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The Project Triangle Paradigm

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Abstract:

Background and Originality: The project triangle, also named the triple constraint, iron triangle, golden triangle, and agile triangle, is a central concept in project management research and practice that represents the relationship between key performance measures. However, there is disagreement about which criteria should be represented at the vertices of this triangle.

Purpose: The purpose of this paper is to explore which concepts are part of the project triangle and how these concepts have changed over time. Our purpose is to conduct a systematic review of scientific articles dealing with the topic of the project triangle and its elements (time, cost, and scope). We want to demonstrate that there is a theoretical gap in the classical theory of the project triangle and that the elements of the project triangle are ultimately reflected in successful project management. Addressing this topic will contribute to eliminating or at least reducing the perceived theoretical research gap, or confusion regarding the positioning of the elements of the project triangle and the connection of these elements to the success of projects.

Method: A systematic review of the scientific literature will be conducted using publicly available databases, namely "iron triangle", "triple constraint", "project performance" and "success factors" as search terms. Scientific articles and doctoral/master's theses were searched in the databases Academia.edu, ProQuest, ScienceDirect, Elsevier/Scopus and Google Scholar. We excluded literature that does not directly relate to the field of research.

Results: We found out that there is a gap in the basic theory of the project triangle or to be more exact confusion about the positioning of quality and scope of the project in the project triangle. We therefore want to reduce the gap and confirm the thesis that quality is not one of the 3 elements of the project triangle but is indirectly defined through the elements of the project triangle (time, cost, scope). The authors of the research carried out so far listed the elements of the project triangle and defined success criteria of the projects by group, among which the individual elements of the project triangle were classified. We expect to confirm the hypothesis that there is a connection between the elements of the project triangle and success of projects.

Society: Our research will confirm the dimensions of the project triangle concept and show the influence of its elements on the most common groups of success criteria, with the help of which companies measure the success of projects. This research will show which elements of the project triangle and criteria are given greater importance by the scientific literature, which represents a starting point for optimization in the field of managing various types of projects.

Originality: Understanding the concept of the project triangle and its role in the creation of success criteria will help the various stakeholders involved in project management to be more motivated to monitor the elements of the project triangle and that this will allow them to manage more effectively, which in turn also affects their commitment in performing project duties.

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Limitations / further research: The topic under discussion has been well studied for the past 20 years, although it has undergone a great deal of theoretical transformation. At the same time, we note that the theoretical treatment is not followed by scientific research, as it mainly covers the field of methodology, factors and strategies for the success of project management in the construction industry or on large investment projects, in the field of IT and healthcare. Proposals for further research will be made to conduct research on this topic in other industries and on other types of projects and on several different stakeholders and/or stakeholder groups involved in project management.

Keywords: project management, project triangle, triple constraint, iron triangle, agile triangle, project performance, success factors

1 Introduction

The concept of the project triangle appears in the foundation of project management theory as a basic model that is helpful in determining the constraints of a project and in defining its success, but the terminology of the project triangle is inconsistently used. With the development of project management and different methodologies for defining success, other concepts appear that replace the project triangle, namely the triple constraint, the iron triangle, the golden triangle and the agile triangle, all of which define the central concept of project management research and practice. The project triangle consists of three elements at the vertices, which represent the relationship between the key performance criteria, which is why some authors also call the project triangle a triple constraint, as these three vertices of the triangle are supposed to outline the boundaries and define the essence of each project. Thus, in the academic world, throughout various periods until today, there is disagreement among authors about which elements should be presented at the vertices or on the sides of this triangle.

A systematic review of the theory of the project triangle for the period between 2002 and 2021 was carried out by Egboga & Cross (2022), based on the existing literature. They used the so-called Systematic Quantitative Assessment Technique (SQAT) and found that the iron triangle components of time, cost, and scope are still relevant performance measures for construction projects (p. 4). They analyzed 45 published articles, conference papers, and book chapters. They combined the results into nine (9) performance measures in chronological order, including time, cost, and scope, as the basic components of the project triangle, for which they used the term iron triangle. The topic of the project triangle has been well studied for the last 20 years, although it has undergone a lot of theoretical transformation. At the same time, we note that the theoretical treatment is not followed by scientific research, as it mainly covers the field of methodology, factors, and strategies for the success of project management in the construction industry or on large investment projects, in the field of IT and healthcare. Due to the above, we included in our research only scientific research contributions from

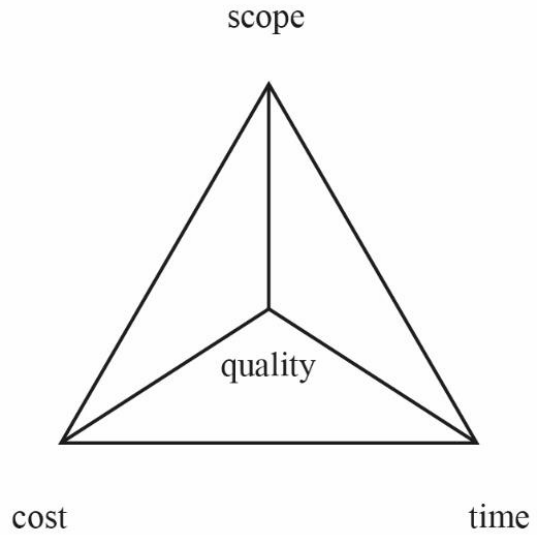
the period from 2021 to 2024. With this, we continued the continuity of the review of the theory of the project triangle and tried to find deviations from what had already been carried out. The purpose of this paper is to investigate which theories or concepts of the project triangle exist and which criteria appear in the vertices of the project triangle in the period of the last 3 years.

2 Theoretical Framework

2.1 The Traditional Project Triangle

The project management triangle consists of three variables that determine project quality: scope, time, and cost (Highsmith, 2009). The traditional project triangle, as shown in Figure 1, illustrates how these three variables are interrelated. At the same time, the rule applies that if one of the variables changes, the other two variables must be adjusted to keep the triangle connected or in balance. In the case one point or a vertex of the triangle moves without adjusting one and/or both of the other vertices, the quality of the project deteriorates. We refer to this as a triangle breakdown. Therefore, a key goal of project management and consequently project stakeholders is that all three elements of the project are balanced, which means that the project is kept within the budget and deadline and meets the essential characteristics regarding the scope of the project (Team Asana, 2024).

Figure 1
Traditional project triangle or iron triangle



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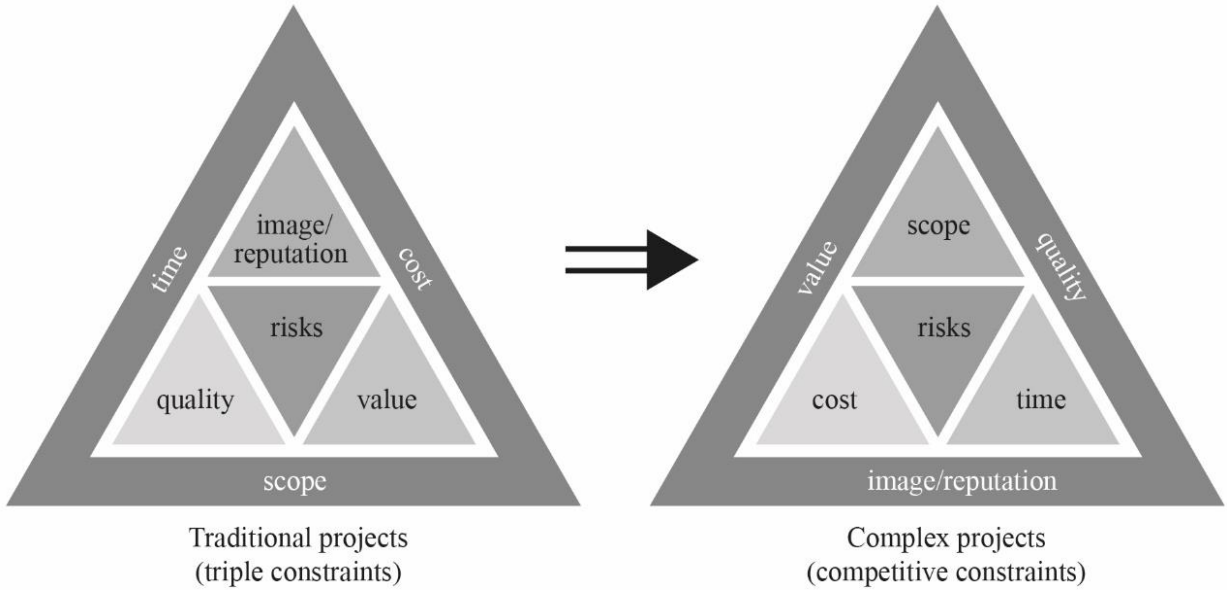
2.2 The Traditional Project Triangle Paradigm

The traditional project triangle paradigm begins with its three constraints. Kerzner (2023, p. 25) states that the triple constraint can be defined as a triangle with three sides representing time, cost, and capacity, and capacity itself should include quality, scope, and technical capability. He goes on to say that nowadays project managers have realized that a project has several constraints, which he calls competitive constraints (p. 29). For more complex projects, the success factors of the traditional triple constraint are constantly changing.

For traditional projects, time, cost, and scope are higher priorities than constraints within the triangle (Kerzner, 2023, p. 23) and as shown in Figure 2, image/reputation, quality, value, and risk are less important. But for more complex projects, constraints within the triangle are more important, so the term the triple constraint is abandoned in recognition of the fact that the exact number of constraints that define project success and their relative importance may vary from project to project. A constraint twist occurs when the traditional triple constraints take a place within the project triangle, and project image/reputation, quality, and value come to the fore with higher priority. It is important to define a metric for each constraint in the project, but it cannot be realistically expected that all constraint metrics will also be considered as key performance indicators of the project.

Figure 2
From triple to competitive constraints



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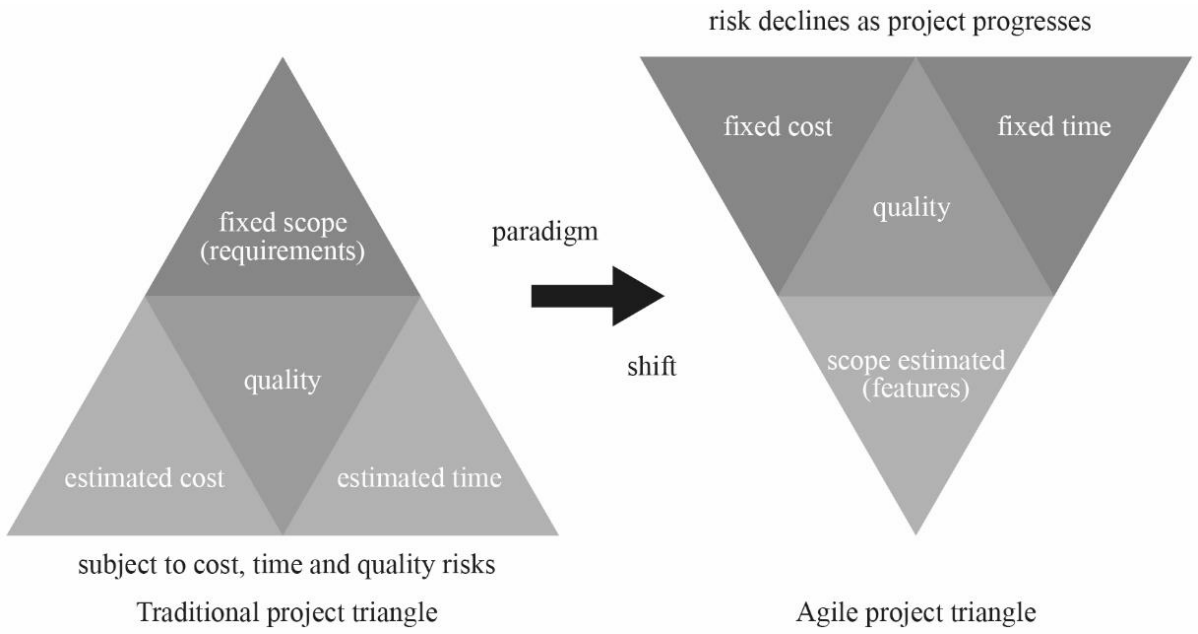
2.3 The Agile Project Triangle

The first paradigm of the project triangle occurs, as shown in Figure 3, when the traditional waterfall triangle is turned upside down (Vertical motion). This most often happens in IT projects, where time and cost are used as fixed constraints, and only the scope changes. This upside-down traditional triangle still fits the dimensions of the project triangle, as project success is still reflected in compliance with cost, time, and scope, but the shape is not stable. The format is only temporary because it does not reflect the essence of true agile projects, which are constantly adapting and therefore cannot be considered successful by traditional standards because they can never be completely consistent with the plan.

Figure 3
Traditional and Agile Iron Triangle



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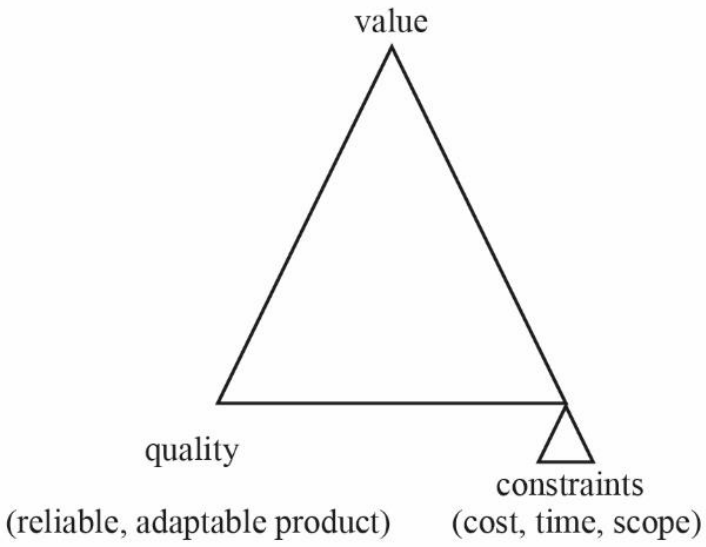
The flexible agile triangle (see Figure 4) derives only in form from the traditional project triangle, which still puts three criteria in the foreground, namely value (for project stakeholders), quality, which ensures the reliability and adaptability of the product in the eyes of the user, and three traditional constraints (time, cost and scope) of the project (Highsmith, 2009). Constraints are still important parameters of the project, but they do not represent the main goal of the project. The primary goal of the project is stakeholder value, and constraints are adjusted as the project evolves and stakeholder value increases. Time still remains a fixed constraint, and we can adjust the range to provide the highest value within the available time.

Figure 4
The Agile Triangle



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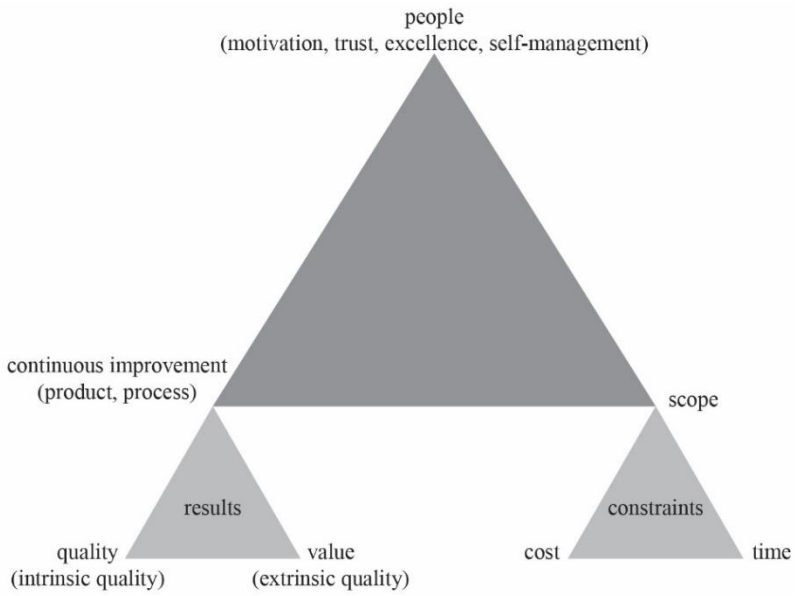
Salazar (2018), among other things in software development projects, emphasizes that improving the quality of products and increasing the value that these products provide to users is a continuous process that brings the user to the next level of optimization, satisfaction and happiness. The author understands this agile triangle model as an extended agile triangle (see Figure 5). The most important factor in any agile project is therefore the people who intervene in the project through personal communication and individual motivation. With constant attention paid to technical excellence, self-management of the project team and the organization's trust in themselves, all this is the basis for the success of the project, for the creation of new services and products, and for the continuous improvement of the project's processes and products.

Figure 5.
The Concept of the Extended Agile Triangle



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2.4 The Sustainable Project Triangle

Modifications of the project triangle have evolved over the decades. Among others, Pollack, Helm & Adler (2018, pp. 544-545) state that scope, capacity, requirements, and quality could be used interchangeably in the third vertex of the project triangle. The third vertex is therefore of varying importance depending on the type of project being evaluated. But there are also new versions of tools that contain six pillars and triangles with a third dimension, in which softer and less measurable aspects are present, e.g. value for the project team, for the user, etc.

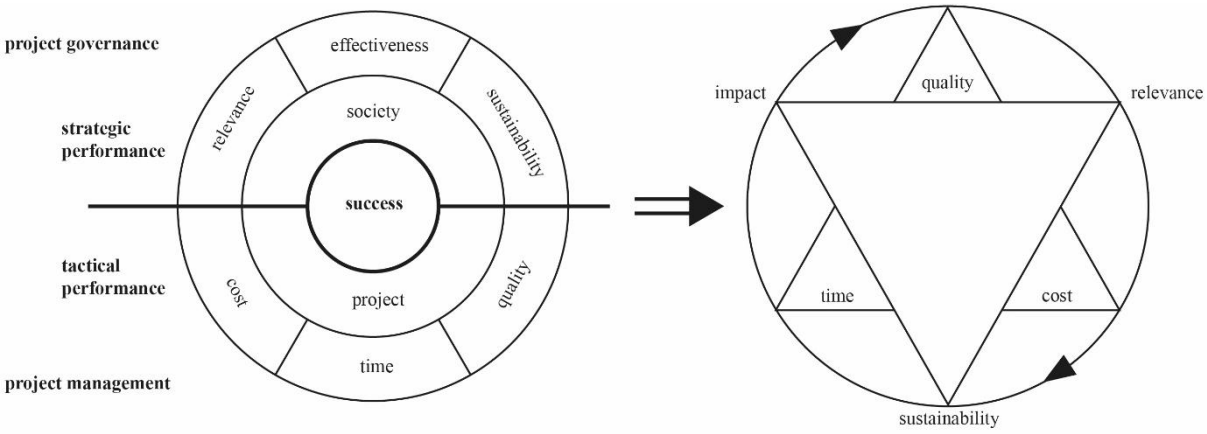
Samset & Volden (2016a) argue:

> Success in a tactical sense usually means meeting short-term performance goals, such as producing agreed-upon results on time and within budget. This is an essential issue of project management. Strategic performance, on the other hand, involves broader and longer-term considerations about whether the project will have a sustainable impact and remain relevant and effective during the implementation phase and throughout its lifetime. This is essentially a question of correctly defining the business case, or in short choosing the most viable project concept. (p. 300)

The concept of successful projects, as shown in Figure 6, is adapted by Samset & Volden (2016b, p. 4) and Madsen (2013). In the concept of successful projects Samset & Volden

(2016, p. 4) emphasize the strategic performance and tactical performance as the key to a successful project, if we want the project to be successful from the perspective of society as well. On the other hand, Madsen (2013) simplified the concept of successful project in the form of a star with six key pillars, namely the first triangle shows the traditional constraints of the project (time, cost and quality), while the second triangle is inverted and resembles agile values with three constraints (impact, relevance and sustainability of the project).

Figure 6.
The Sustainability Project Triangle



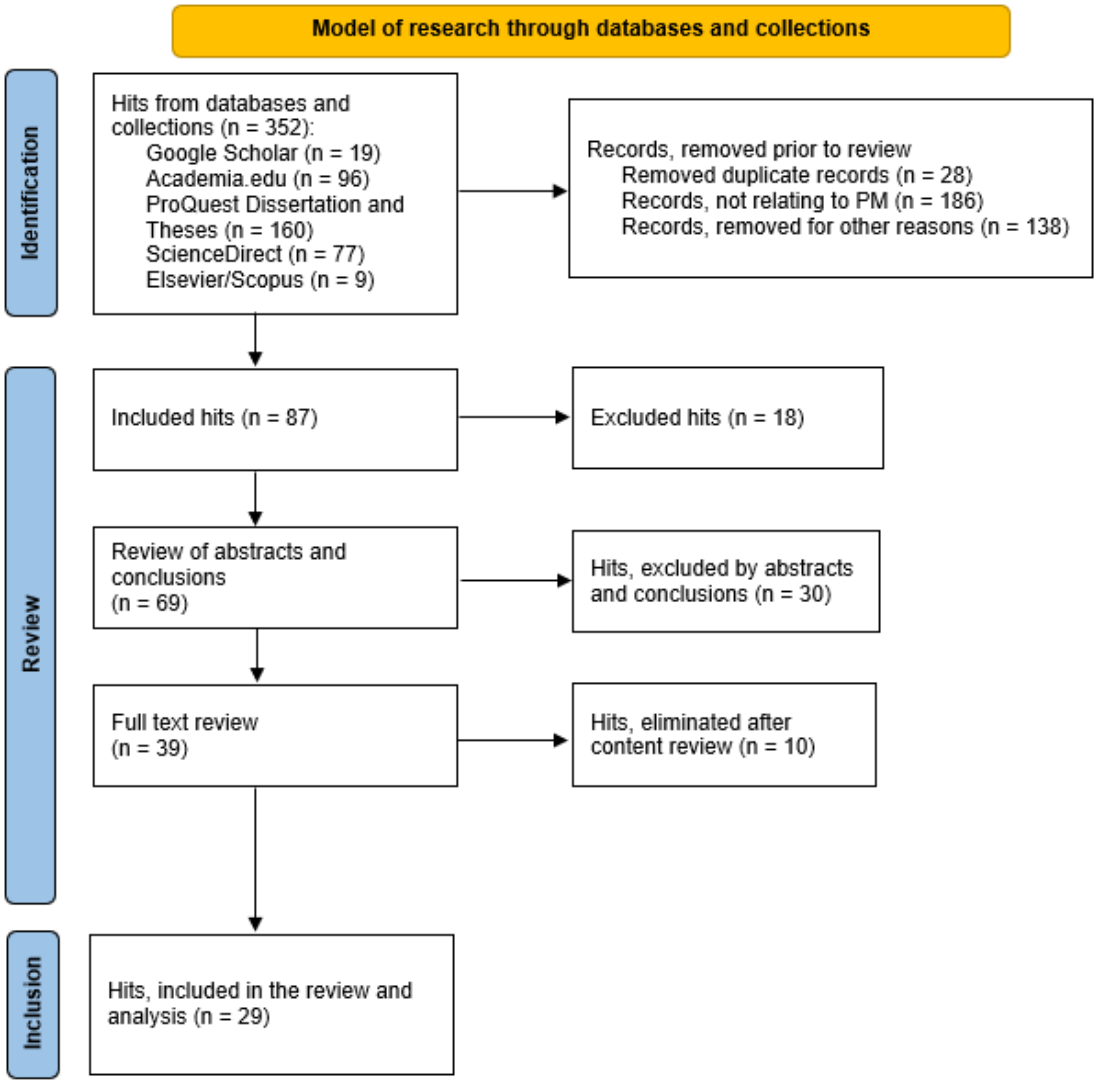
Note. Adapted from "Front-end Definition of Major Public Projects. Theoretical insights and conflicting practices" by K. F. Samset and G. H. Volden, 2016b, A selection of findings from studies conducted by the Concept Research Program. Norwegian University of Science and Technology, Trondheim, p. 4 and from "Is the iron triangle outdated?" by S. Madsen, 2013. Copyright 2016b by K. F. Samset and 2013 by S. Madsen. Reprinted with permission.

3 Method

We searched for scientific research articles and dissertations in the Academia.edu, ProQuest, ScienceDirect, Elsevier/Scopus and Google Scholar databases using the search terms "trojna omejitev" OR "železni trikotnik" AND "uspešnost projekta" OR "dejavniki uspeha" in Slovenian language and "triple constraint" OR "iron triangle" AND "project success" OR "success factors" in English. In the repositories of the University of Ljubljana, the University of Maribor, the University of Primorska and the University of Nova Gorica, we searched for scientific works from the Slovenian area in the period 2021-2024, but we did not find any results. We used Mendeley reference management software to archive scientific works and created our database for analysis in Microsoft Excel. We selected scientific works in such a way that we eliminated duplicates of individual scientific works and those works that did not directly relate to the field of research, i.e. to the project triangle and the success of the project. Works that were not written in English or Slovenian and works dated before 2020 were excluded. We wanted to check whether

the paradigm of the so-called "iron triangle" continues even after 2020, as we found that transparent scientific articles on the discussed topic were written and included the year 2020 as the final year of the period under consideration. In the following, we also selected the scientific papers according to the read abstracts and focused on the papers that, in addition to the relevance of the search parameters, also included empirical research. The research model and the process of selecting relevant scientific research papers for a systematic review of the literature (see Figure 7), which is related to the research question, is shown with the so-called PRISMA diagram based on Page et al. (2021).

Figure 7.
Model of research through databases and collections



After reading the summaries and conclusions of the scientific papers found with the above-mentioned search method, we additionally selected the scientific papers and at the same time ensured that they dealt with the iron triangle or the triple constraints and the success of projects or the success factors of projects. The exclusion criteria were that

the paper was not written in English or Slovenian, we also excluded papers that were purely theoretical and did not include empirical research and studies, and scientific research papers from non-engineering activities, such as e.g. health services, education, tourist services, etc. The inclusion criterion was that the contribution contains at least one constraint that appears in the theory of project constraints according to the project triangle model, i.e. time, cost, scope, or quality constraints, and at the same time has a content connection to project success or project success factors. Only after the additional selection was completed did we start reading the full texts of the contributions. Thus, 29 scientific research works were included in the final review.

4 Results

After reviewing the theoretical starting points and various models that are used to illustrate the project constraints that determine the essence of the project, we found that there is a gap in the basic theory of the project triangle. confusion about positioning project quality and scope in the project triangle model. By reviewing scientific research works after 2020, we want to confirm the continuation of the so-called paradigm. of the "iron triangle" and at the same time reduce the gap and confirm the thesis that quality is not one of the 3 limitations of the project triangle but is indirectly defined through the traditional limitations of the project triangle (time, cost, scope).

The results show that there is no consistent correlation as to what performance is and that the traditional constraints shown by the cost-time-quality project triangle model are still the most appropriate method for performance analysis. Mellado, Lou & Becerra (2020) also claim this and add that this is the reason for the existence and relevance of the term "iron triangle", even though such a model has proven to be ineffective.

In the research, we considered 69 relevant scientific articles with empirical research and/or dissertations (see Table 1), which were obtained by selecting scientific research contributions (hereinafter also "SR") from databases.

Table 1
Relevant scientific research papers included in the research

Journal/Database	Number of SR contributions	Relevant	Applied	The proportion of applied
Google Scholar	19	5	5	26%
Academia.edu	96	27	7	7%
ProQuest Dissertations & Thesis	160	19	7	4 %
ScienceDirect	77	11	5	6 %
Elsevier/Scopus	9	7	5	56%
RUL	0	0	0	0
RUP	0	0	0	0
RUNG	0	0	0	0
DKUM	0	0	0	0
TOTAL	361	69	29	8 %

The scientific research papers included in our research were from the period 2021 to 2023, with 2 hits from ScienceDirect published in early 2024 also being relevant. Table 2 also shows that the topic is still topical, as the number of relevant publications on the discussed topic is represented in each individual year of the period 2021-2024.

Table 2
The number of relevant scientific research papers on the discussed topic

Journal/Database	2021	2022	2023	2024
Google Scholar	2	3	0	0
Academia.edu	11	14	2	0
ProQuest Dissertations and Theses	7	10	2	0
ScienceDirect	2	1	6	2
Elsevier/Scopus	2	3	2	0
TOTAL	24	31	12	2

Through the review of the literature, five (5) important project constraints (the authors also understand them as project "criteria"), as used by various authors in their research, were identified, and we marked them in columns A to E, where: A = time; B = cost; C = scope; D = quality and E = other. Under column E = other, other limitations that appear in the project triangle (e.g. satisfaction, benefits, safety, sustainability, etc.) are defined individually as specifics of the individual author. Column F = project success, with concrete indicators by individual authors in the continuation of the research. Column G lists the method used by the individual author to obtain the data and H the country and/or economic activity where the research was conducted. The use of "x" in the individual box of Table 3 means that the author used or stated in his scientific contribution a certain element and/or connected it to the success of the project.

Table 3
Empirical research indicating the constraints of the project triangle

			Constraints of the project triangle							
No.	Author(s)	Year	A	B	C	D	E	F	G	H
1	Al Mokhtar et al.	2021	x	x	x		x	x	Questionnaire	Saudi Arabia, construction
2	Clark	2021	x	x	x		x	x	Questionnaire (certified PMP)	USA
3	Essien	2021	x	x		x	x	x	Questionnaire and interview	Nigeria, construction
4	Hailemichael	2021	x	x		x	x	x	Questionnaire and interview	Ethiopia, construction
5	Hussain et al.	2021	x	x	x	x		x	Questionnaire	construction
6	Jayyousi	2021	x	x		x	x	x	Questionnaire	UAE, construction
7	Vrchota et al.	2021	x	x	x	x	x	x	Survey of manufacturing companies	Czech Republic, high-tech manufacturing companies
8	Shrestha	2021	x	x		x		x	Questionnaire and interview	mining sector, capital and industrial projects
9	Ajibike et. al.	2022	x	x		x	x	x	Questionnaire	Malaysia, oil and gas industry

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10	Alade et al	2022	x	x		x	x	x	Interview, observations, secondary data	Ethiopia, light rail transport projects
11	Amora & Juanzon	2022	x	x	x	x	x	x	Questionnaire	Philippines, construction
12	Bond	2022	x	x	x				Interview (certified PMP)	UAE, international development projects
13	Bukoye et al.	2022	x	x		x	x	x	Semi-structured interview, secondary data sources	large-scale projects of different sectors
14	Borsuk	2022	x	x		x	x	x	Virtual interview, questionnaire	USA, industry of medical devices & equipment industry
15	Bursaw	2022	x	x	x	x	x	x	Questionnaire	USA, non-IT environment
16	Byers	2022	x	x	x		x	x	Questionnaire and interview	Australia, construction
17	Cardella	2022				x	x	x	Questionnaire	USA, different types of industry
18	Hussain et al.	2022	x	x		x	x	x	Survey questionnaire	Pakistan, construction
19	Ika et al.	2022	x	x	x	x	x	x	Literature review	IJPM
20	Imran et al.	2022	x	x		x	x	x	Structured questionnaire	Bangladesh, construction
21	Lama et al.	2022	x	x		x	x	x	Questionnaire	Nepal, construction
22	Sidlayiya	2022	x	x	x	x	x	x	Questionnaire, case study	SAR, event industry
23	Varajão et al.	2022	x	x	x		x		Literature review (34 articles, 13 IT and 21 non-IT)	IT
24	Volden et al.	2022	x	x		x	x	x	Subsequent evaluation of investment projects	Norway, public investment projects
25	Yedvav et al.	2022	x	x		x	x	x	Interview	Israel, defense industry
26	Adejoh et al.	2023	x	x		x		x	Survey questionnaire	Norway, public investment projects
27	Kumar et al.	2023	x	x	x	x	x	x	Semi-structured interview	construction
28	Locatelli et al.	2023	x	x	x	x	x	x	Literature review and review of cases	Italy, infrastructure projects
29	Moreno-Monsalve et al.	2023	x	x	x		x	x	Structured survey	Columbia, technology sector, infrastructure and services

A = time
B = cost
C = scope
D = quality
E = other
F = project success

The authors of the research carried out so far stated the constraints according to the project triangle model and in different ways tried to meaningfully form the groups of factors, indicators, criteria, etc., that define a successful project.

5 Discussion

Traditional activities such as construction, large engineering investment projects, etc., still define the project using the triple constraint according to the project triangle model.

This is confirmed by an extensive study conducted in the Saudi Arabian construction industry by Al Mokhtar et al. (2021), in which it was established that project managers should not exceed project constraints (scope, budget, and timeline). The specifics of these authors is transformational leadership, which the authors claim positively influences progress and helps project managers ensure project success. Among the factors of transformational leadership, three essential components were highlighted: idealized influence, intellectual stimulation, and individual treatment, which significantly influence success, while the so-called motivation with inspiration does not affect the success of the project.

Our claim is partially confirmed through the findings of a study conducted in 114 high-tech manufacturing companies in the Czech Republic, in which Vrhota et al. (2022, pp. 9-11) pointed out that larger companies focus more on planning (time constraints) and quality, while companies with fewer employees focus more on communication, employees, and leadership.

Girma (2021, pp. 26-27) mentions “social and environmental issues” as a special element of the project triangle, which should appear in 2% of the results of her research, while the traditional project constraints costs have 88% representation, time 85 % and a quality of 98% representation, which undoubtedly confirms our claim about the importance of triple constraints. Among other things, the author connects the success of the project with physical work and financial status, all of which should also be reflected in the performance indicators.

In a study in a non-IT environment, Bursaw (2022, p. 67) confirmed through interviews the hypothesis that projects are associated with a triple constraint in terms of time, scope, and cost, that the triple constraints operate independently but can overlap and thus wrap the project in a spiral. Through interviews, in her study, Bond (2022, p. 79) also found that project managers use more innovative and creative project management strategies to reduce the negative impact of the triple constraints (cost, time, and scope) of international development projects, which increase business profitability and contribute to a healthier and safer working environment. These strategies are scope management, stakeholder management, and project management planning.

Project constraints according to the project triangle model give traditional industries a solid foundation on which to build a successful project. This is the reason why the term "iron triangle" also appears in the literature, which various authors associate with project success criteria. In a study of project competencies and success, Clark (2021, p. 49) used a standard project management model in which a successful project is defined as a

project that is completed within schedule, cost, and scope (the triple constraint) and executed against how stakeholders perceive communication, engagement, and sustainability. He showed that competencies in the field of project management improve the success of the project. The term "iron triangle" or "golden triangle" was traced to Yedvav et al. (2022, p. 9-10), who associate both terms with the success of the project, or with focusing on time, budget, and quality constraints. Their study examined and analyzed the implications and effects of deviations in project limits on defense projects.

Also, Varajão et al (2022, pp. 483-484) emphasizes customer satisfaction as one of the criteria of the project triangle, with the other vertices being occupied by "time-cost-conformity to scope". Sidlayiya (2022) and Varajão's et al. (2022) focus on customer satisfaction or client expectations is so much more interesting, as the first (Sidlayiya, 2022) conducted the study on the example of the event industry, while the second (Varajão et al., 2022) conducted a literature review in the field of information technology (hereafter "IT"), although he included 21 non-IT articles in the survey of 34 articles.

In a study of the impact of contractor selection criteria on critical success factors of public projects in Nigeria, conducted by Adejoh et al. (2023, p. 96), it was pointed out that for the effective implementation of public projects, it is necessary to respect costs, time and quality (the triple constraint of the project), and it is very important to carefully consider all the criteria and factors for selection of the contractor, as each project has its characteristics and peculiarities.

Ika et al. (2022, pp. 835-848) propose a four-dimensional project performance model that includes eight (8) combinations of the first three dimensions: project plan, business case, and green success, and propose four multidimensional sources of project success, among which the newly recognized green performance and an emphasized sharing of stakeholders' feelings. In examining the determinants of risk factors on project success of construction companies in Bangladesh, Imran et al. (2022, p. 995-996) confirmed that risk management and financial risk play an important role in the success of any project in the construction industry, while technical and environmental risks do not affect the success of the project. Among other things, they identified risk factors and their impact on the success of the project in terms of cost, time, and quality (the so-called triple project constraints) and environmental sustainability security.

In the mining sector, a study was conducted in which Shrestha (2021, pp. 181 and 210) confirmed with statistical data that the industry can improve cost and time efficiency by achieving several critical success factors, i.e. CSFs, whereby he included cost efficiency (according to the project triangle model, this is a cost project constraint), agility,

predictability, safety, quality (indirect project constraint), schedule (project time constraint according to the project triangle model), management of changes (project constraint of scope), environmental goals and sustainability, but the identified goals as statistically significant are safety, change management and environmental goals.

In a study of 36 large construction projects from the public and private sectors, Hussain and co-authors identified quality as a third constraint and defined it as “the fulfillment of agreed project requirements” (2021, p. 9), thus focusing on defining quality as a constraint on project requirements in accordance with the contract agreed upon by the interested parties. As a composite measure of project success, it states in the same place that it is necessary to continuously look at whether the project was or is on time, cost, and scope/quality. Through a study conducted in the construction industry in the Philippines, Amora and Juanzon (2022, p. 272) determined 26 critical success factors (CSFs) and 5 most recognizable success criteria (SCs), which also appear most frequently in the existing literature, namely satisfaction customers, costs (budget), time (timetable), quality (implementation) and satisfaction of other stakeholders. Based on the prioritized CSFs and recognized SCs, they have developed a framework that can be used by construction project participants and can serve as a guide to achieving the ultimate goal of all construction projects, which is success. The average success of each project in the study of the Nepalese construction industry by Lama et al. (2022, pp. 1890-1900) defined time, quality, and budget, i.e., a triple project constraint, extending project success to market and customer requirements. Namely, they determined that average project success is one of the 4 dimensions of successful multi-project management. The other 3 dimensions are a strategic fit, balanced portfolio, and future potential.

During the review of SR, we detected a research gap in the positioning of quality or scope in the third vertex of the project triangle model, and this positioning gap needs to be explained. Essien (2021, p. 32) recognizes "time-cost-quality" as a constraint of the project triangle but emphasizes that projects are embedded in complex systems that have internal and external dimensions. Therefore, he found a solution in the creation of 21 project performance indicators, which also include criteria derived from project constraints of costs, time, and quality, as well as stakeholder satisfaction (2021, p. 33), which appear in projects on several levels. In the following, Essien claims that due to the involvement of various project stakeholders, it is necessary to clearly define the goals of the project and to understand the difference between the success of the project and the success of project management. It is necessary to connect both performances with the general organizational goal so that the performance of the project begins to be viewed from both operational and strategic perspectives (p. 31).

Sidlayiya (2022) and Byers (2022) have a somewhat different view of the constraints of the project triangle. Byers (2022, p. 226) places the scope of the project instead of quality in the vertices as criteria of the project triangle and defines an additional, fourth element of stakeholder satisfaction, recognizing 9 factors of project success. Young turns the project triangle into a diamond shape (cited in Sidlayiya, 2022, p. 4), so Sidlayiya states "cost-time-quality-scope" as a four-fold constraint, while client expectations must not be neglected, so he defines NPS as a performance indicator (Net Promoter Score), which is reflected through customer loyalty or satisfaction (pp. 25-26). Also, Bukoye et al. (2022, pp. 893-897), using interviews and secondary data sources from government and industry reports, identified 21 tools that directly and indirectly promote three (3) key project performance measures – time, cost, and quality. Project quality was defined by Burshaw (2022, p. 68) as the expectation of stakeholders. Namely, it argues that key project knowledge is exchanged between project teams during active project implementation through quality-focused collaboration, collaborative techniques, and crosstalk.

Among all the reviewed studies, Cardella (2022, p. 52) focused on studying the impact of quality on organizational learning and project management success. He found that the quality of project completion has a significant impact on organizational learning (p. 78). Somewhat surprising is the statistical insignificance of the mild effect of project completion quality between project organizational capacity and project management success (pp. 80 and 86). From his findings, we can conclude that quality is not a project constraint, but rather the added value of project constraints, which is reflected in the success of the project.

The links between project constraints and project performance measures can be direct or indirect. In the previously mentioned study, Vrhota et al. (2022, pp. 7-13) realized that human resources in project management, plans and deadlines (i.e. time as a project constraint), and quality are success factors, and among these, soft factors are those that are essential for the success of projects. The authors did not investigate whether the links between project time constraints and success are direct or indirect.

Project success is also defined by triple constraints in Ajibike et al. (2022, p. 50), namely with time, cost and quality, where the authors in the study investigated the effect of internal risk factors and government support on the projects of oil and gas companies. They found that all exogenous factors, such as risk planning, risk management, financial risk, and material risk factors, as well as state support, have a significant impact on the success of the project (p. 47). As key performance indicators of the light rail transport project in Ethiopia, Alade et al. (2022, p. 419) highlight price and infrastructure as a recognized advantage of the project, examining the influence of the selection of

architects on cooperation with four key international organizations. This studied impact therefore represents an indirect link to the success of the project.

Research in 4 manufacturing companies of medical devices and industrial equipment conducted by Borsuk (2022, p. 70) confirmed that companies that used agile project methodology had more precisely defined implementation factors that had a positive impact on project success. In his doctoral study, Jayyousi (2021) demonstrated that it is necessary to consider new concepts of project success, as following the framework of triple project constraints is not enough.

In examining the effects of activity planning, time management, human resource management, and tasks on project success in the construction industry in Pakistan, Hussain et al. (2022, pp. 74-76) found that all four factors of project management have a significant impact on project success, with activity planning (project constraint of time) contributing the most to project success. Stakeholders and their satisfaction are key factors influencing the success of the project, but there are several different project stakeholders and each of them has a unique perception of both, the constraints that determine the project and the success of the project itself.

In Norway, an ex-post evaluation of four public investment projects was undertaken and Volden and Welde. (2022, pp. 711-712) found that public projects are often more successful than the public thinks, highlighting the role of the media as the main source of information, which defines success too narrowly or is too negatively biased. Therefore, the authors emphasize three levels of project success, namely operational success (shown by the product, and project outcome and measured by evaluating effectiveness), tactical success (has an effect on individual groups of users, and therefore is measured by the effectiveness of achieving their goals) and strategic success, which has a direct impact on society and is measured by sustainability, relevance, weighing between benefits and costs and other impacts (p. 706).

Our findings regarding stakeholders are also supported by the concept based on business value for the user/customer as proposed by Jayyousi (2021). In this concept, both parties are satisfied - contractors or construction companies and customers or users. The author also confirmed the hypothesis that the use of a transformational approach to construction project management increases the project's compliance with the specifications of the triple project constraints concept (pp. 85-91).

Moreno-Monsalve et al. (2023, p. 11) in their study of sustainable development and value creation focused on the aspect of project management and concluded that a successful

project must always be sustainable and create high value. In the sample of selected companies, it was observed that sustainable projects focused on creating organizational value are more successful than those projects focused on task development. This finding is important because it allows us to break the focus of mechanical control and place project management in a transversal plane that consists of three dimensions: organizational, human, and engineering. The importance of stakeholders in defining projects as successful was also emphasized by Kumar et al. (2023, p. 11) in a study of construction projects, where they pointed out that the traditional constraints of the "iron triangle" are important but considered insufficient in defining project success. Project professionals are increasingly relying on other indicators of project performance, as construction projects are complex, requiring consideration of many stakeholders, complex work systems/tools, and complex communications, as well as uncertainty.

6 Conclusion

As we previously stated, during the SR review, we detected a research gap in the positioning of quality or scope in the third vertex of the project triangle model, since among the 29 studied scientific works that we included in the qualitative synthesis of the period of the last 3 years, only eight SR works covered all the constraints that appear in the traditional project triangle (time, cost, scope and quality). The majority of authors (21 out of 29) still chose between scope and quality as the third constraint of the project triangle model, with 15 selecting quality and 6 selecting scopes as the third constraint of the project triangle.

Traditional industries still define the project using the triple constraint model of the project triangle. This is the reason why the term "iron triangle" also appears in the literature, which various authors associate with project performance criteria. Therefore, even after 2020, the theoretical and methodological core of the "iron triangle" remains a paradigm that offers a model for the further development of scientific thought. Namely, a pattern was established that traditional industries, such as e.g. construction with large investment projects and industry production that is increasingly high-tech oriented, are the biggest proponent of triple constraints according to the classic project triangle model. On the other hand, the modern industries, IT, the event industry, etc. do not bring to the fore triple project constraints, but rather soft, external criteria that go beyond traditional project constraints. Performance criteria, which include sustainable development, environmental impacts, efficiency in all respects, and effects on society, are also being increasingly enforced. However, regardless of what the project constraints are and what the project management approach is - whether it is a traditional or agile approach, if the project constraints and/or success criteria are well defined and

controlled during the project implementation phase, they have a positive impact on project performance.

Project constraints according to the project triangle model give traditional industries a solid foundation for a successful project, hence the term "iron triangle". Following our previous expectations, we found with the SR review that even after 2020 there is a connection between project constraints and the success of projects or success factors because the majority of authors in their studies indicated both individual project constraints and at least one of them that define the project, as well as the success of the projects. Based on the above, we conclude that project constraints and project success should be related, i.e. success factors should come from project constraints, as they define the project as a whole.

We noticed that the authors are defining more and more other project success criteria, which are not necessarily project constraints at the same time. Satisfaction is a key factor in the success of projects, which is studied as the satisfaction of several different stakeholders who appear during the implementation of projects and in one way or another influence it or are only its external observers. Each stakeholder has a unique perception of the constraints that determine the project, as well as the success of the project itself, so it will be welcome to research stakeholders and their perception of project limitations and/or project success. The review of scientific research papers therefore confirmed the dimension of the so-called paradigm of the "iron triangle" and showed that its elements directly define project success and/or indirectly affect project success factors. Also, by reviewing case studies and research in this area, we have shown that the three traditional project constraints according to the project triangle model "cost-time-scope" are still the foundation on which we build a successful project. Most of the time, a successful project is manifested through the quality or satisfaction of clients, users, and customers, we could say all the stakeholders that a certain project concerns, therefore, when studying project management, the achievement of the goals of the various project management stakeholders and the effectiveness of the project team are becoming more and more important.

The field of researching the satisfaction and preferences of various project management stakeholders is the starting point for the optimization of various types of projects. This is the reason that our further research will be aimed at studying the perceived gap in the positioning of the third project constraint on the example of the nuclear industry, which is subject to the slogan "Safety first!". We will focus on the stakeholders of engineering projects in the nuclear industry because given the specifics of the activity, we would expect them to perceive quality as a key project constraint, which is also a criterion for a successful project. The concept of the triple constraint according to the project triangle

model from the aspect of stakeholders will help to understand whether different stakeholders perceive individual project constraints and project success differently or whether they strive for the same common goal. The identified differences in the perception of stakeholders will represent an area for optimizing project management in the nuclear industry, for systematic monitoring of project constraints, and for motivating and raising the commitment of stakeholders in the performance of project duties. As a result, all of this will enable the various stakeholders to manage more effectively and be more satisfied with the successful completion of the project. In this way, we will empirically investigate the "iron triangle" paradigm and the perceived research gap in the positioning of the scope and quality of the project on the example of the nuclear industry and involve a soft factor of success - the aspect of stakeholders, which is otherwise typical for non-traditional industries, such as healthcare, education, tourism and other services.

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Povzetek:
Paradigma projektnega trikotnika

Ozadje in izvirnost: Projektni trikotnik, imenovan tudi trojna omejitev, železni trikotnik, zlati trikotnik in agilni trikotnik, je osrednji koncept raziskav in prakse projektnega menedžmenta, ki predstavlja razmerje med ključnimi merili uspešnosti. Vendar pa obstaja nesoglasje o tem, katera merila naj bodo predstavljena na ogliščih tega trikotnika.
Namen: Namen tega prispevka je raziskati, kateri koncepti so del projektnega trikotnika in kako so se ti koncepti skozi čas spreminjali. Naš namen je opraviti sistematičen pregled znanstvenih člankov, ki obravnavajo tematiko projektnega trikotnika in njegove elemente (čas, stroški in obseg). Dokazati želimo, da obstaja teoretična praznina v klasični teoriji projektnega trikotnika ter da se elementi projektnega trikotnika nenazadnje odražajo v uspešnem menedžiranju projektov. Obravnava te tematike bo prispevala k odpravi ali vsaj zmanjšanju zaznane teoretične raziskovalne vrzeli oz. zmede glede pozicioniranja elementov projektnega trikotnika ter povezave teh elementov na uspešnost projektov.
Metoda: Sistematičen pregled znanstvene literature bo izveden po javno dostopnih bazah podatkov, in sicer smo kot iskalne pojme uporabili »železni trikotnik«, »trojna omejitev«, »uspešnost projekta« in »dejavniki uspeha«. Znanstvene članke in doktorske/magistrske disertacije smo poiskali v bazah Academia.edu, ProQuest, ScienceDirect, Elsevier/Scopus in Google Scholar. Izločili smo literaturo, ki se neposredno ne nanaša na področje raziskovanja.
Rezultati: Ugotovili smo, da obstaja v osnovni teoriji projektnega trikotnika praznina oz. zmeda glede pozicioniranja kakovosti in obsega projekta v projektnem trikotniku. Želimo torej zmanjšati vrzel in potrditi tezo, da kakovost ni eden od 3 elementov projektnega trikotnika, ampak je posredno definirana skozi elemente projektnega trikotnika (čas, stroški, obseg). Avtorji do sedaj izvedenih raziskav so navedli elemente projektnega trikotnika in po skupinah definirali merila uspešnosti projektov, med katere so uvrstili posamezne elemente projektnega trikotnika. Pričakujemo, da bomo potrdili hipotezo, da obstaja povezava med elementi projektnega trikotnika in uspešnostjo projektov.
Družba: Naša raziskava bo potrdila razsežnost koncepta projektnega trikotnika in pokazala vpliv njegovih elementov na najpogostejše skupine meril uspešnosti, s pomočjo katerih družbe merijo uspešnost projektov. Ta raziskava bo pokazala, katerim elementom projektnega trikotnika in meril, pripisuje znanstvena literatura večji pomen, kar predstavlja izhodišče za optimizacijo na področju menedžiranja različnih vrst projektov.

Izvirnost: Razumevanje koncepta železnega trikotnika in njegove vloge pri oblikovanju meril uspešnosti bo pripomoglo, da bodo različni deležniki, ki so vpeti v menedžiranje projektov, bolj motivirani za spremljanje elementov projektnega trikotnika, da jim bo to omogočalo bolj učinkovito menedžiranje, kar posledično vpliva tudi na njihovo zavzetost pri opravljanju projektnih zadolžitev.
Omejitve/nadaljnje raziskovanje: Obravnavana tematika je dobro preučevana zadnjih 20 let, čeprav se je teoretično zelo preoblikovala. Istočasno opažamo, da teoretični obravnavi ne sledijo znanstvene raziskave, saj le-te pokrivajo predvsem področje metodologije, faktorjev in strategij uspešnosti projektnega menedžmenta v gradbeništvu oz. na velikih investicijskih projektih, področju IT in zdravstvene dejavnosti. Predlogi za nadaljnje raziskovanje bodo podani v smeri, da se raziskava te tematike izvede v drugih panogah in drugih vrstah projektov ter na več različnih deležnikih in/ali deležniških skupinah, ki so vpete v menedžiranje projektov.

Ključne besede: projektni menedžment, projektni trikotnik, trojna omejitev, železni trikotnik, agilni trikotnik, uspešnost projekta, dejavniki uspeha.