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O Desenvolvimento de um Instrumento de Medição de Sucesso em Projetos

A Project Success Measurement Instrument Development

GABRIEL FRANCISCO PISTILLO FERNANDES
UNINOVE – UNIVERSIDADE NOVE DE JULHO

Nota de esclarecimento:
O X SINGEP e a 10ª Conferência Internacional do CIK (CYRUS Institute of Knowledge) foram realizados de forma remota, nos dias 26, 27 e 28 de outubro de 2022.

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O Desenvolvimento de um Instrumento de Medição de Sucesso em Projetos

Objetivo do estudo
Desenvolvimento de instrumento de medição de sucesso em projetos, a partir de 15 escalas de uma revisão de literatura, um estudo de Delphi categorizando 182 questões em 31 temas e classificando-se escolhendo 82 questões utilizadas em uma pesquisa com 267 respondentes.

Relevância/originalidade
Este estudo fornece um novo instrumento que combina as escalas publicadas nas principais revistas de gestão de projetos categorizadas e aplicadas.

Metodologia/abordagem
A fase qualitativa envolveu revisão sistemática da literatura, depois um estudo Delphi com quatro especialistas para categorizar e selecionar perguntas e, finalmente, uma pesquisa com 267 respostas.

Principais resultados
Análise fatorial exploratória, por análise paralela, 4 fatores com um conjunto de 40 questões para avaliar sucesso do projeto: Sucesso de resultados do projeto para os clientes; Sucesso no processo de gerenciamento de projetos; Sucesso para Cliente Interno; Sucesso de Negócios.

Contribuições teóricas/metodológicas
Novo instrumento de medição de sucesso do projeto, validação e mapeamento.

Contribuições sociais/para a gestão
Principais temas e forma de medir o sucesso do projeto.

Palavras-chave: Medição de Sucesso em Projetos, Escalas de Sucesso em Projetos, Estudo quantitativo-qualitativo

A Project Success Measurement Instrument Development

Study purpose
This study seek to develop a projet success measurement instrument, from 15 selected scales in a literature review, a Delphi study categorizing 182 questions in 31 themes and ranking choosing 82 questions used in a survey with 267 responses.

Relevance / originality
This study provides a new instrument combining current top journal published scales categorized and applied.

Methodology / approach
Qualitative phase involved systematic literature review, then a Delphi study with four specilists to categorize and select questions and finally a survey with 267 responses.

Main results
An exploratory factorial analysis, through parallel analysis four factors with a final set of 40 questions to assess project success, namely: Project results success for clients; Project management process success; Internal project client's success; Business project success.

Theoretical / methodological contributions
New project success measurement instrument, validation and mapping.

Social / management contributions
Main themes and way to measure project success.

Keywords: Project Success Measurement, Project Success Scales, Qualitative-Quantitative study

1. Introduction

The concept of project success is far from a consensus, nonetheless the measurement of project success is less diverse than its definitions. In a previous systematic literature review (in press) researchers found that current instruments published in top project management journals have common roots to Pinto & Slevin (1987) seminal work and most of them present direct questions about topics like time, cost, scope, users, clients, team members, and business in 5 or 7 point Likert scales to project managers in order to assess project success. Some works add specific questions like the ones from Civil Engineering (Ning, 2017) projects or about NGOs project success (Aga et al., 2016; Nanthagopan et al., 2018), but they also include the core "classical" project management process related questions to assess overall project success.

This systematic literature review also identified a different approach which uses project success dimensions (Bannerman & Thorogood, 2012; Castro et al., 2021; A. J. Shenhar & Dvir, 2007) to address some of the project success measurement issues like diversity of stakeholders perceptions and interests. Nonetheless there are still issues like the time shift between project execution and benefits realization or the full perception of project success among different stakeholders involved in the projects such as project managers, teams, business managers, clients and shareholders or business owners.

From the systematic literature review a collection of 15 project success measurement scales was collected to be used in this research to address the research question: How to measure project success?

To answer this question, the general proposed objective of the work is the development of an instrument to measure project success. This general objective unfolds in the specific objectives of: Obtain state of the art project success measurement scales in top project management journals published articles; Combine multiple scale instruments from literature in a qualitative approach; Apply proposed instrument to verify potential factors and insights in a quantitative approach.

The potential contributions of this work are combined project success instrument derived from current literature and insights on the application of this scale to both researchers and practitioners. In order to achieve that, this work is organized in the following sessions: Literature Review, Methodology, Results, Discussion, Conclusion and References.

2. Literature Review

The triple constraint measurement of project success, the so called "Iron Triangle", has given way to a more complex multi-dimensional measurement over time. There are numerous extensive and multidimensional models and frameworks available to assess a project's success. Project management and product success are examined from a two-dimensional standpoint as the success criteria (Ika, 2009). Three success criteria, including (i) time, cost, and quality, (ii) the process quality of the project management process, and (iii) stakeholder satisfaction, are used to measure the success of a project (Marnewick & Marnewick, 2022). Product success is determined by (i) achieving the project's objective, (ii) fulfilling the product's purpose, and (iii) ensuring stakeholder satisfaction with the finished product (Marnewick & Marnewick, 2022).

One widely cited work on project success is the article from Jugdev & Müller (2005), in which the authors categorize project success in four periods and point that the understanding of project success has been evolving and comprising not only project lifecycle but also products/services lifecycle.

The first period, from the 60s to the 80s was focused on project implementation and handover (Jugdev & Müller, 2005). In the 1970s, project success focused on implementation, measuring time, cost and functionality improvements, and systems for their delivery (Turner &

Müller, 2005). The second one included the planning phase of the projects in critical success factors lists (Jugdev & Müller, 2005). The effectiveness of the planning and hand-off was recognized as crucial during the 1980s and 1990s. Critical success factor (CSF) lists that considered organizational and stakeholder perspectives gained popularity (Turner & Müller, 2005). The third period from the 90s to 2000s included project and product/service conception and product/service utilization (Jugdev & Müller, 2005). CSF frameworks were created based on the idea that success depends on interactions between project suppliers and recipients as well as support from stakeholders. The project's output and how it was used, employee development and growth, the customer, advantages for the delivery organization, senior management, and the environment were also taken into consideration (Turner & Müller, 2005). The fourth period was about strategic project management, comprising the whole lifecycle of both projects and products/services (Jugdev & Müller, 2005). The definition of success was expanded over this period, notably in light of elements from the conceptual stages of the project life cycle and the close-down of the project's product, as well as a growing appreciation for the significance of the project sponsor's definition of success (Turner & Müller, 2005).

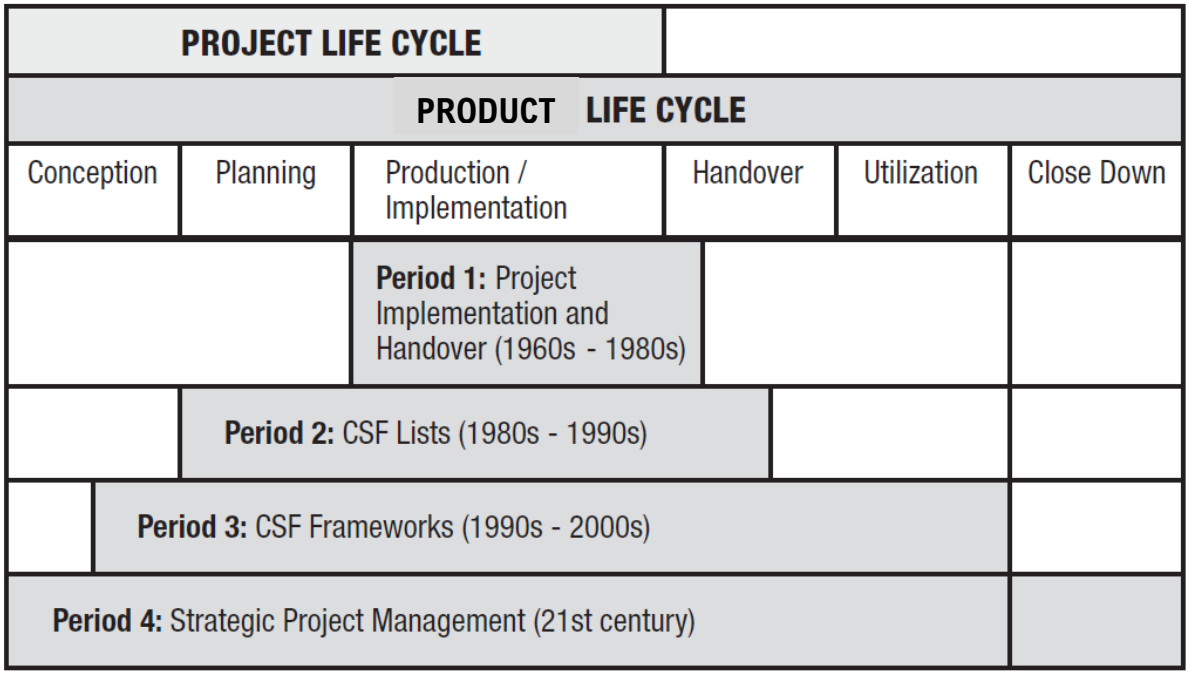

Figure 1: Project success literature periods.
Source: Jugdev & Müller (2005, p. 23)

Product lifecycle success was also incorporated into two literature fronts, one regarding the agile project management literature and other on the multiple project management dimensions.

Shenhar et al. (2001) introduced a four-dimensional framework with a focus on project efficiency, the impact on the customer, business success and preparing the organisation for the future. To assess project success, Bannerman & Thorogood (2012) developed a five-level framework with an emphasis on IT projects. The first level is process success, the second is project management success, the third is product success, the fourth is business success, and the fifth is strategic success. The various stakeholders are concerned about these diverse interpretations of success measurement. Each stakeholder views the success of a project differently and has different ideas about how success should be judged (Davis, 2017). Castro et al. (2021) also developed a multilevel project success measurement instrument within the

dimensions of future potential, organizational benefits, project efficiency, project impact and stakeholder satisfaction. More recently Rode et al. (2022) worked on a broader project evaluation perspective (comprised of four constitutive properties for project evaluation: criteria, times, evaluands, and evaluators) but also on multiple dimensions, being them: process, outcome, and learning.

On the agile project management end Chow & Cao (2008) did a study to determine the most crucial aspects that would lead to a successful agile software development project after taking into account the success criteria in agile software projects. Four criteria were used in their study to define success: quality (delivery of a good product or project outcome), scope (fulfillment of all requirements and objectives), time (delivery on schedule), and cost (delivery within budget and effort) (Chow & Cao, 2008). Chow & Cao's (2008) work was expanded upon by Stankovic et al. (2013). To examine the Yugoslavian perspective on agile software development project success, the same 12 potential CSFs were used. The results of the analysis showed that project nature, which includes time and cost qualities, can be considered a crucial component. Project type and the project definition process can also be considered critical, but only in terms of cost. Notably, their research was unable to demonstrate if the CSFs discovered by Chow & Cao (2008) were truly essential for an agile software development project to succeed.

Although there are commonalities across the various approaches and frameworks for measuring project success, the emphasis now is on the gains that organizations make from their investments in projects. Project management literature focuses on IT project success criteria and important success elements. Both the agile project management success and multiple project success dimensions research recently converged in works like Marnewick & Marnewick, (2022) and Tam et al. (2020).

Time and cost are still employed as project performance evaluation criteria, according to Badewi (2016). According to Lim & Mohamed (1999) and Stankovic et al. (2013), both of these characteristics have been used in a variety of business sectors, including engineering and construction as well as agile software development. On-time delivery is referred to by the time attribute, while adherence to the predicted budget is highlighted by the cost attribute (Toor & Ogunlana, 2010). According to Badewi (2016), project stakeholders must derive benefits from the project's output in order to justify their investment, which results in customer satisfaction, in addition to finishing on time and under budget.

If expectations were lower than the actual performance, customer satisfaction would be attained. Consumer satisfaction is related to how the customer sees the performance of the finished product, which includes its adherence to a pre-defined set of goals (Haverila & Fehr, 2016). According to Alvertis et al. (2016), a software solution's ability to meet user expectations is a key factor in its success. Recently agile project management benefits have been investigated further in other industries than the software development in which they were originated (Gustavsson, 2016; Oprins et al., 2019).

3. Methodology

A systematic literature review (thoroughly described in a previous article, in press) was held to select current project success scales used and published in top project management journals. Those were International Journal of Project Management (IJPM), Project Management Journal (PMJ), and International Journal of Managing Projects in Business (IJMPB) as proposed by Ahola et al. (2014).

From that, 18 scales were collected (Aga et al., 2016; Bannerman & Thorogood, 2012; Belout & Gauvreau, 2004; Castro et al., 2021; Engelbrecht et al., 2017; Fernando et al., 2018;

Fossum et al., 2020; Lu et al., 2017; Müller & Turner, 2010; Nanthagopan et al., 2018; Ning, 2017; Podgórska & Pichlak, 2019; A. J. Shenhar & Dvir, 2007; Tam et al., 2020; Turner & Müller, 2006; Unterhitzenberger & Bryde, 2019; Wu et al., 2017; Zaman, 2020). Three of them were discarded (Castro et al., 2021; Podgórska & Pichlak, 2019; Zaman, 2020). during items collection either because the questionnaire was not available, or it had basis on other cited scales already selected, or because it did not fit the propose of general project success measurement. Also Müller & Turner (2010) was changed to Pinto & Slevin (1987), including this instrument in the final set through its direct use by Müller & Turner (2010) (and also by Davis (2016) and furthermore because Pinto and Slevin are seminal authors in project success measurement).

The final set of 15 scales brought a total of 162 questions. Some themes like the ones from the so-called iron triangle (time, cost, and scope/quality) were recurrent in most of the scales. Questions from the same theme were grouped to seek a reduction from all the scales. After this grouping work, a group of five project management specialists from both organisations and academia (masters and doctors in project management) with ten or more years of experience were consulted to determine which of the questions they judged more appropriate to access each theme and what was the most appropriate name for each category.

The 162 were grouped in 31 categories. The one with most items was Time, with 14 questions. There were 8 categories with a single item. Then the specialists ranked the questions from 1 to 4. Some themes had 4 questions in the final selection but some of them had just 3, 2 or a single question. These themes with less questions are integrally present at the final instrument. Those ranks were taken into consideration to reduce the initial 182 questions to a set of 82.

The instrument with 82 questions was translated from English (original language of all the collected scales) to Portuguese and Spanish. The translations process was trough back translation, so a proficient person in English and the target language, who also have project management knowledge translated the items (pointing the need to adapt some questions) and then another person with the same profile back translated the questions to ensure the contents remained the same. At the final instrument preparation stage some adjustments from questions which were originally yes/no questions were necessary to standardize all questions in Likert scale assessments.

Some of the original scales were 7-point Likert, some others 5 point. As literature states, this does not have significant influence in the results (Altuna & Arslan, 2016; Dawes, 2008; Leung, 2011), although there is still discussion and research being done on that end with some controversy (Cummins & Gullone, 2000; Finstad, 2010). Bouranta et al. (2009) suggested that 5-point rating scales are less confusing and increase response rate. All of the questions were assessed trough 5-point Likert scale and with 1 being strongly disagree and 5 being totally agree (although some instruments like Wu et al. (2017) were designed in the opposite way). Final instrument is presented at the results section.

Source	Quote	Type
(Aga et al., 2016)	The project managers assessed each of these items on a Likert scale of 1–5 ranging between ‘strongly disagree’ and ‘strongly agree’.	Likert 5 points
(Belout & Gauvreau, 2004)	For each factor, the participants had to rate their level of agreement for various statements on a seven-point Likert scale (from 1 strongly disagree to 7 strongly agree).	Likert 7 points
(Pinto & Slevin, 1987)	We have developed an initial Likert scale instrument that consists of 10 items on each critical success factor.	Likert
(Turner & Müller, 2006)	We asked the respondents to judge the success of their last project against the ten dimensions (Table 2) on a five point Likert scale from disagree to agree.	Likert 5 points

(Tam et al., 2020)	The 7-point Likert Scale, ranging from totally disagree (1) to totally agree (7), was used to understand the respondents' agreement level toward each item, except on the perceived level of project success, where the scale ranged from very unsuccessful (1) to very successful (7).	Likert 7 points
(Fernando et al., 2018)	The questionnaire was designed using a five-point Likert-type scale, and the measurement items were adapted from the previous studies.	Likert 5 points
(Unterhitzenberger & Bryde, 2019)	These single-item measures were also assessed with a Likert scale (5 = strongly agree to 1 = strongly disagree)	Likert 5 points
(Nanthagopan et al., 2018)	A seven-point Likert scale is used in this study for assessing the study variables (Jugdev and Mathur, 2006), since it is recommended for increasing the quality of data characteristics.	Likert 7 points
(Fossum et al., 2020)	In order to address RQ2 and RQ3, SQ6 used a Likert scale to allow participants to assess the extent to which a particular practice is important to the success of their projects (managerial success) and the extent to which the practice is implemented in their project organization (see Table III).	Likert 5 points + personalized
(Wu et al., 2017)	All variables were measured using a five-point Likert scale (where 1 means "strongly agree" and 5 means "strongly disagree").	Likert 5 points
(Ning, 2017)	In Section B, respondents were asked to indicate the extent to which control strategies were adopted and trust was perceived on a five-point scale (1 = strongly disagree, 3 = neutral, 5 = strongly agree). In Section C, respondents were requested to rate the project performance.	Likert 5 points
(Lu et al., 2017)	All measures asked receivers to rate each scale item using a five-point Likert scale, which ranged from 1 (strongly disagree) to 5 (strongly agree).	Likert 5 points
(Engelbrecht et al., 2017)	Project success was rated either 1, 2 or 3, 3 signifying a successful project. The questions were measured according to a five point Likert type scale.	Likert 5 points + nominal weight
(A. J. Shenhar & Dvir, 2007)	Most closed questions used 5-point Likert scales, where 1 was related to "I totally disagree" and 5 "I totally agree".	Likert 5 points
(Bannerman & Thorogood, 2012)	The survey asked seven questions about different aspects of project performance, using a 7-point Likert scale for each.	Likert 7 points

Figure 2: Original instruments and collection strategies.
Source: The authors

So, after the qualitative approach in a systematic literature review and specialists' interviews to select the items, a quantitative stage was done. The instrument was directed to respondents asking them to assess the last finished project they took part and was directed to people who worked in projects of any kind and in any role, from project team, project managers to sponsors and executives. Two characterization questions were included asking the persons role in the project and the total experience the person had in projects in years.

The survey was distributed both in project management related groups at instant massing app (namely WhatsApp) and through a professional social network either through a public post and directly to approximately 1.280 people through individual messages (namely LinkedIn Inbox). Total people reached is uncertain as the post had 5 public shares in third party profiles, 1,255 visualisations (but most duplicated from the 1,280 directly reached). Also, instant message app forwarding is not traceable. In a rough estimation response rate is around 9% (from 3,000 reached people, 267 responses). A total of 267 responses were collected in the period from June 10th to June 20th, 2022. An exploratory factorial analysis was done with the collected responses and results are described following.

4. Results

The results of this work are twofold, one is a combined instrument from the original scale comprised of 82 questions grouped in 31 themes validated be specialists and the second is an exploratory factorial analysis based on responses to this instrument.

The final set of 82 selected and categorized questions is presented below:

Theme	**Source**	**Question**
Business Return	Engelbrecht et al. (2017)	Realized the expected commercial and user benefits as outlined in the business case.
Business Return	Lu et al. (2017)	This new product/service meets return on investment expectations.
Business Return	Shenhar & Dvir (2007)	The project increased the organization's profitability.
Business Return	Shenhar & Dvir (2007)	The project increased the organization's market share.
Control	Pinto & Slevin (1987)	Monitoring and feedback were timely and there was comprehensive control.
Control	Fernando et al. (2018)	Our project strategy has given more effort to managing the progress of a project.
Control	Fernando et al. (2018)	We use project management life cycle to guide us in monitoring the progress of a project.
Control	Fernando et al. (2018)	We always ensure that a project progresses in line with our key project performance indicators.
Cost	Belout & Gauvreau (2004)	Project cost objectives were not met.
Cost	Unterhitzenberger & Bryde (2019)	The project was completed within the budget.
Cost	Fossum et al. (2020)	The project was on cost (estimated total costs at completion), in comparison with the original budget?
Cost	Shenhar & Dvir (2007)	The project was completed within or below budget.
Customer	Bannerman & Thorogood (2012)	Client/user expectations met.
Customer	Aga et al. (2016)	The project has made a visible positive impact on the target beneficiaries.
Customer	Aga et al. (2016)	The outcomes of the project have directly benefited the intended end users, either through increasing efficiency or effectiveness.
Customer	Aga et al. (2016)	The project has directly led to improved performance for the end users/target beneficiaries.
Customer Satisfaction	Belout & Gauvreau (2004)	Project clients and/or product users were satisfied with the project outputs.
Customer Satisfaction	Turner & Müller (2006)	End-user were satisfied with the project's product or service.
Customer Satisfaction	Fossum et al. (2020)	This project creates positive impacts on end users.
Customer Satisfaction	Lu et al. (2017)	This new product/service meets customer expectations.
General	Unterhitzenberger & Bryde (2019)	Overall, it was a successful project.
General	Wu et al. (2017)	We are optimistic about the success of this project.
General	Ning (2017)	Overall satisfaction was met.
General	Shenhar & Dvir (2007)	Overall, the project was a great success.
Goals	Bannerman & Thorogood (2012)	The project was aligned with its objectives.

Goals	Bannerman & Thorogood (2012)	Objectives met.
Goals	Pinto & Slevin (1987)	Project mission, goals and direction clearly defined.
Goals	Belout & Gauvreau (2004)	The project output could easily be manufactured and marketed.
Quality	Fernando et al. (2018)	Our project has met quality as specified.
Quality	Ning (2017)	Finished project quality performance was satisfactory.
Quality	Lu et al. (2017)	This new product meets quality expectations.
Quality	Engelbrecht et al. (2017)	Delivered according to an agreed quality.
Recurrence	Wu et al. (2017)	We are likely to cooperate with the other party again in the future.
Recurrence	Shenhar & Dvir (2007)	The project outcome will contribute to future projects.
Recurrence	Shenhar & Dvir (2007)	The customer will come back for future work.
Recurrence	Shenhar & Dvir (2007)	The project will lead to additional new products/services.
Scope	Pinto & Slevin (1987)	There was client acceptance in the selling of the final product to the end users.
Scope	Wu et al. (2017)	The project deliverable meets client's objectives.
Scope	Fossum et al. (2020)	The project was on scope, in comparison to the original scope?
Scope	Bannerman & Thorogood (2012)	Project scope achieved.
Team	Fernando et al. (2018)	We have competent project team members.
Team	Fossum et al. (2020)	The project organizational structure is adapted to the geographical dispersion of the team members.
Team	Fernando et al. (2018)	Our project teams are able to work together to achieve the project objective successfully.
Team	Fossum et al. (2020)	The project organizational structure is adapted to the specialization of the team members.
Team Satisfaction	Aga et al. (2016)	Project team members were satisfied with the process by which the project was implemented.
Team Satisfaction	Shenhar & Dvir (2007)	The project team had high morale and energy.
Team Satisfaction	Shenhar & Dvir (2007)	Team members experienced personal growth.
Team Satisfaction	Shenhar & Dvir (2007)	Team members wanted to stay in the organization.
Time	Fossum et al. (2020)	The project was on schedule, in comparison to the original plan?
Time	Lu et al. (2017)	This project meets the time limit.
Time	Engelbrecht et al. (2017)	Delivered within the allocated time.
Time	Shenhar & Dvir (2007)	The project was completed on time or earlier.
Change Management	Aga et al. (2016)	The project had no or minimal start-up problems because it was readily accepted by its end users.
Change Management	Belout & Gauvreau (2004)	Technical problems were successfully identified and resolved.

Change Management	Pinto & Slevin (1987)	There was troubleshooting ability to handle unexpected problems.
Change Management	Wu et al. (2017)	The project could solve most problems encountered during the project execution.
Change management	Wu et al. (2017)	The project satisfied the client's special requirements.
Senior management	Pinto & Slevin (1987)	Top management provided support resources, authority and power for implementation.
Senior management	Fossum et al. (2020)	Senior executives provided effective support to the project manager.
Senior management	Fossum et al. (2020)	Senior executives defined collaboration strategies with third parties during early stages.
Communication	Pinto & Slevin (1987)	Client consultation, communication with and consultation of all stakeholders happened.
Communication	Pinto & Slevin (1987)	Communication, timely data was provided to key players.
Competition	Shenhar & Dvir (2007)	The project will help create new markets.
Competition	Bannerman & Thorogood (2012)	A competitive response was generated.
Effectiveness	Shenhar & Dvir (2007)	Other efficiency measures were achieved.
Effectiveness	Bannerman & Thorogood (2012)	The project was effectively implemented.
Operation	Ning (2017)	Quality performance during the operation is good.
Operation	Lu et al. (2017)	This new product/service meets repair rates expectations.
Project Manager	Aga et al. (2016)	I was satisfied with the process by which the project was implemented.
Project Manager	Wu et al. (2017)	The project process is satisfactory.
Sponsor	Aga et al. (2016)	Our principal donors/sponsors were satisfied with the outcomes of the project implementation.
Sponsor	Wu et al. (2017)	The owner is satisfied with the project results.
Sustainability	Aga et al. (2016)	The outcomes of the project are likely to be sustained.
Sustainability	Nanthagopan et al. (2018)	Project is sustainable.
Culture and Values	Belout & Gauvreau (2004)	The project has not perturbed the culture or values of the organization that managed it.
Integration	Bannerman & Thorogood (2012)	The project was integrated (as appropriate).
Management	Shenhar & Dvir (2007)	The project developed better managerial capabilities.
PMO	Fossum et al. (2020)	A Project Management Office provides support to the project manager.
Recognition	Bannerman & Thorogood (2012)	The project had external stakeholder/competitor recognition.
Suppliers	Turner & Müller (2006)	Suppliers were satisfied.
Technical knowledge	Pinto & Slevin (1987)	There was technical task's ability on the required technology and expertise.
Technology	Shenhar & Dvir (2007)	The project created new technologies for future use.

Figure 3: Designated categories, sources, and selected questions for project success assessment.
Source: The authors

Following the collection of responses, a total of 267 valid responses (none was discarded as all questions were mandatory, except one for respondent's e-mail if the person choose to be identified, and there was no option to submit the incomplete form) was organized in a dataset for analysis in SPSS software. Project role and years of experience were not used in the exploratory factorial analysis, but 109 respondents were in project management roles, 78 in project teams, 22 in business management, 9 as clients and 4 in other roles. The mean of experience years in project was 14. So, generally, most responses came from experienced project managers.

The exploratory factorial analysis was done in the SPSS software with the following parameters. For the descriptives initial solution, KMO and Bartlett's test o sphericity and anti-image were selected. The extraction method was principal components, with correlation matrix, unrotated factor solution, scree plot, initially based on eigenvalue (and after parallel analysis with a fixed number of factors), and a maximum number of iterations for convergence of 9999. The chosen rotation was Varimax. Nothing was selected about scores. Finally for options missing values were excluded listwise, coefficients were chosen to be sorted by size, suppressing the ones below 0.3.

The first round of the factor analysis with the 222 responses yielded a total of 17 factors. Nonetheless, through parallel analysis the ideal number of factors for the population was 4. Parallel analysis (Hair et al., 2014) was done in RStudio trough "how_many_factors" script developed by professor Storopoli (Storopoli, 2020) available as open source in GitHub.

Running SPSS again with the same parameters but fixing a total of 4 factors generated an initial response with a KMO of 0.935 and the total variance explained 69,749%. Nonetheless communalities of 41 variables (being them coded questions from the 5-point Likert responses) were above 0.500. So, they were excluded one by one (lowest load to highest). In the 42 round of analysis KMO was 0.960 and the total variance explained 64,595%, but there were still two variables (both regarding the project manager) with cross factorial loads among three of the four factors. So, in the 45 and last round of analysis a final set of 40 variables yielded a KMO of 0.959, communalities from 0.513 up to 0.792 and a total variance explained of 64,795%. Following KMO and Bartlett's test data and the rotated component matrix are presented.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.959
Bartlett's Test of Sphericity	Approx. Chi-Square	7164.859
	df	780
	Sig.	.000

Figure 4: KMO and Bartlett's test data from SPSS 45th round of analysis.
Source: The authors

The rotated component matrix is the final instrument with the questions divided at each factor. Figure 5 shows the questions and Figure 6 the count of the questions themes. At Appendix A we present the questions, themes, original sources, and factors.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
The project deliverable meets client's objectives.	.822			
The owner is satisfied with the project results.	.816			
This new product/service meets customer expectations.	.810			
Overall, satisfaction was met.	.809			
Overall, the project was a great success.	.777	.319		
Project clients and/or product users were satisfied with the project outputs.	.773			
End-user were satisfied with the project's product or service.	.766			
The project has made a visible positive impact on the target beneficiaries.	.766			
Objectives met.	.766			
We are optimistic about the success of this project.	.744			
This new product meets quality expectations.	.744			
The project has directly led to improved performance for the end users/target beneficiaries.	.731			.306
The outcomes of the project have directly benefited the intended end users, either through increasing efficiency or effectiveness.	.725			
Project scope achieved.	.722			
Client/user expectations met.	.718			
Delivered according to an agreed quality.	.718			
Our principal donors/sponsors were satisfied with the outcomes of the project implementation.	.716			
Overall, it was a successful project.	.709	.346		
Finished project quality performance was satisfactory.	.698	.329		
Our project has met quality as specified.	.686			
Suppliers were satisfied.	.652			
Quality performance during the operation is good.	.638		.356	
The project was integrated (as appropriate).	.634			
The project satisfied the client's special requirements.	.633			
The outcomes of the project are likely to be sustained.	.627			
The project was completed within or below budget.		.806		
The project was completed on time or earlier.		.780	.341	
This project meets the time limit.		.775		
The project was on cost (estimated total costs at completion), in comparison with the original budget?		.773		
Delivered within the allocated time.	.305	.757	.337	
The project was completed within the budget.	.340	.745		
The project was on schedule, in comparison to the original plan?		.703	.333	
Senior executives provided effective support to the project manager.			.739	
Senior executives defined collaboration strategies with third parties during early stages.			.694	
Top management provided support resources, authority, and power for implementation.	.350		.670	
Team members wanted to stay in the organization.		.312	.610	
The project will help create new markets.				.810
The project will lead to additional new products/services.				.706
The project created new technologies for future use.				.702
The project increased the organization's market share.				.638

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 6 iterations.

Figure 5: Rotated component matrix from SPSS 45th round of analysis.
Source: The authors

In accordance with the categorization of the questions previously done by the specialists the factors can be analyzed for naming.

Category	# of Questions
Factor 1	
Agreed success concept for the project	4
Project impact/benefits to end customers and business areas	4
Quality	4
Stakeholder satisfaction	3
Scope	2
Stakeholder management	2
Goals	1
Supplier satisfaction	1
Continuous improvement	1
Integration	1
Troubleshooting	1
Sustainability of the project results	1
Factor 2	
Time	4
Cost	3
Factor 3	
High management support	3
Team satisfaction	1
Factor 4	
New business	1
Continuity of work for those involved in the project	1
New technologies	1
Benefits	1

Figure 6: Categories and quantity of questions in each factor.
Source: The authors

Analyzing the factors, we note that the first factor loaded the most of the 40 variables (25 in total) and present a wider range of topics. From previously defined categories the factor has 4 general questions about the agreed success concept for the project, 4 on customer and business impacts, 4 on quality, 3 about stakeholder satisfaction, 2 on scope, 2 for sponsor/stakeholder management, and 1 for goals, suppliers, operation continuous improvement, integration, troubleshooting (change management) and sustainability of the project results, each. As previous defined success, costumer impact and quality have all its questions in this factor we argue it has the view of the client on project results success.

The second factor loaded all the 4 questions about time and 3 about cost. This project success view is the “classic” one from the so-called Iron Triangle. Noticeably scope/quality loaded separately in the first factor. As most of the respondents utilized the Portuguese version

of the survey and Brazilian market emphasizes time and cost more than other aspects to determine project management success, we argue this factor brings the view of project management process success.

The third factor has 3 questions about higher management support and 1 about team satisfaction. Those are the internal clients of the projects.

The last factor loaded 4 questions, each one on a distinct theme, being competition or new business, recurrence or continuity of work, new technologies and business return or benefits. All of them are business factors validation of the project success, being it an external, organization wise view.

Factor Name	**# of Questions**
Project results success for clients	25
Project management process success	7
Internal project client's success	4
Business project success	4

Figure 7: Final factors names and quantity of questions.
Source: The authors

5. Discussion

Those four factors are in line with the idea of multiple project success dimensions presented in instruments such as the ones from Bannerman & Thorogood (2012); Castro et al. (2021); and Shenhar & Dvir (2007). One contribution to theory is the verification trough multiple instruments that those kinds of dimensions emerge even if the questions are grouped and shuffled, so currently the most accurate form of measuring project success is trough the assessment of multiple dimensions.

Nonetheless the first factor loaded most of the questions and the more diverse topics group. It might indicate that different project success dimensions bear different weights mainly to project managers and team members (as most of the respondents have these roles). Its positive to see that end client is probably the one with bigger weight for project success assessment as it indicates projects hold a strategic position for companies and the success view might be wider and based on product/service lifecycle, not only at the execution phase. Future research can validate if an instrument with the 25 questions of the first factor is enough to assess project success as it would be much more concise than the original 162 total questions or even the 82 selected questions instrument used in this research.

Another important contribution is about the second factor, it loaded only time and cost questions and even though not all of them. It might indicate that the traditional project success measurement trough time, cost, and scope which some instruments presented as three direct questions answered by the project managers together with questions on other constructs are insufficient per se to determine if the other construct really had any impact on project success. A more adequate way would be to aggregate the verification of the construct impact on multiple project success dimensions.

The observation of a client perspective on project success factor and a second comprising time and costs is in accordance with the literature review as noted by Badewi (2016); and Toor & Ogunlana (2010) that time and cost were still relevant as project performance evaluation criteria. Also, client satisfaction is a relevant aspect in Alvertis et al. (2016); Badewi (2016); and Haverila & Fehr (2016) perspectives.

The third factor indicates the need of higher management support felt by project managers and the validation from project team members wanting to stay in the organization.

This might indicate a stronger hierarchy present in the companies, demanding closer support due to limited project manager autonomy in projects at Brazilian organizations. This observation contraries Chow & Cao (2008) study that found people and technical as the most crucial factors for ongoing agile software development project success out of the five factor categories suggested. However, they were unable to demonstrate that elements, such strong executive support, solid sponsor commitment, the availability of a physical agile facility, or agile-appropriate project types, were in fact requirements for a project's success (Tam et al., 2020).

The fourth factor is in line with the first factor wider view of the project success within a strategic context rather than only in the project execution phase. Business benefits are important for overall organizations sustainability and future projects, new products, services, and technologies.

The only themes that loaded all the four original questions in the end factor analysis were time, agreed success concept for the project, project impact/benefits to end customers and business areas and quality. Those might be the main areas to be considered while assessing project success. Stakeholder (more in the sense of project sponsor than multiple stakeholders) satisfaction, cost and high management support loaded 3 of 4 questions, so they can also be topics to be noticed in project success assessment.

As contributions for practice those several observations about the four factors and the main topics can help people working with projects directing their attention to different factors and topics during projects proposal, planning, execution, and maintenance.

6. Conclusion

This work brings in the contribution of a project success measurement proposed instrument developed from multiple sources from literature and validated by project management specialists and the exploratory factorial analysis using this proposed instrument.

The proposed instrument has 31 topics summarizing 162 questions collected in the literature in 82 (a potential new instrument would have 31 questions, being only the top one of each topic as ranked by the specialists). This brings in the panorama of recent (last 5 years) project success measurement work published in the top project management journals, being them new scales or using older validated scales and, in most cases, a mix of both combining new questions with previous scales.

The application of this instrument brought insight on the formation of four main factors that reflect different project success dimensions or views, from the client perspective to the business. The factorial loads indicate different dimensions might have different weights in project management success and that traditional Iron Triangle measures could no longer be the best way to assess project success.

The research brought insights also about the strategic role of projects in organizations and still strong hierarchy. The factors demonstrate a wide view of project success being it for the clients, internal clients, business and also the project management process, which were previously the main focus of project success measurement. Despite the view of project success having stronger emphasis in product/service lifecycle than in project execution phase, which could indicate a stronger alignment to agile project management practices, there is still the need of high management support indicating hierarchy in companies still demand escalation and a third-party interface with clients to solve potential disputes.

The final four factors were project results success for clients, project management process success, internal project client’s success, and business project success, comprising a

total of 40 questions. This final instrument can be used to further investigate how to enhance project success measurement.

Although indirectly addressing different project success views trough the role question, this research did not use it as an analysis cut to assess if results would be different for different groups. Also, this research strategy does not touch important aspects of project success measurement such as the time shift between project execution and project results benefits realization, which would demand longitudinal assessments. So, for future research its proposed to analyze the different possible instruments for different project perspectives and also seek longitudinal assessments to verify if those perspectives focus are maintained or changed during the project and product/service lifecycles.

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Appendix A – Final Instrument

Following is presented the final instrument with the selected questions, its factors and factorial loads and the questions themes identified by the specialists as well.

Question	Factor (and factorial load)				Theme
	Project results success for clients	Project management process success	Internal project client's success	Business project success	
The project deliverable meets client's objectives.	0.8224				Scope
The owner is satisfied with the project results.	0.816165				Stakeholder Management
This new product/service meets customer expectations.	0.810368				Stakeholder Satisfaction
Overall, satisfaction was met.	0.809241				Agreed success concept for project
Overall, the project was a great success.	0.776531	0.318832			Agreed success concept for project
Project clients and/or product users were satisfied with the project outputs.	0.773269				Stakeholder Satisfaction
End-user were satisfied with the project's product or service.	0.766371				Stakeholder Satisfaction
The project has made a visible positive impact on the target beneficiaries.	0.766247				Project impact/benefits to end customers and business areas
Objectives met.	0.766216				Goals
We are optimistic about the success of this project.	0.743914				Agreed success concept for project
This new product meets quality expectations.	0.743774				Quality
The project has directly led to improved performance for the end users/target beneficiaries.	0.730664			0.305932	Project impact/benefits to end customers and business areas
The outcomes of the project have directly benefited the intended end users, either through increasing efficiency or effectiveness.	0.725313				Project impact/benefits to end customers and business areas
Project scope achieved.	0.722103				Scope
Client/user expectations met.	0.718485				Project impact/benefits to end customers and business areas
Delivered according to an agreed quality.	0.718407				Quality
Our principal donors/sponsors were satisfied with the outcomes of the project implementation.	0.715728				Stakeholder Management
Overall it was a successful project.	0.708593	0.346422			Agreed success concept for project
Finished project quality performance was satisfactory.	0.697544	0.328546			Quality
Our project has met quality as specified.	0.685889				Quality

Suppliers' were satisfied.	0.652001				Supplier satisfaction
Quality performance during the operation is good.	0.637511		0.355535		Continuous Improvement
The project was integrated (as appropriate).	0.634043				Integration
The project satisfied the client's special requirements.	0.63253				Troubleshooting
The outcomes of the project are likely to be sustained.	0.627085				Sustainability of the project result
The project was completed within or below budget.		0.806296			Cost
The project was completed on time or earlier.		0.780459	0.340753		Time
This project meets the time limit.		0.774563			Time
The project was on cost (estimated total costs at completion), in comparison with the original budget?		0.77265			Cost
Delivered within the allocated time.	0.304572	0.757188	0.336977		Time
The project was completed within the budget.	0.34044	0.7454			Cost
The project was on schedule, in comparison to the original plan?		0.702518	0.333344		Time
Senior executives provided effective support to the project manager.			0.738797		High management support
Senior executives defined collaboration strategies with third parties during early stages.			0.694134		High management support
Top management provided support resources, authority and power for implementation.	0.349603		0.670131		High management support
Team members wanted to stay in the organization.		0.311823	0.609679		Team Satisfaction
The project will help create new markets.				0.810263	New Business
The project will lead to additional new products/services.				0.706095	Continuity of work for those involved in the project
The project created new technologies for future use.				0.702368	New Technologies
The project increased the organization's market share.				0.637901	Benefits