

# Key Risk Management to Reduce Deadlines and Costs in the Execution of Construction Sector Works in Peru

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**Abstract**– Peru's economic growth has been affected by the problem of public works. This research has identified a significant gap in basic infrastructure services. This scenario is aggravated by paralyzed public works, an index of social progress that does not show improvement and professionals and technicians who do not fully apply their skills and capacity to improve the results of public works, which generates longer deadlines and costs, affecting the most vulnerable population, and even worse, affecting the future of such population strata. The Academy needs to take responsibility of the human talent improvement that participates directly in the management of construction and infrastructure projects throughout the country.

The results of this research indicate that risks have an impact on the poor results of public works since the deadlines and costs are higher than the planned values. Likewise, it establishes the need to improve project management competencies and capabilities.

**Keywords:** Quality of Life, Construction Engineering, Government Policy, Management, Risk Management, Economic Growth.

## I. INTRODUCTION

The research has contemplated the development of a list of topics distributed in seven stages grouped into two parts.

In the first part, the gaps in basic infrastructure services are analyzed, followed by a review of the foreseeable risks of public works, and then the competencies and capabilities in project management are reviewed.

The second part presents the results of the doctoral thesis in progress: "Risk Management in construction contracts in the Framework of public policies. Proposal to reduce malpractices of deadlines and costs of execution of public works in the construction sector in Peru, the year 2019", such research aims at the relationship between risk management and higher budgets and deadline.

Then, PMI's global research results are presented, followed by the results of the impacts of risks on the main project objectives (time and cost).

## II. STATE OF DE ART

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### A. Gaps in Basic Infrastructure Services

The National Infrastructure Plan for Competitiveness (PNIC) was published on July 28, 2019. This important national policy establishes the gaps in basic infrastructure services. The following is part of the executive summary:

- The objective of the National Infrastructure Plan for Competitiveness (PNIC) is to provide the Peruvian State with input to build a transparent and consensual development agenda to close key gaps in the country's economic and social development. The plan follows a sectoral and territorial logic that has an impact in the short term but is guided by a long-term strategy to contribute to improving productivity and competitiveness that results in better development conditions for the country.

The objective of the PNIC is to seek to close the key gaps in the country's economic and social development, where access to infrastructure is the first condition. Likewise, also makes explicit the relationship between access to infrastructure and economic growth.

- A country's competitiveness depends, to a large extent, on access to and the quality of infrastructure. Improving these factors not only increases connectivity with domestic and international markets but also boosts the development of the country's human capital, which leads to economic growth [1].

TABLE I  
 GAPS IN BASIC INFRASTRUCTURE SERVICES BY 2019 [1].

No.	Sector	Gap		
		Short-term	Long-term	
1	Water	Urban	317	57
		Rural	5,702	
2	Sanitation	Urban	--	
		Rural	28,819	71,544
3	Telecommunications	Cellular	12,151	20,377
		Broadband	--	
4	Transport	Railroads	20,430	160,958
		Roads	15,540	
		Airports	--	
		Ports	--	
5	Electricity			7,059
6	Education	Initial level		5,917
		Primary level		
		Secondary level		
7	Health		27,545	58,727

8	Hydraulic	6,679	14,625
	Total gap	117,183	363,452
	<b>Grand total</b>		<b>480,635</b>

Table I shows that the sum of the short and long-term gaps amounts to S/. 480,635,000,000 million soles. The reflections and analysis of the causes of such a significant figure should be the subject of a new line of research.

### B. Foreseeable risks in the construction works.

From the Doctoral Thesis on the evaluation process by the Graduate School of the Universidad Nacional Federico Villarreal [2], the risks are established in the form of a list as a Risk Breakdown Structure (RBS), see Figure 1.

Risk should be understood as the uncertain event or condition that, if it occurs, has a positive or negative effect on one or more of the objectives of a project [3]. The two types of risks applied, as part of good project management practices, are defined:

- Perform Qualitative Risk Analysis: The process of prioritizing individual project risks for further analysis or action, assessing the likelihood of occurrence and impact of those risks, as well as other features [3].
- Perform Quantitative Risk Analysis: The process of numerically analyzing the combined effect of identified individual project risks and other sources of uncertainty on overall project objectives [3].

In projects, the identified risks are presented in the form of a BSR according to [2], see Figure 1.

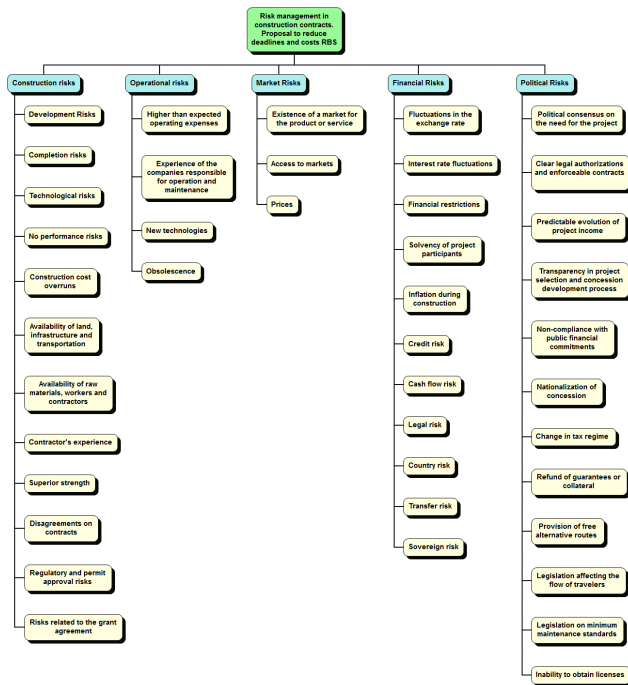


Fig. 1. Model relating the benefits of infrastructure investments and growth [7].

### C. Project Management Competencies and Capabilities

According to the document Competences and profile of the Ibero-American engineer, teacher training, and technological development and innovation (ASIBEI Strategic Plan Documents) [4], there is an important deployment of two items related to competencies and capabilities in project management.

2. Competence to conceive, design and develop engineering projects (systems, components, products, or processes).

This competency requires the effective articulation of several capabilities, among which the following can be detailed:

2.b Ability to design and develop engineering projects. This capability may involve, among others:

- Being able to define the scope of a project.
- Being able to specify the technical characteristics of the object of the project, according to the corresponding standards.
- Be able to select, specify and use the design approaches, techniques, tools, and processes appropriate to the project, its goals, requirements, and constraints.
- Be able to model the object of the project for its analysis (simulation, physical models, prototypes, tests, etc.).
- Be able to evaluate and optimize the design.
- Be able to elaborate on planning the objectives for the realization of the design and evaluate the risks.
- Be able to size and schedule resource requirements.
- Be able to evaluate the economic-financial aspects and the economic, social, and environmental impact of the project.
- Be able to document the project and communicate it effectively [4].

Similarly for other competition, one has:

3. Competence to manage-plan, execute, and control-engineering projects (systems, components, products, or processes). This competency requires the effective articulation of several capabilities, among which the following can be detailed:

3.a. Ability to plan and execute engineering projects This capability may involve, among others:

- ✓ 3.a.1. Being able to identify and procure or develop the necessary resources for the project.
- ✓ 3.a.2. To be able to plan the different stages managing in time the objectives, methodologies, and resources involved to fulfill the plan.
- ✓ 3.a.3. Be able to program in sufficient detail the execution times of the works, following an investment plan.
- ✓ 3.a.4. Be able to execute the different stages of a project by the objective.

- ✓ 3.a.5. Be able to manage human, physical, economic, and technological resources over time to achieve the planned objectives [4].

**D. Budget extensions**

From the Ph.D. Thesis: "Risk management in construction contracts in the framework of public policies. Proposal to reduce malpractices of deadlines and costs of execution of public works in the construction sector in Peru, the year 2019", we have, subsection 2.1.2.1 [2].

Within this context, in accordance with number 41 of the Sole Annex of Definitions of the Regulations, it is established that "The additional work budget is the economic valuation of the additional services of a work that must be approved by the Comptroller General of the Republic when the amount exceeds the amount that can be directly authorized by the Entity, i.e., 15% of the original contract amount".

The causes that originate additional services of work are derived, mainly from: (i) Unforeseeable situations subsequent to the execution of the contract; (ii) Shortcomings in the technical file of the work, (iii) Higher metrics.

These events are catalogued as risks; consequently, deadline extensions are the negative effect of an uncertain event or condition produced in a project [3].

**E. Extension of deadlines**

Likewise, according to section 2.1.2.2 [2]. The contractor may request a deadline extension for any of the following reasons beyond the contractor's control, provided that they modify the critical path of the work execution program in effect at the time of the extension request, according to article 200 of the Regulations. These cases include:

- a) Delays and/or stoppages are due to causes not attributable to the contractor.
- b) Delays and/or stoppages in the performance of its services are due to causes attributable to the Entity. For example: Delay in the payment of advances for materials and supplies, delay in the resolution of queries, unavailability of land, etc.
- c) Fortuitous event or force majeure duly proven. In this context, we may consider as fortuitous events or force majeure, among others, acts of nature such as, for example: landslides, earthquakes, etc.
- d) When the additional work is approved. This cause is complemented with the fifth and last paragraphs of article 207 (additional works of less than 15%). That is to say, if the additional services are approved by resolution of the Contractor, if this service affects the critical route of the work, the contractor may request the corresponding extension of the term. It should be noted that an additional work service may generate two types of time extensions:

- i. Due to the delay in its approval (which would be within the second case described above).
- ii. For the execution of the additional work itself.

Likewise, the contractor may request an extension of time in the event that the supervisor and the Entity do not resolve its work consultations, and it will correspond to the delay from the date on which the non-execution of the works subject to the consultation begins to affect the critical path of the work execution program (Article 196 of the Regulations). In case of different causes or different dates, each request must be processed independently; provided that the different causes do not correspond to the same period, either total or partial.

In the case of causes without an expected completion date, duly accredited and supported by the contractor, the Entity may grant partial extensions, for the purpose of assessing the general expenses for such extension.

**F. PMI Global Survey**

To specify the need for the application of risk management to construction and infrastructure projects, reference is made to two questions from globalized surveys conducted by Pulse Magazine: (i) Pulse Magazine 2016 The high cost of poor performance [4]; (ii) Pulse Magazine 2017 Success Rates Rise Transforming the high cost of low performance [5]; (iii) Pulse Magazine 2018 Success in Disruptive Times Expanding the value delivery landscape to address the high cost of low performance [6]. Table II shows the Pulse Magazine 2016, 2017 and 2018 globalized survey.

TABLE II  
GLOBALIZED SURVEY PULSE MAGAZINE 2016, 2017, 2018.

Variables	Pulse 2018	Pulse 2017	Pulse 2016
In the projects managed by your organization in the last twelve months, what are the primary causes of failures?	<ul style="list-style-type: none"> <li>• 39% Change in organizational priorities</li> <li>• 37% Change in project objectives</li> <li>• 35% Inadequate requirements gathering</li> <li>• 9% Inadequate definition of project objectives</li> <li>• 29% Inadequate or poor communication</li> <li>• 29% Opportunity and risk not defined</li> </ul>	<ul style="list-style-type: none"> <li>• 41% Change in organizational priorities</li> <li>• 39% inadequate requirements gathering</li> <li>• 36% Change in project objectives</li> <li>• 30% Inadequate definition of project objectives</li> <li>• 30% Inadequate or poor communication</li> <li>• 28% poor change management</li> </ul>	<ul style="list-style-type: none"> <li>• 41% Change in organizational priorities</li> <li>• 38% Change in project objectives</li> <li>• 37% inadequate requirements gathering</li> <li>• 31% opportunities and risks were not defined.</li> <li>• 31% an inadequate vision or objective for the Project</li> <li>• 30% inaccurate cost estimate</li> </ul>
How often does your organization use each of	<ul style="list-style-type: none"> <li>• Project performance indicators:               <ul style="list-style-type: none"> <li>○ Always 27%</li> <li>○ Often 35%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Project performance indicators:               <ul style="list-style-type: none"> <li>○ Always 28%</li> <li>○ Often 35%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Project performance indicators:               <ul style="list-style-type: none"> <li>○ Always 29%</li> <li>○ Often 36%</li> </ul> </li> </ul>

the following?	○ Sometimes 24%	○ Sometimes 25%	○ Sometimes veces 24%
	• Risk management practice:	• Practice of change management:	• Risk management practice:
	○ Always 27%	○ Always 28%	○ Always 28%
	○ Often 35%	○ Often 34%	○ Often 35%
	○ Sometimes 25%	○ Sometimes 27%	○ Sometimes 24%
	• Practice of change management:	• Risk management practice:	• Practice of change management::
	○ Always 26%	○ Always 26%	○ Always 27%
	○ Often 34%	○ Often 34%	○ Often 37%
	○ Sometimes 26%	○ Sometimes 26%	○ Sometimes 24%

### G. Performance Research Public Works Peru

From the same doctoral thesis [2], in Table III and Figure 2, an analysis of bad practices in terms of deadlines and costs is made. Also, in Table IV and Figure 3, the level of knowledge about lead time extension is analyzed. The results of the analysis will allow the efficient management of key risks for the reduction of deadlines and costs in the execution of public works in the construction sector in Peru.

TABLE III  
BAD PRACTICES IN TERMS OF DEADLINES AND COSTS.

Percentage (%)	Level of knowledge about bad practices in terms of deadlines and costs for the execution of public works
Strongly Disagree	1.0
Neither agree nor disagree	4.9
Agree	67.6
Strongly agree	26.5

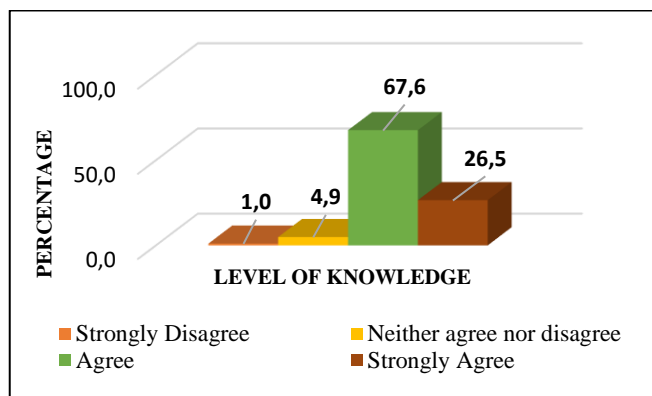


Figure 2 Results level of knowledge of bad practices in terms of time and cost.

TABLE IV  
LEVEL OF KNOWLEDGE ABOUT THE EXTENSION OF DEADLINES.

Percentage (%)	Level of knowledge about the extension of deadlines
Strongly Disagree	1.0
Neither agree nor disagree	15.7
Agree	77.5
Strongly agree	5.9

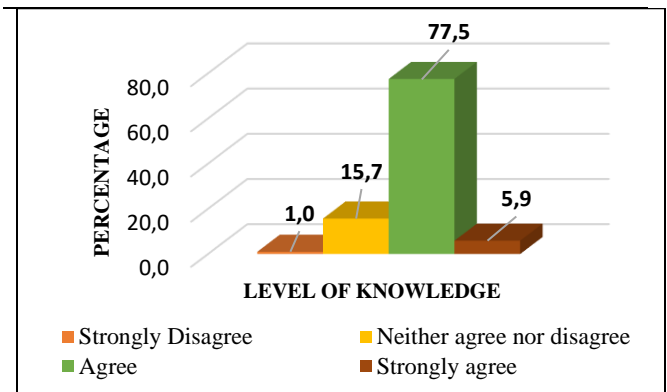


Figure 3 Level of knowledge about the extension of deadlines.

### H. Impact of risks on schedules and costs.

As part of the research and the topics developed in this work; the quantitative risk analysis was applied to the real data of a work: "Recovery and improvement of the trafficability service of the Huarmaca-Provosal road, District of Huarmaca, Province of Huancabamba, Department of Piura", according to [5]. This application will make it possible to validate the impact of risks on the construction schedule and costs.

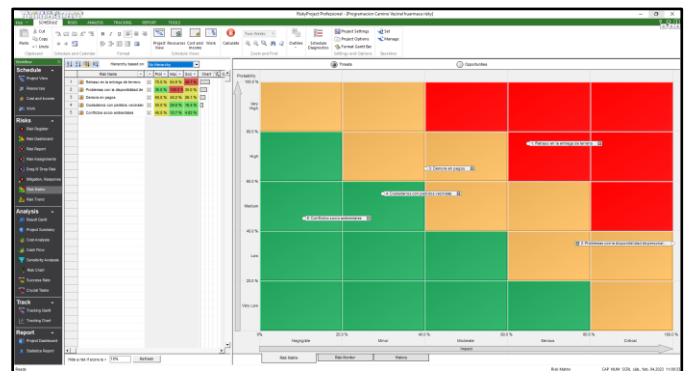


Figure 4 Risk matrix (traffic-light style).

Figure 4 shows the risk matrix (traffic light tool). The risk of "delay in delivery of the site" is in the red zone, which indicates immediate decision-making.

Figure 5 is one of the key reports since two S-curves are presented:

- Red S-curve is the conventional S-curve, i.e., it does not consider the effects of risks on the project.
- Blue S-curve is the real S-curve, i.e., it shows that the project will not meet the "planned schedule and costs" It shows a shift in schedule and an increase in cost. This scenario will occur if the person responsible for the project does not perform risk management.

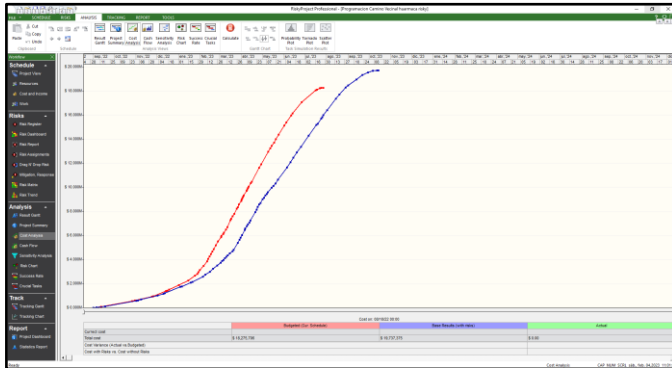


Figure 5 S-curves (red) conventional, and the (blue) includes the effects of the combined risks.

### III. RESULTS

The surveys conducted as part of the Doctoral Thesis in progress: "Risk management in construction contracts in the framework of public policies" proposal to reduce bad practices in terms and costs of execution of public works in the construction sector in Peru, year 2019", show that 67.6% of the respondents know about bad practices regarding terms and costs in the execution of works, and 77.5% of the respondents know about bad practices on term extensions as a consequence of risks.

The global survey conducted by PMI considered the following question: "In the projects managed by your organization in the last twelve months: What are the primary causes of failures?" in 2016, they indicate that the cause: 31% did not define opportunities and risks. And for 2018, they indicate that the cause: 291% of opportunities and risks were not defined.

The application of the quantitative risk analysis based on the "Recovery and improvement of the trafficability of the Huarmaca-Provosal road, District of Huarmaca, Province of Huancabamba, Department of Piura" project leaves no doubt about the impact of risks on the main objectives of any project (time and cost).

The lack of implementation of risk management causes public works projects not meet deadlines and costs; but, in addition, it does not respond to the expectations of the population in their institutions and clear actions are required to avoid this problem.

### IV. CONCLUSIONS

The research in progress of the Doctoral Thesis: "Risk Management in construction contracts in the Framework of public policies. Proposal to reduce bad practices regarding deadlines and costs in the execution of public works in the construction sector in Peru, the year 2019", shows the following: (i) 67.6% of respondents are aware of bad practices regarding deadlines and costs in the execution of public works; (ii) 77.5% of those surveyed are aware of bad practices regarding deadline extensions because of risks.

Therefore, being known by so many people, risk management is not implemented transversally in the execution of public works, despite knowing the consequences.

Two questions were taken from the global survey conducted by PMI, and the results show that the causes of project failures are related to the failure to define opportunities and risks, and that risk management is implemented in the globalized world.

It is demonstrated that the application of quantitative risk analysis to the project "Recovery and improvement of the trafficability service of the Huarmaca-Provosal road, District of Huarmaca, Province of Huancabamba, Department of Piura" generates very important impacts in terms of time and costs.

Finally, it can be affirmed that risk management is key to reducing time and costs in the execution of works in the construction sector in Peru.

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