frequently used phrases (bigrams) in articles' titles*

The phrase "construction projects" is the third most commonly used. It was used in 49 (4.97%) titles in its plural form and 20 (2.03%) titles in its singular form, "construction project." When we combine the two phrases "construction projects" and "construction project" into one, "construction

project" becomes the second most common phrase, occurring in 69 (7%) titles. The analysis of the titles shows that in the period studied between 2015 and 2022, project management was often studied using examples from the construction industry.

Other phrases among the ten most frequent bigrams appearing in the titles are "project success," "project teams," "infrastructure projects," "project performance," "development projects," and "project governance." These phrases define the researched topics (primarily) in construction.

Table 1.7 *Most relevant phrases (bigrams) in articles' titles*

Phrase (bigram)	Occurrence	Share [%]*
Project management	166	16.84
Project managers	52	5.27
Construction projects	49	4.97
Project success	44	4.46
Project teams	30	3.04
Infrastructure projects	29	2.94
Project performance	28	2.84
Development projects	27	2.74
Project governance	22	2.23
Construction project	20	2.03

*Percentage is calculated based on 986 included articles

The co-occurrence network is shown in Figure 1.8. Each circle graphically illustrates a phrase. Its size depends on the frequency of occurrence of the phrase in the titles. The more frequently the phrase occurs in the titles, the larger the circle is. If a line connects two circles, the phrases appear together in one or more titles. The more often they appear together in the titles, the thicker the line is. R-Studio Biblioshiny's Bibliometrix 4.0 has identified seven clusters of phrases.

The largest Cluster in Figure 1.8 evolves around the central phrase "project management." The phrase "project management" is often associated with 15 other phrases, among which "project managers", "project success," and "project performance" stand out. In relation to "project managers," research was conducted on "emotional intelligence," "mediating role," and "project success." In addition, "project success" was frequently mentioned in connection with "project governance," "knowledge sharing," "project managers," "mediating role," and "construction projects."

In the second largest Cluster, in terms of the number of related phrases, the most frequently associated phrase, “development projects,” is in the middle of the Cluster, associated with information systems, systems development, development project, software development, product development and project team.

Figure 1.8 *Co-occurrence network connectivity visualisation for phrases in articles' titles*

The next cluster consists of six equally frequent phrases that refer to the success of partnership projects, with a focus on public-private infrastructure projects. It is linked to the other phrase clusters by the phrases “development projects,” “project management,” and “mediating role.”

An analysis of the trigrams in the titles of the articles was carried out to sharpen the insight into the most common topics of the published articles. The phrase “project portfolio management” is the most frequently used trigram in ten titles. It appeared in ten (1.01%) titles from 2016 to 2020. This phrase has been around for a long time and therefore has probably not reached a mature stage in its development. Similarly, “product development projects” appear yearly in at least one title. “Critical success factor” and “project risk management” appeared in eight (0.81%) titles each in the period from 2016 to 2019.

The trigrams “software development projects,” “construction project management” (2017–2021), “information system projects” (2016–2017) and “project management research” (2015–2018) are similarly common. They each appeared in seven (0.7%) titles. These groups include the most recent title, “software development projects,” which refers not only to this type of project but also to software development projects to support project work.

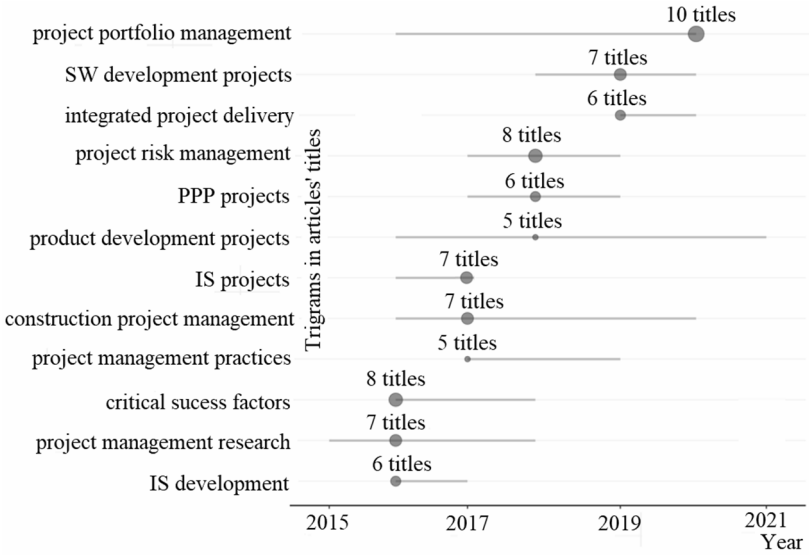

Figure 1.9 *Occurrence of the trigrams in articles' titles in the 2015-2021 interval*

Three pairs of connected trigrams were discovered (Figure 1.10). Among them, the most frequent link is between "public-private partnership projects" and "critical success factors" in 2017. Slightly less frequent is a link between "information systems development" and "systems development projects" in the titles of articles in 2016.

Figure 1.10 *Co-occurrence network connectivity visualisation for trigrams in articles' titles*

Figure 1.11 shows the word cloud based on keywords plus. Keywords plus are words or phrases frequently occurring in the titles of references in the article but not in the article's title (Garfield & Sher 1993). Management is the most frequently used word. It is part of the phrase "project management," and conversely, the practice and theory of "project management" is often based on the skills of "management." The phrase "construction projects" follows as the second most frequently used phrase

as a logical continuation of the findings from the previous sections of the analysis, which have already established that many articles deal with topics from construction projects. With few exceptions, most other words in Figure 1.11 occur only once. Exceptions are “dynamic,” “capabilities,” “strategies,” “organisation,” “explanation,” “challenges,” “emergence,” “knowledge, “inference,” “implement,” and “adoption.”

Figure 1.11 *Frequently occurring keywords plus in articles’ titles of references*

1.3.3 Abstracts analysis

The analysis of the phrases in the titles of the articles showed that the phrase “project management” is the most frequently used bigram. The same was seen in the analysis of the abstracts (Figure 1.12), which revealed that “project management” occurs in 884 (89.66%) abstracts analysed. The phrase “project managers” follows in 365 (37.02%) abstracts, and the phrase “project success” appears in 237 (24.04%) abstracts. Other phrases among the ten most frequently used bigrams in abstracts include “project performance,” “construction projects,” “project governance,” “project team(s),” “project complexity,” and “risk management.” An analysis of the abstracts yields comparable results to the analysis of the titles. Eight out of ten phrases listed in Table 1.8 for abstracts are the same as in Table 1.7 for the titles. The most frequently used bigrams in both tables are “project management” and “project managers.” The abstract analysis adds two frequently used bigrams to the title analysis results, “project complexity” and “risk management.”

Figure 1.12 *Frequently used bigrams in articles’ abstracts*