buildings

MDPI

Article

Factors and Areas of PgMO Supporting the Success of the Program Management in the Construction Sector

Mateusz Trzeciak

Faculty of Organization and Management, Silesian University of Technology, 44-100 Gliwice, Poland; mateusz.trzeciak@polsl.pl

Abstract: In recent years, the construction sector has been increasingly inclined toward using systematic program management approaches. Despite acknowledging the crucial impact of PgMO on program management success, the existing literature lacks sufficient research on the areas where this office can provide support for success in the construction sector. This article aims to identify the critical success factors and PgMO areas that contribute to program success in the construction sector. To address the research questions and goals, standardized interviews were conducted with 49 PgMO members from 14 organizations implementing construction programs. Based on the literature and statistical analysis, ten critical success factors (CSFs) for construction programs were identified. However, the significance of these CSFs may vary depending on the context of the construction sector. Furthermore, statistical analysis revealed five areas where PgMO can support program success: maintaining program governance, program initiation, program planning and budgeting, stakeholder and relationship management, and requirements and knowledge management resulting from program implementation. Managers are advised to take action in all the identified areas of PgMO to increase the likelihood of achieving program success. They should also pay attention to weaker areas and strengthen them as part of best practices.

Keywords: program success; construction program; program management office; PgMO; program management

Citation: Trzeciak, M. Factors and Areas of PgMO Supporting the Success of the Program Management in the Construction Sector. *Buildings* **2023**, *13*, 1336. https://doi.org/10.3390/buildings13051336

Academic Editors: Hongping Yuan and Irem Dikmen

Received: 22 April 2023
Revised: 16 May 2023
Accepted: 19 May 2023
Published: 20 May 2023

1. Introduction

In recent years, there has been a growing trend towards using systematic approaches for program management in the construction industry [1–3], which has highlighted the need to understand the contextual conditions of managing such programs [2–4]. By analyzing the literature in terms of the necessary program characteristics, it can be assumed that a program is a group of interrelated projects [5], carried out within a common pool of resources [6,7], established to achieve benefits [8,9], and managed by the program organization to achieve one or more strategic objectives [10,11]. Furthermore, construction programs are characterized by high complexity [12] and require management of multiple projects with varying levels of interdependence [13] and stakeholder engagement [14,15].

The successful implementation of these programs requires coordinated efforts across all projects [5,6], which can be difficult to achieve without effective program management practices [3]. Program management involves actions taken to coordinate organizations [16], and direct and implement a set of projects that collectively lead to the achievement of results and benefits of strategic importance [17,18]. Ritson et al. [19] emphasize that effective program delivery is a difficult goal to achieve, requiring the ability to adapt to changes in strategy and the environment, which highlights the need for developing strategic plans, approving and managing them. Additonally, van Buuren et al. [20] and Görög [21] emphasize that identifying problem areas in program management enables the identification of links between projects that make up one program during their implementation. Furthermore, the construction industry is heavily regulated [22], and compliance with regulatory requirements is one aspect of program management.

The role of the Program Management Office (PgMO), in this context, is to provide strategic and operational oversight to ensure the efficient and effective implementation of programs [23,24]. The PgMO is a separate entity from the Project Management Office (PMO) because it has a broader role, encompassing complete programs, supporting both the results of individual projects and the benefits at the program level [25]. To achieve this, the PgMO manages the entire program life cycle. Temporary PMOs can be incorporated into the PgMO structure, which has higher decision-making powers and is positioned at a higher level in the organization [25]. Unlike PMOs, which concentrate primarily on project implementation, PgMOs focus on the overall success of programs, not just individual projects [24]. PgMOs also take a more strategic approach than PMOs [23]. While the term PMO is often used in the literature to refer to both types of offices, the correct abbreviation for Program Management Office is PgMO.

However, despite the potential benefits of PgMO, there is a lack of research that clearly focuses on their roles and functions in increasing the likelihood of success in construction program management [26].

Al-Khouri [23] also emphasizes that in the field of program management, PgMOs are often undervalued despite their crucial role in ensuring program success. Although there is an increasing amount of research on PgMOs in the construction industry, the majority of it focuses on initiating and implementing PgMOs in organizational structures [27,28], their role [29,30], evaluation models [31,32], performance [33,34], and functioning concepts [35]. Nonetheless, despite the significant role of PgMOs emphasized by many researchers [36,37], there is still a need to investigate ways in which PgMOs can facilitate program success. As emphasized by Ershadi and Atashfaraz [33], identifying key contextual features of PgMO that contribute to success can directly impact the performance of the program. Furthermore, examining these features can not only provide guidelines for continuous improvement but also help improve program implementation [27], reduce costs [38], and mitigate the risk of failure [8,39]. An extensive review of the literature on PgMO in the construction industry and a synthesis of success variables was carried out by Ershadi et al. [40], emphasizing the need for research to verify PgMO areas that increase the likelihood of success.

Given the above, this article aims to identify the critical success factors and PgMO areas that contribute to program success in the construction sector. To achieve the assumed goal, the following research questions were adopted:

1. What are the critical success factors for a program that PgMO can influence in the construction sector?
2. What areas of PgMO support the success of the program in the construction sector?
3. What functions, relative to PgMO-identified areas, support program success in the construction sector?

To answer these questions, results of the research conducted in the form of standardized interviews among 49 PgMO members from 14 different organizations implementing construction programs were used.

This article consists of six sections. The Section 1 contains an introduction. Section 2 deals with the literature review on the importance and role of Program Management Offices in good practice standards [25,41,42], as well as the identification of program success factors in the construction sector. Next, the methodological assumptions are presented regarding the adopted deductive approach and statistical analyses used. In the Section 5, the author focuses on answering the research questions and highlighting the implications of the article. In the Section 6, brief concluding remarks are stated.

2. Theoretical Background

A literature review was conducted on the significance and role of PgMO in program management considering international standards, as well as the success factors of programs in the construction sector.

2.1. The Significance and Role of Program Management Office in Best Practice Standards

According to the British standard for program management (Managing Successful Programmes—MSP), a program office functions as a support to the program owner and the program board [25]. Additionally, it provides advice and challenges decisions and serves as a source of information on the health of program components [23,43]. According to the MSP guidelines [25], the support provided by a PgMO can cover a wide range, from administration to expert knowledge (such as risk and financial management) to specialized activities (such as tool support). In particular, the standard identifies eight program roles, including [25]:

1. Tracking measurements and reporting progress against plans;
2. Storing originals of all program information and preparing documentation on quality and supervision;
3. Supporting the program manager in controlling the program budget and controlling the costs of component projects;
4. Monitoring risks and issues;
5. Analyzing interfaces and critical dependencies between projects;
6. Maintaining a list of stakeholders and their areas of interest;
7. Establishing consistent practices and standards coherent with program governance, including all processes;
8. Controlling program changes.

The above roles enable the program manager to focus on management and concentrate efforts on ensuring success.

The Standard for Program Management published by the Project Management Institute (PMI) [41], views the Program Management Office as an organization responsible for defining and managing the program governance process, procedures, templates, etc., supporting individual program management teams by centrally performing the administrative function or providing dedicated assistance to the program manager. Additionally, this standard clearly defines that the role of PgMO is to support the program manager through six main functions [41]:

1. Defining program management processes and procedures that will be used;
2. Supporting program-level schedule and budget management;
3. Defining quality standards for the program and its components;
4. Supporting effective resource management throughout the program;
5. Ensuring document and configuration management (knowledge management);
6. Providing centralized support for change management and tracking of risks and issues.

However, the Portfolio, Program and Project Offices (P3O) [42] standard has no separate definition for the program office itself. Instead, for each of the three levels, it emphasizes that it is a business model allowing for decision-making and supporting the entire business change in the organization [42]. This can be a single or complex physical structure or virtual structures, i.e., permanent and/or temporary offices, providing services and performing central and local functions, ensuring integration with program management arrangements and broader areas of activity, such as other corporate support functions [44]. Although a single definition is not emphasized, this standard also identifies the roles that the office should play at the program level [42]:

1. Monitoring, reviewing, and reporting;
2. Risk, issue, and change management;
3. Finance;
4. Commercial (including supplier management);
5. Quality assurance;
6. Information management (including configuration and asset management);
7. Transition management;
8. Administration.

However, it should be noted that if PgMO serves as a center of excellence for a permanent organizational unit for one or several programs and projects included in them, it should additionally focus on standards and methods, internal consulting, organizational learning and knowledge management, and competencies [42,44].

The above PgMO standards is usually included in the organizational structure of the program [43,45]. Its position in the organization depends on the duration and significance of the program it serves, perhaps also at the level of the organization to which its manager belongs (Director, Vice President, CEO, etc.) [25,41]. In practice, the tenure, influence, and control can be attributed to the size of the organization's balance sheet to which the PgMO relates. However, the scope of influence and control of such an office is limited to the program it serves [46], and although some programs may last for many years, the PgMO ceases to exist after the program it serves is closed or when expected business benefits are delivered [47,48]. An exception is the centralized portfolio office of the organization, which in this form will be the primary center of excellence [25,41,42]. Furthermore, due to the size, complexity, and longevity of the program compared to the project, it is very difficult, if not impossible, for a program to exist and deliver expected benefits without the existence of a Program Management Office that supports and serves it. As emphasized by Shehu and Akintoye [49], the success of the program largely depends on the maturity, effectiveness, and efficiency of the central PMO, including the PgMO in this area.

2.2. Success Factors of Programs in the Construction Sector

The success of a program can be defined as achieving the optimal result of delivered benefits while ensuring stakeholder satisfaction [50,51]. Meanwhile, the success of program management comes down to ensuring that the program is implemented optimally, i.e., in the most appropriate and effective way to fulfill its purpose and achieve its intended benefits [26].

Research on the success factors of programs has gained importance among researchers in recent times [50,52], although there is still a publication deficit in understanding the conditions for program success depending on specific contexts. Furthermore, there are only a few publications on the tangible aspects of program success in the construction sector [53].

Zhau et al. [53], examining the success factors of a construction program in the Chinese context, developed seven critical factors covering organizational strategy, organizational support, completeness of management (processes), management team, program management, stakeholder collaboration, and government support.

The above factors are also emphasized by many authors. For example, Liu et al. [54], while examining the Dutch Ministry of Infrastructure and the Environment's Multi Water Works (MWW) program, identified three sets of user values that are co-created by stakeholders in the first stage of the program's life cycle. Furthermore, Smits and van Marrewijk [15], while studying the Panama Canal Expansion Program (PCEP), pay particular attention to building and maintaining relationships among program partners and related cooperation practices that enhance collaboration while preventing cost and time overruns in achieving benefits.

The key value of a program that sets it apart from a single project is the delivery of benefits realized through the cumulative potential generated by the program's projects. In this regard, Breese [8], while studying regeneration programs in neglected areas of northern England, mainly financed by the UK government, emphasizes that increased ambiguity and uncertainty of program benefits should result in greater attention paid to them and addressing the assumptions and risks that may affect their realization. The above is also confirmed by Shi et al. [39], who tested a program risk model on the basis of the 2010 Asian Games in Guangzhou. Additionally, the authors emphasize that effective program management is not possible without effective risk management.

Another area of success in which individual factors occur is resource allocation. For example, Parolia et al. [55] believe that active interdependence of resources between projects

will facilitate the promotion of interaction behaviors and lead to better program performance. The above is expanded by Fernandes and O'Sullivan [9] who researched the University–Industry Cooperation (UIC) program implemented by the University of Minho and Bosch Car Multimedia Corporation and co-financed by the Portuguese government. The authors emphasize that a clear set of controls on costs, outcomes, and resources has a significant impact on the success of the program.

Aspects related to defining program goals and objectives, including vision, requirements, and program goals, also have a significant impact on program success. As Yan et al. [2] emphasize, establishing common and specific program goals is important for achieving program success. Additionally, the authors also emphasize that the success of the program should be based on achieving long-term and strategic benefits for the organization through the use of synergies between program projects.

Another important factor is the aspect of knowledge. As emphasized by Duryan and Smyth [56], knowledge management should be seen as the ability to manage the program, that requires investment, leadership, and robust human resource management processes. The process of shared learning and problem-solving should define and evaluate changes in organizational systems and practices.

A systemic approach is also important for proper program management [57,58]. As emphasized by Frederiksen et al. [7], based on a study of a construction program involving 40 building projects in schools and childcare institutions, management mechanisms are essential in coordinating operations in program organizational spaces. Moreover, Jia et al. [1] state that most problems that arise during program implementation are due to organizational management and process management.

Based on a literature analysis, a list of 31 program success factors and 9 functions performed by PgMO supporting the identified factors was developed. A detailed list and classification of factors by function are presented in Table 1.

Table 1. Functions performed by PgMOs and success factors for construction programs identified based on literature review.

O [1] and F [2]	Functions Performed by PgMO and Success Factors of Construction Programs	References
O1	Defining program goals and requirements	[25,42]
F12	Defining and maintaining consistent program vision	[2,8,52,54]
F13	Defining program requirements	[2,8,15]
F14	Defining clear and realistic program goals	[2,8,15,52]
O2	Developing program plan and schedule	[25,41,42]
F1	Development and execution of strategic program management plan	[1,53,54]
F15	Program planning	[7,15,39]
F16	Planning the program definition phase	[7,51]
O3	Allocating resources and assigning roles and responsibilities	[41,42]
F3	Optimal resource allocation	[1,55]
F4	Procedures for granting legal approvals	[1,39]
F18	Delegation of powers and responsibilities	[1,56]
F28	Resource allocation between projects	[1,55]
O4	Providing project management guidance and best practices	[25,41]
F11	Organization support for the program	[4,53,56]
F31	Program management standard	[39,54]
F20	Appropriateness of the selection of methods, techniques and tools to the level of complexity of the program	[1,53]
O5	Monitoring program progress and making adjustments as needed	[25,41,42]
F17	Approval of the program plan and its evaluation	[1,7]
F21	Measurement and control of the performance of the integrated logistics support (common resources and delivery program)	[15,55]

Table 1. *Cont.*

O [1] and F [2]	Functions Performed by PgMO and Success Factors of Construction Programs	References
F24	Permanent reviews (monitoring and control) of the program	[1,8,19]
F27	Management and control of configuration	[1,7]
O6	Facilitating communication and collaboration among stakeholders	[25,42]
F7	Recognition of stakeholder attributes	[8,39,51,54]
F8	Supplier relationship management	[15,53,57]
F9	Stakeholder management	[8,9,49,51]
F10	Communication management	[15,39,53,55]
O7	Ensuring that program risks are identified and managed effectively	[25,41,42]
F5	Program risk management	[8,39]
F6	Risk management related to the relationship with stakeholders	[8,39]
O8	Providing oversight and quality assurance for program deliverables	[25,41,42]
F2	Supervision of the program	[9,15,54,55]
F22	Strong and structured quality control	[1,21,51]
O9	Tracking program finances and ensuring that the program stays within budget	[25,41,42]
F19	Budgeting the program	[10,51,58]
F23	Financial setup of the program based on a realistic business case	[15,21,58]
F26	Program cost management	[8,54]
O10	Program knowledge and information management	[41,42]
F25	Support for innovation	[54,58]
F29	Knowledge management: measurement and analysis of knowledge	[51,56,58]
F30	Information management	[9,15,39,55]

[1] O1–O10—Functions performed by PgMO; [2] F1–F31—Success factors of construction programs.

3. Materials and Methods

The goal of this article is to identify the critical success factors and PgMO areas that contribute to program success in the construction sector. The initial literature analysis led the research team to identify a research gap and allowed for the following research questions to be posed:

1. What are the critical success factors for a program that PgMO can influence in the construction sector?
2. What areas of PgMO support the success of the program in the construction sector?
3. What functions, relative to PgMO identified areas, support program success in construction sector?

In order to answer the research questions, an empirical research model (Figure 1) was developed based on a generally applicable procedure [59].

To achieve the intended goal and answer the research questions, the results of research conducted in the form of standardized interviews among 49 PgMO members from 14 different organizations implementing construction programs were used. The interview questionnaire was distributed online in cooperation with the branches of the International Project Management Association (IPMA), which made it possible to reach organizations with centralized PgMO implementing programs in the construction sector.

3.1. Selection of the Research Sample

To properly select the research sample, experts were first asked to assess their competence regarding the sent interview questionnaire. The expert competence indicator (K_k) [60] was used to evaluate the experts' competencies. This indicator was calculated based on Equation (1).

$$K_k = \frac{k_z + k_a}{2} \qquad (0.1 \leq K_k \leq 1) \tag{1}$$

where,

k_z—the coefficient of the expert's familiarity with the issue
k_a—the coefficient of argumentation

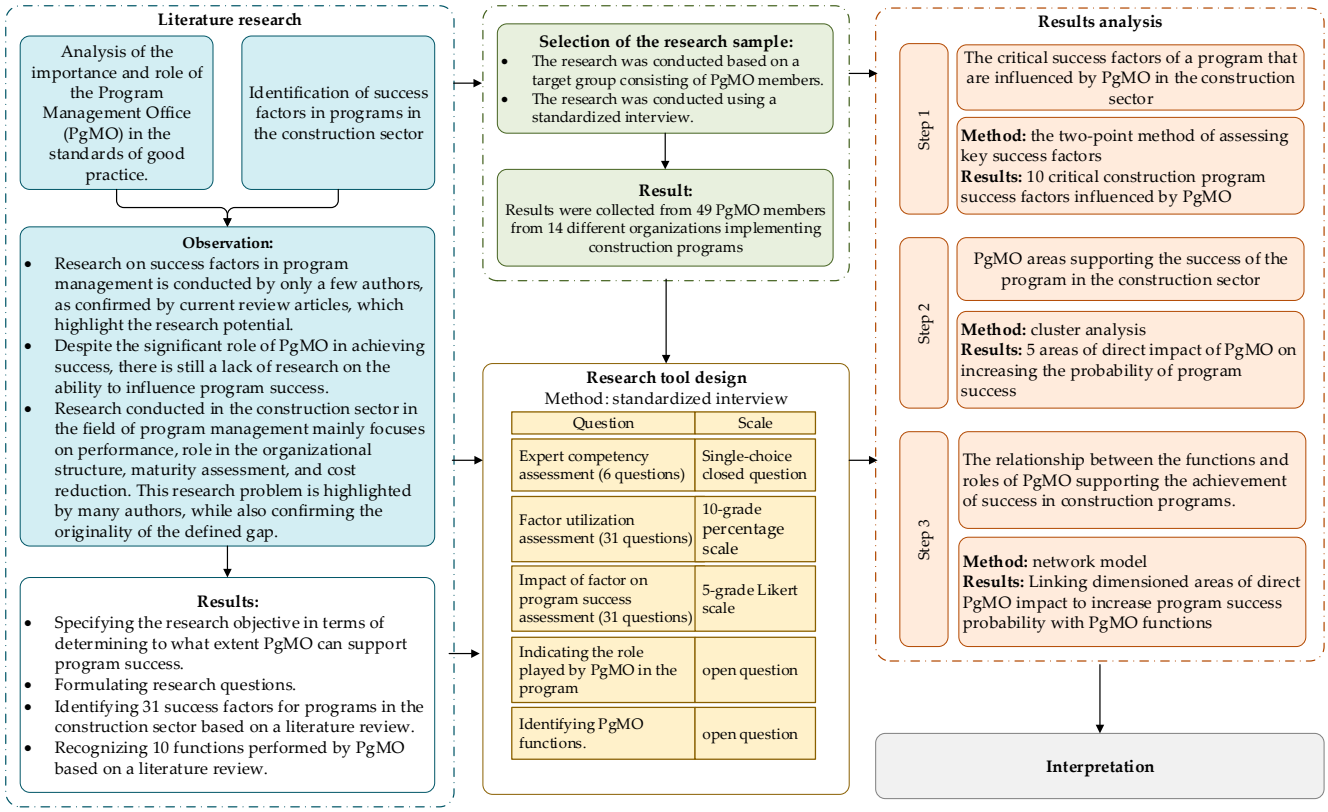

Figure 1. Model of the research process.

The calculated coefficients for each expert (E1–E49) participating in the study are presented in Table 2.

Table 2. The value of the K_k coefficient for the experts participating in the study.

	E1	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**	**E9**	**E10**	**E11**	**E12**	**E13**	**E14**	**E15**	**E16**	**E17**
k_z	0.9	0.7	0.9	0.7	0.8	0.7	0.7	0.8	0.7	0.8	0.8	0.7	0.6	0.8	0.7	0.7	0.7
k_a	0.73	0.83	0.6	0.85	0.93	0.85	0.95	0.95	0.935	0.915	0.95	0.73	0.85	0.765	0.745	0.86	0.845
K_k	0.815	0.765	0.75	0.775	0.865	0.775	0.825	0.875	0.818	0.858	0.875	0.715	0.725	0.783	0.723	0.78	0.773
	E18	**E19**	**E20**	**E21**	**E22**	**E23**	**E24**	**E25**	**E26**	**E27**	**E28**	**E29**	**E30**	**E31**	**E32**	**E33**	**E34**
k_z	0.8	0.9	0.6	0.8	0.8	0.7	0.7	0.8	0.6	0.6	0.6	0.7	0.9	0.8	0.8	0.9	0.6
k_a	0.73	0.85	0.815	0.95	0.86	0.765	0.75	0.96	0.93	0.935	0.7	0.745	0.83	0.9	0.95	0.735	0.715
K_k	0.765	0.875	0.708	0.875	0.83	0.733	0.725	0.88	0.765	0.768	0.65	0.723	0.865	0.85	0.875	0.818	0.658
	E35	**E36**	**E37**	**E38**	**E39**	**E40**	**E41**	**E42**	**E43**	**E44**	**E45**	**E46**	**E47**	**E48**	**E49**		
k_z	0.6	0.8	0.6	0.6	0.7	0.7	0.6	0.9	0.7	0.7	0.8	0.7	0.9	0.9	0.7		
k_a	0.735	0.86	0.635	0.665	0.645	0.85	0.815	0.835	0.665	0.75	0.6	0.715	0.95	0.835	0.73		
K_k	0.668	0.83	0.618	0.633	0.673	0.775	0.708	0.868	0.683	0.725	0.7	0.708	0.925	0.868	0.715		

The data collected from all experts meet the condition $K_k \geq 0.6$, which allows for the use of data for further analysis.

3.2. Construction of the Interview Questionnaire

The interview questionnaire was developed based on a literature review and consultations with other academics, following the suggestion of Saunders et al. [61]. The questionnaire consisted of five sections covering:

- Expert competency assessment (6 questions);

- Factor utilization assessment (31 questions, expressed on a 10-point percentage scale);
- Impact of factors on program success assessment (31 questions, expressed on a 5-point Likert scale);
- Indicating the role played by PgMO in the program;
- Identifying PgMO functions.

As this research is exploratory in nature, it is important to ensure its reliability. Reliability is affected by measurement errors, which are random and associated with the measuring instrument [62]. The research used a 10-point scale and Cronbach's alpha coefficient was calculated to be 0.973, while for a 5-point scale, it was 0.944, indicating high reliability of the research. The data collected were analyzed using STATISTICA 13.3 software.

4. Results

4.1. The Critical Success Factors of a Program That Are Influenced by PgMO in the Construction Sector

To determine the critical success factors of construction programs that are influenced by PgMO, a procedure based on strategic planning guidelines was used. The procedure refers to the method of two-point evaluation of key success factors [63]. The analysis used the experts' answers regarding the assessment of the use of the factor (a 10-point percentage scale) and its impact on the success of the program (a 5-point Likert scale). Taking the above into account, the mean score (*MS*) for each factor was calculated according to Equation (2).

$$MS = \frac{\sum\left(\frac{weight}{10} * impact\right)}{Number\ of\ experts} \qquad (0.1 \leq MS \leq 5) \qquad (2)$$

According to the method [63], the factor is considered critical if the value of the calculated indicator (*MS*) is greater than or equal to 2.94. This limit was set for the significance level of 0.6 with the spread of the range equal to 4.9.

Out of the 31 analyzed factors, 10 critical program success factors influenced by PgMO were selected based on the highest weighted averages of each factor. Detailed statistical measures of the identified factors are presented in Figure 2 and Table 3.

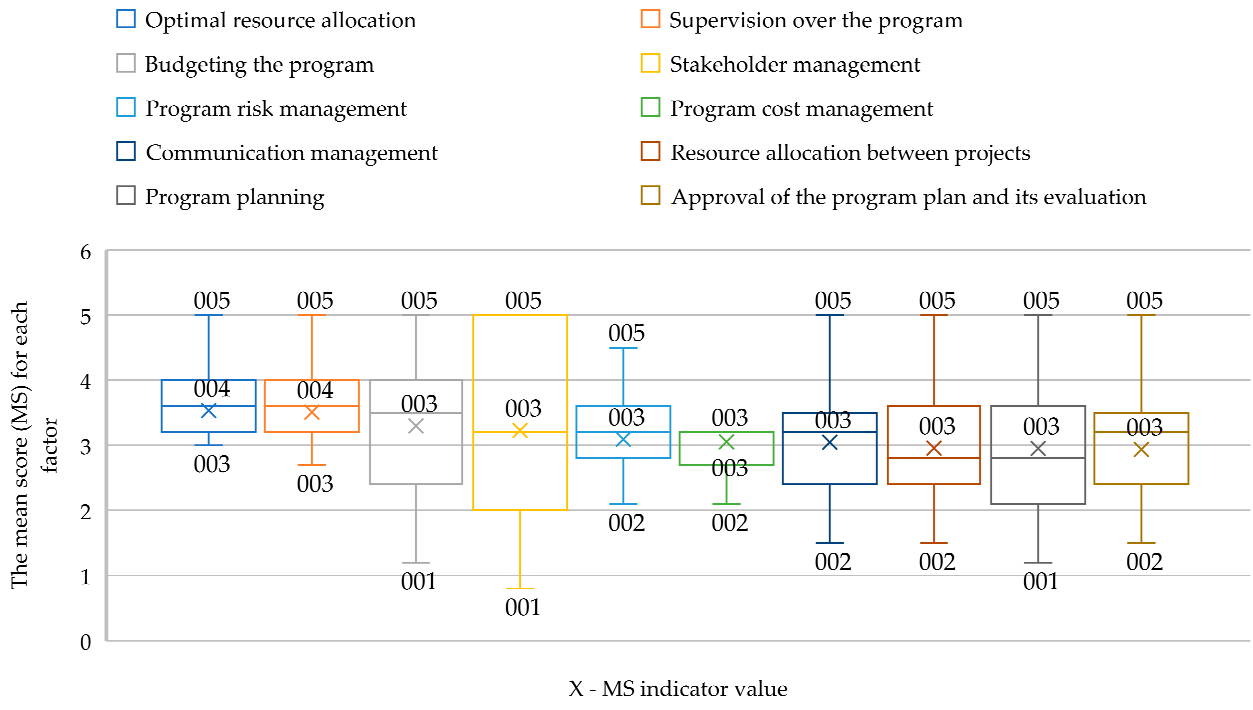

Figure 2. Ten critical program success factors influenced by PgMO.

Table 3. Statistics: critical program success factors influenced by PgMO.

KFC	MS	SD	VAR
Optimal resource allocation	3.535	0.839	0.704
Supervision over the program	3.508	1.028	1.057
Budgeting the program	3.298	1.011	1.022
Stakeholder management	3.229	1.505	2.265
Program risk management	3.092	1.078	1.162
Program cost management	3.053	0.963	0.928
Communication management	3.047	0.895	0.802
Resource allocation between projects	2.957	0.815	0.665
Program planning	2.953	1.019	1.038
Approval of the program plan and its evaluation	2.937	0.746	0.556
Procedures for granting legal approvals	2.865	0.939	0.881
Supplier relationship management	2.841	0.823	0.677
Permanent reviews (monitoring and control) of the program	2.835	0.895	0.801
Organization support for the program	2.798	0.909	0.826
Financial setup of the program based on a realistic business case	2.778	1.073	1.151
Recognition of stakeholder attributes	2.776	1.321	1.744
Strong and structured quality control	2.745	0.883	0.780
Defining and maintaining a consistent program vision	2.700	1.194	1.425
Delegation of powers and responsibilities	2.667	0.890	0.792
Risk management related to the relationship with stakeholders	2.649	1.351	1.826
Program management standard	2.616	0.993	0.986
Appropriateness of the selection of methods, techniques, and tools to the level of complexity of the program	2.602	0.968	0.938
Management and control of configuration	2.531	1.033	1.067
Development and execution of a strategic program management plan	2.496	1.321	1.745
Measurement and control of the performance of the integrated logistics support (common resources and delivery program)	2.453	0.999	0.998
Defining clear and realistic program goals	2.310	0.802	0.643
Planning the program definition phase	2.298	0.984	0.969
Information management	2.231	0.931	0.866
Support for innovation	2.033	0.928	0.862
Defining program requirements	2.000	0.853	0.728
Knowledge management: measurement and analysis of knowledge	1.951	0.741	0.550

Analyzing the obtained results (Figure 2), it can be concluded that for three factors including budgeting the program, stakeholder management, and program planning, there is variance in expert responses. This means that the influence of PgMO on these factors may be subject to change due to specific program contexts. For the remaining seven factors, this influence is smaller, which means that they can be assumed as constant for the entire construction sector. However, it should be noted that this statement does not diminish the importance of the other three factors, which also have a significant impact on achieving program success, especially since the influence of these factors may also change during program implementation. Considering the above, the lack of PgMO support in the identified factors may result in a reduced likelihood of program success.

4.2. PgMO Areas Supporting the Success of the Program in the Construction Sector

To determine the areas of PgMO in supporting program success in the construction sector, cluster analysis was used. This analysis relates to data segmentation [64] and is one of the most commonly used data exploration methods [52,65]. Its goal is to group objects in such a way that the degree of correlation between objects in the same group is as high as possible, and as low as possible with objects in other groups.

For the analysis, only data on the assessment of the impact of factors on program success (questions based on a 5-point Likert scale) were used. Basic statistical data on the factors assessed by experts are presented in Table 4.

Table 4. Basic statistical data of selected factors for cluster analysis.

	Factor	Avg	SD
F1	Development and execution of a strategic program management plan	3.816	0.527
F2	Supervision over the program	4.184	0.565
F3	Optimal resource allocation	4.061	0.556
F4	Procedures for granting legal approvals	3.776	0.715
F5	Program risk management	3.918	0.534
F6	Risk management related to the relationship with stakeholders	3.735	0.884
F7	Recognition of stakeholder attributes	3.959	0.644
F8	Supplier relationship management	3.816	0.697
F9	Stakeholder management	4.306	0.585
F10	Communication management	4.265	0.569
F11	Organization support for the program	3.959	0.644
F12	Defining and maintaining a consistent program vision	4.041	0.455
F13	Defining program requirements	3.224	0.771
F14	Defining clear and realistic program goals	3.898	0.421
F15	Program planning	4.041	0.763
F16	Planning the program definition phase	3.408	0.643
F17	Approval of the program plan and its evaluation	3.980	0.721
F18	Delegation of powers and responsibilities	3.837	0.624
F19	Budgeting the program	4.245	0.723
F20	Appropriateness of the selection of methods, techniques, and tools to the level of complexity of the program	4.143	0.707
F21	Measurement and control of the performance of the integrated logistics support (common resources and delivery program)	3.755	0.804
F22	Strong and structured quality control	3.714	0.764
F23	Financial setup of the program based on a realistic business case	4.041	0.644
F24	Permanent reviews (monitoring and control) of the program	3.776	0.743
F25	Support for innovation	3.388	0.533
F26	Program cost management	3.816	0.727
F27	Management and control of configuration	3.776	0.771
F28	Resource allocation between projects	3.837	0.657
F29	Knowledge management: measurement and analysis of knowledge	3.347	0.522
F30	Information management	3.551	0.542
F31	Program management standard	3.592	0.497

According to the clustering analysis procedure, the first step is to choose a distance measure [64]. Considering the 5-point scale used by experts and the raw nature of the data, the Manhattan distance measure was chosen. In most cases, this distance measure yields similar results to the standard Euclidean distance. However, it is important to note that in the case of the Manhattan distance measure, the influence of individual large differences (outliers) is suppressed due to them not being squared [64].

The next step is to select a method for clustering objects. One of the most efficient and popular hierarchical methods is the Ward method, in which the distance is determined based on variance analysis [65].

In accordance with the assumptions, objects were grouped, resulting in an agglomeration of 31 factors in 30 steps. To determine the number of clusters, it is suggested to use several measures. For the purposes of the analysis, two measures were chosen [66,67]:

- identification of the maximum of the measure

$$g_i = d_i - d_{i-1} \tag{3}$$

- calculation of the T. Grabiński measure [66,67]

$$q_i = max\left(\frac{d_i}{d_{i-1}}\right) \tag{4}$$

where,

- d_i—the length of the i-th branch of the tree

Based on the data of the agglomeration process (Figure 3) and the calculation of the required measures, the decision was made to cut the dendrogram. In the case of the distance difference measure (g_i = 47.714) and the distance product (q_i = 1.53), the cutting point indicates the highest value of the indicator.

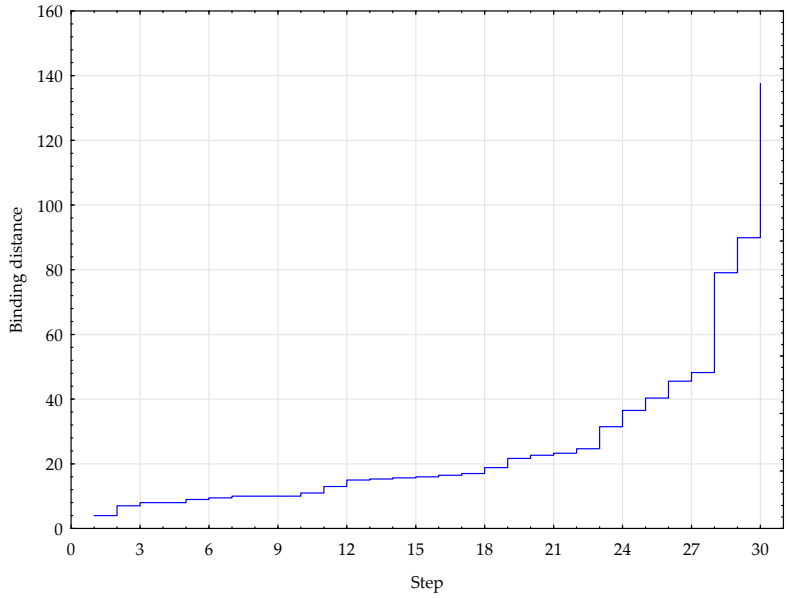

Figure 3. Agglomeration process of cluster analysis with using the Ward's method and Manhattan distance for the analyzed factors.

Considering the obtained results, a decision was made to choose five clusters by cutting the dendrogram after the 47th linkage. The detailed membership of factors in individual clusters is presented in Figure 4.

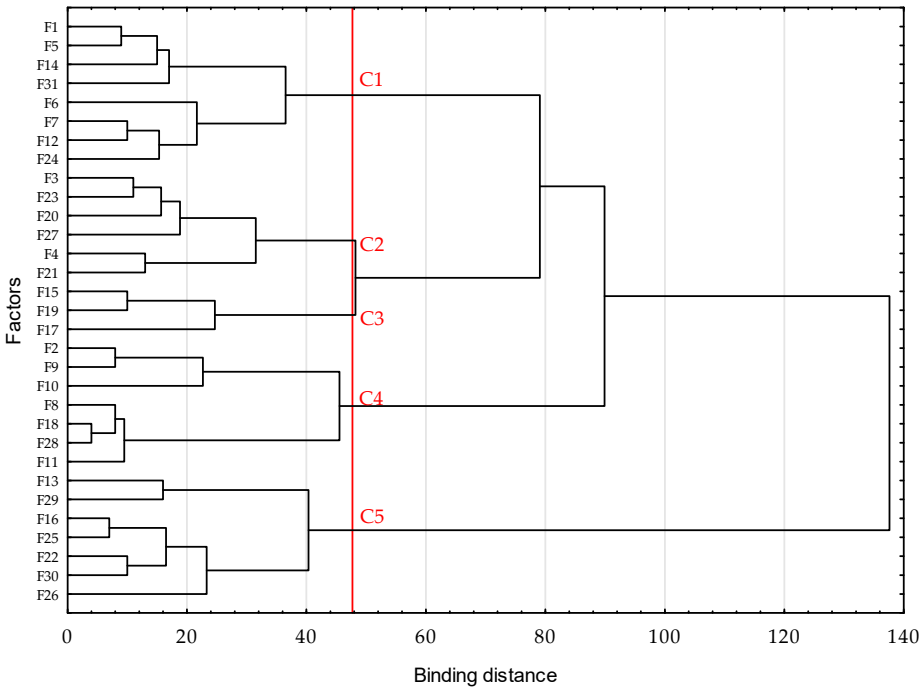

Figure 4. Extracted PgMO roles supporting program success in the construction sector.

Analyzing the obtained results, it can be noticed that:

- Cluster C1 is conditioned by the processes related to maintaining program governance.
- Cluster C2 covers issues related to program initiation.
- Cluster C3 focuses on aspects related to program planning and budgeting.
- Cluster C4 covers processes directly related to engaging program stakeholders and building and maintaining relationships.
- Cluster C5 focuses on managing program requirements and the knowledge arising from program implementation.

4.3. The Relationship between the Functions and Identified Areas of PgMO Supporting the Achievement of Success in Construction Programs

In order to examine the relationship between the functions and the identified PgMO areas supporting success in construction programs, a network model was constructed. For the construction of the first nodes, the results of a literature study were used, including the analysis of three standards of good program management practices and success factors of construction programs (Table 1). The assignment of success factors to individual functions performed by PgMO resulted directly from the descriptions contained in the analyzed standards [25,41,42]. In turn, for the construction of the second nodes, the grouping obtained as part of the cluster analysis was used, where the success factors were grouped into five PgMO areas supporting the achievement of program success. Based on the above assumptions, a network model was constructed (Figure 5), which considers the following connections:

- Success factor (F1–F31, Tables 1 and 3)—function performed by PgMO (O1–O9 Table 1).
- Success factor (F1–F31, Tables 1 and 3)—areas of PgMO supporting the achievement of program success (C1–C5, Figure 4).

Analyzing the generated model of relations, it can be concluded that:

- PgMO supports maintaining program governance (C1) through five functions. However, it should be noted that only two of them (defining program goals and objectives—O1 and ensuring that program risks are identified and managed effectively—O7) have the majority share of connections. The others include only single influences in terms of success factors.
- In the area related to program initiation (C2), the distribution of functions is evenly spread in relation to other areas. Therefore, it can be concluded that the necessary PgMO functions in this area include allocating resources and assigning roles and responsibilities (O3), providing project management guidance and best practices (O4), monitoring program progress and making adjustments as needed (O5), and tracking program finances and ensuring that the program stays within budget (O9).
- Area C3 related to program planning and budgeting shows the smallest share in terms of generated connections. The functions that can support this area (i.e., developing a program plan and schedule (O2), monitoring program progress and adjusting as needed (O5), and tracking program finances and ensuring that the program stays within budget (O9)) have only single connections.
- PgMO support for achieving program success through stakeholder engagement and relationship building (C4) is primarily identified within the function of facilitating communication and collaboration among stakeholders (O6). Additional support impact is highlighted in the case of functions related to allocating resources and assigning roles and responsibilities (O3), providing project management guidance and best practices (O4), and providing oversight and quality assurance for project deliverables (O8).
- The last recognized area related to managing program requirements and the knowledge arising from program implementation (C5) is influenced by five functions. Moreover, in this case, there is one direct connection in the area of program knowledge and information management (O10). The remaining four functions have only a small impact on supporting this area.

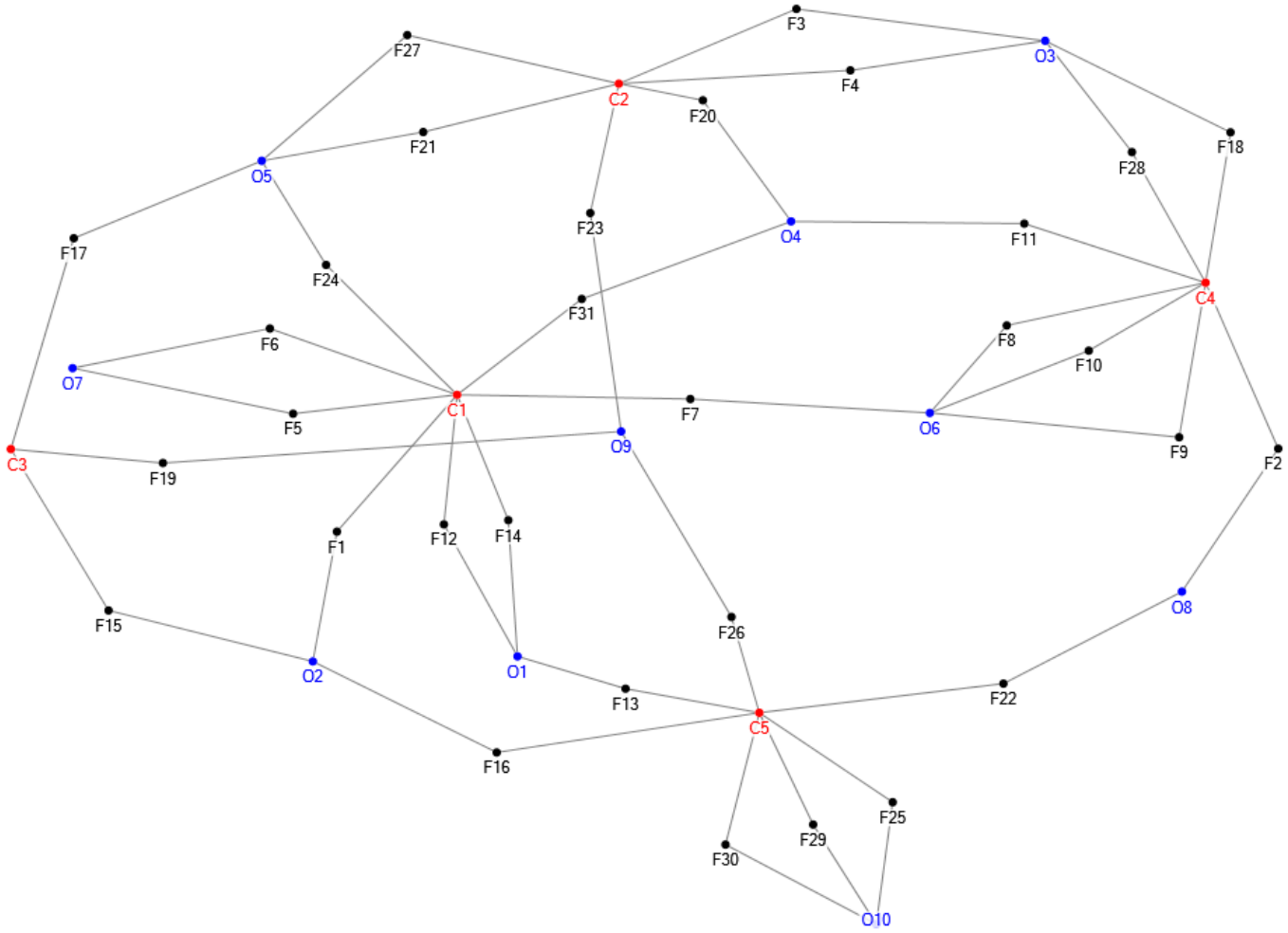

Figure 5. Model of the relationship between the function performed by PgMO and the roles of PgMO supporting the achievement of success in a construction program.

5. Discussion

The following discussion presents the answers to our research questions and indicates the theoretical and practical implications of the research and analysis.

5.1. What Are the Critical Success Factors for a Program That PgMO Can Influence in the Construction Sector?

Based on the literature analysis, 31 factors were identified as having an impact on the success of programs in the construction sector (Table 1). A statistical analysis was conducted, which allowed for the determination of 10 critical success factors (Figure 2), including:

1. Optimal resource allocation.
2. Supervision over the program.
3. Budgeting the program.
4. Stakeholder management.
5. Program risk management.
6. Program cost management.
7. Communication management.
8. Resource allocation between projects.
9. Program planning.
10. Approval of the program plan and its evaluation.

However, considering the importance of the context of the construction sector in terms of complexity [22], size [4], and scope of initiated programs [2], as well as the results obtained from the research, it cannot be unambiguously confirmed that these 10 critical success factors will always have a significant impact.

Moreover, certain regularities have been observed, which are also confirmed in the literature [1,7–10,15,49,51,53–55,58], regarding the importance of the identified success factors. Furthermore, 7 out of 10 critical success factors identified, based on the conducted analysis, have a small dispersion relative to the weights they possess. Therefore, it can be assumed that these factors will play a significant role in achieving program success in the vast majority of cases.

5.2. What Areas of PgMO Support the Success of the Program in the Construction Sector?

As a result of the conducted research and cluster analysis, five PgMO areas, which support the success of the construction program, were identified.

The first area is related to maintaining program governance. PgMO should be responsible for providing supervision and guidance to ensure that the program is implemented in accordance with the best practices, standards, and policies [38]. Moreover, it should support program compliance with organizational strategic goals [2], risk management [8], and progress monitoring [1].

The second area stems from program implementation. PgMO plays a crucial role in ensuring efficient and effective implementation of the program [25] through resource management, selection of appropriate methods and tools, and ensuring compliance with legal requirements. PgMO in this area should also monitor the program's financial configuration and ensure optimal resource allocation.

The third area focuses on the aspects related to program planning and budgeting. PgMO plays a crucial role in developing and approving the program plan [1,7], which defines program goals, scope, schedule, and resource requirements. Additionally, the office should oversee the program budgeting process, ensuring appropriate resource allocation and compliance with budgetary constraints.

The fourth area involves processes directly related to engaging program stakeholders and building and maintaining relationships. According to international standards [25,41,42], PgMO is responsible for overseeing daily program operations, including delegation of authority and responsibilities [56], allocation of resources between projects [1], management of relationships with suppliers and stakeholders [15], and ensuring effective communication among all program stakeholders [53]. Finally, the PMO should provide organizational support for the program, ensuring that necessary resources, tools, and processes are in place to enable program success.

The fifth and final recognized area focuses on managing requirements and knowledge resulting from program implementation. In this regard, PgMO can build support for program success by documenting program requirements, developing a plan for the program definition phase, and implementing robust and structured quality control processes. Additionally, PgMO, as a source of program information, should build support for innovation and knowledge.

5.3. What Functions, Relative to PgMO-Identified Areas, Support Program Success in the Construction Sector?

The researcher did not obtain a clear answer to the posed question. The analysis of the relationships between PgMO functions recognized in the literature with respect to the dimensioned areas based on the cluster analysis confirmed the researcher's assumptions. Each of the functions indicated in program management standards conditions PgMO areas supporting program success in different ways. Therefore, attention should be paid to each of these areas separately and all together. One could even hypothesize that the greatest PgMO support in achieving program success will occur as a result of implementing all areas. Furthermore, managers leading such offices should pay attention to the areas that

determine their weaknesses and subsequently strengthen them as part of best practices. A more detailed description of the relationships is presented in Section 4.3.

Despite the lack of a clear answer to the research question, several conclusions can be drawn. Firstly, PgMO's support of program governance affects the maintenance of program goals and objectives and effective risk management. Secondly, supporting the program initiation allows for optimal allocation of resources, which, according to the research results, is one of the critical success factors. Thirdly, despite the frequent role of PgMO in financial control, the area related to program planning and budgeting shows the smallest share in generated connections. Fourthly, one direct link is also shown in the area of program knowledge and information management.

Considering the above, further research on measuring the effectiveness of PgMO functioning is recommended.

5.4. Theoretical and Practical Implications

This paper has theoretical mainly because it identified research gap.

Firstly, this article summarizes the current state of knowledge on success factors for construction sector programs. As a result of the review, 31 factors were identified that impact program success.

Secondly, using the two-point method, 10 critical success factors were identified for programs implemented in the construction sector. Moreover, for 7 out of 10 factors, there is little influence of response dispersion. This means that they can be accepted as constants for the construction sector.

Thirdly, based on the conducted cluster analysis, five PgMO areas supporting program success were identified. The research also revealed that using systematic approaches to program management can significantly improve the success rates of construction programs. Additionally, the distribution of factors determining individual areas is essentially even, which means that each identified PgMO area plays a crucial role in increasing the likelihood of program success. Furthermore, the identified areas are in line with recognized standards of good practice in program management.

Practical implications are based on recommendations derived from the operationalization of statistical analysis results.

Firstly, it should be noted that the influence of PgMO on critical success factors may vary depending on the specific context of the program. Lack of support for identified factors by PgMO may reduce the likelihood of program success.

Secondly, there are five areas of PgMO that support the success of construction programs: program governance, program initiation, program planning and budgeting, stakeholder engagement and relationship building, and managing program requirements and knowledge arising from program implementation. Due to the even distribution of factors determining individual areas, each identified PgMO area plays a crucial role in increasing the likelihood of program success. Therefore, attention should be paid to strengthening the weaker aspects of PgMO and improving them.

Thirdly, the functions of PgMO that support program success vary for each area, examples of which are as follows:

- The functions of defining program goals and objectives and managing program risks have the most significant impact on program governance.
- Program initiation requires an even distribution of PgMO functions, including optimal resource allocation and role assignment, project management guidance, program progress monitoring, and financial tracking.
- The smallest share of connections is related to program planning and budgeting. Only a few functions, such as developing a program plan and schedule, program progress monitoring, and financial tracking, can support this area.
- Stakeholder engagement and relationship building require the PgMO to facilitate communication and collaboration among stakeholders and provide project management guidance and quality assurance.

- Managing program requirements and knowledge arising from program implementation can be supported by functions, such as program knowledge and information management, quality assurance, and program progress monitoring.

Fourthly, PgMO should provide supervision and guidance, monitor progress, oversee budgeting and resource allocation, manage stakeholder relationships, and document program requirements and knowledge to ensure program success.

Furthermore, the above recommendations can serve as guidelines for formulating the responsibilities of established Program Management Offices to increase the likelihood of program success.

6. Conclusions

This article aimed to identify critical success factors and PgMO areas that contribute to program success in construction. Based on standardized interviews conducted with 49 PgMO members from 14 different organizations implementing construction programs, the intended goal was achieved, and the research questions were answered.

This article discusses the critical success factors (CSFs) of programs in the construction sector and the role of the Program Management Office (PgMO) in supporting program success. Based on the literature and statistical analysis, ten CSFs were identified, including optimal resource allocation, program supervision, stakeholder management, and communication management. However, the importance of these CSFs may vary depending on the context of the construction sector.

PgMO can support program success through five different areas, including maintaining program governance, program implementation, program planning and budgeting, managing stakeholders and relationships, and managing requirements and knowledge resulting from program implementation. The researcher recommends implementing all PgMO areas to achieve program success, and suggests that managers should pay attention to the weaknesses and strengthen them as part of best practices.

However, this study did not provide a clear answer to what functions, relative to PgMO-identified areas, support program success in the construction sector, and thus further research is recommended. Overall, this article highlights the importance of effective program management and the role of PgMO in supporting program success in the construction sector.

Taking into account the methodological, theoretical, and critical approach to the selection of research methods, the obtained results should only be interpreted in the context of program management in the construction sector. In other sectors, the results may be different, depending on the specific context. In addition, the results were based only on one study, that is, standardized interviews, which may also affect the limitations of the results obtained. Future research should include a diverse group of respondents and various research methods (surveys, observations, and documentation analysis).

Despite these research limitations, this article contributes to filling the research gap in the literature. Furthermore, the present paper presents recommendations based on statistical analysis results that can serve as guidelines for formulating the scope of responsibilities of the Program Management Offices to increase the likelihood of program success.

Funding: This research was funded by the Silesian University of Technology, Poland, grant number 13/010/BK_23/0072.

Data Availability Statement: Data are contained within the article.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Jia, G.; Chen, Y.; Xue, X.; Chen, J.; Cao, J.; Tang, K. Program management organization maturity integrated model for mega construction programs in China. *Int. J. Proj. Manag.* **2011**, *29*, 834–845. [CrossRef]
2. Yan, H.; Elzarka, H.; Gao, C.; Zhang, F.; Tang, W. Critical success criteria for programs in China: Construction companies' perspectives. *J. Manag. Eng.* **2019**, *35*, 04018048. [CrossRef]

3. Rawai, N.M.; Fathi, M.S.; Abedi, M. A Review of Project and Programme Management Reference Models for the Construction Industry. *J. Constr. Eng. Manag.* **2013**, *2*, 17–20.
4. Hu, Y.; Chan, A.P.; Le, Y.; Jin, R.Z. From construction megaproject management to complex project management: Bibliographic analysis. *J. Manag. Eng.* **2015**, *31*, 04014052. [CrossRef]
5. Shao, J.; Müller, R.; Turner, J.R. Measuring program success. *Proj. Manag. J.* **2012**, *43*, 37–49. [CrossRef]
6. Martinsuo, M.; Hoverfält, P. Change program management: Toward a capability for managing value-oriented, integrated multi-project change in its context. *Int. J. Proj. Manag.* **2018**, *36*, 134–146. [CrossRef]
7. Frederiksen, N.; Gottlieb, S.C.; Leiringer, R. Organising for infrastructure development programmes: Governing internal logic multiplicity across organisational spaces. *Int. J. Proj. Manag.* **2021**, *39*, 223–235. [CrossRef]
8. Breese, R. Benefits realisation management: Panacea or false dawn? *Int. J. Proj. Manag.* **2012**, *30*, 341–351. [CrossRef]
9. Fernandes, G.; O'Sullivan, D. Benefits management in university-industry collaboration programs. *Int. J. Proj. Manag.* **2021**, *39*, 71–84. [CrossRef]
10. Miterev, M.; Engwall, M.; Jerbrant, A. Exploring program management competences for various program types. *Int. J. Proj. Manag.* **2016**, *34*, 545–557. [CrossRef]
11. Angus, G.Y.; Kittler, M. Matching programme structure to environment: A comparative study of two IS-based change programmes. *Int. J. Proj. Manag.* **2012**, *30*, 740–749.
12. Yan, H.; Yang, Y.; Lei, X.; Ye, Q.; Huang, W.; Gao, C. Regret Theory and Fuzzy-DEMATEL-Based Model for Construction Program Manager Selection in China. *Buildings* **2023**, *13*, 838. [CrossRef]
13. Karamoozian, A.; Wu, D. A hybrid risk prioritization approach in construction projects using failure mode and effective analysis. *Eng. Constr. Archit. Manag.* **2020**, *27*, 2661–2686. [CrossRef]
14. Trzeciak, M.; Jonek-Kowalska, I. Monitoring and control in program management as effectiveness drivers in polish energy sector. Diagnosis and directions of improvement. *Energies* **2021**, *14*, 4661. [CrossRef]
15. Smits, K.; van Marrewijk, A. Chaperoning: Practices of collaboration in the panama canal expansion program. *Int. J. Manag. Proj. Bus.* **2012**, *5*, 440–456. [CrossRef]
16. McGrath, S.K.; Whitty, S.J. What is a program: An examination of terminology in practitioner reference documents. *J. Mod. Proj. Manag.* **2019**, *6*, 6–27.
17. McGrath, S.; Whitty, S.J. The suitability of MSP for engineering infrastructure. *J. Mod. Proj. Manag.* **2020**, *7*, 348–368.
18. Midler, C.; Maniak, R.; de Campigneulles, T. Ambidextrous program management: The case of autonomous mobility. *Proj. Manag. J.* **2019**, *50*, 571–586. [CrossRef]
19. Ritson, G.; Johansen, E.; Osborne, A. Successful programs wanted: Exploring the impact of alignment. *Proj. Manag. J.* **2012**, *43*, 21–36. [CrossRef]
20. Van Buuren, A.; Buijs, J.M.; Teisman, G. Program management and the creative art of coopetition: Dealing with potential tensions and synergies between spatial development projects. *Int. J. Proj. Manag.* **2010**, *28*, 672–682. [CrossRef]
21. Görög, M. Translating single project management knowledge to project programs. *Proj. Manag. J.* **2011**, *42*, 17–31. [CrossRef]
22. Yousri, E.; Sayed, A.E.B.; Farag, M.A.M.; Abdelalim, A.M. Risk Identification of Building Construction Projects in Egypt. *Buildings* **2023**, *13*, 1084. [CrossRef]
23. Al-Khouri, A.M. Program Management Philosophy and the Importance of a PgMO. In *Program Management of Technology Endeavours: Lateral Thinking in Large Scale Government Program Management*; Al Khouri, A., Ed.; Palgrave Macmillan: London, UK, 2015; pp. 42–86.
24. Kunkle, J.; Contreras, A.; Abba, W.; Haase, M.; Pells, D.L. The Enterprise Program Management Office: Another Best Practice at the National Nuclear Security Administration. *PMWJ* **2017**, *6*, 1–14.
25. AXELOS. *Managing Successful Programmes, 2011 ed.*; The Stationery Office: London, UK, 2014.
26. Trzeciak, M. Research issues in programme management: A systematic review of literature. *Sci. J. Sil. Univ. Technol. Ser. Org. Manag.* **2022**, *2022*, 551–567.
27. Higham, A.A.A. How project management office (PMO) can be established in the Saudi Arabian construction organisations. In Proceedings of the 13th International Postgraduate Research Conference 2017, Salford, UK, 14–15 September 2017; p. 597.
28. Almansoori, M.T.S.; Rahman, I.A.; Memon, A.H. Correlation between the Management Factors Affecting PMO Implementation in UAE Construction. *Int. J. Sustain. Constr. Eng. Technol.* **2021**, *12*, 155–165. [CrossRef]
29. Silvius, G. The role of the project management office in sustainable project management. *Procedia Comput. Sci.* **2021**, *181*, 1066–1076. [CrossRef]
30. Kiani, S.; Yousefi, V.; Nouri, S.; Khadivi, A.M.; Mehrabanfar, E. Determining the role of project management office in the success of project-based organizations. *Mediterr. J. Soc. Sci.* **2015**, *6*, 325. [CrossRef]
31. Szalay, I.; Kovács, Á.; Sebestyén, Z. Integrated framework for project management office evaluation. *Procedia Eng.* **2017**, *196*, 578–584. [CrossRef]
32. Azevedo Junior, J.A.I.R.; Barroso, A.C.D.O.; Monteiro, C.A. An expedited model to appraise project management office value. *Int. J. Dev. Res.* **2022**, *11*, 52699–52704.
33. Ershadi, M.; Atashfaraz, R. Improvement of project management office performance: An empirical investigation of effective factors in iranian construction industry. *Int. J. Ind. Syst. Eng.* **2016**, *9*, 146–164.

34. Hu, Y.; Chan, A.P.; Le, Y.; Xu, Y.; Shan, M. Developing a program organization performance index for delivering construction megaprojects in China: Fuzzy synthetic evaluation analysis. *J. Manag. Eng.* **2016**, *32*, 05016007. [CrossRef]
35. Oliveira, C.; Tereso, A.; Fernandes, G. PMO conceptualization for engineering and construction businesses. *Procedia Comput. Sci.* **2017**, *121*, 592–599. [CrossRef]
36. Chen, X.; Wang, Z.; He, S.; Li, F. Programme management of world bank financed small hydropower development in Zhejiang Province in China. *Renew. Sustain. Energy Rev.* **2013**, *24*, 21–31. [CrossRef]
37. Hu, Y.; Chan, A.P.; Le, Y. Understanding the determinants of program organization for construction megaproject success: Case study of the Shanghai Expo construction. *J. Manag. Eng.* **2015**, *31*, 05014019. [CrossRef]
38. Teubner, R.A. IT program management challenges: Insights from programs that ran into difficulties. *Int. J. Inf. Syst. Proj. Manag.* **2018**, *6*, 71–92. [CrossRef]
39. Shi, Q.; Zhou, Y.; Xiao, C.; Chen, R.; Zuo, J. Delivery risk analysis within the context of program management using fuzzy logic and DEA: A China case study. *Int. J. Proj. Manag.* **2014**, *32*, 341–349. [CrossRef]
40. Ershadi, M.; Jefferies, M.; Davis, P.; Mojtahedi, M. Project management offices in the construction industry: A literature review and qualitative synthesis of success variables. *Constr. Manag. Econ.* **2021**, *39*, 493–512. [CrossRef]
41. PMI. *The Standard for Program Management*, 4th ed.; Project Management Institute Inc.: Newtown Square, PA, USA, 2017.
42. Roden, E.; Vowler, S. *Portfolio, Programme and Project Offices*; Stationery Office Books: London, UK, 2013.
43. Al-Khouri, A.M. Overview of Various Project and Program Management Standards. In *Program Management of Technology Endeavours: Lateral Thinking in Large Scale Government Program Management*; Al Khouri, A., Ed.; Palgrave Macmillan: London, UK, 2015; pp. 87–132.
44. Reiss, G.; Rayner, P. *Portfolio and programme management demystified: Managing multiple projects successfully*, 2nd ed.; Routledge: New York, NY, USA, 2013.
45. Taylor, M.P.; Mead, M.R.; Holloway, M.J. *Delivering Successful PMOs: How to Design and Deliver the Best Project Management Office for Your Business*; Gower Publishing Limited: England, UK, 2015.
46. McNally, C.; Smith, H.; Morrison, P. *Improving Portfolio, Programme and Project Financial Control*; The Stationery Office: London, UK, 2011.
47. Janka, T.; Kosieradzka, A. The new approach to the strategic project management in the polish public administration. *Found. Manag.* **2019**, *11*, 143–154. [CrossRef]
48. Saeed, M.A.; Abbasi, A.; Rashid, T. Project Benefits Realization-Academics' Aspiration or Practitioners' Nightmare. *PGCAR* **2019**, *2*, 21–32.
49. Shehu, Z.; Akintoye, A. Major challenges to the successful implementation and practice of programme management in the construction environment: A critical analysis. *Int. J. Proj. Manag.* **2010**, *28*, 26–39. [CrossRef]
50. Shao, J. The moderating effect of program context on the relationship between program managers' leadership competences and program success. *Int. J. Proj. Manag.* **2018**, *36*, 108–120. [CrossRef]
51. Rijke, J.; van Herk, S.; Zevenbergen, C.; Ashley, R.; Hertogh, M.; ten Heuvelhof, E. Adaptive programme management through a balanced performance/strategy oriented focus. *Int. J. Proj. Manag.* **2014**, *32*, 1197–1209. [CrossRef]
52. Trzeciak, M.; Kopec, T.P.; Kwilinski, A. Constructs of project programme management supporting open innovation at the strategic level of the organisation. *JOItmC* **2022**, *8*, 58. [CrossRef]
53. Zhou, C.; He, Z.; Hu, P.; Yan, H. Empirical Research on the Critical Success Factors of Construction Program. *Comput. Intell. Neurosci.* **2022**, *2022*, 9701963. [CrossRef]
54. Liu, Y.; van Marrewijk, A.; Houwing, E.J.; Hertogh, M. The co-creation of values-in-use at the front end of infrastructure development programs. *Int. J. Proj. Manag.* **2019**, *37*, 684–695. [CrossRef]
55. Parolia, N.; Jiang, J.J.; Klein, G.; Sheu, T.S. The contribution of resource interdependence to IT program performance: A social interdependence perspective. *Int. J. Proj. Manag.* **2011**, *29*, 313–324. [CrossRef]
56. Duryan, M.; Smyth, H. Service design and knowledge management in the construction supply chain for an infrastructure programme. *Built Environ. Proj. Asset Manag.* **2019**, *9*, 118–137. [CrossRef]
57. Wen, Q.; Qiang, M.; Gloor, P. Speeding up decision-making in project environment: The effects of decision makers' collaboration network dynamics. *Int. J. Proj. Manag.* **2018**, *36*, 819–831. [CrossRef]
58. Laine, T.; Korhonen, T.; Martinsuo, M. Managing program impacts in new product development: An exploratory case study on overcoming uncertainties. *Int. J. Proj. Manag.* **2016**, *34*, 717–733. [CrossRef]
59. Bell, E.; Bryman, A.; Harley, B. *Business Research Methods*, 6th ed.; Oxford University Press: Oxford, UK, 2022.
60. Dzwigol-Barosz, M. Enhancement methods of emotional intelligence-related competencies of successors in family businesses. In Proceedings of the Economic and Social Development: Book of Proceedings, Moscow, Russia, 30–31 October 2017; pp. 718–726.
61. Saunders, M.; Lewis, P.; Thornhill, A. *Research Methods for Business Students*, 5th ed.; Pearson education Limited: England, UK, 2009.
62. Cresswell, J.W. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 3rd ed.; Sage: London, UK, 2009.
63. Park, S.H. Whole life performance assessment: Critical success factors. *J. Constr. Eng. Manag.* **2009**, *135*, 1146–1161. [CrossRef]
64. Granato, D.; Santos, J.S.; Escher, G.B.; Ferreira, B.L.; Maggio, R.M. Use of principal component analysis (PCA) and hierarchical cluster analysis (HCA) for multivariate association between bioactive compounds and functional properties in foods: A critical perspective. *Trends Food. Sci. Technol.* **2018**, *72*, 83–90. [CrossRef]

65. Sienkiewicz-Małyjurek, K.; Owczarek, T. Complementarity of Communication and Coordination in Ensuring Effectiveness of Emergency Management Networks. *Sustainability* **2021**, *13*, 221. [CrossRef]
66. Kempa, W.; Rydarowska-Kurzbauer, J.; Halama, M.; Smuda, E.; Biel, M. Statistical and Econometric Analysis of Selected Effects of COVID-19 Pandemic. *Multidiscip. Asp. Prod. Eng.* **2021**, *4*, 395–407. [CrossRef]
67. Grabiński, T. Podstawy Kwantyfikacji Zmiennych Przestrzennych. In *Badania Przestrzenne Rynku Konsumpcji*; Mynarski, S., Ed.; PWN: Warsaw, Poland, 1992.