

IDENTIFICATION OF PARAMETERS FOR THE ANALYSIS OF STRUCTURAL WEAKNESSES IN IPA INFRASTRUCTURE PROJECTS: LITERATURE REVIEW

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Abstract

The implementation of infrastructure and other projects financed through the European Union Instrument for Pre – Accession Assistance (IPA) in the Republic of North Macedonia is associated with significant deviations from planned schedules, budgets and outcomes that are expected to achieve, indicating the presence of structural weaknesses in project management. The aim of this paper is to identify and systematize the critical parameters influencing the successful implementation of infrastructure projects through a literature review of relevant methodologies and procedures applied by international financial institutions, as well as analyzing available reports and documentation related to IPA projects. The research focuses on parameters associated with phases of the project life cycle, including project initiation and planning, preparation of technical documentation, procurement procedures, contractual condition, implementation, supervision and final project delivery with quality control. The identified parameters are grouped and structured according to project life cycle in order to facilitate a clearer presentation of critical factors that most frequently contribute to time delays, cost overruns and reduced efficiency in project implementation. Furthermore, this study provides a foundation for further empirical analysis and validation through the application of data derived from real implemented infrastructure projects.

Keywords: infrastructure projects, IPA funds, parameters, structural weaknesses, project life cycle

Introduction

The development of a country largely depends on the quality of planning and implementation of infrastructure projects, as a fundamental prerequisite for sustainable development – long term economic and social development, as well as maintaining environmental protection requirements. The aim of this research is to identify and analyze the critical factors that can directly influence the performance of infrastructure project financed through the IPA programs. The analysis encompasses the entire project life cycle, from the early stages – initiation of the project idea, preparation of feasibility study and project documentation, through public procurement procedures and contractual conditions, to the phase of construction, supervision and closure with quality control. Within the scope of the research, critical parameters with potential impact on the success of project implementation are identified, highlighting their role within different project life cycle phases. The transformation of initial project concepts into a complete built environment represent a complex process influenced not only by the needs of society, but also by institutional capacities, planning frameworks and governance structures [1]. In the context of transition economies, including the Republic of North Macedonia, previous experience in the implementation of such projects indicates the existence of systematic weaknesses manifested through low implementation rates, frequent time delays, cost overruns and insufficient utilization of available financial resources [2]. These phenomena negatively affect the performance of public investments, disrupt the continuity of development planning and contribute to increased fiscal pressure. Of particular concern is the fact that such challenges are evident in projects financed through non – repayable funds provided by the European Union and other financial institutions, where the Republic of North Macedonia demonstrates a relatively low level of implantation efficiency. This situation directly affect the dynamics of economic growth and slows down the transformational processes necessary for

successful European integration, because significant share of planned capital investments within national strategic and budgetary documents is expected to be financed through these mechanisms [3].

Sustainable management of capital investments requires timely identification, analysis and control of project weaknesses, as well as continuous monitoring of project performance throughout the entire project life cycle [4]. Emphasizing the importance of informed decision making based on systematic and quantified risk analysis [5]. From the initial stages of project development, it is essential to balance design intentions with institutional capacity in order to achieve sustainability objectives [6]. Structuring the risk according to the phases of project life cycle represent a classical and fundamental element of modern project management, given that risks are not static, but rather evolve and manifest differently throughout the phases of planning, design, public procurement, construction and operation. Such approach enables a clearer identification of risk sources, assessment of their probability and impact within a specific temporal context and selection of appropriate corrective measures [7]. Neglecting or insufficiently addressing any of those challenges may lead to the accumulation of risks, inefficient use of resources and deviation from planned project objectives [8]. The successful implementation of such projects depends on effective leadership and active involvement of competent stakeholders advocating investments in sustainable direction [9]. Furthermore, effective project management represents a fundamental component in the realization of architectural and infrastructural development, not only as a technical framework but also as a crucial aspect of spatial, functional and operational performance [10]. In addition, selection and application of construction materials must comply with relevant legal regulations and technical standards in order to ensure safety, durability and long term operational performance [11].

In order to precisely define and measure the impact of critical risks on project success, it is necessary for such risks to be systematically identified, analyzed and structured according to clearly defined and measurable parameters [12]. This approach enables an objective assessment of both the probability and consequences of risks and provides the basis for their quantification. Particularly significant are the findings confirming that the early phase of project life cycle have decisive influence on the overall success of the project.

Research methodology

In this research, a systematic approach of literature review was applied for the identification of critical parameters with influence on the performance of capital infrastructure projects financed through IPA funds in the Republic of North Macedonia. During the research process the following sources and materials were analyzed:

Scientific literature in the field of architecture and project management, with focus on the analysis of potential risks related to project delays and cost overruns.

PRAG procedures and FIDIC contractual standards which are mandatorily applied from international financial institutions.

Other projects documentation including reports from evaluation committees, audit reports etc. related the IPA infrastructure projects.

Based on this research process, a total of 30 parameters were identified and classified according to the phases of the project life cycle.

Within the scope of the research, the following phases were considered:

Idea – project initiation

Preparation of feasibility study

Preparation of project documentation

Procurement procedures and contractual conditions

Project implementation

Closure with quality control

Results

The following section presents the results of this study obtained through the analyses of selected literature, project documentation, procedures and guidelines used from international financial institutions, as well as applicable national legislation. The research identified a total of 30 parameters with direct influence on the performance of IPA funded infrastructure projects. In order to ensure a clearer analytical structure and facilitate a more comprehensive interpretation of their role in different stages of project management, the identified parameters are grouped into six categories according to the phases of the project life cycle described in the research methodology. For each parameter, the following elements are presented: the parameter name, conceptual explanation – definition of the parameter, the corresponding indicator for its measurement and the relevant literature source from where parameters are identified. Such a structured presentation enables a clear and transparent representation of the identified parameters, while simultaneously providing a consistent analytical framework for their further evaluation.

3.1 Parameters for the project initiation phase: Following table presents the identified parameters related to the project initiation phase, including their conceptual definition, measurement indicators and corresponding literature sources.

Table 1: Identified parameters for the project initiation phase

PARAMETERS	DEFINITION	INDICATOR	LITERATURE
Project justification	Degree to which project objectives, scope, expected benefits and strategic alignment are clearly defined during the initial phase, providing a stable basis for feasibility analysis and subsequent decision making	Degree of completeness of the project justification section, consistency between the problem definition, objectives, scope and preliminary budget	[17], [18], [60]
Institutional readiness	Degree to which the responsible possess adequate organizational capacity, clearly defined roles, decision making authority and human resources for project control throughout the entire project life cycle	Existence of a formal project management structure, availability of dedicated project team, clarity of roles and responsibilities, experience with similar projects	[19], [50], [53]
Stakeholder identification	Degree to which all relevant stakeholders (institutional, technical, financial) are systematically identified, analyzed and documented during initial phase, including their roles, interests and influence on the project	Existence and completeness of a stakeholder register, coverage of key stakeholder categories, analysis, addressing roles, interests and influence	[15], [20], [60]
Financing structure	Degree to which financing sources, financing structures, eligibility conditions, co – financing requirements, cash flow needs and financial risk are systematically analyzed and documented prior to project implementation decisions	Completeness of financing analysis, identification of financing sources, clearly defined co – financing participation and prepared cash flow projections	[21], [53]

Level of political sensitivity	Degree to which project is exposed to political influence or political pressure, public visibility, that may affect the objectivity of decision making process, prioritization or stability of the project throughout its life cycle	Political visibility of project, frequency of political references in official decisions, changes in project scope, schedule, budgeted influenced from political cycles	[17], [22], [53]
Constraints	Degree to which predefined constraints (technical, institutional, financial, environmental or time related) limit project flexibility and decision making processes and implementation possibilities throughout project life cycle	Number and type of documented constraints, existence of binding legal, budgetary, technical or other limitations affecting project scope and implementation	[15], [23], [50]

3.2 Parameters for the feasibility study phase: Following parameters were identified as critical elements within the feasibility study phase, primarily influencing the reliability of project planning and the accuracy of early strategic and operational decisions.

Table 2: Identified parameters for the feasibility study phase

PARAMETERS	DEFINITION	INDICATOR	LITERATURE
Initial cost estimate	Degree to which the initial project cost estimate (prepared prior to detailed design) is realistic, comprehensive and aligned with the project scope, market condition and identified constraints	Difference (%) between the initial cost estimate and the contracted price	[24], [59], [60]
Initial duration estimate	Degree to which the initial project duration estimate is realistic, comprehensive and aligned with institutional capacity, procurement procedures, technical and financial constraints	Difference (%) between the estimated and actual project duration	[17], [25], [60]
Identification of critical points	Degree to which critical points, risks, sensitive moments within the project implementation are systematically identified, documented and analyzed at an early stage in order to enable preventive planning	Existence of a documented critical path analysis, risk register and identified mitigation measures	[26], [59], [61]
Alignment with administrative capacity and procedures	Degree to which project requirements, deadlines, documentation and procedural complexity are realistically aligned with actual administrative capacity and institutional experience	Evidence of conducted capacity assessments, alignment between procedural complexity and available administrative resources, frequency of procedural delays and repeated procedures	[27], [58]

3.3 Parameters for the preparation of project documentation phase: The parameters presented below reflect the technical quality, consistency and implementation readiness of the project documentation, which are considered essential requirements for successful project execution.

Table 3: Identified parameters for the project documentation phase

PARAMETERS	DEFINITION	INDICATOR	LITERATURE
Maturity of project documentation	Degree to which technical documentation is sufficiently developed, coordinated and verified, ensuring clarity of project scope, quantities, construction feasibility in compliance with applicable standards	Number of unresolved design issues, degree of completeness of the bill of quantities calculations	[17], [28], [61]
Alignment of design with cost and time	Degree to which the technical design is explicitly coordinated with cost estimates and project schedules, ensuring that design solutions are feasible within the approved budgeted and planned duration	Consistency between the design scope, bill of quantities, cost estimate and baseline project schedule	[14], [29], [59]
Level of innovation	Degree to which the project incorporates new or non - standard technical solutions, construction methods, materials, digital tools or management approaches compared to local practices	Presence of non – standard solutions, innovative design or construction elements, existence of innovation – related risk assessment or pilot validation	[15], [30], [61]
Detected errors	Degree to which errors, inconsistencies, deficiencies in the technical design affect quantity analyses, technical specifications and project implementation	Number of errors during bid evaluation or project execution	[13], [31], [59]

3.4 Parameters for the procurement procedures and contract award phase: The parameters identified in this phase reflect the procedural efficiency, regulatory compliance, contractual structure and marked related factors that may significantly influence the transparency and effectiveness of project implementation.

Table 4: Identified parameters for the procurement procedures and contract award phase

PARAMETERS	DEFINITION	INDICATOR	LITERATURE
Duration of procurement procedures	Total duration required for conducting procurement procedures related to the selection of contractors for technical documentation, supervision services and construction works, including repetitions, cancelations and procedural delays	Duration of each procurement procedure, number of cancelled or repeated tenders	[32], [48], [52]
Technical and financial requirements	The degree to which the technical specifications, qualification criteria and financial requirements defined within the tender documentation are appropriated, clear and aligned with the complexity of the project and market capacity	Lever of compliance with PRAG and FIDIC requirements, number of clarification requests, number of compliant bids, frequency of tender cancellations	[14], [33], [48]

Structural imbalance in participation	Degree to which procurement procedures result in unbalanced participation among bidders, indicating the existence of structural barriers related to financial capacity, technical requirements and experience criteria	Ratio of awarded contracts between domestic and international companies, diversity of bidder participation, representation of subcontracting or consortium participation	[34], [52], [51]
Irregularities in procurement procedures	The occurrence of cancelled, repeated, suspended procurement procedures resulting from procedural errors noncompliance with regulations, audit findings or suspicions for irregularities and frauds	Number of cancelled or repeated tenders, references to procedural noncompliance in official decisions	[35], [48], [52]
Contract type and risk allocation	The degree to which the selected contract type and payment mechanisms appropriately allocate risks and responsibilities among contractual parties	Type of contract used, payment mechanisms, risk allocation matrix frequency of claims , variations and extensions of time	[36], [49], [56]
Transparency among project participants	The degree to which different types of contractual engagement (main contractor, sub-contractor, consortium) create unequal responsibilities and risk exposure	Level of disclosure of sub-contractors and providers of technical and financial capacity during the tendering phase, differences in contractual conditions (prior to contract award versus after contract award)	[37], [49], [54]

3.5 Parameters for the project implementation phase: The parameters associated with the implementation phase primarily address operational, technical, financial and managerial conditions that directly affect the continuity, efficiency and overall performance of project execution.

Table 5: Identified parameters for the project implementation phase

PARAMETERS	DEFINITION	INDICATOR	LITERATURE
Delayed start of implementation	The time difference between the formal commencement date of the contract and the actual start of works, caused by unresolved preconditions, administrative delays or procedural inefficiencies	Number of days between the planned and actual commencement of works and reasons for delay documented in official reports	[17], [38], [59]
Technical and financial capacity of contractor	The degree to which the selected contractor possesses adequate technical expertise, human resources equipment and financial stability to execute the contracted works in accordance with project requirements	Compliance with qualification criteria, financial indicators, relevant references, key personnel and equipment	[14], [39], [58]
Unforeseen conditions and additional works	Degree to which unforeseen site conditions, deficiencies in technical solutions or external factors require additional works, modifications or variations	Number and value of variation orders, justifications for additional works, documented unforeseen conditions	[15], [40], [59]
Currency risk	Changes in exchange rates between the contract currency and the local currency affect project	Exchange rate fluctuations during the contractual period, existence of price adjustment or foreign exchange risk clauses	[41], [58]

	costs, payments, cash flow during project implementation	
Material supply	The degree to which the availability, timeliness of delivery, logistics and reliability of construction material supply affect project implementation including import dependency and market shortages	Delays in material delivery, number of work interruptions caused by material shortages, changes in material prices , meeting eligibility requirements [16], [42], [59]
Effectiveness of supervision	The degree to which the supervising authority effectively manages , coordinates and response to unplanned events , ensuring timely decisions in order to mitigate impact on time and cost	Response time to unplanned events, number of unresolved issues quality of site instruction , impact of unplanned events on schedule and costs [13], [43], [58]

3.6 Parameters for the project closure and quality control phase: The following parameters are associated with the final phase of the project life cycle and are intended to evaluate the effectiveness of project completion, quality assurance processes and long term performance after formal project delivery.

Table 6: Identified parameters for the project closure and quality control phase

PARAMETERS	DEFINITION	INDICATOR	LITERATURE
Completion within planned time and budgeted	The degree to which the project is formally completed and accepted in accordance with the originally approved schedule, budget and quality requirements without unresolved defects or significant deviations	Difference between the planned and actual completion date, final cost deviation, number of defects identified during handover	[16], [44], [55]
Defects liability and warranty period performance	The effectiveness with which defects and performance related issues identified during the defects liability period are addressed , corrected and resolved in accordance with contractual requirements	Number of defects reported during the warranty period , response time for defect correction, unresolved defects after the expiration of the warranty period	[45], [55], [57]
Rework and corrective works	The degree to which completed works require repetition , correction or modification do to defects , errors or changes , indicating inefficiencies in design , execution or quality control processes	Percentage or reward relative to the total value of works, cost and time impact of corrective works	[14], [46], [55]
Post completion quality complains	The degree to which formal compliance related to quality defects or performance deviations are submitted after formal project completion and handover, indicating deficiencies in construction quality or control processes	Number of formal quality complains after handover, type of complaints, required corrective measures	[47], [55], [57]

4. Conclusion

This research provides a systematic identification and structuring critical parameters that can influence the performance of IPA funded infrastructure projects in the Republic of North Macedonia. Through the analysis of scientific literature and other documentation as a different regulatory frameworks, a total list of 30 parameters were identified and classified according to six phases of project life cycle. The proposed analytical framework enables a clearer understanding of the institutional, managerial, technical and procedural factors that contribute to project delays, cost overruns and reduced implementation efficiency. By structuring the identified parameters according to the project life cycle phases, the research establishes a consistent methodological basis for the identification of critical points and weaknesses throughout project implementation.

Identified parameters present a foundation for further empirical validation and expert based evaluation, with the aim to develop a more objective and comprehensive approach for assessing the performance of infrastructure projects financed through international financial assistances.

References

- [1] Rushadije HALILI, Endrita KERMENDI, Merita BAJRAMI, Getoar ABDURAMANI, APPLICATION OF CONIC SECTIONS IN ARCHITECTURE, Journal of Applied Sciences SUT 9, (17-18). pp. 180-195, 2023
- [2] North Macedonia 2024 Report, European Commission, Brussels, 2024
- [3] Буџет на Република Северна Македонија за 2024 година, 2025
- [4] PMI, A Guide to the Project Management Body of Knowledge PMBOK GUIDE six edition, Project Management Institute, 2017
- [5] BSI, Project Management – Principles and Guidance for the Management of Projects, BSI Standards Publication, 2019
- [6] Rushadije HALILI, Edon RAMADANI, Merita BAJRAMI, Getoar ABDURAMANI, Lazim KAMBERI, APPLICATION OF GEOMETRY IN ARCHITECTURE FOCUSING ON METAL CONSTRUCTIONS, Journal of Applied Sciences SUT 11, (21-22). pp. 239-245, 2025
- [7] Chapman, C., & Ward, S. How to Manage Project Opportunity and Risk, Wiley, 2011
- [8] European Commission, Guide to Cost-Benefit Analysis of Investment Projects. Directorate-General for Regional and Urban Policy, 2014
- [9] Getoar ABDURAMANI and Enis JAKUPI and Strahinja TRPEVSKI, FIDIC CONTRACTS: INTERNATIONAL COMPETITION ON THE NORTH MACEDONIAN INFRASTRUCTURE PROJECTS, Journal of Applied Sciences-SUT 8, 2022
- [10] Enis JAKUPI, Getoar ABDURAMANI, FLOOR DESIGN IN LEARNING SPACES: SHOULD THE PLANING AND IMPLEMENTATION PROCESS BE CHANGED AFTER THE PERIOD OF COVID19, Journal of Applied Sciences SUT 9, (17-18). pp. 64-70, 2023
- [11] Enis JAKUPI, Getoar ABDURAMANI, Gajur KADRIU, Festim ADEMI, Murat MURATI, VERTICAL COMMUNICATION IN BUILDINGS AND OPPORTUNITIES FOR VERTICAL COMMUNICATION IN UNIVERSE, Journal of Applied Sciences SUT 11, (21-22). pp. 118-123, 2025
- [12] Flyvbjerg B., What You Should Know About Megaprojects and Why – An Overview, PM World Journal, Vol.III Issue I, 2014
- [13] Miljan S. Mikić, Upravljanje rizicima pri izgradnji kapitalnih infrastrukturnih objekata u cilju poboljšanja njihove održivosti, 2015
- [14] Nevena R. Simić, Hybrid system for highway construction cost estimation in initial stages of project development, 2023
- [15] Марија З. Ивановић, Модел за детекцију и анализу узрока кашњења на пројектима базиран на подацима издвојеним из неструктурираних извора, 2023
- [16] Небојша В. Шурлан, Управљање вредностима, примена локалних знања и учење избором случајева као подршка доношењу одлука на међународним пројектима, 2015
- [17] Александар С. Сенић, Хибридни систем за квантификацију и управљање ризицима на пројектима путне инфраструктуре, 2025
- [18] Flyvbjerg, B., What You Should Know About Megaprojects and Why, 2013
- [19] Pritchard, C., Risk Management in Public Projects, 2014
- [20] Yang, J. et al., Stakeholder management in construction projects, 2009

- [21] European Commission, Guide to Cost–Benefit Analysis of Investment Projects, 2014
- [22] Flyvbjerg, B, Rationality and Power: Democracy in Practice, University of Chicago Press, 1998
- [23] PMI, Triple Constraint Concept, 2021
- [24] Love, P. E. D., Ahiaga-Dagbui, D. D., & Irani, Z., Cost overruns in transportation infrastructure projects: Sowing the seeds for a probabilistic theory of causation, 2016
- [25] PMI, Schedule Management, 2021
- [26] PMI, Risk Identification Processes, 2021
- [27] World Bank, Project Management Capacity Assessment, 2016
- [28] Construction Industry Institute, Front-End Planning Effectiveness, 2012
- [29] PMI, Project Integration Management, 2021
- [30] Slaughter, E. S., Models of innovation in construction, Journal of Construction Engineering, 1998
- [31] Love, P. E. D. et al., Rework causation: Emergent theoretical insights and implications for research. International Journal of Project Management, 2012
- [32] OECD, Public Procurement: Efficiency and Delays, 2015
- [33] European Commission, Practical Guide to Contract Procedures for EU External Actions, 2021
- [34] OECD, Competition in Public Procurement, 2015
- [35] European Court of Auditors, Public procurement irregularities, 2019
- [36] FIDIC, Conditions of Contract for Construction, 2017
- [37] OECD, Public Governance of Infrastructure Investment / Transparency in Infrastructure, 2015
- [38] Love, P. E. D. et al., Causes and consequences of pre-construction delays, International Journal of Project Management, 2019
- [39] World Bank, Contractor Qualification Guidance, 2019
- [40] FIDIC, Contractual variations clauses, 2017
- [41] World Bank, Managing Exchange-Rate Risk in Investment Projects, 2019
- [42] Love P. E. D. et al, Supply-chain risks in construction projects, Journal of Project Management, 2018
- [43] FIDIC, Role of the Engineer, 2017
- [44] PMI, Project Closure, 2021
- [45] FIDIC, Conditions of Contract – Defects Notification Period, 2017
- [46] Love, P. E. D. et al., Rework in construction projects: A review of causes, costs and solutions, 2000
- [47] Forcada, N. et al., Post-occupancy defects: A building pathology approach, 2014
- [48] Contract Procedures for European Union External Action – PRAG, European Commission, 2022
- [49] Constanta-Nicoleta BODEA, FIDIC contracts: analysis of the impact of general and particular conditions on the financial risk management in Romanian infrastructure projects, Romania, 2016
- [50] Eric Brousseau, Contract as Reference Point: A New Approach to Contracting and Implications for Relationship among Levels of Government, EC-OECD, 2017
- [51] Humiras Hardi Purba, Potential Risks Occurring in Fidic Contract Construction Projects: A Literature Review, Industrial Engineering Department, 2020
- [52] Marko Sostar, Challenges in Public Procurement in EU Founded Projects, Pozega, 2017
- [53] Mladen Radujkovic, Project Management Success Factors, Croatia, 2017
- [54] Oliver Hart, Incomplete Contracts and Control, Nobel Prize Lecture, 2016
- [55] Petar Jovanovic, Upravljanje Investicijama, peto izdanje, Beograd 2005
- [56] Upravljanje Procesom Izbora Ugovorne Strategije u Građevinarstvu uz Primenu Teorije Fazi Skupova, Nenad Ivanisevic, Doktorska Disertacija, Beograd, 2007
- [57] Zeljka Beljkas, Nenad Ivanisevic, Milos Knezevic, Kontrola izvođenja radova-uporedna analiza crnogorskog zakona i Fidic uslova ugovora, Research Gate, 2012
- [58] Wang, S. Q., Dulaimi, M. F., & Aguria, M. Y., Risk management framework for construction projects in developing countries. Construction Management and Economics, 2004
- [59] Luu, Kim, Van & Ogunlana, Quantifying Schedule Risk in Construction Projects, 2009
- [60] Evangelista et al., Quantitative Risk Assessment Model and Optimization in Infrastructure Fast-Track Construction Projects, 2023
- [61] Moses Joseph, Quality of project documentation, as a major risk source in infrastructure projects, Stellenbosch University, 2017