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Implementation of Project Management Knowledge Areas by Project Managers

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Abstract: Academic and professional literature records the primary areas of interest within a discipline and how they change across time. However, it does not always keep up to date with the practical needs of various industries. This article discusses the Project Management Body of Knowledge (PMBOK) areas and their implementation among active project managers (PMs). The PMBOK guide defines terms, guidelines, and knowledge areas within project management. A survey was conducted among 117 active PMs who were asked to rate the degree to which they implement the PMBOK areas. PMs reported integration, cost, and procurement as being implemented by them to the greatest extent, while their implementation of quality, scope, and stakeholders was not reported. This points out the need for reinforcement among PMs. No correlation was found between the degree to which additional knowledge was implemented by PMs and the degree to which the knowledge areas were covered in the last generation of textbooks. Textbooks do not align with the PMs' implementation in their working fields. The study identified gaps between the degree to which the knowledge areas of project management were implemented and the importance that the authors of the textbooks attach to the above areas of knowledge. The research findings may contribute greatly to reducing these gaps. They can also contribute to training programs targeted at project managers.

Keywords: PMBOK knowledge areas, textbooks, project management

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1. Introduction

Project management applications have existed since ancient times, from the pyramids of Egypt through to the Great Wall of China, and the Roman Colosseum, aqueducts, and roads. Modern project management was born in the early 19th century. The first management consultant, Frederick Taylor, was an initiator of modern business practices. He introduced management theory, a set of tools, rules, and guidelines to administer organizations. Later, Henry Gantt, an associate of Frederick Taylor, developed planning techniques and created the famous Gantt chart in 1915 to effectively visualize a project, control the project schedule, and break it down into prioritized tasks. Subsequently, project management was defined as a method of directing and coordinating manpower and other tangible resources throughout the life of a project by utilizing up-to-date management techniques to achieve the desired targets in terms of scope, cost, time, quality, and the satisfaction of all participants (Project Management Institute Standards Committee, 1987). Project management is a branch of management science that aims to ensure that projects are completed and goals are achieved. Project management is about reaching the requisite endpoint at a predictable point in the future, which usually means within a given financial framework and a set amount of time (Newton, 2016).

In recent years, project management has become widely recognized due to its wide-ranging advantages and benefits in rapidly changing organizational environments (Abdessamad and Ibrahim, 2019). Project management applications are to be found in a wide range of fields, such as construction, engineering, science, and software development. It involves tools and techniques that help to define the project plan, evaluate progress, provide better

communication, collaboration, and budget management (money, time, and resources). The success of project management is dependent on the application of suitable project management tools (Kostalova and Tetrevova, 2014). Until the turn of the 20th century, many organizations chose not to have any model of management in their projects or processes. Today, not only do they have complex and unique project management systems, but their survival also depends on the successful implementation and execution of these project management models that were once not even an option (Sändig, 2016). Projects not being managed properly and professionally can cause many problems. Therefore, deploying an appropriate project methodology helps the project achieve its objectives.

A project management methodology has been defined as "an application of knowledge, skills, tools, and techniques to meet or exceed the project requirements" (Project Management Institute, 2017). The main aim of project management methodologies is to control the management process by making effective decisions. The aims have been enhanced over the years, since the revolution of the information age. Different types of methodologies are suited to certain projects, with the best-known tools and methodologies being Agile, Scrum, Kanban, Lean, PRINCE2, and PMI's PMBOK.

Selecting the right methodology depends on factors such as the project's type, scope, scheduling flexibility, budget, industry, customers, and stakeholders. This implies that specific methodologies should be defined for groups running similar projects (Jovanovic and Beric, 2018). PRINCE2 (PRojects IN Controlled Environments) and the PMBOK are the most popular methodologies among organizations and companies, and studies have examined them to provide management recommendations for future generations.

PRINCE2 was initially developed and released in 1989. It is a process-based approach that focuses on organization and control throughout an entire project. It was developed in the United Kingdom by the OGC (Office of Government Commerce) and has been used worldwide. This methodology insists on good communication and on including clients in the project management process, on dividing the projects into phases, and on an orientation towards the expected project outcomes (Jovanovic and Beric, 2018). The structure of PRINCE2 consists of seven principles that make a project compliant and scaled. These seven themes can be overlapped and work in parallels, such as business case, organization, quality, risk, planning, change, and progress (PRINCE2). The seven processes are broken down into forty activities that define what needs to be done and by whom (Ghosh et al., 2012).

The PMBOK was first published in 1996 by members of the Project Management Institute (PMI), an international non-profit organization founded in 1969 by a group of NASA graduates who decided to institutionalize the knowledge they had accumulated within the world of project management. The PMI aims to develop and disseminate best practices, carry out research, offer training, testing, and certification (Dos Santos and Cabral, 2008). The PMBOK repository has a more comprehensive framework in the project management field, in that it encompasses both standards, methods and, processes, as well as established practices (Errihani et al., 2015). It recognizes five process groups (initiating, planning, executing, monitoring and controlling, and closing) and ten knowledge areas that define the processes with aspects in common. Each knowledge area is an essential component that contributes to project success.

Several types of research have compared PRINCE2 and the PMBOK (Wideman, 2002; Siegelaub, 2004; Rehman and Hussain, 2007; Yeong, 2007; Chin and Spowage, 2012; Ghosh et al., 2012; Sánchez et al., 2013; Singh and Lano, 2014; Waheed, 2014; Jamali and Oveisi, 2016). There is an elemental difference between the PMBOK and PRINCE2. The PMBOK is a knowledge-based project management methodology incorporating widely proven practices. PRINCE2, however, provides a more prescriptive or process-oriented approach that can be applied to projects by the project or team manager (Yeong, 2007). The conclusions of Wideman (2002) were that PRINCE2 provides a robust methodology for running projects where the objectives are clear, while the PMBOK takes the best approach for the purposes of teaching the subject content of each knowledge area, but is not so effective when it comes to providing guidance for running a particular project. On the other hand, with respect to the coverage provided by PRINCE2 of the PMBOK knowledge areas, it seems that the PMBOK has a complete integration mechanism. It is stronger in human resources (HR) and stakeholder management and has a more detailed concept of communication management. Procurement management is only covered in the PMBOK (Karaman and Kurt, 2015). McGrath and Whitty (2020) concluded that PRINCE2 cannot claim to be generic in the engineering infrastructure space and consequently cannot reasonably claim to be considered best practice for it. The current study does not focus on a specific type of project, but on project management in general. Consequently, the PMBOK's areas of knowledge were chosen as the basis for the study.

As mentioned above, there are ten areas of knowledge, with each an essential component that helps the project succeed (Project Management Institute, 2017). We shall explain every area in brief.

- *Project Integration Management (ING)* includes first identifying and then integrating the processes required to ensure that the various elements of the project are correctly coordinated.

- *Project Scope Management (SCP)* includes a set of processes that ensures a project's scope is accurately defined and mapped out. The techniques that it encompasses validate the managers in assigning the correct amount of work to successfully complete a project.

- *Project Schedule Management (SDE)* includes all the processes needed to manage the timely completion of the project. It involves schedule management, defining activities, sequencing activities, estimating activity resources and durations, developing, and controlling the schedule.

- *Project Cost Management (CST)* involves all the processes that are involved in the planning, estimation, budgeting, financing, funding, management, and controlling of costs, so the project can be completed within the confines of the approved financial budget.

- *Project Quality Management (QLY)* involves all the processes to achieve quality deliverables. Quality is

maintained throughout the project. It includes three main processes: quality planning, quality assurance, and quality control.

- *Project Human Resource Management (RSS)* involves the processes necessary for the identification, acquisition, and management of the resources needed for the successful completion of the project.

- *Project Communications Management (CMS)* involves the processes that are required to ensure the timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and, ultimately, provision of project information.

- *Project Risk Management (RSK)*: all the processes involved in this area are connected to risk identification, regulation, and negotiations in a project. The objective is to increase the probability of positive risks (opportunities) and decrease the likelihood of negative risks (threats).

- *Project Procurement Management (PCT)* involves the processes necessary for the purchase or acquisition of products, services, or essential results that originate from outside the project team.

- *Project Stakeholder Management (SKL)* involves the processes required to identify all the entities that the project could impact upon, or that could impact the project. These consist of individuals, groups or organizations. The information obtained will enable stakeholder expectations and their impact on the project to be analyzed and allow managers to develop appropriate strategies.

The PMBOK provides a valuable source of information for project managers (PMs). They will be more effective if they are familiar with the ten knowledge areas and the various tools related to project management (Schwalbe, 2015). The organization at hand assigns PMs to this challenging, high-profile role, which carries with it significant responsibility and shifting priorities that must be met in order for the project objectives to be achieved. The characteristics required to fulfil this task include strong leadership abilities, flexibility, good negotiating skills as well as good judgment, and, of course, solid knowledge of effective project management practices. PMs need to utilize and apply tools and techniques that enable them to effectively adapt the PMBOK processes and principles to the practical world of project management. A PM should identify the relevant criteria for success and determine appropriate factors for success that would increase the chance of achieving them. Only then can a project management methodology to deliver these success factors be selected (Crawford et al., 2005). The latest version of the PMBOK (PMBOK 7th edition) has, in comparison to the previous editions, brought changes: the function of process groups using ten knowledge areas has been transferred to a series of principles applied to eight performance domains. Each of the ten areas of knowledge is covered by at least two domains of PMBOK7, therefore ten knowledge areas are relevant for students (Faraji et al., 2022).

PMs manage the constraints (knowledge areas) of individual projects, while the Project Management Officer (PMO) focuses on the standards, methodologies and overall risks, or opportunities, at the enterprise level of projects. Together, they form a team in the area of project management. The PMO, then, is an organizational entity that is established in order to offer assistance on matters relating to strategy and functional entities (Ward, 2000). The PMO has attained popularity in organizations as it assists with delivering projects that run to schedule, avoids cost overruns, and generates the required specifications for the project according to the specified quality levels (Wedekind and Philbin, 2018). Darling and Whitty (2016) summarized the PMBOK guide to PMOs and observed that the second edition of the PMBOK was the first to discuss the PMO while the third edition stated that PMOs are varied but used to coordinate the organization's business objectives through projects. The fourth edition has similar descriptions while the fifth edition includes a general description of three PMO typologies: supportive, controlling and directive.

After examining hundreds of articles on Google Scholar with the keywords "10 areas of knowledge PMBOK" between 2020 and 2021, we found that 373 articles addressed the areas of knowledge. Of the 373 articles, only 27 mentioned the word PM/PMO in the title/abstract along with the PMBOK knowledge areas. The findings of the research were: (1) managers should consider integration and scope planning and not simply rely on resources, communication, and cost planning on virtual teams (Gallego et al., 2021); (2) PMs already have sufficient competence in the project quality management unit. There are, however, still deficiencies in the project HR management and cost management unit that require attention (Sitohang et al., 2020); (3) most PMs have difficulties with HR management (Nobre, 2020); (4) PMs should understand that multiple factors contribute to the success of construction projects (Ali Khan et al., 2021); and (5) implementing a PMO in a company assists in improving project performance in terms of cost, time, and scope; the cross-cutting axis of all the processes will be quality (Meléndrez et al., 2021). We conclude from the review that not many studies (6.9%) have looked at the knowledge needs of PMs. We could not determine which PMs needs resulted from implementation and therefore set out to study and explore these information gaps. Table 1 summarizes the review of the 373 articles that addressed the PMBOK knowledge areas.

The discipline of project management is based on theory and practice (Angolia and Reed, 2021; Marcelino and Domingues, 2022). Practice is very important and is based on learning. For this reason, it is important that project management courses, learning games and simulations be based on the topics that PMs need. Therefore, textbooks which form the fundamental bases for building the complementary tools above must contain all the necessary information about the field.

In this paper, the main goal is to understand the observations of PMs in different industries, as reported in the survey, and recognize the implementation of the PMBOK knowledge areas among active PMs, as well as the degree to which knowledge areas are covered in third-generation textbooks in the field of project management.

Table 1. The frequency of the appearance of knowledge areas in research

Keywords	Knowledge Areas										
	ING	SCP	SDE	CST	QLY	RSS	CMS	RSK	PCT	SKL	% of Mentions
Project management	11	32	61	78	48	38	37	129	8	64	64.9%
Methodologies	5	5	12	14	10	3	7	10	1	8	9.6%
PMBOK	4	6	6	11	6	5	6	15	2	6	8.6%
PMs/PMOs	1	8	9	11	3	4	5	6	2	5	6.9%
PMI	0	2	2	1	0	0	0	2	0	0	0.9%
Implementations	2	4	9	11	6	8	5	11	3	12	9.1%

2. Methods

1.1. Research Questions

Q1. Is there a significant difference in the degree to which different knowledge areas are implemented among PMs?

For each separate knowledge area, we shall investigate whether there is a significant difference in the degree of implementation for the knowledge area, depending on different categories such as gender, age, level of education, number of organizations managed, and project management seniority.

Q2. Is there a correlation between the degree to which different knowledge areas are implemented among PMs and the degree of knowledge areas covered in the textbooks (third-generation)?

1.2. Questionnaire Design and Survey

The study area focuses on active PMs, with differences in their field of work, gender, age, educational level, and seniority. Using the survey method, we shall obtain insights into our topic of interest, answer our research questions, examine the intensity of the phenomenon, and report the main findings and recommendations.

We aimed to collect data to identify the observations of PMs from different perspectives. The database is based on a survey distributed among active PMs. We wanted to know how well PMs implement a particular area of knowledge. The survey was built in Google Forms and consists of two parts: introductory questions and knowledge areas questions. The introductory questions are based on independent variables such as gender, employment sector, level of education, age range, project management field, seniority in the current firm, seniority in project management, and the organizations in which the PM works (see Appendix 1.a). The knowledge areas questions ask to what extent a PM implemented tools from the knowledge areas. Each PM was required to rank the responses from 1 to 6 for the question "To what extent do you apply tools from any of the following areas of knowledge?" (1 = to a very small extent, 6 = to very a large extent). Each of the respondents answered ten questions in this part of the survey (See Appendix 1.b).

One hundred and seventeen anonymous PMs answered the survey (66% male, 34% female, with the age range for the majority being aged between 30 and 50), from different working fields, and different educational levels, as shown in Fig. 1 and Fig. 2. Table 2 shows the results of the survey by the respondents' fields of work. As will be recalled, the respondents gave weights between 1 and 6 according to the degree to which they applied the knowledge area in their work. Each of the areas of knowledge is applied in their professional work. The lowest average weight is 3.18 and the highest is 4.37.

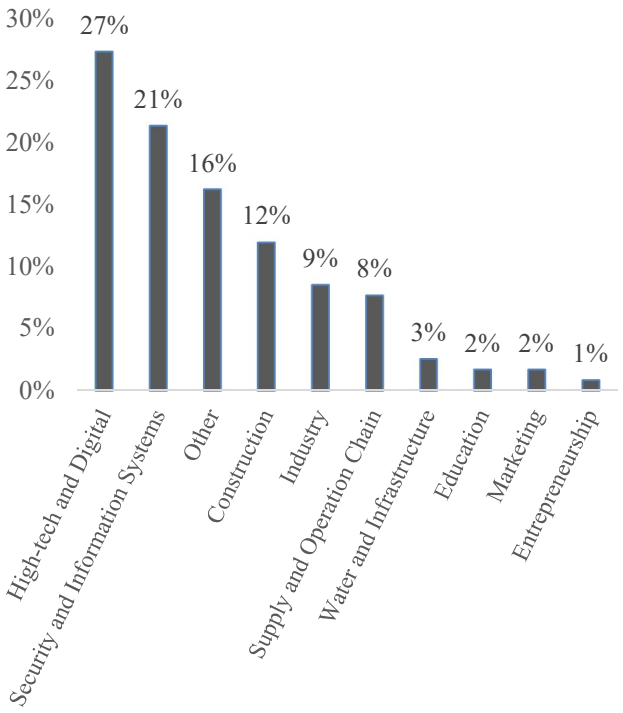

Fig. 1. The distribution of fields of work among the pm respondents

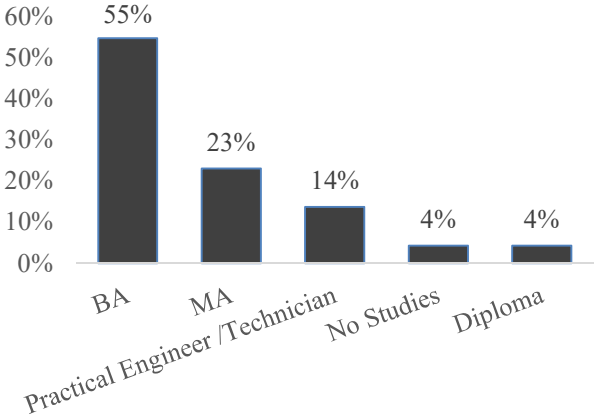

Fig. 2. The distribution of educational levels among the PM respondents

Table 2. The weights and rankings of the knowledge areas according to responses obtained from the pms

	Knowledge areas									
Field of work	ING	SCP	SDE	CST	QLY	RSS	CMS	RSK	PCT	SKL
High-tech and digital	3.75	3.88	4.38	3.59	3.69	3.03	3.75	3.31	3.41	3.88
Security and information	3.84	4.20	4.32	3.12	3.84	3.16	3.20	3.84	3.04	3.16
Other	3.50	2.89	3.94	3.61	3.44	3.22	3.06	3.39	2.67	2.78
Construction	3.93	4.14	4.71	4.14	3.29	2.86	3.36	3.86	3.57	3.43
Industry	3.55	3.91	4.36	3.64	3.00	3.27	2.27	4.09	3.82	2.55
Supply and operation chain	4.33	4.22	4.67	4.22	2.44	3.11	3.11	4.56	4.22	4.22
Water and infrastructure	3.33	3.67	5.00	4.00	4.00	4.67	3.33	3.33	2.67	3.67
Education	4.00	4.00	4.00	4.50	3.50	4.00	3.50	3.00	4.00	4.00
Marketing	3.50	3.50	5.00	4.00	3.50	4.00	2.50	4.00	3.00	3.50
Entrepreneurship	3.00	3.00	3.00	3.00	3.00	4.00	3.00	3.00	3.00	3.00
Average weight	3.76	3.84	4.37	3.64	3.47	3.18	3.25	3.68	3.32	3.38
Rank	3	2	1	6	5	10	8	4	9	7

1.3. Data Collection from Textbooks

In order to answer the second research question, we needed to collect data about project management textbooks. Data was collected from 12 textbooks from the third generation, i.e. textbooks published during the period from 2011 to 2020 (Allan, 2017; Badiru, 2019; Badiru et al., 2018; Dobson and Dobson, 2012; Kerzner, 2017; Lester, 2017; Lock, 2017; Maley, 2012; Meredith and Mantel, 2011; Patzak and Rattay, 2011; Richardson and Jacks, 2018; Zwikael and Smyrk, 2019). The following describes the stages used for the data collection:

a. Searching for third-generation project management textbooks.

b. Identifying lists of topics included in each of the textbooks.

c. For each book, counting the total number of pages devoted to each knowledge area. When a knowledge area appeared in multiple places, all the space was included.

d. Expressing, as a percentage, the number of pages devoted to each knowledge area, in each textbook relative to the total number of pages in the textbook, to allow comparisons to be made. Davidov and Globerson (2020) proposed expressing the importance of the various topics in textbooks by calculating the percentage of coverage of the topics. The percentage of coverage is calculated as the ratio of the number of pages that the topic occupies in the textbook to the total number of pages in the textbook.

Table 3 shows the degree of coverage for each area of knowledge in each of the 12 sources. There are areas of knowledge that are not explained at all in a considerable number of the textbooks. For example, SKL does not appear in 50% of the sources and PCT and CMS do not appear in about 42% of them. In contrast, SCP appears in all the textbooks and SDE, QLY, and RSS appear in about 92% of them.

To compare the two databases (PMs' answers and textbook coverage), each with its unique values, we used rankings of the knowledge areas (1–10), where 1 expresses the highest value obtained. As a result, SDE received a rank of 1 (highest) and RSS received a rank of 10 (lowest) among PMs (see Table 2). QLY received a rank of 1 and SKL received a rank of 10 among textbooks (see Table 3).

3. Results

According to the Kruskal-Wallis test, there is a significant difference in the degree to which the knowledge areas are implemented. Among the group of respondents, the knowledge area that was implemented the most is SDE ($p<0.05$). In addition, for each separate knowledge area, the same test was applied to check whether there is a significant difference in the degree to which a knowledge area is implemented, depending on:

- Gender- a significant difference was obtained in CST and RSK, which means that these knowledge areas are used more by male PMs than female PMs ($p<0.05$).
- Age- the Spearmen correlation test was applied to explore whether there is a significant difference in the degree of implementation of each knowledge area by age. It was determined that the older a PM is, the more s/he implements ING, CST and PCT ($p<0.05$, a positive correlation coefficient).
- Educational level- a significant difference was also seen in the degree of implementation of knowledge areas depending on educational level. Managers with a Master's degree use CST more than those with a Bachelor's degree ($p<0.05$).
- Number of organizations managed- the more organizations a PMs manages, the more s/he implements knowledge areas like ING, CST, RSS, CMS, PCT and SKL ($p<0.05$, a positive correlation coefficient).

Project management seniority- PMs implement tools more in ING, CST, CMS, PCT, and SKL ($p<0.05$; a positive correlation coefficient) when they have greater seniority in managing projects. The opposite is also true for those with lower seniority, the result is a negative coefficient.

Table 3. The coverage and ranking of knowledge areas in the third generation of the textbooks

Author(s)	Knowledge areas									
	ING	SCP	SDE	CST	QLY	RSS	CMS	RSK	PCT	SKL
Meredith and Mantel (2011)	0%	8%	6%	6%	13%	11%	3%	0%	0%	0%
Patzak and Rattay (2011)	7%	31%	4%	0%	8%	16%	0%	0%	0%	2%
Maley (2012)	16%	13%	10%	0%	0%	0%	0%	9%	10%	3%
Richardson and Jacks (2018)	9%	3%	7%	5%	15%	8%	2%	6%	3%	4%
Lock (2017)	15%	7%	9%	16%	7%	9%	0%	10%	7%	0%
Lester (2017)	7%	1%	11%	6%	2%	3%	1%	6%	8%	1%
Dobson and Dobson (2012)	13%	16%	6%	0%	12%	6%	0%	6%	0%	0%
Kerzner (2017)	0%	7%	5%	10%	9%	4%	4%	7%	4%	3%
Allan (2017)	15%	11%	0%	8%	11%	18%	8%	0%	0%	0%
Badiru et al. (2018)	0%	12%	7%	12%	10%	11%	11%	5%	10%	0%
Zwikael and Smyrk (2019)	18%	4%	1%	3%	10%	3%	0%	12%	0%	5%
Badiru (2019)	0%	8%	11%	11%	24%	14%	0%	0%	7%	0%
Avg. % Coverage	8.38%	10.13%	6.33%	6.45%	10.20%	8.45%	2.43%	4.96%	4.03%	1.44%
Rank	4	2	6	5	1	3	9	7	8	10

To compare the textbooks studied, we examined whether there is a correlation between the degree to which knowledge areas are implemented among PMs and the degree to which the knowledge areas are covered in the textbooks (third generation). See Fig. 4 for rank comparisons. It can be seen that four of the knowledge areas (SCP, CST, PCT and CMS) received the same ranking but the most important knowledge area among PMs, SDE, received a rank of 6 (relatively low) and QLY, which received the highest rank in the textbooks, received a rank of 6 among PMs.

According to the Spearmen correlation test, there is no correlation between the two ranks. Thus, there is no correlation between the level of coverage in the textbooks and the rank of implementation that was applied from the questionnaire. The textbooks do not match the PMs' implementation in their fields of work.

Knowledge areas	Survey Rank	Textbook Rank
SDE	1	6
SCP	2	2
ING	3	4
RSK	4	7
CST	5	5
QLY	6	1
SKL	7	10
PCT	8	8
CMS	9	9
RSS	10	3

Fig. 3. The comparison of the ranking of knowledge areas, both in the survey and in textbooks

4. Conclusions

In the present study, we successfully analyzed the survey responses obtained from the 117 active PMs, intending to investigate the degree of implementation in the various fields of the knowledge areas. We were able to discover from the perspective of the PMs whether and how the PMBOK knowledge areas form a basis or an anchor for their work. The results concentrate on PMs' needs and examine the gaps between the PMBOK knowledge areas as a project management methodology and the PMs' real application of these knowledge areas.

Different conclusions emerge from the data analyzed, depending on the independent variables examined. Looking at the PMs' responses, it can be seen that there is no overall alignment among the various knowledge areas. There are differences between the various knowledge areas in terms of implementation. PMs also handle other areas, such as integration, budgeting, procurement, and communication. Other knowledge areas such as quality, scope, and stakeholders still require reinforcement among PMs.

The comparison analysis of the degree to which additional knowledge is implemented among PMs and the knowledge areas are covered in the last generation of textbooks leads us to recommend: (1) adjusting the degree of coverage of the knowledge areas to align with the degree of implementation in PMs' practice; (2) considering adding more content to the textbooks in the knowledge areas that are required in PMs' practice.

The limitations of the present study lie in the non-separation between the role of the PM and the role of the PMO in the organization. On the other hand, not every organization has two separate bodies in this respect. Another limitation is that the survey did not address the size of the organization in which the PM is employed and the nature of the projects that are managed by the PM (development or implementation).

Further research should focus on investigating reasons for the partial application of knowledge areas among PMs, whether there is a difference in the application of knowledge areas in development projects compared to implementation projects and whether there is a relationship between the application of knowledge areas and the size of the organization. In addition, it is important to analyze the degree to which the principles published in PMBOK7 are applied, the degree to which PRINCE2 methodology is implemented among PMs and the degree to which these topics are covered in textbooks. The study identified gaps between the degree to which the knowledge areas of project management are applied and the importance that the authors of textbooks attach to the above areas of knowledge. The research findings may contribute greatly to reducing these gaps. The research findings can also contribute to the professional training of people who are employed or will be employed in project management, such as engineering students of all kinds.

Author Contributions

Davidov Pini contributed to conceptualization, methodology, manuscript editing, visualization, supervision, project administration and funding acquisition. Inessa Ainbinder contributed to validation, visualization, analysis, and manuscript editing. Nadine Ayoubi contributed to data collection, analysis, and the preparation of the draft manuscript. Batel Avivi contributed to investigation, data collection, software, and analysis. Lital Eliyahu contributed to investigation, data collection, software, and analysis.

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Appendix 1.a. Introductory Questions in Survey

Please indicate your gender. ○ Male ○ Female
To which employment sector does your organization belong? ○ Private ○ Public ○ Non-profit organization
What age range do you belong to? ○ 20–30 ○ 30–40 ○ 40–50 ○ 50+
In what field are you currently a project manager? ○ Security and information systems ○ Construction ○ High-tech and digital ○ Education ○ Electricity ○ Marketing ○ Industry ○ Water and infrastructurez ○ Supply and operation chain ○ Entrepreneurship ○ Other
What is your seniority (in years) in your current workplace? _____
What is your seniority (in years) in project management in all the workplaces you have worked in? _____
What is the number of organizations in which you have managed a project? ○ 0–4 ○ 5–8 ○ 9–12 ○ 13–17 ○ 18+
What is your highest level of education? ○ BA ○ MA ○ PhD ○ Practical Engineering/Technician ○ Diploma ○ No degree

Appendix 1.b. Knowledge Areas Questions in Survey

Please indicate to what extent (1 to a small extent, 6 to a large extent) you apply tools from any of the following areas of knowledge.
1. Integration Management (preparation of a launch document and management plan for the project, directing control and supervision of the project work, performing change control). 2. Scope Management (requirements collection, content definition, work content structure (WBS), validation and control of project content). 3. Schedule Management (preparation, management and control of the schedule, definition of activities and activities in sequence, estimation of active resources and estimation of activity durations). 4. Cost Management (cost estimation, budget setting, cost control). 5. Quality Management within the project (quality assurance, quality control). 6. Human Resource Management within the project (project staff recruitment, team development and management). 7. Communication Management (communication management and control). 8. Risk Management (risk identification, qualitative and quantitative analysis of risks, planning solutions to overcome risks, control). 9. Procurement Management (execution and conclusion of procurement). 10. Stakeholder Management (identification and planning of stakeholders, management, and control of their involvement).