

Evaluating models of project success^{*}

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Abstract

Achieving project success is the most desired project endpoint for practitioners, organizations, and stakeholders to realize strategic goals. Yet there is no universal agreement amongst academics nor practitioners on its definition with a variety of different project success frameworks in existence. A multiplicity of project success models exist including the iron triangle, quadruple constraint, multidimensional, and more recently the ‘Tesseract’ types. However, current literature only seeks to create new models of project success with no work seeking to evaluate these different models. This article fills this knowledge gap. Through the analysis of a large scale survey dataset primarily aimed at project managers, we demonstrate that there is in fact empirical evidence for these four dimensions. This exploratory work provides initial support to the Tesseract model and acts as a justification for those wishing to delve more deeply into the topic.

Keywords: project management, project success, megaproject, benefits realisation management, societal benefits

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1. Introduction

Achieving successful project outcomes is one of the key ways for delivering strategic success. Projects are the primary means by which strategy or policy is operationalised and benefits are realized. The issue of what a successful project is has evolved significantly over the past 60 years or so, from conceptions of success solely in terms of *project management* success through to recent work characterising it in much broader terms (Barnes, 1988; Ika and Pinto, 2022; Shenhar et al., 2001). However, current work is mostly theory building - this has led to many new models of project success. This article evaluates these models by using quantitative analysis on a large-scale survey dataset to identify four different ‘factors’ of project success and observing how well these pre-existing models map onto those factors. In doing so, this article also addresses the challenge posed by Ika and Pinto (2022) to provide supporting evidence for their ‘Tesseract’ model of project success and provides early empirical evidence to support their theoretical construct.

The topic of project success has a long history; from very fundamental conceptions where success is defined in terms of delivering within resource constraints to much broader conceptions including stakeholders and benefits. Despite this large body of research (APM, 2015; Howsawi et al., 2011; Hussein et al., 2015; Ika, 2009; Pinto and Slevin, 1988), there is still no general agreement amongst academics and practitioners regarding what qualifies as project success. This is particularly troubling as the lack of such clarity may be one of the underlying reasons for 80% of projects fail to wholly meet their planned objectives (APM, 2015). Those studies that have managed to create any agreement on the conceptualisation of project success have usually had to restrict their scope to specific industries or research areas (Savolainen et al., 2012; Soon Han et al., 2011). This article does not seek to solve these issues by creating another project success framework; it explores how well these frameworks map onto practitioner conceptions of project success. This is achieved through the analysis of a large-scale survey of project managers with 1,010 responses - far more than is considered standard in project management research.

The project management literature demonstrates the broad criteria that constitute project success and identified that its multidimensional and dynamic character due to market and technical pressures (Albert et al., 2017; Bryde, 2005; Cleland and Ireland, 2006; Collins et al., 2003; Cooper and Kleinschmidt, 1987; Baker et al., 1983; DeCotiis and Dyer, 1979; Gomes and Romao, 2016; Shenhar et al., 2001). Market and organizational evolutions have led to the adoption of broader notions of success encompassing macro dimensions and distinct key indicators (DeCotiis and Dyer, 1979; Dvir and Lechler, 2004; Shenhar et al., 2001). These success dimensions evolved based on a distinction between *project* success or *project management* success (de Wit, 1988). *Project* success tends to be represented in terms of stakeholder satisfaction (Freeman and Beale, 1992), and realising benefits for the organisation (Dvir and Lechler, 2004; Shenhar et al., 2001). Whereas the criteria defining *project management* success tends to include traditional performance measures such as adherence to budget, schedule, and scope – traditionally known as the ‘Iron’ or ‘Barnes Triangle’ for its creator (Bryde, 2005; Morris and Hough, 1987).

Organisations have likewise elevated their project management maturity by broadening the scope of

project management success to include project success measures that capture project outcomes to contribute to organisational success (Cooke et al., 2012; Serrador and Pinto, 2015; Serra and Kunc, 2015). Such elevations have allowed strategic improvements in terms of systematizing how projects are managed more uniformly, opportunities for improvements are identified and rolled out across the entire project portfolio, and how mistakes not be made repeatedly. With this have come much broader conceptualisations of project success, elevating project success from a pure operations perspective to include more strategic concepts such as direct business success and being prepared for future opportunities (Shenhar et al., 2001). Each of these have different time frames where the evaluation can be made from immediately after project completion to as far as five years in the future (Shenhar et al., 2001). New dynamics have also emerged around the realisation of project benefits which some studies identified as a very important success dimension in some specific contexts (Bryde, 2005; Lipovetsky et al., 1997; Serra and Kunc, 2015). Yet, the literature surrounding project success makes little use of project benefits integral to success criteria. For example, most studies assessing Critical Success Factors (CSFs) that could bring about project success adopted multidimensional success measures such as ‘project extended performance’ by including satisfaction criteria (Muller et al., 2012; Müller and Turner, 2007; Pinto and Mantel, 1990). Only a few studies have examined project benefits for the assessment of CSFs (Anand et al., 2010; Carvalho et al., 2015; Geoghegan and Dulewicz, 2008; Khalifeh et al., 2019; Shenhar et al., 2001; Yang et al., 2012; Atkinson, 1999).

A recent dynamic for project success has been to consider its societal effects with a particular emphasis given to environmental sustainability (Ika and Pinto, 2022). This creates something of a challenge for both project managers and for project management academics; projects have traditionally had very definite starting points and very definite endpoints. Following project closure, all aspects of the project including assets, projects structure, and human resources must be returned to their ‘home’ department and organisation. The challenge is therefore for these temporary endeavours to account for potentially long-lived legacies. This is something that has been implemented in some megaprojects and most notably for the London 2012 Olympics where the ‘legacy’ societal impact became a major selling point for the initial bid. This is considered in more depth in the literature review.

The debate surrounding project success criteria has resulted in a plethora of project success frameworks, each new one trying to correct for the perceived inadequacies of the previous ones. The effect of this trend simply serves to increase the number of project success frameworks by one (Ika and Pinto, 2022; Shenhar et al., 2001). This article adds to the body of knowledge by evaluating pre-existing project success frameworks by using the Ika et al. (2012) in two ways. Firstly, by bringing in further evidence on whether project benefits are now seen as an integral part of project success criteria in project management. Secondly, this research attempts to understand which multidimensional frameworks or which components thereof have proven themselves to be most effective at gaining mindshare amongst project practitioners.

This article seeks to understand how well these project success frameworks map onto first-hand practitioner views. Therefore the research question that motivate this article is (1) *do the most prominent*

academic project success frameworks map onto practitioner views of project success and if so, which one(s) most effectively capture these views?

75 The remaining sections of this article are structured as follows: Section 2 examines the most relevant literature for conceptualising project success. In particular the literature review examines the most prominent project success frameworks. For clarity these are the Iron/Barnes Triangle, the quadruple constraint model (Pinto and Slevin, 1988), the Shenhar et al. (2001) multidimensional model, and the Ika and Pinto (2022) ‘Tesseract’ model. The literature review also examines how project success frameworks have evolved
80 in three eras drawing on the work of Ika and Pinto (2022). Section 3 outlines the methodology used for this research which for clarity was confirmatory factor analysis using a survey dataset with over 1,000 responses. Section 4 sets out the research findings from the statistical analysis.

2. Literature review

This section examines the most relevant bodies of literature related to the most prominent project success
85 frameworks, and new developments that have emerged since these frameworks were devised. This section also contains an examination of other frameworks for conceptualizing success in work more broadly. This literature review is structured by examining the most relevant project success frameworks that are relevant for this article before using the Ika et al. (2012) framing to set out how project success has evolved through three eras since scholars started examining the topic in depth. It is notable that project success criteria
90 are divided into ‘soft’ and ‘hard’ types based on whether or not they can be measured and are regarded as objective (Albert et al., 2017). While hard criteria meet these twin criteria, soft criteria do not (Albert et al., 2017). The notion of trade-offs between the hard and soft criteria have been theorized but have not been fully explored (Albert et al., 2017; Eriksson and Westerberg, 2011).

2.1. Ika’s three project success periods

95 The work of Ika (2009) is particularly useful for contextualising the project success frameworks investigated for this research. Ika (2009) characterised project success through three distinct periods that evolved over time. The first period dominated project success research from the 1960s to the 1980s and defined project success solely in ‘Iron triangle’¹ terms. This limited project success solely in terms of *project management* success as alluded to above. As project management was still emerging as a distinct academic
100 discipline, most work was primarily theoretical or drew on anecdotal accounts as a foundation for further theoretical development. The second period, which Ika (2009) characterised as being between the 1980s and the 2000s, had a much greater empirical emphasis. The academic definition of project success expanded to include dimensions including benefits and satisfaction amongst stakeholders (Atkinson and Flint, 2001; Ika, 2009). Likewise, the scope of the project success literature also broadened out to include how to best ensure

¹More specifically this was defined as time, cost, and quality.

105 that success would be achieved - these were described as ‘critical success factors’ (CSFs) (Pinto and Slevin, 1988). The third and current period encompasses a highly content-dependent set of project success criteria as well as an eclectic array of different formats with projects, portfolios, and programmes all having their own set of criteria (Ika, 2009). There is also an expectation that there will be a move away from a pure quantitative approach to determining project success, with qualitative narratives becoming intertwined with
110 symbolic and rhetorical measures of success as well (Ika, 2009; Fincham, 2002).

Modern project success frameworks are now considered multidimensional (Muller et al., 2012; Shenhar et al., 2001; Ika and Pinto, 2022). However, it is essential to understand the evolution of project success from its origins in terms of project management success through to these multidimensional frameworks (de Wit, 1988). The latter measures the project’s overall objectives and takes a holistic view of the effects of projects
115 both as vehicles for realising strategies or achieving outcomes. The second uses classic performance measures using cost, time, and quality to determine success (Morris and Hough, 1987); this is often referred to as the ‘Iron Triangle’ or the ‘Triple Constraint’ model and was originally developed by Martin Barnes in the late 1960s (Barnes, 1988, 2007).

2.2. Iron Triangle framework

120 The original conception of project success emerged during the latter half of the last century. This framework used three parameters by which a project could be judged to be a success or failure - cost, time, and quality² (Barnes, 2007). This ‘Iron Triangle’ framework³ has become one of the most fundamental tools for project managers to determine whether they are delivering successfully (Morris and Hough, 1987). Yet it is clear that the ‘Iron Triangle’ framework is limited to understanding *project management* success as other
125 components that could determine project success, such as whether the final product is successful in the market or stakeholder satisfaction, are not present in this framework. In particular, de Wit (1988) distinguished between *project* success and *project management* success. The former can be measured against the project’s overall objectives, whilst the latter is measured against the widespread and traditional measures of performance against the iron triangle. Some success measures may be more relevant during the internal
130 project development phase than others at later stages. For example, the iron triangle constraints are considered unimportant after project closure (Pinto and Slevin, 1988). Therefore, success indicators can and have been divided into those internal to project development such as meeting budget, schedule, and technical performance, and external, such as customer’s needs and satisfaction as will be examined below. This was borne out in empirical evidence as subsequent work challenged the use of the iron triangle as they identified
135 that despite implementing success factors, projects were still failing (APM, 2015). This provided empirical support for the argument that a pure iron triangle perspective may represent a rather restrictive measure

²These terms themselves may be articulated differently specifically in terms such as ‘budget’, ‘schedule’, and ‘scope’. However, they clearly refer to similar if not identical parameters: in this case the original terms used by Barnes have been used

³It is also referred to as the ‘Barnes Triangle’ or the ‘Triple Constraint’ model

for project success.

A long running thread through project success research has been concerned about going ‘beyond the iron triangle’. This has been a consistent theme since the 1980s; yet even recent work still regards developments that go beyond the iron triangle as a new concept (Tabish and Jha, 2018; Liu et al., 2016; Dimitriou et al., 2018). This demonstrates that, despite the many different models for conceptualizing project success, the iron triangle has exceptional usefulness and power for capturing *project management* success. Even those new project success frameworks that have emerged still incorporate the iron triangle in some form which further underlines its utility for judging one component of project success and is extremely prominent in practitioner-oriented project research especially with the emergence of data science and artificial intelligence in project management (Pollack et al., 2018; Ong et al., 2018).

2.3. Multidimensional model

The concept that project success may involve a much broader set of criteria than just project management success emerged at the start of the current century. This really began with the creation of the ‘square route’ which broadened out project success to include benefits to organizations, stakeholder communities, and to existing systems (Atkinson, 1999). This also included the emergence of time as a dimension that may affect project success with (Shenhar et al., 2001) introducing concepts such as short and long term success to the organization as additional criteria that could determine project success.

Shenhar et al. (2001) characterized project success in much broader terms than either of the two conceptions considered above. They proposed four main dimensions of project success, which will shift in relative importance and are assessed at different time points after project completion; however, the exact time points where success measures can be captured are relatively vague with more detail provided. These different dimensions identified by Shenhar et al. (2001) are:

- Project efficiency - adherence to schedule and budgetary goals. This is nearly identical to the Iron Triangle concept with the obvious omission of the quality dimension. This can be evaluated in a short time period immediately following project completion.
- Impact on the customer - whether the end product delivers the benefits to the customer, this also includes the third vertex of the iron triangle. This can be evaluated in the short to medium term.

Shenhar et al. (2001)	Atkinson (1999)
Project efficiency	Iron triangle
Impact on the customer	Benefits (stakeholder community)
Business success	Benefits (organisational)
Preparing for the future	The information system

Table 1: A summary of the multidimensional project success paradigms examined in this section

- Business and direct success - whether the end-product delivers commercial success and contributes to an enhanced market share. This can be evaluated over the medium term, specifically described as a "year or two" (Shenhar et al., 2001).
- Preparation for the future - the creation of new markets, products, or technologies. The benefits of this dimension of project success will only become quantifiable after three to five years.

Linked to this project success model is the idea of technological uncertainty. Notably one dimension of project success according to this model includes the creation of new technologies and how the technological uncertainty may impact each dimension of project success. Many of the projects assessed during the development of this model had a significant level of technological uncertainty and this has also been linked to the 'Diamond model' for assessing appropriate project management attitudes based on pace, technological uncertainty, level of product innovation⁴, and complexity (Shenhar and Dvir, 2007).

A critique of this model relates to its generalizability. There was a strong industrial and defense emphasis in the projects examined in the qualitative phase, and the quantitative research sample included seemingly no service industry projects. The sample used in this survey have a very different industrial composition so this articles provides the opportunity to test the generalizability of the multidimensional project success concept.

2.4. The Tesseract model

This Tesseract model is relatively new, having been proposed by Ika and Pinto (2022) as a means of synthesising development evaluation work into the broader project management field (OECD, 2019). Yet it contains a strong synergy with the Shenhar et al. (2001) multidimensional project success framework, with the primary contribution being that it integrates sustainability criteria into project success. The priorities also carry different weights depending on the demographic under examination. It is alluded to that different stakeholder groups will prioritise different aspects of success differently. Project managers will prioritise project plan success, business leaders will prioritise business case success, while society may prioritize green efficacy and so on.

2.5. Knowledge gap and hypotheses

It is apparent from the above that there remains a gap in knowledge. Most of the above project success paradigms have developed theory by drawing on project databases or literature databases. Those that have developed theory from empirical evidence have done so using industrial projects with relatively little role for the services sector (Shenhar et al., 2001). Moreover the new 'Tesseract' project success framework devised from literature has yet to be tested with empirical evidence. This was an explicit challenge made by Ika and

⁴The exact term used is 'novelty' but this article uses 'level of product innovation' to avoid conflating technological uncertainty and technological novelty which Shenhar and Dvir (2007) also used as a descriptor

Pinto (2022) and this article starts that process. Seemingly all work that examines project success either does so by taking a pure literature approach to develop new theory or uses empirical evidence to develop a new model. There does not appear to be any work that seeks to use empirical evidence to map data onto pre-existing models.

This article fills that gap in terms of using a quantitative survey-based instrument to understand whether there is evidence to support the most prominent project success models in the specific case of project practitioners group. We do so by posing the research question **”To what extent which of the most prominent project success frameworks or components thereof have proven to be most effective at gaining mindshare amongst project practitioners?”** This research also uses the Ika (2009) periods to determine which project success concepts to experiment with. Table ?? summarises these periods and which concepts were used in the research accordingly.

With specific reference to the Tesseract model, Ika and Pinto (2022) stated that different stakeholder groups would attach different levels of importance to each dimension of this Tesseract model of project success, it is reasonable to expect that this may be present in any data seeking to identify empirical evidence to support this model. Therefore it is hypothesised that project managers would prioritize project plan success above other dimensions. Table 2.5 below theorises how different groups may prioritise different Tesseract dimensions.

3. Methodology

3.1. Data

This research is underpinned with a survey dataset gathered for the Association for Project Management (APM) funded study ‘dynamic conditions for project success’. As part of this study, a wide ranging survey was completed asking project practitioners what their conception of project success was and whether certain organisational, professional, and socio-economic factors acted as critical success factors that could help to deliver that conception of success. The primary focus of the study was the UK context and this represents by far the most respondents; however, no formal barriers existed that prevented respondents from further afield from completing the survey.

Our population was formally defined as UK project practitioners meaning any UK-based person who is involved in project management. Previous consultancy work indicates that there is around 2.13 million full time equivalent workers that meet these inclusion criteria (APM and PwC Research, 2019). This population

Group	Most important dimension	Second most important dimension	Third most important dimension	Fourth most important dimension
Project managers	Project plan success	Business case success	Green efficacy	Shared stakeholder perspective
Owners	Business case success	Project plan success	Green efficacy	Shared stakeholder perspective
Society	Green efficacy	Shared stakeholder perspective	Business case success	Project plan success
Key stakeholders	Shared stakeholder perspective	Business case success	Green efficacy	Project plan success

Table 3: A hypothesis of how stakeholder groups may prioritise different Tesseract dimensions

was operationalised through the APM’s membership database which contains the details of approximately 100,000 persons and provided the sampling frame. The survey was designed using the Qualtrics online platform and data collection took place over Winter 2020/2021.⁵ Additional contacts was also made with UK government institutions and the devolved administrations who circulated the survey amongst their email lists.

After data cleaning for this research, which involved removing partially completed surveys and the removal of question responses that did not contribute meaningfully to the research questions, there were 1,012 full responses that contributed to this research. From the sample, the average project practitioner was aged in the 35-49 age bracket with between ten and 15 years of experience in a project management role.

3.2. *Confirmatory Factor analysis*

The analysis for this research was conducted in two phases.

The validation for the chosen analysis used a Kaiser-Meyer-Olkin (KMO) and Barlett test of sphericity. These two statistical measure test the null hypotheses that the sample is suitable for factor analysis and that the sample correlation matrix is an identity matrix where the variables have no relationship respectively. With this data the KMO test produced a statistic of 0.832⁶ and all KMO values for the individual variables were greater than 0.74. and the Barlett test for sphericity produced a highly significant result (χ^2 (91) = 2631.391, $p < 0.001$). On this basis the analysis could proceed.

The analysis used was an confirmatory factor analysis to reduce the 14 different dimensions of project success offered to survey respondents into the one or more composite variables mapped onto the constructs from the pre-existing project success frameworks. A table showing how these different dimensions were mapped onto the factors from pre-existing project success frameworks can be seen below in Tables 4, 5, and 6. The analysis was performed using R, a standard language for statistical analysis.

Assessment of model fits used χ^2 tests, Root Mean Square of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker Lewis Index (TLI). In line with the established literature for comparing non-nested models the Akaike Information Criterion (AIC) and Bayesian Information Criterion were incorporated into the analysis.

⁵A list of the questions asked in the survey is available from the authors upon request.

⁶This sort of figure is considered to be 'meritorious'.

Factor Name	Variable Name
Iron Triangle	TimePerformance
	CostPerformance
	ScopePerformance

Table 4: The mapping used to develop the Iron Triangle confirmatory factor analysis

Factor Name	Variable Name
Project Efficiency	TimePerformance
	CostPerformance
Impact on the Customer	ScopePerformance
	UserSatisfaction
	UserBenefits
Business Success	ShortTermOrganizationalBenefits
Preparing for the Future	LongTermOrganizationalBenefits

Table 5: The mapping used to develop the multidimensional success confirmatory factor analysis

Factor Name	Variable Name
Project Plan Success	TimePerformance
	CostPerformance
	scopePerformance
Green Efficacy	SocietalBenefits
Business Success	UserSatisfaction
	UserBenefits
	ShortTermOrganizationalBenefits
	LongTermOrganizationalBenefits
Shared Stakeholder Point of View	SupplierSatisfaction
	PublicSatisfaction
	EmployeeRetention
	StakeholderSatisfaction

Table 6: The mapping used to develop the Tesseract confirmatory factor analysis

4. Results

4.1. Iron Triangle

The path diagram from performing confirmatory factor analysis can be seen below in Figure 1.

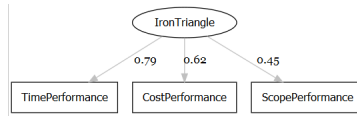


Figure 1: Iron Triangle path diagram from confirmatory factor analysis

4.2. Multidimensional project success

The path diagram from performing confirmatory factor analysis can be seen below in Figure 2.

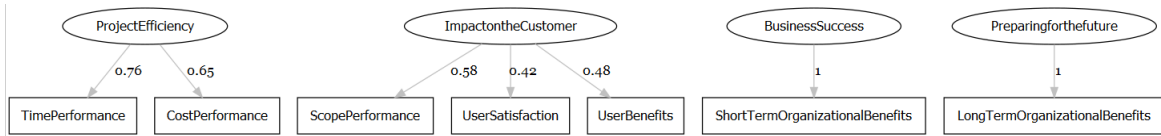


Figure 2: Multidimensional model path diagram from confirmatory factor analysis

4.3. Tesseract mode

The path diagram from performing confirmatory factor analysis can be seen below in Figure 3.



Figure 3: Tesseract model path diagram from confirmatory factor analysis

4.4. Comparisons

This section compares the findings from above to identify which of the models examined in this paper best captures how project managers conceptualise project success. The full results including the individual models are shown below in Table 4.4.

	χ^2	df	p -value	RMSEA	CFI	TLI	SRMR	AIC	BIC
Iron Triangle	0.00	0.00	-	0.00	1.00	1.00	0.00	3880.13	3911.08
Multidimensional model	84.70	10.00	0.00	0.08	0.93	0.86	0.04	9764.91	9857.76
Tesseract model	435.29	49.00	0.00	0.08	0.84	0.78	0.06	14278.71	14428.31

Table 7: Factor analysis comparisons results

4.4.1. χ^2 results

As can be seen, the χ^2 is rejected, which is to be expected with models using 400 or more cases (Babiyak and Green, 2010).

4.4.2. Root Mean Square Error of Approximation (RMSEA)

RMSEA values are interpreted with lower values indicating better fit with values of 0.01, 0.05, and 0.08 acting as the cutoffs between close, reasonable, and poor fits respectively (Kline, 2016). As can be seen, both the multidimensional and Tesseract models are on the cusp of poor fit while the Iron Triangle model has a perfect fit indicating that there may be a need to further investigate as the model may be overly simple.

4.4.3. Comparative Fit Index (CFI)

This metric is interpreted as higher is better with 1 indicating perfect fit. This is one of the least sensitive metrics to sample size and values greater than 0.9 indicate a good fit (Hooper et al., 2008). As can be seen this is where the multidimensional project success framework appears to perform better than the ‘Tesseract’ model in a way that is significant. The Tucker Lewis Index (TLI) is also reported here but given the significant correlation between CFI and TLI only CFI is discussed

4.4.4. Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC)

These indicate relative fits with lower values preferred. As can be seen the Iron Triangle concept outperforms the multidimensional and ‘Tesseract’ models with the multidimensional model performing relatively better than the Tesseract model.

References

- Albert, M., Balve, P., Spang, K., 2017. Evaluation of project success: a structured literature review. INTERNATIONAL JOURNAL OF MANAGING PROJECTS IN BUSINESS 10, 796–821. doi:10.1108/IJMPB-01-2017-0004.
- Anand, G., Ward, P.T., Tatikonda, M.V., 2010. Role of explicit and tacit knowledge in Six Sigma projects: An empirical examination of differential project success. Journal of Operations Management 28, 303–315. doi:10.1016/j.jom.2009.10.003.
- APM, 2015. Conditions for Project Success. APM, Princes Risborough, United Kingdom. URL: https://www.apm.org.uk/media/1621/conditions-for-project-success_web_final_0.pdf.
- APM, PwC Research, 2019. The Golden Thread: A Study of the Contribution of project management and projects to the UK's economy and society. Report. APM. Princes Risborough, United Kingdom. URL: https://www.apm.org.uk/media/35408/apm_research_report_v2.pdf.
- Atkinson, R., 1999. Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. International Journal of Project Management 17, 337–342. URL: <https://linkinghub.elsevier.com/retrieve/pii/S0263786398000696>, doi:10.1016/S0263-7863(98)00069-6.
- Atkinson, R., Flint, J., 2001. Accessing Hidden and Hard-to-reach Populations: Snowball Research Strategies. Social Research Update 33. URL: <http://eprints.gla.ac.uk/37493/>.
- Babyak, M.A., Green, S.B., 2010. Confirmatory Factor Analysis: An Introduction for Psychosomatic Medicine Researchers. Psychosomatic Medicine 72, 587. URL: https://journals.lww.com/psychosomaticmedicine/fulltext/2010/07000/confirmatory_factor_analysis__an_introduction_for.11.aspx, doi:10.1097/PSY.0b013e3181de3f8a.
- Baker, B.N., Murphy, D.C., Fisher, D., 1983. Factors Affecting Project Success, in: Cleland, D.I., King, W.R. (Eds.), Project Management Handbook. John Wiley & Sons, Inc., Hoboken, NJ, USA, pp. 902–919. URL: <https://onlinelibrary.wiley.com/doi/10.1002/9780470172353.ch35>, doi:10.1002/9780470172353.ch35.
- Barnes, M., 1988. Construction project management. International Journal of Project Management 6, 69–79. URL: <https://linkinghub.elsevier.com/retrieve/pii/0263786388900282>, doi:10.1016/0263-7863(88)90028-2.
- Barnes, M., 2007. Some Origins of Modern Project Management A Personal History. PM World Today II. URL: <https://pmworldlibrary.net/wp-content/uploads/2018/11/Nov2007-Barnes-history-of-modern-project-management.pdf>.

Bryde, D.J., 2005. Methods for Managing Different Perspectives of Project Success. *British Journal of Management* 16, 119–131. doi:10.1111/j.1467-8551.2005.00438.x.

Carvalho, M.M.d., Patah, L.A., de Souza Bido, D., 2015. Project management and its effects on project success: Cross-country and cross-industry comparisons. *International Journal of Project Management* 33, 1509–1522. doi:10.1016/j.ijproman.2015.04.004.

Cleland, D., Ireland, L., 2006. *Project Management: Strategic Design and Implementation*. McGraw-Hill's AccessEngineering, McGraw-Hill Education, New York City, NY, USA. URL: https://books.google.co.uk/books?id=cjrZ0Z_YQW0C.

Collins, F.S., Morgan, M., Patrinos, A., 2003. The Human Genome Project: lessons from large-scale biology. *Science* 300, 286–90. URL: <https://www.ncbi.nlm.nih.gov/pubmed/12690187https://science.sciencemag.org/content/sci/300/5617/286.full.pdf>, doi:10.1126/science.1084564.

Cooke, V., Garard, J., Lewis, T., Lee, M.E., Davila, H., Mueller, C., 2012. DISSEMINATING PROJECT SUCCESSES AND RESEARCH FINDINGS. *Gerontologist* 52, 688–688.

Cooper, R.G., Kleinschmidt, E.J., 1987. What makes a new product a winner: Success factors at the project level.*. *R & D Management* 17, 175–189. doi:10.1111/j.1467-9310.1987.tb00052.x.

DeCotiis, T.A., Dyer, L., 1979. Defining and Measuring Project Performance. *Research Management* 22, 17–22. URL: <https://www.tandfonline.com/doi/full/10.1080/00345334.1979.11756516>, doi:10.1080/00345334.1979.11756516.

Dimitriou, L., Marinelli, M., Fragakakis, N., 2018. Early Bill-of-Quantities Estimation of Concrete Road Bridges: An Artificial Intelligence-Based Application. *Public Works Management & Policy* 23, 127–149. doi:10.1177/1087724x17737321.

Dvir, D., Lechler, T., 2004. Plans are nothing, changing plans is everything: the impact of changes on project success. *RESEARCH POLICY* 33, 1–15. doi:10.1016/j.respol.2003.04.001.

Eriksson, P.E., Westerberg, M., 2011. Effects of cooperative procurement procedures on construction project performance: A conceptual framework. *International Journal of Project Management* 29, 197–208. URL: <https://linkinghub.elsevier.com/retrieve/pii/S0263786310000050>, doi:10.1016/j.ijproman.2010.01.003.

Fincham, R., 2002. Narratives of Success and Failure in Systems Development. *British Journal of Management* 13, 1–14. URL: <https://onlinelibrary.wiley.com/doi/10.1111/1467-8551.00219>, doi:10.1111/1467-8551.00219.

Freeman, M., Beale, P., 1992. Measuring Project Success. *Project Management Journal* 23, 8–17.

Geoghegan, L., Dulewicz, V., 2008. Do Project Managers' Leadership Competencies Contribute to Project Success? *Project Management Journal* 39, 58–67. URL: <https://doi.org/10.1002/pmj.20084>, doi:10.1002/pmj.20084.

345 Gomes, J., Romao, M., 2016. Improving project success: A case study using benefits and project management, in: Varajao, J.E.Q., CruzCunha, M.M., Martinho, R., Rijo, R., BjornAndersen, N., Turner, R., Alves, D. (Eds.), *International Conference on Enterprise Information Systems/International Conference on Project Management/International Conference on Health and Social Care Information Systems and Technologies*, Centeris/Projman / Hcist 2016. Elsevier Science Bv, Amsterdam. volume 100 of *Procedia Computer Science*, pp. 489–497. URL: [GotoISI://WOS:000392695900060](https://www.sciencedirect.com/science/article/pii/S187876661630187), doi:10.1016/j.procs.2016.09.187.

Hooper, D., Coughlan, J., Mullen, M.R., 2008. Structural Equation Modelling: Guidelines for Determining Model Fit. *Electronic Journal of Business Research Methods* 6, pp53-60–pp53-60. URL: <https://academic-publishing.org/index.php/ejbrm/article/view/1224>.

355 Howsawi, E.M., Eager, D., Bagia, R., Ieee, 2011. Understanding Project Success: the Four-Level Project Success Framework. 2011 Ieee International Conference on Industrial Engineering and Engineering Management, Ieee, New York. URL: [GotoISI://WOS:000309676200125](https://www.sciencedirect.com/science/article/pii/S000309676200125).

Hussein, B.A., Ahmad, S.B.S., Zidane, Y.J.T., 2015. Problems Associated With Defining Project Success, in: CruzCunha, M.M., Varajao, J., Rijo, R., Martinho, R., Schubert, P., Boonstra, A., Correia, R., Berler, R. (Eds.), *Conference on Enterprise Information Systems/International Conference on Project Management/Conference on Health and Social Care Information Systems and Technologies*, Centeris/Projman / Hcist 2015. Elsevier Science Bv, Amsterdam. volume 64 of *Procedia Computer Science*, pp. 940–947. URL: [GotoISI://WOS:000373839900119](https://www.sciencedirect.com/science/article/pii/S187876661500611), doi:10.1016/j.procs.2015.08.611.

Ika, L.A., 2009. Project Success as a Topic in Project Management Journals. *Project Management Journal* 40, 6–19. doi:10.1002/pmj.20137.

Ika, L.A., Diallo, A., Thuillier, D., 2012. Critical success factors for World Bank projects: An empirical investigation. *International Journal of Project Management* 30, 105–116. URL: <https://linkinghub.elsevier.com/retrieve/pii/S0263786311000469>, doi:10.1016/j.ijproman.2011.03.005.

Ika, L.A., Pinto, J.K., 2022. The “re-meaning” of project success: Updating and recalibrating for a modern project management. *International Journal of Project Management* , S0263786322000990 URL: <https://linkinghub.elsevier.com/retrieve/pii/S0263786322000990>, doi:10.1016/j.ijproman.2022.08.001.

Khalifeh, A., Farrell, P., Al-edenat, M., 2019. The impact of project sustainability management (PSM) on project success. *Journal of Management Development* ahead-of-print. doi:10.1108/jmd-02-2019-0045.

- 375 Kline, R.B., 2016. Principles and practice of structural equation modeling, 4th ed. Principles and practice of structural equation modeling, 4th ed, Guilford Press, New York, NY, US.
- Lipovetsky, S., Tishler, A., Dvir, D., Shenhar, A., 1997. The relative importance of project success dimensions. *R & D Management* 27, 97–106. doi:10.1111/1467-9310.00047.
- Liu, J., Love, P., Smith, J., Matthews, J., Sing, C., 2016. Praxis of Performance Measurement in Public-Private Partnerships: Moving beyond the Iron Triangle. *JOURNAL OF MANAGEMENT IN ENGINEERING* 32. doi:10.1061/(ASCE)ME.1943-5479.0000433.
- 380 Morris, P.W.G., Hough, G.H., 1987. The anatomy of major projects: a study of the reality of project management. Wiley, Chichester ; New York.
- Muller, R., Geraldi, J., Turner, J.R., 2012. Relationships Between Leadership and Success in Different Types of Project Complexities. *Ieee Transactions on Engineering Management* 59, 77–90. doi:10.1109/tem.2011.2114350.
- 385 Müller, R., Turner, R., 2007. The Influence of Project Managers on Project Success Criteria and Project Success by Type of Project. *European Management Journal* 25, 298–309. URL: <https://linkinghub.elsevier.com/retrieve/pii/S026323730700059X>, doi:10.1016/j.emj.2007.06.003.
- 390 OECD, 2019. Better Criteria for Better Evaluation - Revised Evaluation Criteria: Definitions and Principles for Use. Technical Report OECD/DAC Network on Development Evaluation. OECD. Paris, France. URL: <https://www.oecd.org/dac/evaluation/revised-evaluation-criteria-dec-2019.pdf>.
- Ong, H., Wang, C., Zainon, N., 2018. Developing a Quality-Embedded EVM Tool to Facilitate the Iron Triangle in Architectural, Construction, and Engineering Practices. *JOURNAL OF CONSTRUCTION ENGINEERING AND MANAGEMENT* 144. doi:10.1061/(ASCE)CE.1943-7862.0001533.
- 395 Pinto, J., Mantel, S., 1990. The causes of project failure. *IEEE Transactions on Engineering Management* 37, 269–276. URL: <http://ieeexplore.ieee.org/document/62322/>, doi:10.1109/17.62322.
- Pinto, J., Slevin, D., 1988. Critical Success Factors in Effective Project Implementation. *Project management handbook* , 479.
- 400 Pollack, J., Helm, J., Adler, D., 2018. What is the Iron Triangle, and how has it changed? *INTERNATIONAL JOURNAL OF MANAGING PROJECTS IN BUSINESS* 11, 527–547. doi:10.1108/IJMPB-09-2017-0107.
- Savolainen, P., Ahonen, J.J., Richardson, I., 2012. Software development project success and failure from the supplier’s perspective: A systematic literature review. *International Journal of Project Management* 30, 458–469. doi:10.1016/j.ijproman.2011.07.002.
- 405

Serra, C.E.M., Kunc, M., 2015. Benefits Realisation Management and its influence on project success and on the execution of business strategies. *International Journal of Project Management* 33, 53–66. doi:10.1016/j.ijproman.2014.03.011.

Serrador, P., Pinto, J.K., 2015. Does Agile work? - A quantitative analysis of agile project success. *International Journal of Project Management* 33, 1040–1051. doi:10.1016/j.ijproman.2015.01.006.

Shenhar, A., Dvir, D., 2007. Reinventing project management: the diamond approach to successful growth and innovation. Harvard Business School Press, Boston, Mass.

Shenhar, A., Dvir, D., Levy, O., Maltz, A.C., 2001. Project Success: A Multidimensional Strategic Concept. *Long Range Planning* 34, 699–725. URL: <https://linkinghub.elsevier.com/retrieve/pii/S0024630101000978>, doi:10.1016/S0024-6301(01)00097-8.

Soon Han, W., Md Yusof, A., Ismail, S., Choon Aun, N., 2011. Reviewing the Notions of Construction Project Success. *International Journal of Business and Management* 7, p90. URL: <http://www.ccsenet.org/journal/index.php/ijbm/article/view/11364>, doi:10.5539/ijbm.v7n1p90.

Tabish, S., Jha, K., 2018. Beyond the Iron Triangle in Public Construction Projects. *JOURNAL OF CONSTRUCTION ENGINEERING AND MANAGEMENT* 144. doi:10.1061/(ASCE)CE.1943-7862.0001517.

de Wit, A., 1988. Measurement of project success. *International Journal of Project Management* 6, 164–170. URL: <https://linkinghub.elsevier.com/retrieve/pii/0263786388900439>, doi:10.1016/0263-7863(88)90043-9.

Yang, L.R., Chen, J.H., Wang, H.W., 2012. Assessing impacts of information technology on project success through knowledge management practice. *Automation in Construction* 22, 182–191. doi:10.1016/j.autcon.2011.06.016.